I. INTRODUCTION

Patient medical record is the single most important document in the medical field. While its primary purpose is to furnish documentary evidence of the course of a patient's medical evaluation, treatment and progress, it serves many other equally important functions. It is the source of information for most of the medical education. The medical knowledge, as it exists today, is based on the cumulative observations made by thousands of physicians over the past few centuries. These observations have been compiled into textbooks and monographs by prominent educators and medical scholars. As we stand on the threshold of an electronic medical information system, we become acutely aware of the need for a system of medical data entry which is accurate and uniform. This is to make certain that our sea of electronic medical knowledge does not become contaminated by misinformation due to the removal of the expert judgement of the medical scholar who poured over the medical records, extracting the reliable and pertinent facts to be included in the textbooks of yesteryear.

II. DESIGN REQUIREMENTS

1. The paper record of today does have the advantage of being a universally understood means of communication of medical data. As we strive for the paperless office, we should try to make sure that this understandibility is preserved without having to translate all the information back to the old paper system. Therefore, one of our major requirements has been to design a coding system for the storage and transmittal of the medical data such that this universal communicability via the electronic medium is preserved.

2. Some of the earlier as well as the current computer systems have failed to gain acceptance because of the inadequacy of the user interface. The CLINICAL METHOD is an art which has evolved over the past 400 years. The art of medical history taking is cultivated over a long period of time with innumerable, and often imperceptible influences shaping the physician's instinct and intuition. A patient with chest pain presenting to ten different physicians, will be interviewed and examined in ten different ways. Yet in the majority of them, a correct diagnosis will be arrived at. The computer system must respect this individuality and be as unobtrusive as possible for it to be acceptable to the majority of the physicians. We see the role of the computer as that of an "intelligent" data acquisition device. It must perform this function without imposing the personality and the prejudices of the programmer on the physician.

3. While we do not want a system which starts off by asking a hundred questions each time, we do have an interest in using the best capabilities of the computer in helping us in our thought process when we need this help.

4. The system must be comprehensive and allow entry of all types of medical data.

III. ANATOMY OF THE 'PATIENT MEDICAL DATA'

Patient medical record is essentially a collection of statements concerning a series of observations made about an individual by a health professional. Each of the statements usually has a central element of interest which the statement elaborates on by making qualifying remarks or by attaching certain values to it. For example, chest pain may be described in terms of location, radiation, intensity, etc. A statement about a lab test is completed by attaching a value to it. These elements are the smallest building blocks of which the record is constructed. Each of them has an independent identity. Chest pain, cough, Valium, heart are all examples of codable data elements. These are also the terms that one will usually find coded in the manuals such as ICD-A. Unless they are considered in association with the code element which they describe, their meaning is uncertain. Still they are an extremely important part of the medical record, since without the elaboration that they provide, the code elements will not give an accurate description of the patient's data.

Items such as location, severity, radiation, duration, date of onset are all terms which may be used to describe a code element such as 'chest pain'. The value of a code element or one of its attributes may be a number, a character, or a string of characters.

Most of the information in a medical record can be
represented by a well designed code structure. Some of the other phrases of text in a medical record which do not fit into the above code structures tend to be rather insignificant from the point of view of arriving at a proper diagnosis and from a statistical standpoint.

IV. PROGRAM DESCRIPTION

A UNIFORM CODE STRUCTURE

Based on the above observations, we have designed a basic code structure which forms the nucleus of a DICTIONARY. Unlike the dictionary concepts of the earlier works (COSTAR, TMR) we visualize this dictionary to be a universally understood collection of codes and their descriptions in the same way that the ENGLISH LANGUAGE dictionary is a collection of ENGLISH words and their definitions. Just as a person's own vocabulary does not encompass an entire dictionary, an individual physician (or institution) is free to use just those codes which it needs for its own purpose.

We used the following guidelines in the design of this code.

1. There is an exact equivalence between the English language phrase morphology and the code. This means that on translation, a certain code will yield the exact phrase assigned to it. We feel that this is the only way to accurately and faithfully store the information. High blood pressure and hypertension are two terms which represent the same medical fact but they are represented by two different codes.

2. The code structure does not seek to classify by trying to group like-elements together. This allows the dictionary an expansion capability without tying the code into any one classifying scheme.

3. While the inherent structure of the code is indifferent to a classifying function, the codes can be built into a hierarchical structure by the user for efficient operation.

4. The code is portable. The structure uses a universal data format. The program modules concerned with the handling of the codes are separate from those which handle the data entry and display. The latter can be implementation dependent programs utilizing whatever user interface capabilities the computer offers.

5. The structure allows expansion of the dictionary by the user, while maintaining the universal understandability. The recognition and handling of the user's own codes is identical to the handling of the system supplied codes. The process is transparent to the user.

With the establishment of a uniform code structure, the manipulation of the data can be made specific to the medical application. Storage, retrieval, and sort operations can be more efficient. The data acquisition and display may be implementation dependent. Data obtained on a smaller machine can just as easily be processed on a more powerful computer in a research center.

CODE TRANSLATOR

The heart of the program is a translator which changes the user-entered data into the code for storage and decodes it back to natural language for display. The program is written in Pascal allowing for portability.

DATA ENTRY

The code elements along with their attributes and values constitute the most basic building blocks of our system. From these building blocks, the user constructs the pattern and the order of his data entry. Because they are constructed of universal building blocks, they are universally understandable. But because they are constructed by the user himself, his individual preferences are preserved.

HARDWARE

Motorola's MC68000 is a 32/16 bit microprocessor. Microcomputers utilizing this processor are just beginning to appear on the market. Unlike the older microcomputers which typically had 64K bytes of core memory, these new microcomputers usually come with one half to one megabytes of RAM. This and other features of the MC68000 have made it possible to write sophisticated software which previously was only possible on the larger minicomputers. Yet the price of one of these computers is almost one tenth of a typical minicomputer.

In the final configuration, our software will be implemented on Apple computer Inc.'s new LISA* computer which utilizes Motorola's MC68000 microprocessor with 1 megabyte of core memory. LISA uses a mouse as a screen-pointing device which is essential for taking advantage of all the advanced user interface features of the program.

The software has been developed using the CORVUS CONCEPT,** another MC68000 machine which currently lacks a screen pointing device and therefore has a different user interface.

See system diagram next page.

*LISA is the trademark of Apple Computer Inc.
**CORVUS CONCEPT is the trademark of of Corvus Systems, Inc.
FIGURE: General schema of the program