The Use of Automated Ambulatory Medical Records

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An extensive survey of the uses of computerized automated ambulatory medical record systems has been conducted. The medical services provided which seem to offer the greatest benefits include: patient profiles which are a concise summary of a patient's medical status, patient surveillance to help in preventive care and management of chronic disease, data presentation by flow sheets and graphs, and data-base searches for audit, training, and research. The close integration of medical data with patient management and administrative services such as scheduling, registration, and financial systems, gives valuable utilization and practice information. Improvement in the billing and accounting process is in itself a most important benefit. In addition, the collection and analysis of medical data for health services research, quality of care audits, and training of future providers offers much potential. A number of innovative and economically viable computerized ambulatory record systems are currently operating.

The author recently had the opportunity of visiting a number of clinics and offices across the United States which are now using various kinds of automated ambulatory medical records (Table 1). The 17 sites were selected from the more than 200 which have, plan to have, or have had in operation some portion of an automated ambulatory medical record (AAMR). From these visits much insight into the advantages and disadvantages of automated records was gained. A full report of this evaluation is available elsewhere.[1]

AAMR connotes the use of computers to store some portion of the medical record besides (but usually including) billing data. In a few clinics there is a total computerized medical record with the identification data, history, physical, progress notes, laboratory, and pharmacy data all entered and stored, and no paper chart available. In other systems only a portion of this data is entered into the computer and the traditional paper record is also kept (which may be augmented by computer-generated reports).

This paper will attempt to provide an overview of the current state of the art of automated ambulatory medical records in the United States.

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Data Entry

Medical data are entered into the computer in a variety of ways. In a few settings the physicians themselves enter the data directly into a computer terminal. At the University of Vermont, which employs Dr. L. L. Weed's Inpatient Record System, the physicians touch a heat-sensitive screen which displays a variety of available choices and, following a branching logic-type display, they can record history and physical data or enter orders.[2] Patients can also enter their own histories.

In the outpatient or ambulatory systems where providers enter data directly, it is usually done by typing on a typewriter keyboard connected to a cathode ray tube (CRT) at the computer terminal. Although some sites possess the necessary equipment and some highly motivated physicians use it, this type of interactive entry has not been accepted by many providers for the obvious reasons – the extra time and effort required.

Most data entry in AAMR, however, is done indirectly with the provider using some sort of form to record data which are later entered into the computer by a data clerk. These forms may require one to check a box, make a number, mark a space, or write or dictate a note. The data are then entered by the clerk in a variety of ways such as keypunching, typing at the CRT or other terminal, or may be processed by optical scanning.

At a few clinics the data are abstracted directly from the traditional medical chart by clerks, so that physicians are not involved with data entry. At some sites the physician's dictation is entered (by typing) into the computer by the data clerk and is stored by the computer as "free text."

The encounter forms used have a myriad of designs. Some are just one page and ask the provider to enter only diagnostic data (written or code) and, perhaps, medicines or therapy prescribed (written or code). The rest of the data are put in the medical chart in the routine manner. Other forms ask for laboratory data (either for ordering or results) and certain history and physical data which can be specific for each problem. For example, at the Harvard Community Health Plan (HCHP), each specialty has its own four-page form listing the common diagnoses in that area. The provider writes his note under the appropriate diagnoses which is then entered by typewriter keyboard. At Regenstrief Institute in Indianapolis, the computer generates a different form for each different problem and/or therapy (Figure 1). At Dr. Victor Straub's practice in Cleveland (Medical Data Systems), there is a different display on the CRT terminal in his office for each problem: it asks that information pertinent to the problem be typed in. At his practice and at HCHP no written or traditional chart is maintained. At CHCP, a prepaid health plan in New Haven, Connecticut, a 16-page form was tried that enabled physicians to use checkmarks to describe almost any physical abnormality.

The problems of data entry are as follows:

1. Computers accept and analyze only finite bits of data. Therefore, all data which are to be analyzed must be in a catagorized or coded form. This imposes a burden on providers because they must force things into categories and sometimes organize the thoughts in different and perhaps impractical ways. Because of this and a need for flexibility, those systems designed by physicians who wished to store larger parts of the medical record (particularly progress notes) use "free text." Notes are stored as written or dictated and can be retrieved as such, but cannot be analyzed.

2. Physicians in general type slower than they can write or dictate. It is doubtful that in the immediate future any direct machine-physician interface (touch, screen, menu-type selection, or other) will permit as rapid a recording as a written note or a few sentences on a dictaphone. In one specialty clinic setting, the Hypertension Clinic at Massachusetts General Hospital, it is reported that a physician-CRT interactive system was developed that allowed physicians to enter data as quickly as writing a note. However, the subject matter was narrow and the time (average 3.6 minutes per note) was longer than most busy physicians spent writing.[3] Inpatient hospital systems have been developed that do depend on these kinds of direct entry; however, here the physician uses a standard and detailed format. In ambulatory practice the note is usually briefer and more variable, and the need for quickness and flexibility is uppermost. Most sites will, therefore, continue to rely on forms and/or dictation for data entry. This has also been the conclusion of others.[4,5]

Table 1.
Sites Visited Employing Automated Medical Record Systems for Ambulatory Care

Appalachia II District
Health Department
Greenville, South Carolina

Cardiovascular Clinic
Oklahoma City, Oklahoma

Casa de Amigos
Department of Community Medicine
Baylor College of Medicine
Houston, Texas

County of Los Angeles
Department of Health Services
Los Angeles, California

Department of Community
Health Services
Duke University
Durham, North Carolina

Department of Family Practice
Medical University of South Carolina
Charleston, South Carolina

Division of Immunology
Stanford University Medical Center
Stanford, California

East Los Angeles Child
and Youth Clinic
Los Angeles, California

Harvard Community Health Plan
Boston, Massachusetts

Indian Health Service
Tucson, Arizona

Insurance Technology Corporation
Berkeley, California

Medical Data Systems Corporation
(Automed)
Olmsted Falls, Ohio

Pediatric Outpatient Clinic
Bellevue Hospital
New York, New York

Regenstrief Institute
Indiana University Medical Center
Indianapolis, Indiana

Rockland State Hospital
Orangeburg, New York

Section of Medical Computer Sciences
Yale University School of Medicine
New Haven, Connecticut

US Naval Air Station Dispensary
Brunswick, Maine

The Computer

The world of computers changes constantly. They are getting smaller, faster, and able to store more data. Many corporations now sell or lease "mini" computers for billing and management for small group practices. The market for these mini-in-house automated billing systems is likely to increase, and from them more physicians will become familiar with the terminology, strengths, and weaknesses of computers. Many of these physicians considering computer billing systems will inquire about storing medical data as well.

Current systems use a variety of types and sizes of machines. The reasons for this probably relate more to what is available in the individual settings than to any ideal choice. Many clinics we visited are near a university or university hospital, and they use whatever machine the computer science department or hospital has. This machine was frequently not purchased or leased for the purpose of automating medical records, and the computer may be shared with other projects. In many sites which we visited the computer itself is located off-site; in fact, in two instances it is several hundred miles away. The communication from the site to the computer is done in a variety of ways, usually via a dedicated telephone line. Batches of key punched cards or encounter sheets can also be mailed or electronically transmitted. There seem to be more problems in reliability with the communication than with the computer itself. A more sophisticated terminal with the ability to screen out errors in data to help in faster transmission offers a definite improvement in this area.

It is likely that in the long run the trend for AAMR will be away from large, shared machines to an in-office "mini" whose initial purpose will be billing and practice management. The office medical data entered and information generated will be tailored to the practice. Pollis has recently published a report which will help guide physicians in their choice of computer systems and provides guidelines for system-cost comparisons.[6]

Cost

The costs to operate an AAMR obviously depend on factors such as: development (system design and programming), hardware (buying or leasing the computer and/or terminals, telephone lines, etc), installation, data entry (personnel and equipment), operating and maintenance costs, and physician time. These costs vary according to the setting. However, the following are a few general guidelines:

1. The more innovative or extensive a system, the more programming and system development cost. Technological development at most sites visited has been supported by federal grants or some external source of support. Sites with higher costs of development and outside support tend to have more of the medical data stored and are more complex. It is unlikely that a small clinic could by itself support development, programming, and "debugging" of a unique system because these things are very expensive in terms of manpower and

computer test time. However, with the availability of programs developed by computer equipment vendors, service bureaus, medical consultant companies, or other clinics, the development costs are markedly reduced.

2. Of all the sites visited, only four could be classified as financially self-sufficient in that the users are paying for the total ongoing costs of the system. One of these had extensive initial federal support. It appears that at present further large scale development of AAMR requires outside support. However, the successful system is one the users will pay for, and the long-term viability for an AAMR depends upon the user's financial involvement. Service charges to the user must support the system. These charges depend on the equipment and the software (programs used). At least one family physician group found that the charges for computer storage became too great to allow it to continue using the system.[7] On the other hand, some users (usually large groups) felt that the secondary (management) costs reduction more than paid for the system. At the sites visited the estimated cost per patient visit for the AAMR ranged from $.50 to $14.

3. Cost reduction, or containment, was a stated goal of most systems. Such things as improved utilization of health manpower, fewer unnecessary visits, quicker chart review, fewer redundant laboratory tests, better referrals, better recording of data, and reduced hospitalizations were all cited as possible savings. Unfortunately, these savings are hard to document, and many expected savings could not be realized as the user does not have control over the total health-care system. Improved billing practices and collecting of administrative data, along with close integration of medical, business, and administrative areas offer the most obvious savings.

4. If we accept that in most instances an AAMR is not going to mean an immediate reduction in the costs of health care, then the relative benefits and costs must be weighed. Benefits are tangible and intangible. Tangible benefits include elimination of lost charges, improved claims processing, improved manpower utilization, and increased productivity. Intangible benefits include improvement in the quality of care (patient compliance and management), access to health care (scheduling and follow-up), facility management (planning and budgeting evaluation), and social benefits (such as technological advancement in AAMR, quality of care review methodology, research activities, and training programs).

For the private physician or small group, the major benefits probably concern management functions: billing, improving cash flow, and the ability to answer patient inquiries about billing. The physician will look toward those areas which increase his productivity (such as ability to do quick searches for medicines or diagnoses) and his ability to give good care (using patient surveillance and establishing and keeping a minimum data base). For those in a large group or HMO, the emphasis will be on appropriate utilization of services, budget information, patient enrollment data, and planning.[8] Medical information in which the physician may be more interested are patient profiles, problem lists, or abstracts of the medical chart; these are particularly useful when the physician is not familiar with the patient, for referrals, or when the chart is not available.

Medical Services Provided by an AAMR

Patient Profile

Of all the various medical services a computer can provide, the one most consistently of value is some sort of abstract of the social and medical information (a patient profile). Most sites visited (15 of 17) produced a patient profile, usually a one-to-four page printed document. This summarizes important medical information about the patient, and allows the provider to become rapidly acquainted with important aspects of the medical history (Figure 2). Patient profiles are particularly useful in settings where the traditional record is not always available or where each visit is with a different provider. All of the patient profiles contained patient identification data (age, occupation, etc); a few had free-text social information (a sentence or two by the doctor that he felt would help "characterize" the patient). At two sites a copy of the identification data was also printed for the patient.

Most sites also had some form of problem list, whether it be in the true Weed fashion, or simply a list of diagnoses from each previous visit. At a few sites one could resolve, up-date, or inactivate problems. At most sites the patient profile also contained the medications the patient is currently taking or has recently taken.

At the majority of sites the patient profile contained some data from the last or the last few visits. Most frequently this included recent laboratory data. Other kinds of data from the last visit included chief complaint, problems treated, treatment given, and provider name. Some sites provided much more extensive visit information, essentially the notes from the last encounter(s). For instance, at HCHP, each provider can specify how much previous medical data he wants with the computer generated summary.[9] Many internists there request the complete notes (mostly free-text) from the last three visits for that patient's major problem. This computer-prepared, preselected portion of the medical record is then the record for that visit.

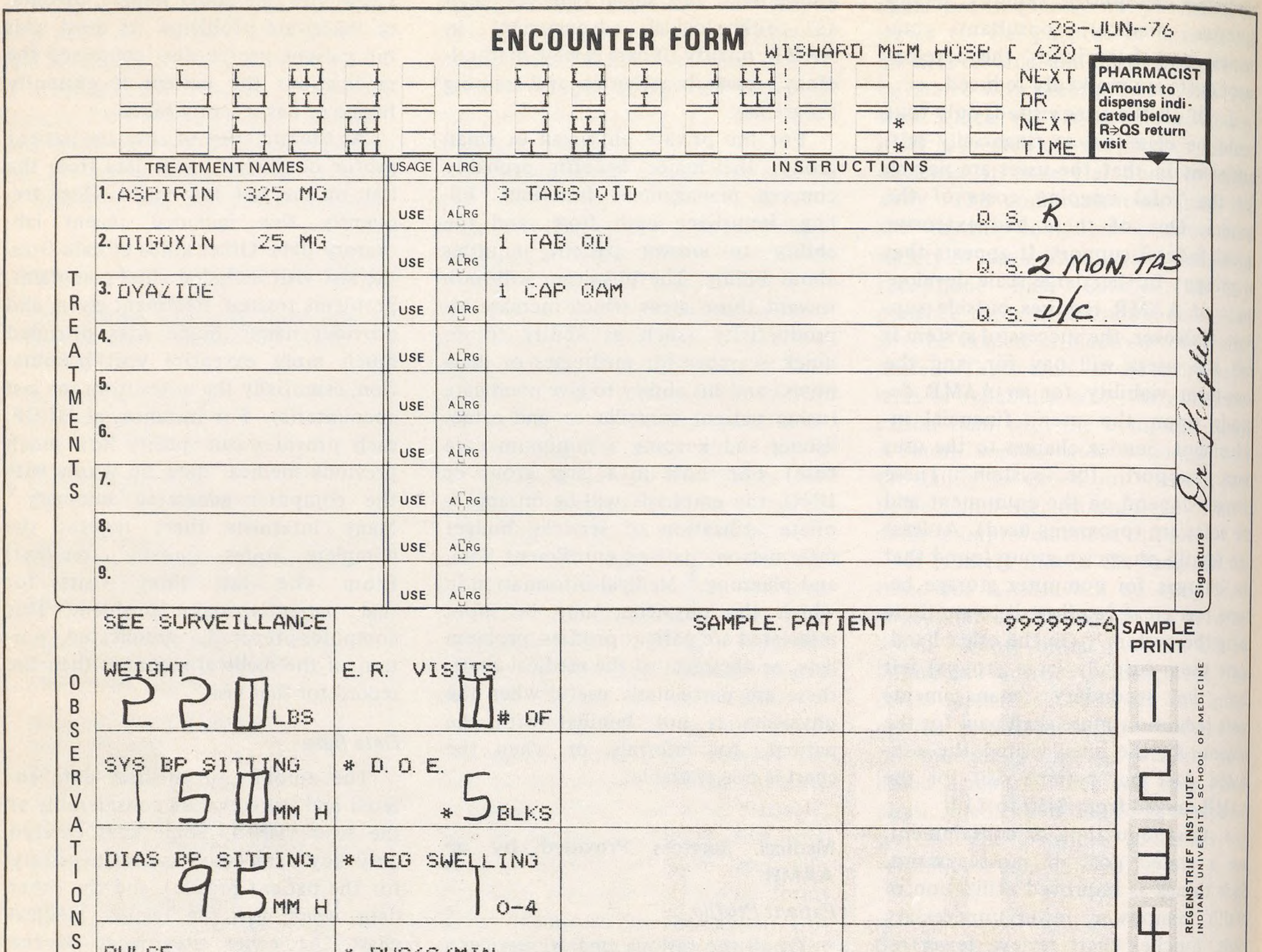
Data Base

The amount of medical data entered and stored varied considerably at the sites visited. Some sites entered only key data (such as that necessary for the patient profile), and the other data went into the regular medical chart. At other sites most of the medical data was entered in free-text form in the AAMR, and although this is retrievable, it is not analyzable. Lastly, at a few sites most of the entered medical data was primarily in a codeable form, not as free-text.

The decision of whether or not to enter extensive amounts of medical data depends on a number of factors, but most important is the overall goal of the system. If a total computerized record is desired then all medical data must be entered. If the goal is to prepare only certain items – such as a patient profile or flow sheets – then only the data necessary for these would be entered, and the rest kept in the traditional record.

The chief complaint or main presenting symptom was usually entered, and was usually captured in free-text form. The problem description or history of the present illness was about evenly distributed between free-text and coded forms.

The other historical details of the



ENCOUNTER FORM

28-JUN-76

WISHARD MEM HOSP [620]

NEXT DR

NEXT TIME

PHARMACIST Amount to dispense indicated below R→QS return visit

TREATMENT NAMES	USAGE	ALRG	INSTRUCTIONS
1. ASPIRIN 325 MG	USE	ALRG	3 TABS QID Q. S. R. . . .
2. DIGOXIN .25 MG	USE	ALRG	1 TAB QD Q. S. 2 MONTHS
3. DYAZIDE	USE	ALRG	1 CAP QAM Q. S. D/C
4.	USE	ALRG	
5.	USE	ALRG	
6.	USE	ALRG	
7.	USE	ALRG	
8.	USE	ALRG	
9.	USE	ALRG	

TREATMENTS

Signature

OBSERVATIONS

SEE SURVEILLANCE

SAMPLE. PATIENT 999999-6

SAMPLE PRINT

WEIGHT 220 LBS	E. R. VISITS 0 # OF
SYS BP SITTING 150 MM H	* D. O. E. * 5 BLKS
DIAS BP SITTING 95 MM H	* LEG SWELLING 1 0-4
PULSE 88 /MIN	* PVC'S/MIN 2 /MIN

REGENSTRIEF INSTITUTE- INDIANA UNIVERSITY SCHOOL OF MEDICINE

ORDERS & DX

IDENTIFY NEEDED LAB TESTS

LYTES

CBC ON RETURN

DX-COMPLAINTS

1 --ANGINA

2 CHF

* PROTOCOL GENERATED

PROVIDER ID 3 | RETURN 3 | ENCOUNTER DATE M M / D D | NEXT APPT DATE M M / D D / Y

99

28-JUN

NAME: SAMPLE. PATIENT 999999-6

DC 33 - 1958 OPTICAL SCANNING CORPORATION

Figure 1. An encounter form used at the Regenstrief Institute in Indianapolis. The data needed are indicated, and the clinician prints in his numerical observations which can be read by the computer. Reprinted with permission.

CARDIOVASCULAR CLINIC PATIENT MEDICAL INFORMATION
JUN 28, 1976

NONAME, JOHN (N00000)	ROBBINS
123 NW 45	SEX: M
TEST CITY, OKLA 73112	BIRTH DATE: DEC 31, 1924
PHONE: 999-9999	STATUS: BYO

THE FOLLOWING INFORMATION WAS LAST REVIEWED DURING THE PATIENT'S VISIT ON SEP 2, 1975.

PROBLEMS AND MEDICATIONS

PROBLEMS

DUODENAL ULCER (UGI)	12/27/74	1968
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	
VENTRICULAR FIBRILLATION	01/09/75	
ANGINA PECTORIS	01/09/75	MILD
	03/14/75	NONE - 1 MO
SELECTIVE CORONARY ARTERIOGRAM	02/06/75	LAD ST. 90%, RC OCCL
RENAL ARTERIOGRAM	02/06/75	NORMAL
HYPERTENSION PROTOCOL	12/04/75	

MEDICATIONS

ISORDIL	5 MG QID	01/09/75
PRONESTYL	500 MG QID	01/09/75
DIUCARDIN	50 MG BID	02/13/75
INDERAL	40 MG QID	03/14/75
ZAROXOLYN	5 MG QD	11/12/75
DYAZIDE	1 BID	12/04/75

PRESENT ILLNESS

LAST PRESENT ILLNESS (03-14-75): SO FAR NO MORE ANGINA PECTORIS. TOLERATING MEDICATION WELL BUT BP CONTROL STILL NOT ADEQUATE. ELECTED TO INCREASE INDERAL.

HISTORICAL RISK FACTORS

					INFARCTION							
	EXP	ALIVE	HYP	CVA	<39	40-50	>50	HD	DM	CAB	CAC	MAL
MOTHER	63		1	1								
FATHER	78						1		1			
BROTHER(S)		3					1					
SISTER(S)												

MARITAL STATUS: MARRIED	SOCIO-ECON. TYPE: MIDDLE
WORK TYPE: SEDENTARY	EXERCISE PROGRAM: NONE
HOME: LIVES WITH OTHERS	DISABILITY RATING: 4D

END OF REPORT

Figure 2. An example of a patient profile or medical summary used by the Cardiovascular Clinic in Oklahoma City. The physical examination and laboratory data, although not printed here, usually are also included. Reprinted with permission.

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                        HYPERTENSION CLINIC DATA SHEET
 A39821                                                                  FORS
AFOLABI, JULIUS                                                      06-29-76
T-2
   INITIAL  VISIT: 04-02-75      BP: 184/114 (137)      WGT: 145
   LAST     VISIT: 06-09-76      BP: 126/84 (98)        WGT: 154

  CURRENT MEDICATIONS                         LAST LAB VALUES
ALDOMET        500 MG BID               URIC ACID      7.6    (05-18-76)
DYAZIDE          1 BID                  BUN            8.0    (03-23-76)
K SUPL           1 BID                  POTASSIUM      3.0    (05-18-76)
                                        HGB           13.8    (05-18-76)
                                        RENIN          0.6    (04-02-75)

                        BLOOD PRESSURE/MEDICATION GRAPHS
    >200 :
     200 :
         :
     190 :
         :
     180 :                  S
         :
     170 :
         :                   S
     160 :
         :
     150 :                      S                   S
         :                                           S
     140 :                         S                  S
         :                    S  S      S     S         S
     130 :                                  S   S
         :                                 S              S
     120 :                           S
         :
     110 :                  D
         :
     100 :                   D                      DD
         :                       D            D         D
      90 :                    D D  D        D         D
         :
      80 :                           D  D       D         D
         :                                 D
      70 :
    < 70 :
         :++++++++++++++++++++++++++++++++++++++++++++++++++
                     74^75                   75^76         T

 DIUCARDIN                   +...+-...-..........+......+....0
 ALDACTONE                    +..+0
 ALDOMET                          +.......................
 K SUPL                             +.....................
 DYAZIDE                                                 +.
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Figure 3. An example of a computer generated hypertension flow sheet from the Cardiovascular Clinic in Oklahoma City. Reprinted with permission.

data base (past medical history, family history, review of symptoms) were less frequently stored. Approximately six sites stored this information in coded form and four as textual data. Although much work has been done in the computerization of the medical history, particularly with the patient recording or entering his own history, none of the sites used the patients to enter the medical history and none had the capability to enter a *complete* medical history in analyzable form.[10-13] Of all the subparts of the past medical history, current medications and past hospitalizations were stored most often.

A limited amount of physical examination data was stored in coded form by most of the sites. Often this was restricted to vital signs, blood pressures, and weight. Those sites which have been committed to free-text storage can also store more details of the physical examination.

The assessment of the patient's problems, diagnosis, or problem list was generally stored. Approximately one half of the sites recorded this data in coded form and one half as text.

Plans for patient management can be divided into diagnostic orders and therapeutic orders. About half of the sites entered the fact that tests were to be done or entered the result when obtained. Most sites entered the medications prescribed, a few entered other therapeutic orders, such as diet, physical therapy, or activity orders, and patient education. The disposition of the patient was usually stored in a coded form.

Encounter Reports

Computer-generated encounter reports range from a complete history and physical examination with laboratory reports (at Cardiovascular Clinic in Oklahoma City) to a simple free text progress note (at Automed). These reports are usually prepared from dictation or from forms which were checked or marked at the time of the encounter. At three sites the format and type of data presented was problem-specific, and two sites linked all data gathered to a specific problem. This linkage is necessary to have problem-oriented charting.

Ordering Laboratory Tests

At the Naval Air Station, Brunswick, Maine, laboratory tests are ordered directly by entering commands on the CRT terminal in the physician's office. At two other sites laboratory tests are ordered by checking appropriate boxes on the encounter form. At eight sites laboratory test results, once obtained, are entered and then can be recalled, displayed, or printed when needed. Hospital inpatient systems, such as the Technicon System at El Camino Hospital, Mountain View, California, use the computer extensively for ordering and processing laboratory work.

Flow Sheets

Computer-generated medical flow sheets offer much potential for displaying a time sequence of medical data.[14] Immunization data was the most common flow sheet, followed by prenatal data. The ability to generate flow sheets depends in principle only on the extent of coding and on the machine's ability to search and analyze this data (Figure 3). Flow sheets appear particularly useful in allowing a physician to gain rapid appreciation of a patient with a complicated chronic disease, such as hypertension. Flow sheets are also useful for pediatric preventive care and family planning because the same parameters are followed for a considerable time.

Searches

Data-base searches have potential in three areas: research, audit, and patient surveillance. Most sites could search the records for any coded variable or combination of variables. However, most sites did not do a large number of medical data-base searches. Output was usually in the form of histograms, tables, or graphs. At Stanford, a graphical computer display, a scattergraph of any two selected medical variables for all patients with a given diagnosis, could be quickly generated. In addition, at Stanford, because the system was designed for a university immunology practice, its searches could be done to look at the natural history of rheumatic diseases. As part of a rheumatology consultation, computer predictions were made regarding the likelihood of a given patient developing specific complications based on the data collected from similar patients (Figure 4). At the Medical University of South Carolina (MUSC), because of a strong education component, family practice residents did data-base searches for peer review and grand rounds presentations.[15] The ability to search through large amounts of data to find, for example, those patients under age 45 with a blood pressure of greater than 150/100, on thiazide medication, and with a potassium level of less than 3.5, is an important aspect of computerization. This ability was the basis of a computerized medical audit which has been done at HCHP, MUSC, Stanford, and Duke. Data-base searches appear particularly useful to medical researchers, and current quality of care review methodology depends on this type of search.

Surveillance

Surveillance, in this setting, means the computer indicating to the provider what data are needed but have not been obtained. Obviously, this first entails rigorous decisions on what medical data (history, physical, laboratory, or procedure) are necessary. At Regenstrief Institute in Indianapolis, such a system functions in the diabetic clinic. The data needed for each patient (geared toward monitoring potential complications of the illness and medications) were individualized (Figure 5). The feedback to clinicians significantly increased the likelihood of their following-up on missing or abnormal tests.[16] As part of the Health Summary at the Indian Health Service, Tucson, Arizona, the needed surveillance is indicated both for the monitoring of chronic diseases as well as the minimum for preventive care (Figure 6). This surveillance of preventive care was used to provide work-lists for community health personnel. HCHP used surveillance to identify those patients with a positive throat culture who were not immediately started on an antibiotic, or those patients with a last diastolic blood pressure reading of more than 100 who had not been seen in three months.

Prevention of illness is frequently not a high priority in a busy practice. However, there is little question about the value of pediatric and prenatal preventive care. There is widespread acceptance for many tests in adult preventive care, such as the Pap smear, cholesterol testing, tonometry, and stool guaiac tests. A surveillance system can produce reminders to patients or physicians in a timely and sys-

JANE DOE, PATIENT — Stanford University Hospital
Medical Record Number: 0 — Stanford, California 94305
Date: JUL 1, 1976 — COMPUTER PROGNOSTIC ANALYSIS
Referring Physician: DR. FRIES
Ward or Clinic: IMMUNOLOGY

30 patients have been selected with the following criteria:

Diagnosis: SLE	Patient value	Range used for selection
Hematocrit	42.0	38.4 to 44.9 (%)
Wintrobe Sedimentation Rate	12.0	3.00 to 24.0 (mm/hr)

CLINICAL FINDINGS

Age (mean) 37.4 years
Sex: 4 male, 26 female

Rash (% of patients)	43.3	%	
Pleurisy (% of patients)	16.7	%	
Arthritis (% of patients)	26.7	%	
Proteinuria (% of patients)	30.0	%	
Hematocrit (mean)	42.0	%	(+/- 1.56)
White blood count (mean)	6.48	x1000/cumm	(+/- 2.99)
Sedimentation rate (mean)	12.1	mm/hr	(+/- 5.70)
Creatinine (mean)	0.882	mgm %	(+/- 0.189)
Complement (mean)	90.0	mgm %	(+/- 38.8)
FANA: % patients	70.0	%	mean titer 1:191
Anti-DNA: % patients	23.3	%	mean titer 1:32
Anti-ENA: % patients	30.0	%	mean titer 1:2491
Latex Fixation: % patients	6.7	%	mean titer 1:10

THERAPY

Drug	# Pts.	Mean Dose	Associated Therapy	Subsequent Therapy
Prednisone	14	23.4 mgm/day	ASA(1)Plaq(1)	Aza(2)ASA(3)Plaq(2)
OH-Chlor	3	66.7 mgm/day	ASA(1)	

Other Therapy (7):
Aspirin(2),Pred + Aza(2),Cyclophos(1),Pred + Chlor(1),Cyt + Chlor(1)

PROGNOSIS

Per cent of patients experiencing each event.

End Event	Months 1	2	4	6	8	10	12	14	16	18
Death (cumulative %)	0	0	0	0	0	0	0	0	0	7
Proteinuria(3-4+) measured (%)	3	3	3	3	3	3	3	3	3	3
Skin Rash, increase by 1+ (%)	0	0	0	0	5	5	5	5	11	43
Pleurisy, increase by 1+ (%)	0	4	8	8	8	13	13	13	13	31
Proteinuria, increase by 1+ (%)	3	3	3	3	8	8	8	8	14	20
Creatinine, increase by .2 (%)	3	3	3	8	8	8	8	8	8	34
Patients followed (number)	30	24	23	23	20	19	18	15	14	14

Figure 4. A computer analysis of the probability of various complications in a patient with SLE based on comparison with 30 other patients with similar hematocrit levels and sedimentation rates. Reprinted with permission.

DO NOT PLACE IN CHART

[620]

SURVEILLANCE REPORT 30-JUN-76

SAMPLE PATIENT 999999-6

THE FOLLOWING ARE ONLY SUGGESTIONS

THE PHYSICIAN'S OWN JUDGEMENT SHOULD ALWAYS TAKE PRECEDENCE

RESPONSES TO SUGGESTIONS: A=AGREE, D=DISAGREE, M=MISSING DATA

ORDER RHYTHM STRIP

[ ] SINCE ON "CARDIAC GLYCOSID" (DIGOXIN) AND NO "RHYTHM STRIP"
SINCE 1 YEAR AGO AND NO "EKG" SINCE 1 YEAR AGO R: 12

ORDER RENAL FCT TESTS

[ ] TO ASSES RISK OF HYPERKALEMIA. ON "K+SPARERS" (DYAZIDE) AND NO
"RENAL FCT TESTS" SINCE 1 YEAR AGO
SINCE ON "CARDIAC GLYCOSID" (DIGOXIN) AND NO "RENAL FCT TESTS"
SINCE 1 YEAR AGO R: 10

ADD ANTACIDS/ADSORB

[ ] TO REDUCE RISK OF GI BLEEDING FROM HIGH ASA DOSAGE. ON "ASA" >
1800 MGS

INCREASE K+SUPPLEMENTS

[ ] TO REDUCE CARDIAC TOXICITY. ON "CARDIAC GLYCOSID" (DIGOXIN) AND
LAST "K+" < 3.2

REFERENCES:

10 A PRACTICAL GUIDE TO DRUG USAGE IN ADULT PATIENTS WITH
IMPAIRED RENAL FUNCTION
JAMA V214 P1468 NOV 23 1970

12 HARRISONS PRINCIPLES OF INTERNAL MEDICINE
MCGRAW-HILL SIX EDITION

Figure 5. A Regenstrief Institute generated report suggesting various tests or changes in therapy for a sample patient. The rationale and references are also included. Reprinted with permission.

****CONFIDENTIAL PATIENT DATA****

SKIN TESTS

TINE	12/29/71	
PPD	04/11/75	N 00
PPD	09/07/73	N 00
PPD	05/05/70	N

LAB/X-RAY RESULTS

	04/20/76	03/12/76	01/20/76	01/06/76	12/19/75	12/03/75	10/16/75
FBS						390.	284.
POTASSIUM							4.2
SODIUM							135.
BUN							12.7
U GLUCOSE						5%	
U PROTEIN						1+	
URINE CUL							N
THROAT CU		N		N	N		
SKIN CULT				N			
CH X-RAY	OTH ABN		OTH ABN				

SPECIAL SURVEILLANCE

HYPERTENSION

PATIENT IS HYPERTENSIVE CHECK BLOOD PRESSURE, WEIGHT + COMPLIANCE WITH PLAN

*06/19/76 DUE FOR MED REFILL

*04/16/76 DUE FOR SERUM K, PATIENT ON DIURETICS

*04/20/76 DUE FOR EKG TO FOLLOW HEART DISEASE

RHEUMATIC FEVER

*04/15/76 DUE FOR MED REFILL

REGULAR SURVEILLANCE STATUS

	LAST	NEXT
*DT	10/07/64	DUE NOW
*COCCI		DUE NOW
CH X-RAY	04/20/76	04/20/77
*PAP	01/22/75	DUE NOW
*BREAST	04/11/75	DUE NOW
HEART	08/20/75	08/20/76
RECTAL	07/02/73	07/02/76
*PELVIC	01/22/75	DUE NOW
*HEARING		DUE NOW
*FMLY PLN		DUE NOW

****END**** ****CONFIDENTIAL PATIENT DATA****

Figure 6. A portion of the Health Summary from the Indian Health Service illustrating indicated surveillance requirements. Reprinted with permission.

tematic manner.

Patient Management Services

Computerized patient scheduling is the most common task in this catagory. In a setting with a large number of clinics and/or providers, this kind of service can save clerical time, assure a well-booked practice to make the best use of provider's time, and decrease patient waiting time. In some cases, it can also make it simpler for patients to make appointments, and improve the percentage of appointments kept by patients. This was the case at Greenville, South Carolina, where 131 county clinics (family planning, immunization, dental, etc) were connected to a central appointment system. Each clinic was programmed according to the individual provider's preference in terms of how long per appointment, how many add-ons, etc. If a patient needed an appointment at more than one clinic, the system would attempt to make them on the same day.

Other types of services commonly seen at sites included: no-show and cancellation rates, encounter time duration and frequency, visit reminders for patients, staff schedules, chart review or audit schedules, patient medication, and compliance schedules. This type of practice information is an important byproduct of an AAMR.[4] At MUSC the use of practice data was considered an important component of the training for family physicians.

Administrative Services

Although most of the AAMRs were primarily oriented to the automation of the medical record, the administrative services provided the primary cost justification for the system. These services can be classified into two broad catagories:

1. Billing and Financial
    a. Accounts receivable
    b. Statement preparation
    c. Preparing third-party claims
    d. General ledger
2. Management
    a. Collection and reporting of various types of utilization statistics
    b. Registration and patient identification
    c. Record accession
    d. Collection and reporting of other useful data such as manpower staffing and scheduling

For a more detailed discussion of these services the reader is referred to the report by Henley and coworkers previously mentioned.[1]

The administrative objectives are dependent primarily on the type of practice. Private solo or group practices must depend upon fee-for-service charges. Thus, management is interested in proper recording of services performed and billing. For prepaid capitation plans, the management orientation is to control the nature and amount of services provided, to set the prepayment rates to allow cost recovery, and to assure that only eligible patients receive services. In contrast to private practices, public agencies generally receive substantial funding support from governmental agencies. Management goals are directed to producing utilization data to meet reporting requirements and budget justification. It is implicit that the integration of management and medicine in one system is an advantage in any setting.

Other Aspects

Health Services Research

Although huge investments have been made in biomedical research, comparatively little has been spent in the study of factors concerning quality, cost, and access to health-care services and in determining basic health status and outcomes. Automated ambulatory medical records are an important mechanism in acquiring data and knowledge about these areas. In order to gather data about the pattern of ambulatory care services, the Conference on Ambulatory Medical Records recommended a minimum data base set which will help in comparability of medical data and health services.[17] Essentially all of the sites store this data. Not only do these systems offer advantages to meet federal, state, and PSRO reporting needs, but also they offer ways to collect the information needed to provide for intelligent decisions in health-care delivery.[18] A specific example is the work of Wentz, Tindall, and Zervanos, who used a computerized data collecting system to describe a family practice and help design an educational program for the training of family practice residents.[19] Michas, Wilcox, and Walters describe a low-cost surgery reporting system for departmental reports, training activities, and clinical research.[20]

Training

At five sites resident physicians were directly involved with the AAMR, but only for the family practice residents at the Medical University of South Carolina was the information system considered to be an important adjunct to their training. This was achieved in four ways, First, by knowing the active problems of each patient, a reasonably balanced practice is maintained for each resident by using the AAMR. Secondly, the system stores much information on pharmacology and drug interactions which can be displayed when medicines are ordered. Other systems, such as at Vermont and Stanford, are also used to educate and remind physicians about the action and interaction of drugs. Thirdly, the AAMR at MUSC requires the use of the problem-oriented record, although it is achieved primarily by dictation. Finally, the data base search is used for grand rounds presentations, peer review, or review of specific problems.

Quality of Care

Objective evaluations of quality of care improvement from AAMR are limited.[21] Record accuracy and validity have probably been improved; however, the relationship between quality of care and recording of data is not proven.[22] Changes in health management systems may also result in significant benefits in the quality of care. The difficulty in measuring outcomes and the difficulty in deciding what constitutes an appropriate process of medical care need to be worked on before improvements in the quality of medical care alone will be able to justify an AAMR. The use of an AAMR does, however, offer important advantages in the procedures for monitoring care and data gathering, both necessary and frequently missing ingredients in the analysis of quality of care.

Privacy

The protection of privacy is an area of considerable concern, for in AAMR the data is potentially available to more people than that in a conventional record. Some sites used a password that is protected and/or easily changed. At two sites the computer could report attempts to gain unauthorized access. The constraints of physical location of terminals, knowledge of passwords, and system operation were in general considered adequate. A distinction needs to be made between data of an individual and that of a population. Most state laws covering health information disclosure are geared to specific information rather than comprehensive coverage of all health data.[23] In New York, because of concern over privacy with a multi-institutional psychiatric information system, a new law was passed to protect the data.[24] The issue of confidentiality of patient and provider data is not limited to the AAMR, for PSROs are also faced with this problem, and in many senses the issue is more a societal than a technological one.

Summary

From the provider's viewpoint, it has yet to be proven that total automated record systems are superior to paper systems for the delivery of ambulatory care. Indeed, most of the medical objectives of such systems – the accurate and detailed recording of data, flow sheets, surveillance, database searches, patient profiles, and patient and practice management can be achieved through well-done manual records.[25-27] However, the advantage inherent in the AAMR is in the use of potentially inexpensive technology for analysis of medical data for decision making, research, and evaluation and management functions.

As Kerr White has pointed out, there are several major considerations that affect the success of computer applications: the needs of people must be specified and the technology must materially assist in meeting these needs; the technology should be used to enhance efficiency, keeping in mind that it can generate new costs; heavy investments to increase the efficiency of services that are of dubious value should be avoided; applications should be well tested and "practice ready" and have the best chance of success where "critical masses" of both consumers and providers exist.[28] The use of automated ambulatory medical records to provide health inventories (patient profiles), patient encounter data, and flow sheets; to foster preventive care and health surveillance; and to link patients' problems with the services used and their costs goes a long way towards meeting these criteria.

Many of the AAMR systems are viable both economically and medically. Certainly most are innovative and offer potential use that far outweighs their current application. It is axiomatic that the goals and objectives desired from the system must be clearly identified, and the costs and benefits carefully considered. With the increasing availability of medical computer technology more physicians will be looking closely at the ambulatory medical record applications.

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