

Construction of an Automated Health Problem Inventory

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An Automated Health Problem Inventory was designed to monitor resident exposure, provide access to subgroups of the patient population, allow for study of patient care patterns over time, and aid in health-care evaluation studies. Major design steps such as choosing data and codes are discussed. Data collection documents and data reports are described. Data were collected over a 12-month period in two clinical settings — a model clinic in a residency program and a private practice clinic. These data are displayed by categories of problems and frequency of individual problems. The authors comment on the human and procedural support needed to make a data system useful.

The purpose of this paper is to share with interested readers the cumulative experience of approximately five years of working with automated clinical data systems in a family practice outpatient setting.

The inaccessibility of outpatient health-records information led in 1972 to development of our first automated data retrieval system called APORS (Automated Problem-Oriented Record System). That project has been described elsewhere.¹ A number of problems were identified during that project and that experience was useful in the development of the most recent system, the Health Problem Inventory (HPI).

The HPI was developed under a US Department of Health, Education, and

Welfare grant.* This grant was for the development of the Health Inventory and Care Evaluation System (HICES) of which the HPI was a subset. While this paper discusses the HPI, the ambulatory care audit system portion of the project is described elsewhere.² The original grant period was for three years but was reduced to two due to a delay in release of funds.

In May 1975 the HPI was implemented in two sites. The first site was a model Family Practice Clinic in the University of Minnesota Hospitals. This clinic is part of the residency sponsored by the Department of Family Practice and Community Health at the University of Minnesota. The second site was a private solo Family Practice Clinic in a northern suburb of the greater metropolitan area of Minneapolis/St. Paul.

The principal purpose of the HPI was to describe problems** that are presented to health-care professionals

in order to monitor clinical exposure of residents, compare the exposure to that in a private practice, create access to subgroups of patients, study the patterns of patient care over time, and provide a substrate for the care evaluation portion of the project.

Project Design

In determining data to be collected the project staff began by looking at the items of information that were necessary for fiscal and administrative management of the clinic. These items were compared to the Uniform Minimum Basic Data Set.³ This data set was included in order that the HPI system would contain a core of data that would be comparable to other ambulatory care systems. Selection of the final data set was also based in part on a desire to minimize the task of data collection since the work was to be done by busy clinic personnel.

Four types of data were collected for the project. These were: (1) demographic, (2) service and procedure, (3) problem, and (4) appointment (cancel, fail, new to clinic, old to clinic). Demographic and problem data were collected to monitor the clinical exposure of residents.

Family practice residencies have a commitment to expose residents to a variety of patients and medical problems. This type of data also provided access to subgroups of patients through production of problem-specific indices. These indices were used for problem-specific audit, research, and follow-up studies. In addition, therapeutic and appointment data were combined with demographic and problem data to allow a study of the patterns of patient care over time.

The data collection system was designed so that health-care professionals would record and code data at the time of service, thereby eliminating abstracting errors that might occur if a third party were to abstract from the records. It was felt that the accuracy of data collection and coding increases if the information is collected at or close to the source.

Two data collection instruments were developed: the family registration form and the encounter form. The family registration form is filled out by the first family member who visits the clinic. The completed form includes the relatively stable socio-

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**For the purpose of this paper the term will be used in the traditional sense to include diagnosis, symptom, sign, etc.

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economic and demographic attributes of the patients which do not need to be re-collected at each visit. The information entered for purposes of the HPI includes the account number, patient number, name, address, age, sex, years of education completed by the head of the household, marital status, financial class, and birthdate.

The multipart encounter form contains two major sections: the services and procedures checklist and the problem checklist. The top part of each page contains the essential identifying information for that visit including the patient's number, the date, and place of service. The problem checklist enables entry of the episode types: (1) new diagnosis, (2) follow-up diagnosis, or (3) inactive problems. The level of responsibility assumed by the primary physician is also entered: (1) no consultation or referral, (2) consultation but responsibility stays within the hands of the primary physician, or (3) referral of the patient with transfer of responsibility for a period of time. A number of classification systems for both services and procedures and for problems were considered for use in this project. The Minnesota Relative Value (MRV) Index was selected for classifying services and procedures. This selection was consistent with the aim of making the system compatible with the administrative needs of the clinic. The same considerations weighed heavily in the selection of H-ICDA-II as the problem coding system. This system had been recently adapted to the problem-oriented record and therefore included rubrics for coding symptoms and signs, as well as diagnoses. The model Family Practice Clinic was located in the outpatient clinics of the University Hospital and shared some information with colleagues in a wide variety of specialties and subspecialties. Under these circumstances use of H-ICDA-II was more satisfactory than the RCGP code which had been used in the previous system (APORS).

Several of the H-ICDA-II categories were restructured for the purposes of this study. Chapters were broken up when they seemed to be too broad to be helpful in monitoring the nervous system and sense organs. This was broken into categories of eye problems, ear problems, and the nervous system. All changes from the standard coding system were well documented.

Table 1. Categorical Analysis — Outpatient Problems

Problem Category: Pregnancy, Delivery Problems
Total Number of Encounters — This Problem: 311
Time Period: September, October, November, 1975

Number of Half Days in Clinic	MD	%					Total Number of All Problems Encountered
		5	10	15	20	25	
26	xxxxxxxx						220
37	xxxxxxxx						249
34	xxxxxxxx						247
30	xxxxxxxx						230
31	xxxxxxxx						181
35	xxxxxxxx						217
34	xxxxxxxx						196
65	xxxxxxxx						453
25	xxxxxxxx						115
22	xxxxxxxx						170
39	xxxxxxxx						209

Table 2. Number and Percent of Problems Seen in All Categories at a Model Family Practice Clinic from June 1975 through May 1976

Category	Category Heading	Problem Encounters	
		Number	Percent
00	Problems without a category (coding errors)	5	.04
01	Infective diseases	124	1.17
02	Neoplasms	87	.82
03	Endocrine, nutritional & metabolic problems	423	4.01
04	Hematologic	42	.39
05	Neuroses/psychoses	466	4.42
06	Psychosocial problems	767	7.27
07	C.N.S.	111	1.05
08	Eye	113	1.07
09	Ear	385	3.65
10	Cardiac problems	233	2.21
11	Vascular problems	584	5.54
12	Respiratory problems	957	9.08
13	Gastrointestinal	454	4.30
14	Hepatobiliary problems	30	.28
15	Urinary problems	217	2.05
16	Genital problems	737	6.99
17	Pregnancy, delivery problems	1119	10.61
18	Skin and subcutaneous tissue	530	5.02
19	Musculoskeletal	178	1.68
20	Newborn and congenital problems	58	.55
21	Trauma/poison	316	2.99
22	Allergy	315	2.98
23	Generalized symptoms	526	4.99
24	Health maintenance/family history	1714	16.26
25	Other supplementary codes	48	.45

Definition of terms was given a high priority in this project. Terms used on reports were defined on the printout automatically before any data were displayed under the terms.

The number of problems vs the number of patient visits vs the number of patients required careful differentiation.⁴ Three definitions were central to this system:

1. *Patient* – an individual who has received care in the clinic during the given period of time. The number of patients is independent of the frequency of visits or the number of identified problems.

2. *Patient visit* – a personal interaction between a professional and a patient where health problems are identified, evaluated and/or managed, and recorded.

3. *Problem encounter* – each problem presented by a patient at each visit, about which a progress note is written.

One initial objective of this project was to link specific services and procedures to the problems for which they were ordered. In part, the interest in this linkage related to the possibility of computer-assisted auditing of the care process in the evaluation phase of the HICES project. Two factors were instrumental in our abandoning this linkage attempt. The first and major factor was the additional cost necessary to develop the systems capability and implement the linkage in the ongoing project. Also, the care evaluation phase became outcome-oriented, rather than process-oriented, thereby lowering the priority for linking services to specific problems.

In selecting a medical billing service bureau as "research partner," the availability of developmental personnel and service representation in the field was closely examined. This type of project requires substantial commitment of the company's resources in research and development, as well as follow-up problem solving in the field.

Project Reports

A number of reports were used in displaying the data collected during this project. Some of these reports came at regular intervals (routine reports) and some came upon request (special reports). Also, some of the data from the reports were routinely transcribed onto graphs and charts by

Table 3. Number and Percent of Problems Seen in All Categories at a Private Solo Family Practice Clinic from June 1975 through May 1976

Category	Category Heading	Problem Encounters	
		Number	Percent
00	Problems without a category (coding errors)	7	.08
01	Infective diseases	89	1.03
02	Neoplasms	142	1.64
03	Endocrine, nutritional & metabolic problems	508	5.88
04	Hematologic	70	.81
05	Neuroses/psychoses	158	1.83
06	Psychosocial problems	258	2.99
07	C.N.S.	94	1.08
08	Eye	89	1.03
09	Ear	633	7.33
10	Cardiac problems	193	2.23
11	Vascular problems	611	7.08
12	Respiratory problems	1160	13.44
13	Gastrointestinal	456	5.28
14	Hepatobiliary problems	11	.12
15	Urinary problems	156	1.80
16	Genital problems	363	4.20
17	Pregnancy, delivery problems	184	2.13
18	Skin and subcutaneous tissue	546	6.33
19	Musculoskeletal	470	5.44
20	Newborn and congenital problems	50	.57
21	Trauma/poison	516	5.98
22	Allergy	259	3.00
23	Generalized symptoms	463	5.36
24	Health maintenance/family history	1047	12.13
25	Other supplementary codes	92	1.06

hand for educational, audit, or administrative purposes.

Routine Reports

Routine reports included the Category Analysis of Problems Encountered, the Analysis of Specific Problem Encounters, the Age/Sex Analysis, the Longitudinal Patient Care Report, and the Clinic Problem Register.

The *Category Analysis of Problems Encountered* lists each diagnostic category corresponding with H-ICDA-II

chapters with modifications as noted earlier. For each of these categories the number of patient encounters, percent of total encounters, percent of visits, and number of patients in which problems in this category were encountered are displayed. This quarterly report is designed to allow comparison among various physicians within the clinic as well as comparing one clinic to another. This categorical information was used regularly to prepare a manual graph for rapid visual comparison of the educational experience of various residents, as shown in Table 1.

The *Analysis of Specific Problem Encounters Report* is similar to the Category Analysis except that it displays specific problems, each with its own H-ICDA-II rubric. The specific problems are listed in their order of frequency. The number and percent of encounters, number of patients and percent of encounters, number of patients and percent of visits for each problem are also displayed. The problems are categorized on this report as to their episode type (new, follow-up, or inactive).

The *Age/Sex Analysis Report* describes the residents' and clinics'

Table 4. The Top Twenty Most Frequently Seen Problems, in Order of Frequency, Encountered at a Model Family Practice Clinic from June 1975 through May 1976

Problem Description	Problem Encounters	
	Total	Percent
1. Pregnancy, normal/prenatal	952	9.03
2. Screening examination	623	5.91
3. Other general medical examination	399	3.78
4. Hypertension, benign	343	3.25
5. URI	334	3.16
6. Pharyngitis	232	2.20
7. Desensitization to allergens	217	2.05
8. Obesity, no specific origin	216	2.04
9. Adjustment reaction, adult	215	2.04
10. Otitis media, acute	213	2.02
11. Anxiety neurosis	193	1.83
12. Prophylactic vaccination and inoculation	183	1.73
13. Contraception, oral	183	1.73
14. Abnormal blood pressure	174	1.65
15. Abdominal pain	150	1.42
16. Depressive neurosis	149	1.41
17. Medical examination for administrative purpose	135	1.28
18. Marital conflict	124	1.17
19. Vaginitis/vulvitis	121	1.14
20. Cystitis, acute and subacute	118	1.11
Total	5,274	49.95

patient populations. The patients are sorted by sex and arranged into 11 age categories. Those were: under 1, 1-4, 5-9, 10-14, 15-19, 20-24, 25-34, 35-44, 45-54, 55-64, and 65 or over. Based upon this information, an effort was planned to increase the number of older patients who used the model Family Practice Clinic.

The *Longitudinal Patient Care Report* allows for study of patterns of care by focusing on individual and family care over time. Patients are sorted by account number so that individuals are grouped under the head of the household account number, thereby clustering most family units on the report.

In addition to the account and

patient numbers, the following variables are displayed: age, sex, marital status, physician number, place of encounter, problems identified, and a list of services and procedures. This quarterly report encompasses the preceding 12 months' activity starting in January. The file in the computer is updated every month so that any information over 12 months old is purged and put into a permanent purge file.

The *Longitudinal Patient Care Report* provides a summary of data on the clinic's active patients, ie, those seen during the past year. Scanning the sheet from left to right provides an overview of the amount of activity in the clinic of a family, including the

number of different physicians involved with a single patient and a family, and types of services provided. The following are two examples of the use of this report. Patients over age 65 were screened to determine those who should be visited by the geriatric nurse practitioner, and those patients were reviewed who had more than six visits in a half year's time (excluding allergy shots and pregnancy). A number of modifications to individual or family care were undertaken based on the initial insights acquired in this report.

The *Clinic Problem Register* is designed to allow access to subgroups of the patient population. It lists each problem by H-ICDA-II code number and patients identified as having been

Table 5. The Top Twenty Most Frequently Seen Problems, in Order of Frequency, Encountered at a Private Solo Family Practice Clinic from June 1975 through May 1976

Problem Description	Problem Encounters	
	Total	Percent
1. Screen exam of population grps	532	6.16
2. Acute up resp inf mult unsp st	441	5.11
3. Essential benign hypertension	389	4.51
4. Otitis media acute purulent	328	3.80
5. Obesity n/spec endocrine orig	293	3.39
6. Other general medical exam	281	3.25
7. Acute bronchitis	162	1.87
8. Prenatal care normal pregnancy	155	1.79
9. Desensitization to allergens	126	1.46
10. Abdominal pain	126	1.46
11. Cystitis acute	121	1.40
12. Diab mell adult w/o complications	114	1.32
13. Prophylactic vaccination and inoculation	93	1.07
14. Other acne	88	1.02
15. Prostatitis	85	.98
16. Sprains-lumbar	85	.98
17. Chronic nasopharyngitis	84	.97
18. Depressive neurosis	83	.96
19. Osteoarthritis	83	.96
20. Acute pharyngitis	79	.91
Total	3,748	43.37

seen for the problem within the preceding 36 months. The patients are identified by clinic number only and are ranked according to age in two columns, one for each sex. The number of visits per patient for each problem is shown, and a code number of each physician who saw a patient is also listed. This report was used to select cases for problem-specific audit, special studies, and follow-up of selected problems. For example, hypertensive patients were identified on a Clinic Problem Register which was six months old. A current register was then reviewed to see whether there had been any new activity listed after their numbers. Follow-up proce-

dures were implemented for those patients who had not been seen in six months.

With the exception of the Clinic Problem Register, reports are not needed more often than quarterly. Quarters are based on the seasons of the year.

Special Reports

In addition to the five basic reports described above, the system is designed to allow for special reporting,

using a parameter program. With this program, multivariable sorts can be run with the variables selected by the inquirer. The chart selection program was used to provide a listing of cases with problems which interested the audit committee.

A *Flu Vaccine Report* was produced which displayed all patients over age 65, and other patients who had chronic heart, pulmonary, or metabolic disease. The report listed patient number, name, address, telephone number, and reasons for each patient's appearance on the report. The Flu Vaccine Report was produced in September 1975, and patients were called in for prophylactic vaccination.

Validation

Validation of data collected is always a difficult task in this type of project. The opportunity exists for careless recording of data.

Coding errors were of two kinds. Some residents tended to use diagnoses which were too specific for a problem (this became clear in the chart audit process). Other residents tended to force diagnoses into supplementary codes such as "general examination" to avoid looking up more specific codes. The audits, which ran concurrently with the Health Problem Inventory, were a great help in finding and rectifying common coding errors.

Programming logic errors were also discovered. Manually collected counts of diagnoses and encounters were compared to the computer printouts of the same period. Initially there was a discrepancy between the two counts. For example, in the Fall Quarter, the manual count of patient visits yielded 2,134 for the model clinic, whereas the computer count yielded 1,335. The program errors were identified and corrected. The counts became similar and remained so throughout the last half of the data collection period.

Summary of Data

During the course of this project 19,164 problems were presented by 4,208 patients during 13,774 patient visits in the two clinics. The problem category frequency is displayed in Tables 2 and 3. Tables 4 and 5 show the 20 most frequently encountered problems and their percent of total problem encounters, by clinic, displayed in order of frequency.

Project staff learned in reviewing the data that the types of problems being seen in the two clinics are fairly similar and that these findings correlate to those of the APORS project as well as to other ambulatory projects.*⁶

*In our data obstetric care ranked higher and congestive heart failure ranked much lower. The latter discrepancy may be due in part to the different coding systems.

There were, however, some specific differences in the model clinic and the private practice. For example, neuroses/psychoses plus psychosocial problems accounted for 11.7 percent of all problem encounters at the model clinic, as compared to 4.8 percent in the private clinic. The model clinic functioned in part as a consulting service within the University system for patients with psychosocial problems. There were two psychologists and a psychiatrist attending, and the residents were encouraged to follow their patients in therapy under supervision. In the private clinic, patients had an initial evaluation of those types of problems and were usually referred to other resources for therapy.

The model clinic also had a much higher percentage of obstetrical encounters — 10.6 percent as compared to 2.1 percent in the private clinics. Of the females seen in the model clinic, 56.5 percent were between 20 and 34 years of age, as compared to 30.4 percent in the private clinic. Both factors might be explained by the fact that the model clinic had a special obstetrical insurance rate for University students and families.

The model clinic had lower rates of ear problems (3.7 percent vs 7.3 percent) and respiratory problems (9.1 percent vs 13.4 percent) than did the private practice. An explanation for this might be the lower percentage of school-age children (10.4 percent of all patients were between the ages of 4 and 15, as compared to 22.2 percent for the private practice).

Conclusions

During the course of the project, the HPI became an integral part of both the ambulatory evaluation process and the resident education program. A summary of key design steps is as follows: (1) survey perceived data needs, (2) select those data items that have potential value for improving efficiency or delivery of health care, (3) determine the feasibility of collecting the needed data items as well as formulae which will be used to manipulate the information, (4) monitor output for system and coding errors, and (5) document the system.

Project staff found that in addition to good basic system design, adequate human and procedural support is needed to make a clinical information system useful in a service-oriented setting. Such support includes: (1) professionals in the clinic staff who are committed to using the system and who help stimulate use by others. Such commitment and system use increases the motivation to keep accurate information, (2) A data analyst who understands the system thoroughly and knows how to access, interpret, and use the data on behalf of clinic staff, (3) A feedback system which reaches all involved personnel with regular reporting of their monitored experience, (4) An agreement by the clinic to change policy or procedure when such a need is supported by the data, (5) A system for double checking that policy and procedural change is implemented.

The experience and observations of the project staff are reflected in the following comments: "Mere accumulation of more data is not necessarily productive. More attention needs to be given to asking the right questions, to encouraging receptivity on the part of potential users, and to interpreting and displaying data effectively."³ Furthermore, "Data of themselves are not useful. They must be aggregated and analyzed in the light of actual decisions that physicians, administrators, public officials, and medical educators are called upon to make and action they can realistically be expected to take."³

References

1. Filiatrault LJ: Use of health problem inventory in family practice records. *J Clin Comput* 2:14, 1973
2. Filiatrault LJ, Larsen PJ: Quality assurance activities as part of a residency training program: An examination of the potentials. (Accepted for publication, *Medical Record News*)
3. Murnaghan JH: Ambulatory medical care data. Report of the conference on ambulatory medical care records: Review of the conference proceedings. *Med Care* 11(Suppl):13, 1973
4. Petrich FA, House M: Improved data generation needed for ambulatory planning. *Hosp Prog* 54:84, 1973
5. Eickhoff TC: Immunization against influenza: Rationale and recommendations. *J Infect Dis* 123:446, 466, 1971
6. Marsland DW, Wood M, Mayo F: Content of family practice: Part I. Rank order of diagnoses by frequency. *J Fam Pract* 3:37, 1976