Development of a Prototype IAIMS at the University of Utah

Homer R. Warner, M.D., Ph.D.
Professor and Chairman
Department of Medical Informatics
University of Utah School of Medicine

IAIMS at the University of Utah is now in the prototype development phase. A major activity this past year has been the completion of our integrated library system for the Eccles Health Sciences Library. We have now installed a system developed by OCLC which is running on a Data General machine and provides, among other services, online access to the complete catalog of library holdings. This will provide important new services to users in all four colleges (Medicine, Nursing, Health, and Pharmacy) on the medical campus. In addition, we have embarked on the development and implementation of some other innovative components of a prototype integrated information management system for the medical center at the University of Utah. The focus of this effort is to structure medical information in the form of models that will be useful in solving problems in a clinical setting.

Information needed to solve a medical problem can be obtained from three sources:

1. a patient database,

2. the medical literature, and

3. an expert in the subject.

Existing computer resources are providing us the opportunity to build a system which can facilitate access to all three of these information sources for any user with a clinical problem to solve. As part of our IAIMS development, we are implementing and testing a system for servicing the query function for two types of users: researchers and developers of medical decision support technology and medical students during their third year clerkship in internal medicine.

These activities are directed toward (1) improving access to information about existing models of decision support technology (DST) and (2) facilitating the teaching of internal medicine as part of a third year clinical clerkship using a patient database coupled to an operational decision support system.

Part 1. Access to Models of Decision Support

The HELP system is a large computer-based hospital information system developed by the Department of Medical Informatics of the University of Utah for the LDS hospital in Salt Lake City, Utah. This system is fully operational at the LDS hospital and is being installed at the University Medical Center. It not only consists of a patient data file on which all hospital and medical functions depend, but also provides a data-driven decision-making function which operates from a file of decision frames developed by medical experts in a variety of areas. Under IAIMS support, four groups are presently expanding the HELP knowledge base in the following areas:

a. pain management by nurses

b. therapy decisions in patients with hip fracture

c. antibiotic use

d. hematological diagnosis

In addition, we propose to implement a clearinghouse function for information regarding the existence and current status of Decision Support Technology (DST) across the whole field of medicine. To accomplish this we have built a prototype many-to-many linked database. One file contains descriptive parameters for each DST, another file, titles in the literature which describe these DST's, and a third that has information about the experts who developed and maintain the DST. Medical and DST experts from many centers in the United States and elsewhere are being contacted and asked to identify DST's and specify the parameters to be used to describe each of them. Information specialists at the University of Utah are reviewing the pertinent literature, extracting the relevant parameter values for each model, and creating the links. Interested users may access this database via modem.

Part 2. Use of Decision Models for Education

We are exploring the use of decision models as a teaching tool using a particular DST (the HELP systems). This DST is coupled to a hospital-wide patient dababase which contains not only the data that contributed to each decision made by HELP, but also the decisions (interpretations) made on each patient. Another file contains the decision logic in the form of frames or modules that can be displayed in easily readable format.

Front-end programs are being built to permit easy perusal of this knowledge base and patient database for use as a teaching tool. In addition, we have begun the development of a set of special literature files that represent a subset of the literature considered most relevant for student needs by a member of the faculty who is experienced in a particular specialty area. To make it easy for a student to access these files to get information needed to solve a problem, we have developed a system called ILIAD.

Using this concept, a student may use a variety of word combinations in 'and' and 'or' arrangements to express a concept to be used in a query. This provides a mechanism for matching the thought processes of the person who stores information in a database and the person (someone else or the same person at a later time) who wishes to retrieve information. For example, information stored under the key words "subacute bacterial endocarditis" could be retrieved by entering "heart infection" if the system 'knew' that 'heart' included 'endocardium' and 'infection' included 'bacteria'.

Such knowledge is represented in ILIAD as a 'relation' consisting of a stem term (with or without synomyms) and its branches. The stem term 'heart' has as branches the terms 'endocardium', 'myocardium', 'pericardium', 'valves', etc. Branches are treated as alternatives ('or' terms) to the stem term(s) when performing a search. A branch term in one relation may be a stem term in another, thus allowing large heirarchial structures to be represented in this format. Thus, relations broaden the list of items retrieved and remove the constraint of requiring the searcher to specify the exact key word that was used by the person responsible for storing the item. By entering more than one keyword to specify a search, however, the list of items retrieved is narrowed again, but without as high a risk of missing the desired item since each key word has been expanded to include 'related' terms.

This approach has several advantages:

1. Relations can be entered after the fact—they need not be anticipated by the person storing the original data and can even be entered or modified at retrieve time.

2. Relations can be used interactively at retrieve time to allow user to limit a search to a subset of the branch terms.

3. An expert in a given area can supply relations for a database which will facilitate successful querying of the system by a non-expert.

4. A term may be part of more than one relation, thus allowing the database to express a variety of heirarchial structures. For example, a given diuretic might be related to other potassium-losing drugs in one relation and in another to drugs which are nephrotoxic.

Medical students will have access to literature databases selected by faculty and may build their own 'reprint files' as well using the ILIAD system. In the third year of the project, each student will have experience in building his/her own decision modules using knowledge derived from the medical literature. The effects on each student's ability to solve real clinical problems will be assessed as a function of his/her use of this system during the clerkship.

These are the prototype activities directly supported by the IAIMS grant from the National Library of Medicine. There are other activities not directly supported by NLM but vital to the building of a modern integrated information system on the medical campus at the University of Utah. These fall in three categories:

1. completing the installation of the HELP system in various departments of the hospital, and responding to the requests for expanded services.

2. installation of a network for basic science researchers who share programs and databases primarily around genetics and genealogy, and

3. coordination of efforts to install local area networks within most departments for both administrative and research purposes.

The IAIMS committee meets twice each month, and subcommittees are active as well in much the same way they were a year ago. We continue to sponsor meetings of small computer users and interest in our annual INFOFAIR is encouraging. We are hoping to get major support this year from one or both of two major companies interested in our IAIMS research.