observations and opinions

COLLABORATION IN CLINICAL COMPUTING AT LDS HOSPITAL

The HELP clinical computing system has been in place at the LDS Hospital in Salt Lake City for nearly two decades [1,2]. Members of the hospital's medical informatics department have collaborated with physicians and other clinicians in a number of projects designed to optimize the usefulness of the HELP system in patient care, research, and management. We are sometimes asked why these collaborative efforts have succeeded at our institution, leading to the publication of more than 40 articles [3–48], whereas they have failed at many others. I discussed this question with seven of my clinical colleagues in five departments at LDS Hospital—intensive care, respiratory care, the blood bank, the pharmacy, and infectious diseases—and will summarize the interviews here.

Background: Applications of the HELP System

Intensive Care

In one of the first applications of our clinical computing system, physiologic and laboratory data from patients in the intensive care unit (ICU) were recorded by computer [3]. In the 16 years since then, programs have been developed for a number of patient care protocols [3–26], and personal computers have been installed at every bedside. Data from bedside monitors, intravenous pumps, and pulse oximeters are automatically recorded in the computer with use of a medical information bus [21–24].

Respiratory Care

In 1985 a computerized charting system was developed for use in respiratory care [27]. Data entered at bedside terminals are recorded in the patient's computerized record, and the computer performs billing and personnel management functions and sends daily reports on clinical quality to the medical director. Computerized charting has been shown to increase productivity and improve staff performance [27,31].

The Blood Bank

In recent years, heightened concern about the risks associated with transfusing blood products has led to the development of a computerized expert blood ordering system [34–37]. Physicians and nurses are required to enter all blood orders at terminals, along with a reason that meets established criteria. As a result of this system, a high percentage of blood units ordered meet established criteria; the true exception rate for all blood orders is less than 0.4% [37]. The mean value for hematocrits ordered for anemia has dropped from 28.6 to 24.8.

Pharmacy

Based on a project started by a graduate student and an assistant director of

pharmacy, the pharmacy system was begun in 1975 [38]. It was used at first to check for drug-drug interactions and drug allergies, but we soon found that with access to patients' laboratory data, other important contraindications could also be detected [38,39]. More recently the integrated patient record available in the HELP system has allowed detection, prevention, and minimization of adverse drug events [40,41].

Infectious Diseases

A computerized system for infectious disease monitoring was introduced in 1983 [42]. Since that time methods have been developed to minimize infections by optimizing the administration of prophylactic antibiotics for surgical patients, treating known infections with the most appropriate antibiotics, and offering other "real-time" prompting and assisting mechanisms [42–48].

Methods

Structured interviews were carried out with seven clinicians in the five specialties mentioned above. The interviews were conducted face-to-face, and every effort was made to avoid guiding the discussion; I interrupted only to obtain clarification. Six questions were asked: (1) Has the collaboration between your department and the medical informatics department been successful? (2) What issues have been crucial to our successful collaboration? (3) In what ways has the computing system succeeded? (4) In what ways has it failed? (5) Why haven't similar programs been developed elsewhere at LDS Hospital and in other hospitals? (6) What would you recommend to other clinical users who wanted better collaborative relationships and better clinical computing?

Results

All seven respondents answered "yes" to Question 1, on whether the collaborations had been successful. In response to Question 2, five items were repeatedly cited as essential to successful collaboration: cooperation between individuals, "vision" (the ability to envision the long-term advantages of clinical computing and computerized decision support), freedom from "turf" issues (absence of competition based on ownership), good communication between clinicians and medical informatics specialists, and close physical proximity between medical informatics specialists and clinicians (as well as having them work in a mutually responsive, team-like environment).

In addition, the respondents thought it was important that the attitude toward computing among the medical staff at LDS Hospital had been fostered by Dr. Homer R. Warner, a founder of the HELP system who is highly respected at LDS Hospital and elsewhere. The HELP system is considered usable and friendly to physicians. The medical staff leadership at LDS Hospital supports the idea of computerization, and the hospital administration is coming to appreciate the "vision" of medical computing. Doctoral and master's degree students in medical computing are available to do much of the detailed work involved.

In response to Question 3, on ways in which the computing system has succeeded, all seven respondents said that the HELP system had improved the quality of patient care. Specific statements were "The system works in the clinical situation!," "We have changed the 'paradigm' of how clinicians think about and give patient care," "Computerized alerts are helpful and important," and "Movement to a computer-based record is a crucial step toward understanding and improving the practice of medicine." In other remarks, the adverse drug event project, improvement in antibiotic use, and computer-directed protocols in the ICU were noted. The ability of clinical departments and the medical informatics department to work through system updates and transitions was cited as a success. The implementation of the medical information bus in the ICU for acquisition of data from intravenous pumps and other bedside devices was considered unusually successful. Finally, the number of publications in medical, medical informatics, engineering, and computer science journals was judged to be a great success for a community hospital.

The HELP system, its development, and its continued operation are not without faults, and my clinical colleagues were quick to point out some of the failures when I asked them Question 4. Some typical responses were "The computerized record is not complete," "Needed changes and updates take too long to accomplish," "We don't have a common language between clinicians and those in medical informatics," "Physicians do not yet do all their ordering through the computer," and "The system seems to get slower as more applications are installed." The respondents also cited funding problems and difficulty agreeing on priorities for the system. One clinician observed that as clinical computer applications are used by more and more people, larger and more difficult compromises are involved.

When asked why similar collaborative relationships have not developed at LDS Hospital, in other Intermountain Health Care hospitals, and elsewhere, the respondents agreed on three factors at LDS Hospital: lack of "computer vision" on the part of non-participating departments, a need for more medical informatics staff or more graduate students to work with departments not yet integrated into the system, and the fact that it is easy to perform simple, important, but non-integrated functions on a PC.

In regard to the other 23 hospitals in the Intermountain Health Care group, the respondents cited failure to envision the importance of clinical computing ("they have mostly an administrative perspective"), a need for more medical informatics personnel to help implement computing, and the "not-invented-here syndrome." One subject said, "LDS Hospital is a special place with an excellent mix of house staff and attending physicians, who interact well. Learning the concepts takes time." Another said, "The adjustment is more social than technical."

When asked about other academic hospitals and institutions in the United States and Europe, one of the respondents said that "turf" issues were a special problem of academic institutions, where "the incentives are for departments to become strong, and cooperation with other departments is secondary." Other comments were that hospitals else-

where "don't have the vision of what integrated clinical computers with computerized clinical decision support can do," that they "don't know how to get started," and that "change is difficult." Amplifying comments were also made: "A community hospital is a better place to install a developmental clinical computing systems because we don't carry all the baggage of individual departments competing with each other seen in academic settings." "LDS Hospital has a different and cooperative environment." "The medical staff at LDS Hospital are willing to agree to patient care rules and protocols that would be very difficult in a university environment." "People interact well with each other at LDS Hospital." "A university hospital is a different and sometimes hostile environment." "Integrated clinical computing systems are seldom seen elsewhere because collegiality and collaboration are often lacking."

Finally, I asked each clinician what he or she would recommend to other physician and clinical users who wanted to collaborate with their medical informatics departments and improve the clinical computing systems in their institutions. They suggested changing the paradigm and vision about how computers can help in the clinical practice of medicine; starting with projects that are easy to accomplish and have big payoffs (for example, installing an integrated laboratory reporting system first); getting the "key players" together before purchasing or installing a system; and hiring clinically oriented medical informatics staff to support and develop applications with the clinicians. "Time and technology are on the side of medical computing," one commented. "It will happen and we need to make as smooth a transition as possible."

Another clinician added that medicine tends to be "reductionistic," whereas using computers and integrating them into a hospital tends to be "holistic." Others advised getting users involved in the continuous quality improvement process so that they can review a procedure every time it is done, even if it is done several hundred times a month, and get immediate feedback on the quality of the procedure. "Point out," he suggested, "that there will be no need to wait for a month or two while a 'manual' review is done that may capture only 90% of what was really done. With the computer they can do 100% review." Another said, "Talk with clinical users and ask them what they need."

Conclusions

These interviews provided some insight into the factors leading to successful collaborative relationships developed at LDS Hospital. Five factors were noted repeatedly: a need for capable people who communicate well and have mutual respect, an appreciation of the potential capabilities of clinical computing and computerized decision support, an ability to break down barriers between individual departments and get them to cooperate rather than compete, an ability on the part of medical informatics specialists to understand and communicate with clinicians, and close proximity between medical informatics specialists and clinicians.

All the respondents said that clinical computing had improved the quality of patient care. The computer's ability to send alerts and to make recommendations for care were rated highly. The respondents were also quick to point out the failures of the medical informatics staff. We were too slow at making desired changes, had language problems in being able to share data across all the applications, and sometimes had only "short-term" support for projects involving graduate students. The clinicians were concerned about the fact that the computerized medical record was incomplete. There are still large gaps in our patient database, and filling them is a priority for all of us.

It is clear from the survey information that many of the issues in developing a successful clinical computing system are not technological, but sociological. A team spirit is needed for the complex interactions that have been worked out over decades with manual methods to be implemented with computers. For the science of medical informatics to succeed at its primary goal of improving patient care, collaboration must exist. We think we have shown that the skills and knowledge of medical informatics specialists, computer scientists, physicians, nurses, paramedical professionals, and researchers can be combined in a harmonious collaborative effort for enhancement of patient care.

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