

# University of Cincinnati Medical Center: Integrating Information

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## ABSTRACT

The University of Cincinnati Medical Center has combined five existing units into a new organization responsible for initiating an Integrated Academic Information Management System (IAIMS). This new organization, Medical Center Information and Communications, was reorganized into nine departments, which now provide a variety of information services. Ultimate goals for IAIMS include a patient-centered database, a decision-support system, and a knowledge network. The IAIMS prototype, currently under development for the University of Cincinnati Hospital's Internal Medicine Service, consists of components representative of the IAIMS model's ultimate goals. A major premise of this IAIMS effort is that it is patient-centered.

**THIS REPORT** reviews the establishment at the University of Cincinnati Medical Center (UCMC) of an organization focused on the integration of information and communications for the health sciences center of the 1990s and the subsequent charge to that organization to develop an Integrated Academic Information Management System (IAIMS).

In 1982, Wilson's *The Management of Information in Academic Medicine* [1] and Matheson and Cooper's *Academic Information in the Health Sciences Center: Roles for the Library in Information Management* [2] were published and disseminated widely at UCMC. As part of a proactive approach, the University of Cincinnati Medical Center convened a committee to address the issues raised in these two publications and to recommend a course for the medical center to follow. The committee recommended that UCMC actively pursue the basic premises of the two studies. First,

however, it was recommended that UCMC needed a strong unit to direct the planning process for strategic information management. Five distinct organizations from the medical center were combined into a single organization. This organization was, in turn, responsible for initiating the IAIMS project for the medical center.

## MEDICAL CENTER INFORMATION AND COMMUNICATIONS

The Medical Center Information and Communications (MCIC) organization began in 1984 to integrate all the information and communication functions of the medical center. MCIC was created with a five-fold mission:

1. To serve as the primary health sciences information/communications resource for the greater Cincinnati area;
2. To implement and maintain an organizational framework for the management of information and communications;
3. To develop and recommend institutional policies, goals, and directions for information and communications;
4. To develop and support information and communication services and products to support the medical center's missions of patient care, education, research, and community service;
5. To create and develop a successful model for the integration of information and communications to support clinicians, researchers, and educators in carrying out the medical center's mission.

Guided by these directional statements, MCIC reorganized into nine departments: professional administrative services, graphic and publication services, educational television services, nursing educational resources, historical, archival and

\*This program was sponsored by NIH Grant Nos. G08 LM 04275-01 and G08 LM04663-01 from the National Library of Medicine.

museum services, medical center support services, the news bureau, information research and development, and the health sciences library.

#### IAIMS PLANNING

In 1984, UCMC was awarded a two-year IAIMS planning grant by the National Library of Medicine. The planning process attempted to gain support for IAIMS by involving the largest number of potential supporters from all UCMC constituencies including its Colleges of Medicine, Nursing and Health, and Pharmacy, and the University of Cincinnati Hospital. This accounted for a process composed of six task forces, (finance, evaluation, education, information management, technology and behaviors and attitudes) a sixteen-member university-wide overview committee, and an executive steering committee. The goal of the IAIMS project team, along with the information management task force, was to study the work of the task forces and to produce a conceptual framework:

The UCMC IAIMS is a patient-centered biomedical information system which integrates clinical, academic, and management information for improved patient care, education, research, and quality assurance. Users' information needs are met through multiple gateways and access levels. The core components of the UCMC IAIMS are a patient-centered community database, interacting with multiple distributed patient care databases, and value-added knowledge bases generated from the patient-centered database, relevant biomedical literature, and everyday health care practices.

This conceptual framework was also guided by the recognition that IAIMS is interactively constituted by three key elements: users (clinicians, researchers, faculty, students, administrators, and staff whose needs are paramount in the development and design of an IAIMS); content (information and its structures); and technologies (selection of computer and communications alternatives that can successfully satisfy our institutional directions).

A literature review revealed that little was known about the information needs of users at academic health sciences centers. One method of gaining the necessary understanding was through the development and study of stand-alone information system/pilot projects. Examples of development projects implemented by MCIC through the life-cycle of the planning process included:

- Medical Information Quick (MIQ), a filtered (280 journal titles) subset of the MEDLINE database, focusing on the core clinical information needs of medical, nursing and pharmacy students. MIQ offers free

access, at seven locations distributed throughout UCMC, twenty-four hours a day.

- A distributed database of UCMC employees, places, maps and events; available in a center-wide series of icon-based, touch-screen electronic kiosks.
- Digital Equipment's All-in-One office automation has been installed for all MCIC staff. This 100-user site (VAX 750) is part of the university's twelve-site network.
- Quick Medical Reference (QMR), the University of Pittsburgh's diagnostic decision-making aid, was used and evaluated for educational purposes with residents in internal medicine's morning report.
- Access to the university's Student Access Network was made available at the medical center through sixteen distributed terminals, and a node (VAX 780) dedicated to student instructional computing at MCIC was installed.

Computer- and communications-based educational support is a primary focus of several MCIC units in addition to the IAIMS project. MCIC broadcasts over seventy teleconferences annually, utilizes two computer-generated graphics systems to produce materials to enhance lectures and scientific presentations, and has produced several interactive videodisc programs that facilitate clinical skills instruction.

The development of the information systems described above was augmented by studies that clarified further the challenges of building an IAIMS prototype at UCMC: users' perceptions of the office automation system's effects on their work were examined; uses of and attitudes toward MIQ were studied; an examination of QMR use, in relation to alternative information sources of residents, has been pilot-tested with twenty residents; and the effects on users of the implementation of UCMC's clinical laboratory medicine computer system has been reported [3].

Our attempt to gain a data-based understanding of the UCMC information environment was enhanced by an in-depth study of the completed IAIMS planning process. Using independent interviewers from the university's Departments of Psychology and Sociology, key participants and nonparticipants of the planning process were interviewed at length, and the critical points of the interviews were categorized through content analyses. The results illuminated issues that described and predicted the possibilities and problems of

model development and eventual IAIMS implementation.

#### THE UCMC IAIMS MODEL

Three areas constitute the UCMC IAIMS model: a vision of UCMC's IAIMS direction, political and organizational issues that must successfully be negotiated, and a prototype of the IAIMS model.

##### *Vision*

An IAIMS network will be providing significant integration of information at UCMC by 1990. A central component of this network will be a clinical information system—a patient-centered database for the Internal Medicine Service of the university hospital which is integrated with data from the hospital's clinical laboratory and radiology information systems. Via this network, a physician, nurse, student, or other authorized user may access this database, which contains demographic and core clinical information about each patient.

By 1990, UCMC will also have an operational decision-support system consisting of academic information sources and services focused on the precise information needs of the Internal Medicine Service users. This includes the MCIC libraries' databases and catalogs; an expert system; online databases and databanks; and tools that support access, analysis, and report-generation for the individual user.

The 1990 IAIMS will also have a knowledge network (K-net). This will be the system by which information from the decision-support component is first linked and then integrated to the information in the clinical components. When the K-net is fully operational, a physician, nurse, or student located on the internal medicine floors of the university hospital can request information on a specific patient from the patient-centered database, retrieve the appropriate lab values and radiology findings, and study relevant data in an expert system such as QMR in order to facilitate appropriate diagnoses. Also, if the requestor needs academic information, she or he can immediately access the library-based systems. Through the K-net, appropriate information, whether citations or the complete text of materials, will appear at the workstation. The K-net will thus allow the requestor to gain access to the multiple components of the IAIMS and provide a rudimentary level of integration of academic and clinical information.

##### *Issues*

The political and organizational issues surrounding the IAIMS model are those that emerge from

the restructuring of the information environment and the varying perspectives of organizations (e.g., libraries, computing centers) and of professional groups (e.g., physicians, administrators, technical personnel). Negotiation of these issues, in an informed and proactive manner, is ongoing and critical to the success of an integrated information model. Traditional beliefs about information, its ownership and control, are called into question when a system such as IAIMS is envisaged. When networked access and personalized workstations are made available, for example, the individual user is empowered further and professional autonomy and control is preserved. At the same time, centralization of data and computerization of ever-increasing amounts of it replaces control by the individual professional with institutional control, with the technician as caretaker. This paradox is brought to bear on the developing IAIMS model in the following ways:

1. *Roles and responsibilities in IAIMS development:* What are the new roles of the libraries and computing centers? What are the roles of clinicians? What are the varying beliefs about information ownership, particularly patient information? What is the responsibility of the hospital regarding data availability and data used for research purposes? How can patient confidentiality be safeguarded?
2. *Governance structure:* During the life cycle of the IAIMS process, senior leadership at the medical center has changed. With a new senior vice president and provost, new dean of the College of Medicine, and new chair of the Department of Internal Medicine, the governance structure is changing from one which was highly decentralized to an increasingly centralized structure with strategically determined, focused areas of excellence. The success of the IAIMS model can be assessed by its adaptability to changing institutional directions as well as its contributions to them.
3. *Technology selection:* How can the IAIMS project support university-wide technological directions and, at once, because of its experimental nature, utilize state-of-the-art technical tools and solutions? In an environment with scarce resources, how can beneficial compromises be reached? Can IAIMS provide a model for the rest of the university?
4. *On-going strategic planning:* Although the IAIMS planning process was completed in 1986, planning for IAIMS must be continu-

ous to insure compatibility with UCMC's new directions, new personnel, and to allow us to remain cognizant of changing technological opportunities. Clarifying the IAIMS initiative, defining it for various groups, and gaining acceptance of it requires a significant time investment by project staff.

#### UCMC IAIMS PROTOTYPE

In July 1987, UCMC received an IAIMS model development and testing grant from the National Library of Medicine.

##### *Organization*

The organization for IAIMS phase II includes a steering committee and the staff of MCIC. This group is responsible for advising project staff and integrating the directions and issues raised by a content steering group, a technical systems group, and a user relations group. The content steering group is responsible for 1) the content selection and evaluation, 2) information policies clarification, 3) clinical decisions and practices as they affect prototype development, and 4) content selection decisions as they affect patient care and provider relations.

The technical systems group is responsible for: 1) the technical components of prototype development, 2) all systems and network analyses, 3) network development and compatibility decisions, 4) database decisions, 5) technical site preparations, 6) evaluation of commercially-available products and tools, and 7) interface development.

The user relations group is responsible for: 1) needs assessments, 2) disseminating information about prototype developments, 3) education about IAIMS, 4) communication with the users, and 5) feedback into prototype development on users' perspectives regarding content and technology. Thus the systems orientation at the University of Cincinnati allows the professionals involved with facilitating the IAIMS process to link together the users to the content that they desire through nearly invisible technologies.

##### *Prototype*

The IAIMS model is being developed and tested through a prototype for the Internal Medicine Service of the University of Cincinnati Hospital. Its key components are: a patient-centered database, Internal Medicine Service patient care database(s), a decision-support system, and a knowledge network.

A major construct of the UCMC IAIMS is that it is patient-centered. The role of information is seen to subserve the delivery of high quality patient care, education of its providers, and the retention and production of biomedical knowledge.

The core clinical model, or patient-centered database (PCD), was defined by the planning process as a centralized repository of information which reflects, but does not simply mechanize or replace, the patient record. The PCD will contain fundamental patient information and demographics and will function as the key index for the IAIMS prototype. The challenge in prototype development is to ascertain and validate the PCD's core data categories so they will serve as a viable data model for all clinicians at UCMC.

The PCD will bear an integrated, interactive, non-redundant relationship to other databases or information systems functioning as clinical or patient care systems which are developing at a rapid pace throughout UCMC. The Internal Medicine Service prototype is one of UCMC's many newly developing, physically distributed systems that attempt to satisfy the information and data-handling requirements at the level of the department, specialty, specific mission, or research project. The Internal Medicine Service's patient care database will interact with the model PCD to extract basic patient information, and return to that database new diagnoses, modalities of treatment, and related patient data.

In addition to the collection of a few new data categories, sources of information for the prototype include data from the university hospital's information system, the clinical laboratory and radiology information systems and the Internal Medicine Service's discharge summaries. Retrieval of these data requires building interfaces between our multi-vendor hardware.

Other projects which will form a part of the IAIMS prototype are all currently in the development or evaluation phase: integration of an expert system, or diagnostic decision-making aid, is seen as critical to IAIMS' education function. QMR and other aids are currently being evaluated by internal medicine faculty and students.

Important components of the UCMC IAIMS conceptual framework identified by the planning process are "knowledge bases." Knowledge bases containing the biomedical literature and other "knowledge" in direct support of provider activities will be logically attached to or integrated with the internal medicine patient care database and will be

accessible through the universally available knowledge network. "Knowledge base" was understood for planning purposes as a general term representing a database/databank for organizing the academic components necessary for IAIMS. Knowledge bases may be constituted by expert systems, subsets of the biomedical literature, heuristic or other value-added access to commercially available online databases, peer-reviewed treatment protocols, "handbooks," or reorganized, clinically derived information not tied to a particular patient. The purpose of access to these is, first, simply to bring the traditional knowledge retention function of the library to the health care delivery site; second, to support the formulation of decisions in patient care delivery and clinical investigation; and third, when placed within an instructional framework, to support the educational process.

The exact configuration—content, organization, and interface locus of a knowledge base (or groups of them) is dependent on the needs, requirements, and uses of the internal medicine providers and their various roles in patient care, education, and research. Characterizing, modeling, and enabling the relationship between the knowledge bases and clinical information is one of the most significant challenges to IAIMS; it is, in fact, what will differentiate IAIMS from a medical information system.

The UCMC IAIMS model assumes that the academic or knowledge-based information needed and made available is not the encyclopedic "universe of biomedical knowledge" but a need-sensitive subset, crystallized or filtered, and evaluated on the basis of whether or not it is used. Our experience with an IAIMS planning prototype, Medical Information Quick (MIQ), a quality-filtered MEDLINE subset, suggested that when faculty and providers are involved in the selection of content, these information sources will be used. But access and use of MIQ (and other library systems) are conducted separately from direct patient care. Once sources like MIQ form a part of an integrated system, we can determine whether or how "academic" information will be integrated within the conduct of everyday practice. While we know that the organization of the traditional library presents obstacles to information use, which IAIMS projects and online library systems attempt to ameliorate, we recognize that Simon may be right when he suggests "the fact that information can be transmitted to a decision point does not mean that it can and will be used there" [4].

### *Services*

MCIC services have been put in place to support IAIMS and the UCMC integrated information direction. Services are considered to be an integral part of the IAIMS model. To increase the effective use of information sources and to promote the integration of information into everyday clinical practices, providers must be given opportunities to develop information literacy, information management skills, and basic computer literacy. To achieve information literacy they must be able to: recognize a given problem as an information problem, attain literacy in the language(s) of the various IAIMS systems, and know which information sources have the highest probability of solving their problem. To increase the probability that information will be used once it is obtained, providers must possess an understanding of available information management tools and techniques to organize their own data and records.

To support the IAIMS prototype, the University Computing Center offers a number of courses covering basic computer literacy. The Microcomputer Information Center, a joint project of MCIC and the computing center, provides hardware and software support on a consultative basis. Both the Microcomputer Information Center and an information management center (electronic classroom) are conveniently located in MCIC's Health Sciences Library.

The MCIC librarians have designed and introduced formal and informal course offerings on the fundamentals of online retrieval using both BRS/Saunders' Colleague and MCIC's MIQ. While both systems are user-cordial and menu-driven, they are used also to provide users with an understanding of the organization of the biomedical literature, generalized information retrieval principles, and the rudiments of searching. Consultation and user support is available and the librarians are also involved with development of programs about information management tools and techniques.

Augmenting the IAIMS prototype will be the development of the K-net, or highway, which will provide user-cordial assistance for information identification and subsequent use. The network will provide navigational information so that a user can find information residing anywhere in the system without concern for its actual physical location. At its primary level, K-net will function as a global or meta-directory, giving information about the system as well as pertinent information related to

IAIMS services and products (e.g., training schedules, resource people, ongoing project development). A second level will provide hierarchically structured "help" information. A future goal is to provide a single gateway or interface language to access all IAIMS subsystems.

#### *Tools*

Design of the IAIMS workstation is seen largely as a matter of selecting, modifying, and evaluating university and commercially available tools and integrating them by means of explanations and directions available through the knowledge network, and training and consultative services already available through MCIC and the computing center. A key integrating element at the level both of the individual workstation and of the navigational highway to databases newly created for the prototype, is acquisition of a commercially available fourth-generation language. This language must be capable of being used as a front-end language to the various relational databases under development, as well as work successfully in our multi-vendor hardware environment (Amdahl, VAX/VMS, PC-DOS). We are at the final stages of selection of this product and are working with the computing center to select a tool favorable to other university projects so that together we can build a support structure for this tool and a critical mass of applications rapidly. Additionally, electronic mail, document processing, spreadsheet, SAS, and communications software will be provided with the IAIMS workstation.

#### SUMMARY

UCMC's philosophy for integrating information was to create an organizational structure—Medical Center Information and Communications. Further definition and demonstration of this philosophy became the responsibility of MCIC, especially its Department of Information Research and Development. Strategic planning for the UCMC IAIMS was conducted and a model developed. At present, a prototype is being developed and tested for the Internal Medicine Service of the university hospital.

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*Received February 1988; accepted March 1988.*