DESIGN OF AN OFFICE MEDICAL RECORD MODULE

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ABSTRACT

The Medical Records module allows the physician to use the computer to store, track, and analyze medical records. The computerized record structure is a problem-oriented medical record based on predefined data types and corresponding dictonaries. Data types include tests, diagnosis, findings, allergies, services, medications, and devices (e.g. glasses, intraocular lenses, etc.). The corresponding dictionaries contain the actual terms entered into the patient's record. This form of record keeping standardizes and improves the quality of patient data, and thus results in better quality patient care.

BACKGROUND

Paulmarc Systems has designed software modules which are available to organize and process all data within a doctor's practice. The system is written in the MIIS language, which is a dialect of ANSI MUMPS. The MIIS Standard is designed to perform interactive. string-oriented data base management. MIIS is an interpretive language, this means separate copies of source code and object code are not required.

The source code is the object code and is more compact than source codes produced in other languages. The system doesn't require the various loaders, linkage editors, and various compilers associated with many other high level languages. The result is a substantial savings in both disk and CPU memory. In fact, the MIIS operating system occupies only 52 KB of memory.

MIIS is supported on DEC, IBM, and Data General equipment. MIIS was selected as the programming language over MUMPS because of greater ease in programming and more powerful database manipulation ability.

The Paulmarc comprehensive office automation system can almost eliminate the use of paper files within the doctor's practice. The philosophy of the system is one of total information integration. All areas of the system interact. The system is on-line, which means all of the information involved in the practice is instantaneously available.

The system is divided into the following modules:

1) Patient Registration
2) Patient Accounting
3) Word Processing
4) Scheduling
5) Financial Managment
6) Medical Records
7) Contact Lens
8) Slide Catalog

DESIGN CONSIDERATIONS

The goals of this system are to produce an on-line record keeping for use by the physician or his technician while conducting an examination. Also, after data of patients has been collected, insight into treatment and techniques from the patient data base is required. The files of the system need to be designed in such a way that the physician has the capability to search through his patient population for any shared criteria. Important statistical analysis of the information is required in order to make further studies.

SYSTEM DESCRIPTION

The Medical Records module is a dictionary driven system which incorporates a problem-oriented record format along with a file design which allows the physician to use his patient population as a research tool.

The dictionaries are at the root of the medical record system and contain all of the predefined terms necessary for the entry of the medical record into the system. Each data type has associated with it a dictionary of user-defined terms. Diagnosis, findings, medications, and services are stored in a topological and associated group relationship. The dictionaries can be continually updated by the user.

The dictionaries also contain mnemonics or synonyms in order to speed up the entry of any data element into the patient record. Each dictionary element has an associated search name which is stored in the search dictionary and is used in analysis of patient data.

Record tracking consists of entry, editing, deletion, and listing of individual patient medical records. There are various forms of entry of information into the medical record. Each method is tailored to a specific type of entry process.

A batch entry method has been designed for technicians or secretaries adding information to a patient's record through the use of forms filled out by physicians. This method is more detailed and cumbersome. and more oriented to lower level data entry personnel.

Another form of entry is through the use of user-defined protocols, The protocol Driver is a branching questionaire which may be used to simulate actual study forms or examination procedures. This requires that a protocol be entered into the computer system. When a protocol is run, the computer will prompt the user with the questions entered. The information is entered directly into the patient's record. The protocols are used for predefined entry procedures.

The final form of entry is the Quick Entry method. This allows the doctor to use abbreviated terminology in order to quickly and efficiently enter patient information into the medical record.

The Quick Entry system has been specifically designed for the physician so that he may review the patient's record without ever leaving the entry program. The Quick Entry allows the physician to enter, edit, delete, and list the patient's record. It also allows the use of the protocol Driver in order to make use of predefined protocols to standardize entry information. After the protocol or any of the other functions described are executed, the Quick Entry will then return to the prompt area and wait for more commands. This method of entry and tracking is by far the fastest, most flexible method on the system.

For example, the physician may want a graph of intraocular pressure versus date in order to track the pressure during each visit; at the same time, the physician is capable of scheduling follow-up appointments for the patient without ever leaving the Quick Entry program.

This Medical Records system offers the doctor the best method of tracking, maintaining, and analyzing his patient data base. The computerized patient record has many advantages in that the total patient record is of better quality since it is developed from data which has been standardized through the use of dictionaries. The standardization of data is of great importance. for example, if a doctor or group of doctors wish to collaborate.

These multiple populations can be combined in order to observe and analyze larger subpopulations. Using this system, the quality of data is much better than any paper system could ever produce. The ability to search through a data base within seconds can render deeper insight into the efficiency of treatment and diagnostic techniques.

After the accumulation of a substantial patient data base, search programs can be utilized to analyze patient populations. Subpopulation searches are based on a combination of reserved words and terms in the search dictionary to facilitate the creation of subpopulations for analysis. The search parameters are user-defined and therefore the physician will have the ability to search an entire population for whatever is deemed necessary.

The search programs are used to create subpopulations and charts for analysis. After a subpopulation has been created, a chart can then be developed to display pertinent information. Simple statistics can be used to analyze the patients within the chart. Histograms can be displayed for any of the columns developed in the chart are also available.

For example, a search can be run to find all patients with a diagnosis "Glaucoma" and a surgical treatment of "Trabeculectomy". The result is a list of patients. A chart can then be defined on the system to show the age of each patient, the average IOP six months prior to the trabeculectomy, the IOP immediately prior to surgery, immediately after surgery,

and the average pressure one day, one month, three months, and six months after surgery.

For each of these columns, the mean, variance, and standard deviation are calculated for the operative. fellow, or both eyes. Histograms may be produced showing the distribution of values for each parameter. In addition, the charts may be used to rank associated diagnoses in the subpopulation. The columns may be mathematically manipulated to produce other meaningful statistics.

The patient's medical record is stored in a problem-oriented fashion by ID number and a date entry number. A problem-oriented index organizes the patient's record into the proper format; a date index is used for searching data; an index by entry date for medical records lists and charts. There are several data type indicies which are used in the searching process. Each data type and element are stored with an ID number in separate indicies. This number is used to search through patient populations for various data types and elements. These lists can be merged to produce smaller lists and can be checked for date ranges by using the other indicies to produce the pertinent information requested.

The structure of the Medical Records system uses the inverted index approach. This means that list structures use pointers to link records into chains via any of several keys. In this approach. no pointers appear in the records themselves. For each key value. a chain of addresses of all records containing that particular value is formed. Thus each possible value of every field can be the basis of retrieval.

This approach requires indicies and dictionaries. The indicies contain the location of patient information throughout the system. Each index has a particular function to the system. Some link date and medical information together and others are used for sorting and combining medical records for searches. The dictionaries contain user-defined terms to link the patient records with actual data names.

The use of dictionaries reduces the amount of storage associated with each patient's record. The MIIS language is an excellent vehicle for merging and sorting lists. The records of thousands of patients can be sorted within a matter of seconds. Some of the dictionaries are built in a hierarchial format so that main headings can be selected and subterms can be found without having to recognize each term during the searching process.

MIIS has a merge command which can merge two or more files using boolean algebra. This merging is done through the operating system and is therefore quite fast. Since MIIS is very efficient, the manipulation of these indicies is done without much CPU time or power.

A recent study was performed charting Yttrium Argon Garnet (YAG) laser versus Argon laser effectiveness in producing iridectomies in glaucoma patients, and utilized a forty patient population.

The information was gathered from patient charts. A protocol was devised to simulate the chart for ease of entry. The computer prompted for each selection from the chart. A technician was used to enter this information.

The information entered was stored in the patients' medical record files. Each data type and element are set up in special files for searching. These files are linked together by an inverted indexing approach. After all the information was entered via the protocol, the analysis portion of this study could be conducted. Using the seach routines in this module, subpopulations and charts were set up to analyze the data.

The subpopulations were divided into laser type and then further by iris color. The result of the subpopulation search is a list of patients for each of the parameters selected. Charts were then set up for each of the subpopulations created.

was displayed in two charts; one for Argon laser and the other for YAG laser. The columns displayed for each patient constituted the operated eye, and the laser specifications used during the procedure. Statistics were run to find the mean, standard deviation, and variance. The subpopulations were then further separated by iris color type in the charts. A separate chart was created to show each laser type and iris color.

Each of these charts displayed the laser eye, visual acuity before surgery, visual acuity after surgery, the intraocular pressure before surgery, intraocular pressures at one day, one week, one month, three months, and six months after surgery. The laser pulse energy and number of shots required to penetrate the iris were also displayed. The statistics then gave more detailed information as to how each iris type responded to the laser surgery. All of

this data was then printed out and readied for further in-depth analysis by the physician.

The subpopulations were created from the data type, element, ID number. and index files. The list of patients is selected from the parameters entered. The lists were then merged, and a list of patients was developed from the criteria entered. The list produced is an index to the patients' record from which the charts display apropriate information from the record.

The goals of this system have been accomplished and are in use a several sites throughout the nation. The research capabilities of this system are being used at research foundations to help reduce the cost of research and increase the number of studies which may be done to produce meaningful results. The research capabilities of this system have increased the effectiveness of several research studies being conducted throughout the nation by physicians in their own practice.

CONCLUSION

Using an inverted indexing approach and the MIIS language creates an efficient data base design and usage. The programs used to access this data base are user-friendly and give the doctor the ability to quickly enter, track, and analyze his patient data base. The information gathered can be used not only to analyze an office patient population, but also to increase the quality of patient care and aid in the overall efficiency of the physician's practice.