The MAClinical Workstation Project at Georgetown University*†

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The intent of the MAClinical Workstation Project is to develop computer workstations for medical students of the sort they will use in future medical practice. The idea is to instill information query habits in the daily clinical activities of these young physicians-in-training. The Georgetown University Medical Center Library spearheads the project in conjunction with the School of Medicine. The library handles technical support, including software development, user training, equipment maintenance, and network installations. The project began in 1988 with nine Macintosh®‡ computers; today thirty machines are distributed throughout the Georgetown University Hospital conference rooms, faculty and resident offices, and at four affiliated hospitals.

The Macintosh computers are connected to the medical center's local area network (LAN) with access to the Integrated Academic Information Management System (IAIMS) and Library Information System (LIS) databases. The MAClinical workstations serve multiple educational purposes in the clinical setting. Primarily, students gain experience in medical informatics by using a variety of software systems installed at the stations: the H&P Writer, a history and physical system written in the C programming language, can be used by students to prepare the admission record on patients they examine; also, students can keep patient records, check findings against a diagnostic system, look up drugs and treatment protocols, develop medical sketches, and find additional information when needed in the medical literature.

INTRODUCTION

The Georgetown University Medical Center Library is placing computer workstations at the teaching hospital so that physicians-in-training can integrate and automate some of their information management tasks. This long-term effort is called the MAClinical Workstation Project.

A pilot project was launched with nine Macintosh computers that were strategically placed in the clinical setting at the Georgetown University Hospital for the medical students to use during their clinical rotations.

The MAClinical Workstation Project is part of the National Library of Medicine's (NLM) Integrated Academic Information Management Systems (IAIMS)

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‡ MAC and Macintosh are registered trademarks of Apple Computer, Inc.

program at Georgetown to improve information flow through an integrated network system. In 1987–1988, a pilot project was launched with nine Macintosh computers that were strategically placed in the clinical setting at the Georgetown University Hospital for the medical students to use during their clinical rotations. The pilot project met with immediate success and was incorporated into the overall IAIMS project.

The MAClinical Workstations have been so well received that in the current IAIMS Phase III Project the library is extending the program by adding more machines for residents, students, and faculty. Macintosh computers are being placed throughout the entire medical center campus and also in the teaching hospitals affiliated with Georgetown.

PROJECT GOALS AND OBJECTIVES

The goals of the project are to improve instruction in clinical informatics and to enhance the teaching program of the Georgetown University School of Medicine. The project attempts to address medical education issues highlighted in three major national reports. Matheson and Cooper called for library leadership in the integration of information systems in academic medical centers to support education, research, and patient care [1]. The GPEP report emphasized the introduction of computers in clinical education for problem solving and independent lifelong learning skills [2]. The AAHSLD-MLA *Challenge to Action* report encouraged librarians to seize opportunities to introduce educational change [3].

The Georgetown Medical Center Library has taken a leadership role in meeting these goals and developing the project. The goals are being accomplished by instructing medical students to use Macintosh machines to develop automated medical records of the patients they examine and to access library information. The specific objectives are to

- integrate use of computers in the medical school curriculum
- improve clinical informatics instruction
- automate history and physical reports written by students
- teach use of computerized diagnostic systems
- access the medical literature and related knowledge systems
- improve communication between faculty/residents and students for learning and patient care.

PROJECT DESIGN

Setting the stage

The infrastructure necessary to accomplish the project objectives needed to be established. The medical center library acquired the necessary computers and established facilities to launch and support the project. Since 1987, the library and the IAIMS project have acquired over eighty-five Macintosh computers, which have been distributed throughout the medical center. Thirty computers were specifically designated for the MAClinical Workstation Project. They include nine for student use at clinical settings in the Georgetown University Hospital and seven for residents in otolaryngology, obstetrics and gynecology, pediatrics, psychiatry, surgery, medicine, and radiology. Clinical faculty involved in the project received ten machines. The MAClinical project was extended beyond the campus in 1989, and four computers were placed at affiliated hospitals including the Fairfax, Arlington, and Washington, D.C., Veterans Administration, and Washington, D.C., General Hospitals. An additional six basic sciences faculty in physiology, biochemistry, and microbiology, involved in IAIMS-related projects, were later given computers.

The Biomedical Information Resources Center (BIRC), located in the library, was established as the core support facility for the project. BIRC was equipped with more than fifty Macintosh computers to provide basic computer instruction and to prepare the students to work independently at the MAClinical workstations in the hospital. BIRC is a modern, 5,000-square-foot facility in the lower level of the library where nonprint materials, audiovisual equipment, and microcomputer workstations are located. It has two computer classrooms, open workstations, and a lab with a mixed variety of microcomputers (Macintosh, IBM, and AT&T). One classroom is a large Macintosh-equipped room that accommodates twenty-one machines; the other is a smaller IBM classroom with ten machines.

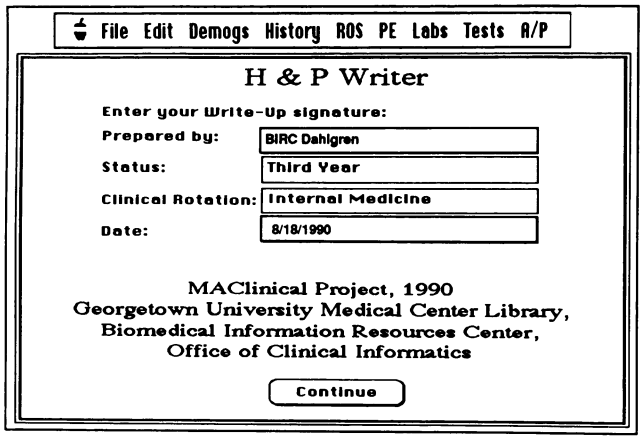
Software design and features

In designing the MAClinical project, a network of stations was envisioned where third- and fourth-year students could write admission notes on the patients they see, call up the library via communications programs, contact residents and clerkship directors via electronic mail, perform clinical dosage and decision analysis calculations, and conduct patient simulations. Course directors could use the network to send messages to students, obtain course evaluations, and collect a database of the students' clinical experience [4].

The project began with development of a HyperCard® § program named HypeRite-Up. In 1990, the software was replaced with H&P Writer, a history and physical software application program, which is written in the C programming language. This new

§ HyperCard is a registered trademark of Apple Computer, Inc.

Figure 1
First screen of the H&P Writer software program, where the student's name, class, clinical rotation, and date are entered



software added features that enable students to use screens with windows, to develop a patient record using a few clicks of the computer's mouse to move progressively through the software, and to rely on minimal manual typing.

Sample screen displays illustrate the window capabilities and ease-of-use provided by H&P Writer (Figures 1–6). Faculty have demonstrated their enthusiasm and support by adding an instructional component requiring all third-year students to use the Macintosh computers to write history and physical reports during their clinical rotations.

Figure 2
Second screen of H&P Writer. The top bar of each screen includes a pull-down menu with the following capabilities: file, edit, demographics, history, review of symptoms (ROS), physical examination (PE), laboratory, and tests and assessment plan (A/P)

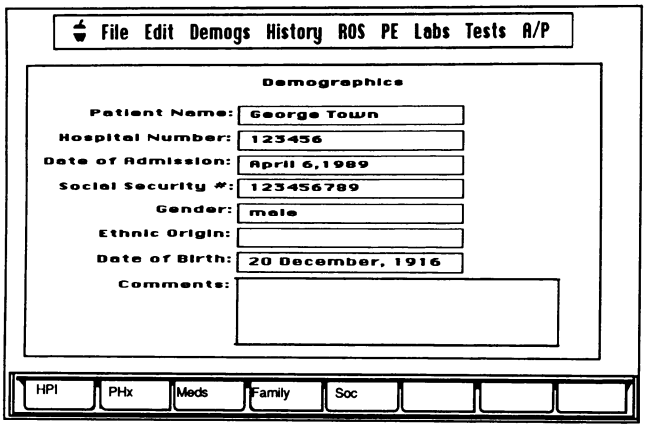
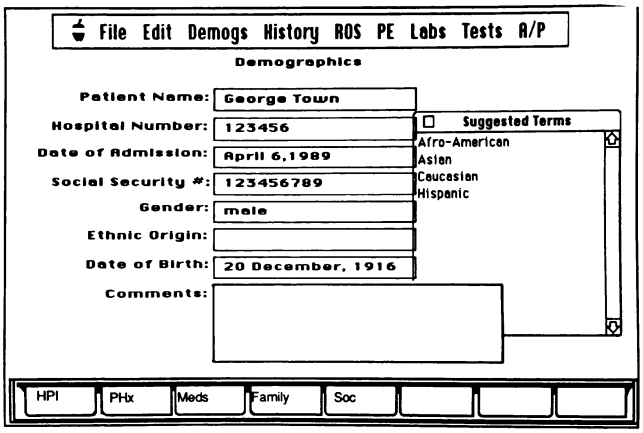


Figure 3
Side window of suggested terms that allows the student to highlight the appropriate ethnic origin, which is then automatically transferred to the designated place. By clicking on the tabs at the bottom, the student can enter date, history of present illness (HPI), physical history (PHx), medications (MEds), family history, and social history



The student begins to use the software by entering name, class status, and department of the clinical assignment (Figure 1). Demographics on the patient are easy to enter (Figures 2–3). Windows with toggle buttons assist data entry by using the click, highlight, and data transfer capabilities of the mouse. A clean format and template approach allow the student to enter narrative describing the patient's illness (Figure 4). Charts for entry of vital signs, lab reports, medications, and family history are attractively arranged and easily used. The most commonly used medications have been pre-entered into the system to avoid misspellings of difficult terms. The MacWrite II word processing software is used for typing in the narrative sections (Figures 5–6).

Instruction and technical support

Project personnel are based in the library. The BIRC librarian, an instructional librarian, and one programmer provide user support on a part-time basis. An electronic technician and network manager provide technical support as needed. A faculty member also assists the librarians by coordinating instructional time in the clinical setting. Students are given an overview of the system in a lecture at the end of their second year. They receive background information about the project and are shown special system features. Students also are instructed in access to the IAIMS Knowledge Network and its family of databases. This instruction is followed by either general

Figure 4
History of the present illness: the student enters the patient's major complaint and a brief description of the medical problem in this section

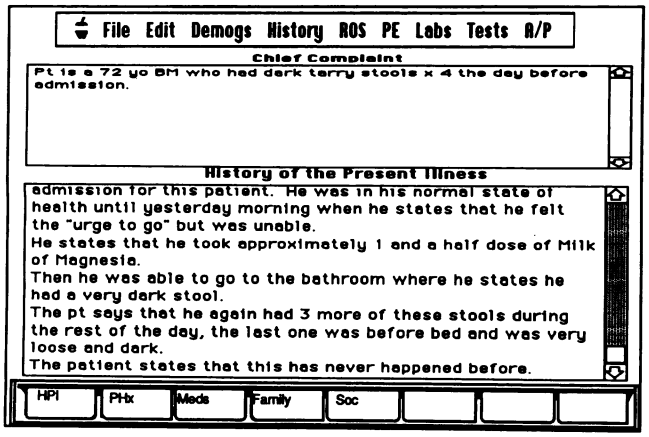
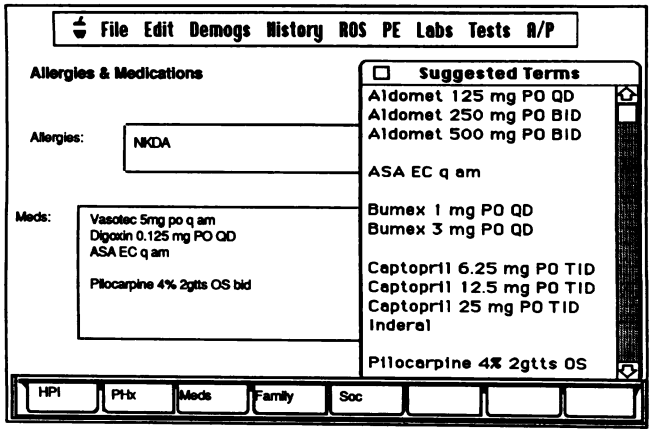


Figure 5
Allergies and medications: the student can enter the patient's specific allergies or NKDA (no known drug allergies) and medications taken by the patient. The side window of suggested terms includes a list of common drugs and dosages from which the student can select the appropriate drug and transfer it to the patient's medication list



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sessions in BIRC or small group sessions in the clinical setting.

THE KNOWLEDGE NETWORK

Currently, the IAIMS Knowledge Network of multiple databases is accessible from the MAClinical workstations through a single access menu using a push-button approach. The Knowledge Network includes the Georgetown University Library Information System (LIS℠)** [5] with a series of bibliographic, informational, and diagnostic database systems. The bibliographic databases include the online catalog of the medical library's holding, the miniMEDLINE SYSTEM®†† [6] and ALERTS℠/Current Contents®‡‡, Full Text, and George, the main campus library online catalog. The information systems include the Physicians Data Query (PDQ®)§§ for cancer treatment protocols; the MicroMedex CCIS℠*** drug, poison, and emergency information systems; and other databases under development [7]. The diagnostic systems currently available through the network are RECONSIDER®††† [8], and DXplain℠‡‡‡ [9]. Additional communications systems are MAILBOX for electronic mail and an automatic electronic news system.

To further support the students, the library recently designed a Macintosh interface to the IAIMS Knowledge Network that includes access to the various medical decision support systems shown in Figure 7. Plans are to incorporate this interface in late 1991.

The MAClinical Workstations are directly connected to the IAIMS network. Two LANs provide electronic access: the AT&T ISN℠ (Integrated System Network)§§§ used by the university campus and the library, and the Hughes LocalNet 2000®****, a

** The Georgetown University Library Information System (LIS), the miniMEDLINE SYSTEM, and ALERTS are trademarks of Georgetown University.
†† miniMEDLINE is based on a subset of the NLM MEDLINE file. MEDLINE is a registered trademark of the National Library of Medicine.

‡‡ *Current Contents* is a registered trademark of the Institute of Scientific Information.
§§ PDQ is a registered trademark of the National Cancer Institute.
*** CCIS is a trademark of MicroMedex, Inc.
††† RECONSIDER (c) copyright 1981, 1986 by the regents of the University of California.
‡‡‡ DXplain is a trademark of the Massachusetts General Hospital.
§§§ AT&T ISN is a trademark of AT&T.
**** LocalNet 2000 is a registered trademark of Hughes LAN Systems, Inc.

Figure 6
Family history: the student can easily build a family tree using this graphic component

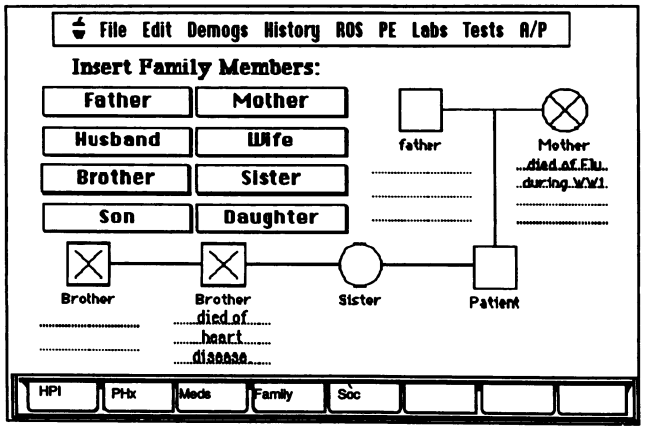
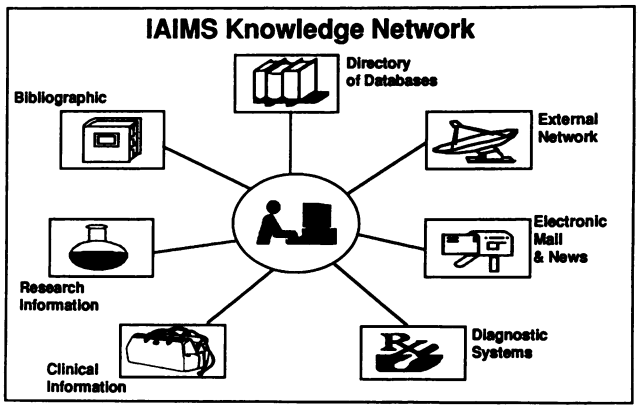


Figure 7
This Macintosh icon-based interface can serve as a main menu to a variety of IAIMS databases



broadband-based terminal-to-host network used by the hospital. These networks are interfaced by a modem pool. The systems are available also to Georgetown users via modem dial access from home or office [10].

THE NEXT PHASE

From 1991 through 1993, as part of the IAIMS Phase III Implementation at Georgetown, the library plans further extension of the MAClinical Workstation Project. A new group of departments will join the existing project and form a MAClinical user group that is linked electronically to the existing IAIMS Knowledge Network. Georgetown envisions this to be a network of users with a common purpose, clinical education. Thirty-five departments and divisions are targeted for the expansion program. The timing to begin expansion in early 1991 is ideal, because the library recently implemented the new H&P Writer educational software for the next clinical rotations. In addition, machines have been upgraded from Macintosh IIs to more powerful Macintosh IIcis, and more software, including two diagnostic systems, have been installed.

New diagnostic systems

Georgetown is the first institution to add the Macintosh version of Quick Medical Reference (QMR®)††††, a diagnostic system developed by the University of Pittsburgh [11]. This Macintosh prototype of QMR is the result of a joint venture between the Georgetown IAIMS project, the University of Pittsburgh, and CAMDAT, the distributor for QMR. The IBM version of QMR has been tested and incorporated in many medical schools and IAIMS projects throughout the country.

Clinical departments are recognizing the usefulness of having computers available for students and residents. The students are already asking for more machines because they need them to conduct their daily work. Faculty from other schools, having heard of the project, have visited Georgetown and have requested the software program.

In addition, the Macintosh-based ILIAD™‡‡‡‡ system, which is licensed from Applied Informatics in Salt Lake City, Utah, was put in use at Georgetown in 1990. ILIAD was originally developed at the University of Utah, and it is currently being used by forty medical schools [12–13].

Since these diagnostic systems were acquired, many Georgetown clinical departments have expressed interest in participating in the IAIMS MAClinical project. Therefore, during this next phase, the QMR will be included with the H&P Writer at the participating departments. ILIAD will be placed at four selected stations and also in the BIRC classroom. As the departmental workstations are installed, they will be connected to the IAIMS network, giving access to the decision support systems already described. In ad-

†††† QMR is a registered trademark of the University of Pittsburgh.

‡‡‡‡ ILIAD is a trademark of Applied Informatics, Inc.

dition, they will be able to use the medical campus e-mail system.

Implementation plan

Thirty-five Macintosh IIci 4 MByte machines, each with 80 MByte hard drive, keyboard, color monitor, and Image Writer printer, need to be acquired for each workstation. Because of the increased workload and immense costs associated with this expansion, the additional stations will be phased in over a five-year period.

CONCLUSION

Bringing the Macintosh computer to the patient teaching site has been a model project of major significance at the medical school. The clinical departments are recognizing the usefulness of having computers available for students and residents. The students are already asking for more machines because they need them to conduct their daily work. Faculty from other schools, having heard of the project, have visited Georgetown and have requested the software program.

This immense effort to extend the MAClinical Workstation into all clinical departments is part of Georgetown's approach to changing the medical curriculum and to demonstrating that computers can be broadly adopted directly in the clinical teaching environment. The project also reinforces the library's leadership role of providing instruction on use of computers and access to information resources. Through this program, the librarians are receiving additional visibility and recognition from the faculty for their expertise in information management and technical teaching skills. The project has been reported and demonstrated at national conferences and the software has been shared with other medical schools [14–15].

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