Plans for a program in medical information science

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ABSTRACT

Although the "information revolution" has pervaded nearly every other aspect of modern industrial life, the health care system—replete with an overdose of information—lags behind in management and control. Although there are isolated examples of the use of information technology in the health delivery system, these are fragmented and usually limited to isolated processes, rather than to an integrated information system.

This underutilization is largely the result of an isolation of the health professional and the physician from any substantive knowledge of computing. "Computer ignorance" has led to overexpectation and consequent disappointment and failure. We propose that formal structured training of health professionals at the postgraduate level will provide the knowledge base that will lead to intelligent planning and practical implementation. The details of a graduate training program, with a strong embedded research component, are presented.

INTRODUCTION

Although the nation is in the third decade of the "information revolution," clinical medicine and the health care delivery system are only now beginning to realize the substantial impact of computer technology and information science. Developments in medically-related computing date back scarcely ten years. In health care delivery, the scope of applications has substantially broadened: early efforts were limited to hospital accounting; the present spectrum encompasses applications ranging from health information systems to laboratory automation to computer consultation. 1 In addition, the digital computer has become a research tool of high utility to both the basic medical scientist and to the clinical researcher.

Computer technology has made practical the accumulation of large data bases; their actual utilization, however, has been limited in both patient support and in health planning functions. It is ironic that some of the heaviest users of large health data bases have been insurance carriers concerned with economic risk factors. Parenthetically, this reminds us that substantial ethical and legal issues relating to individual rights of privacy must be taken into account when considering the management of health data bases. 2

Minicomputers are now out-pacing monolithic large computers in terms of both variety and versatility. Costs of processors have decreased almost exponentially. Minicomputers are now widely used in medicine, for patient monitoring, for control of laboratory instruments, and for a wide variety of other applications. The effective amalgamation of large central computers with minicomputers into integrated information networks is a developmental area of high potential. 3

Educational and training activities related to medical computing lag far behind. 4 The responsibilities for biomedical computing have been assumed in an unstructured manner by most American medical schools. In some, departments of physiology have subsumed the task and have placed primary emphasis on research applications involving hardware development. In a number of medical schools, special computer research resources have been established under the Biotechnology Resources Program of the National Institutes of Health; these function as service centers, as well as local foci for computer-related research. The attention of such centers to medical education has been relatively minor, primarily because of the statutory limitations to research inherent in the program.

Consequently, it is fair to state that although computer applications in medicine are increasing both in variety and extent, there has not been a commensurate increase in developing programs in medical information processing science. There is the real danger that unless more programs are developed, health professionals will become less capable of adequately specifying sensible requirements for medical information processing, will be less able to make effective use of computer technology, and will be less capable of evaluating the impact of the computer technology to which they are exposed. Furthermore, if such uncoupling between health professionals and computer scientists should continue, new developments will inevitably grow less relevant to the real needs of the health care delivery system.

It is therefore postulated that effective educational pro-
grams in medical information science are a necessary component of a health science educational institution. We propose that such a program should be designed and effectively implemented.

PROGRAM DEVELOPMENT

The establishment of the School of Clinical Medicine at Urbana-Champaign campus of the University of Illinois is projected for July, 1977 with the first class of students entering in Fall, 1978. A proposal to establish a Center for Medical Information Science in the School of Clinical Medicine [Appendix A]. Urbana-Champaign has been submitted to the planning officers of the School of Clinical Medicine. It will be a basic instructional unit within the School of Clinical Medicine. Since July 1975, ongoing programs have been coordinated, new research projects have been initiated, and the instructional goals and learning objectives in medical information science for professional students have been developed. An application for a physician training grant in medical computer science has been submitted to the National Library of Medicine and has been approved.

Instruction

The goals and learning objectives of instruction in medical information science have been defined as:

Goals
- to enhance the understanding of computer science and its relations to clinical medicine, basic health sciences and the health care delivery system.
- to encourage career development in medical informatics.

Learning Objectives
To provide physician-in-training:

- the basis for understanding in cybernetics, mechanisms of human intelligence, and the clinical decision processes.
- the means for acquiring, structuring, analyzing, and displaying data to enhance its usefulness in the health care process.
- skills in the appropriate important applications of computers in clinical consultation; medical record maintenance; pattern recognition in ECG, EEG, and other physiological recordings; utility of computer assisted tomography; and patient monitoring.
- experiences in the usefulness of simulation and modeling, both as a learning tool and as a means for enhanced decision making.
- skills in the use of problem oriented and computer based medical records through the development of a school ↔ clinical affiliate system.
- opportunities for complementary experiences via computer-assisted and managed instruction.

Program Description

- Undergraduate Medical Education

The instructional efforts will be directed to the needs of the medical students in the School of Clinical Medicine as listed in the learning objectives above. It will also be coordinated with the activities at the School of Basic Medical Sciences, Urbana-Champaign (SBMS-UC).

The curriculum of SBMS-UC is self-paced and is problem oriented. Computer based instructional materials and a sophisticated diagnostic examination system through the PLATO IV terminals are an integral part of the present basic science experience. Thus, students here are familiar with computers and terminals. We will capitalize on such familiarity: the use of computer by medical students as an integral part of their regular medical education, in our opinion, will be the only effective method for providing an operational understanding of medical information science.

During their clinical years, students will be using a computer based and problem oriented medical record system which is currently being developed here. A few lectures will be given in medical information science; but more important, the use of terminals in actually creating and inspecting medical records will provide that element of familiarity which can be obtained in no other way. Participation of developmental and research activities in this field will be encouraged on the same basis as in other clinical areas. Education in medical information science will be on the same level as biological and physiological components of medicine.

- M.D. Master in Computer Science Training (This program has been approved by the National Library of Medicine. Funding will begin in fiscal 78.)

The purpose of the program is to provide an effective medicine computer science interface for four physicians per year who have completed or partially completed their residency training in a conventional specialty. They will be enrolled here in an individualized but intensive two year program in computer science. Upon completion of the program, the trainees will receive the degree of Master of Computer Science from the Department of Computer Science, University of Illinois and may pursue the doctoral program if they so desire.

It is anticipated that demand and opportunities for graduates from this program should be and will remain high for the foreseeable future. Most projections indicate that the health field will become one of the major, and perhaps the major user of computer technology after the developmental threshold of minimally acceptable systems has been reached. As physician graduates of a program of this type are needed to reach this threshold, their own work should contribute to the future rapid expansion of demand for similarly qualified personnel.

From the collection of the Computer History Museum (www.computerhistory.org)
Research

The training experiences of our students will be conditioned strongly by the ongoing medical computing research activities of our faculty. Our research activities can be summarized in two areas:

1. PLATO-Based Health Science Network Activities

Since 1972, SBMS-UC of the University of Illinois College of Medicine has been extensively committed to the development of basic medical sciences CAI materials. During the last three years, under contract support from the Bureau of Health Manpower, a group of faculty has been developing basic sciences lesson materials on the PLATO IV system. The target of this project is 300 hours of CAI lessons in basic medical sciences. There are about 200 lessons currently available.

Since the College of Medicine of the University of Illinois consists of six schools in four cities (Chicago, Peoria, Rockford, and Urbana-Champaign), it was natural to think of a small medical CAI network for the schools. Our work has been directed toward coordinating system development and use by the several campuses.

In late 1973, we recognized that the College of Medicine PLATO IV health science activities should encompass institutions outside the University, in order to facilitate more multi-institutional participation in lesson development and delivery, and to get a wider experience with student needs. We consider it desirable to explore the feasibility of expanding these CAI activities to a "Health Science Computer Network" which includes computer management of instruction (CMI), as well as CAI and a medical information system (MIS).

The four campuses of the College of Medicine are the nidus of this presently existing ad hoc health sciences network. The University of Southern California, the University of Oklahoma, the Southern Illinois University, the University of Tennessee, and the University of Maryland are among the participants. The Regional Health Resource Center, the Champaign County Blood Bank, the Mercy Hospital Pathological Laboratory, three private physicians' offices, and the University of Illinois McKinley Health Service are also local users in the Urbana-Champaign area. A terminal at the Lister Hill National Center for Biomedical Communication is presently in use for their staff's observation of the activity. Eighty terminals are currently in operation, within and without the University of Illinois College of Medicine.

2. A Depository Health Science Computer Network

One of the objectives of our research in the PLATO-based activities is to specify the design for the creation of a dedicated regional medical information system suitable for linkage to networks of small individual units. The current research in developing a depository health science computer network is an effort directed toward that goal.

A depository network consists of two types of nodes: the depository node and the local node. The depository node is an information center into which the local nodes put and through which they inquire and access information. Each local node provides independent computational power and support, administratively and physically, the man-machine interface to its users.

The successful implementation of a depository computer network requires the presence of both local and depository nodes. The experience gained in the past indicates the practicality of a small to medium size computer supporting PLATO-like system for such activities. We have proceeded to implement and operate a PLATO-like system on a minicomputer. System development efforts are now directed toward the refinement of the existing system, the development of a multiple terminal, multiple user, PLATO-like system. CAI, CMI and MIS programs developed on the PLATO IV system are being transferred to the small system. Such development is important to the application of computer technology to health education and health care delivery because:

- in the framework of such a system, health professional education, patient education, consultation, monitoring, and referral programs can be effectively integrated and utilized.
- the distributed computer network makes it feasible to share courseware developed at different institutions on a locally administered computer system.
- via such a system, it is feasible to develop a comprehensive, incremental, and detailed health and clinical data base. Such a data base is essential to resolving problems in other areas of computer application to health care, particularly in those domains involving probabilistic decision and prediction algorithms, and those involving validation of criteria of quality of care—decisions that are now largely made on an intuitive basis.

SUMMARY

Plans for a program in medical information science have been developed at the Urbana-Champaign campus of the University of Illinois College of Medicine. Curricula for undergraduate and postgraduate medical students are being planned. Several research projects in medical computing are well under way.

Like many other institutions, our University is facing reduction in federal funding for many programs. The relevance of health care technology to a better health care delivery system is under close examination by various governmental agencies. With the tight budget situation, every institution is now experiencing greater cooperation, and a coordination among all institutions and members of the health computing profession is a necessity for the future progress of medical computing systems. A greater emphasis should be placed on the direct education of senior medical and other health professional manpower: the present abyss
between potential and realization may well be largely due to
the expectation by health professionals without the accom­
panying knowledge that would enable them to effectively
implement. We believe that structured training will remedy
this and provide a more realistic basis for a national
cooperative effort.

APPENDIX—GOALS AND OBJECTIVES OF A
PROPOSED CENTER FOR MEDICAL
INFORMATION SCIENCE

GOALS

• To advance the quality of health care delivery by
increasing understanding of the effective uses of com­
puter science and information processing in clinical
medicine; and
• To advance basic knowledge in medicine, both clinical
and experimental, through research in medically-re­
lated information science.

OBJECTIVES

Instructional

• Develop an educational program in the principles and
use of information science and computer science as
related to clinical medicine and health care delivery;
• Define the specific learning goals and objectives in
information science for medical students (including
students in basic science and in the clinical program),
as well as students in allied health science programs:
  i. Identify objectives and goals common to all health
science students.
  ii. Define specific objectives for individual health sci­
cence careers (including allied health) relevant to the
needs of the particular disciplines.
• Develop teaching and instructional programs to fulfill
the defined objectives. The instructional programs are
designed to be integrated into the overall curriculum
and learning goals of the students. They encompass:
  i. Basic principles of computer science related to
medicine.
  ii. Information processing technology related to data
analysis and medical records.
  iii. Systems design related to health care delivery in
community health maintenance, ambulatory care
systems, and hospital information systems.
• Participate in curriculum development and the defin­
tion of learning goals and objectives in information
science related to medicine for University undergradu­
ate students (particularly those majoring in the Depart­
ment of Computer Science).

• Participate in instruction to such undergraduate stu­
dents.
• Participate with the Department of Computer Science
in the design of a curriculum for graduate instruction in
medically-related computer science for those students
majoring in Computer Science who wish to specialize
in health areas.
• Provide opportunities for advanced training (fellow­
ships) for physicians and others on the doctoral level in
medical information science.
• Serve as overall coordinator of the PLATO Medical
CAI project within the College of Medicine.
  i. Assist in the definition of goals and objectives.
  ii. Assist in preparation of instructional material.
  iii. Develop tools for the evaluation of the utility of
computer-assisted instruction in various settings.

Research

• Engage in original research and development in medi­
cal information science.
• Broaden scientific knowledge by the delineation and
identification of important interdisciplinary problems.
  i. Define those areas where important health-related
problems may be solved only by the application of
skills from medical and other University disci­
plines.
  ii. Cooperate in the structuring of such interdiscipli­
nary research and participate in its execution.
• Provide opportunities for research and research train­
ing for medical students, graduate students and under­
graduates.
• Advance scientific knowledge by contribution to the
scientific literature.

Service

• Professional
  i. Provide professional and technical support to the
affiliated hospitals in the areas of medical comput­
ing.
    • Assist in the development and operation of
medical data bases shared by the University and
affiliated hospitals.
    • Assist in the creation of specialized information
modules and information systems utilized jointly
by the University and affiliated hospitals.
  ii. Provide a supportive educational resource in the
field of medical computing and information systems
for health professionals throughout the State.
iii. Make available consultative support to health professionals throughout the State.

iv. Provide special support services for health-related information processing for health professionals and State and local planners.

- Assist in the design and maintenance of health resources and health manpower inventories.
- Develop software for specialized health data management needs.

v. Provide assistance, consultation, and support to health professionals and other departments in the University involved in:

- developing systems of data collection and classification.
- developing models of clinical management.
- developing computer-based quality assessment and assurance systems.

vi. Assist other faculty and departments by providing a computer and information technology support base for categorical discipline research problems.

• Public Service

Assist in the wider understanding of the impact of technology and systems organization on the quality of health care delivery.

REFERENCES
