Developing a health information infrastructure for Arizona*

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Network connectivity is critical in Arizona, where travel distances are great, academic programs dispersed, and health care practitioners often geographically isolated. Accordingly, the University of Arizona (UA) applied for $50,000.00 in National Library of Medicine/National Science Foundation (NLM/NSF) Connections Program funding to promote statewide collaboration in supporting UA’s health sciences education and research programs by expanding network connectivity to hospitals and other health-related institutions. The proposal outlined three strategies: Each major nonuniversity teaching hospital would secure and maintain a leased communications line dedicated to network connectivity, and NSF funds would be used to buy some necessary hardware. NSF funds would be used to establish a modem bank for dial-up Internet access by rural practitioners and teaching sites. Co-principal investigators of the project would promote and support the use of this new statewide connectivity and foster its continued expansion. The proposal was based on a conservative philosophy: familiar technologies and, where possible, existing networks and equipment would be used.

The proposal was approved, and NSF funds hastened creation of an expanded health information network in Arizona. Once that network was in place, participants moved quickly from managing the mechanics of connectivity to planning for a computing and communications platform with services. Private funds were obtained to help organize the Arizona Health Information Network to direct these expanded services.

BACKGROUND

Arizona, with an area of 113,909 square miles, is the sixth largest of the United States. Despite its size, Arizona has only fifteen counties. Thirteen counties are rural; only Maricopa and Pima Counties, in which Phoenix and Tucson are located, are metropolitan areas. The state’s rural population, constituting one quarter of state residents, is distributed over 95,000 square miles. Health services and health care providers are distributed unevenly, and many rural areas are badly underserved. Because the state is large and travel distances great, citizens need means other than a library visit for obtaining information to support health care delivery, education, and research.

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Network connectivity is perceived as critical in Arizona, where academic programs are dispersed and health care practitioners are often geographically isolated. Internet connectivity in particular can enhance health sciences education and research in a large state with few centers of population, only three public universities, and a single medical college. Internet connectivity can enhance instructional programs in colleges of nursing, pharmacy, and medicine by replacing travel, mail, and facsimile with networked communications and document transfer. Connectivity also could extend to all parts of the state certain computer-assisted instruction now available only on the University of Arizona (UA) Tucson campus. Furthermore, network access to the Arizona Health Sciences Library (AHSL) collection and other information resources could be a step toward equalizing resource availability statewide. Rural rotations for health care students could be supported more fully than in the past with information resources, and continuing education schedules and instruction could be widely available.

Research programs also can benefit from connectivity. The University Medical Center (UMC) in Tucson is the principal but not the sole site for faculty and students of the UA colleges of medicine, nursing, and pharmacy. Because UMC is one of the smallest research and teaching hospitals in the United States, the numerous clinical trials led by UA faculty could benefit from the increased numbers of patients anticipated as a result of widespread electronic dissemination of protocols. Access to university-maintained databases would serve researchers at Phoenix hospitals and in rural areas, strengthening collaboration on projects now underway among researchers in various health sciences and at multiple institutions.

THE UA PROPOSAL

When funding for the National Library of Medicine/National Science Foundation (NLM/NSF) Connections Program was announced [1], most connections to the Internet in Arizona were through the three public universities, UA in Tucson, Arizona State University in Tempe (outside Phoenix), and Northern Arizona University in Flagstaff. Use of the Internet for communications and information resources had not penetrated other health sciences institutions to a great extent.

In June 1992, UA submitted a proposal for $50,000.00 to the NLM/NSF Connections Program. The objective of the proposed project was to promote statewide collaboration to support the educational and research programs of the UA Health Sciences Center (AHSC) through expanded network connectivity among Arizona’s hospitals and other health-related institutions. It was anticipated that achievement of this objective would stimulate development of a statewide infrastructure for health information. The project team sought to facilitate direct connectivity to the Internet for major nonuniversity teaching hospitals affiliated with the AHSC, and to provide dial-up access to the Internet for a demonstration group of rural teaching sites affiliated with the AHSC.

The proposal outlined three strategies. First, each major nonuniversity teaching hospital affiliated with the AHSC would secure and maintain a leased communications line dedicated to the project’s network connectivity. NSF funds would be used to buy some of the hardware necessary to make this connection. Second, NSF funds would be used to establish an AHSC modem bank through which dial-up access to the Internet would be available at no cost to rural practitioners and teaching sites. Third, the co-principal investigators of the project would promote and support the use of new statewide connectivity and foster its continued expansion.

The proposal was based on a conservative philosophy: familiar technologies and, where possible, existing networks and equipment would be used to link partners in health sciences education, research, training, and delivery of care for purposes of communication, instruction, and information resource sharing.

PROJECT PARTICIPANTS

The AHSL initiated and led the organization of the project. All other constituents of the AHSC were included as well: the UA colleges of medicine, nursing, and pharmacy and the School of Health-Related Professions; the AHSC Learning Resources Center; University Physicians, Inc., the physician practice plan; and UMC, the hospital, and various treatment and research centers. The University of Arizona Center for Computing and Information Technology (CCIT) also was a partner in planning and executing this project.

The UA College of Medicine’s Phoenix Program and other nonuniversity clinical teaching sites constituted another set of participants. University Medical Center in Tucson, with 312 beds, is too small to support fully the educational programs of the College of Medicine. All third-year clerkships and many fourth-year electives are offered at one or more other clinical teaching sites in Tucson, Phoenix, and a variety of rural Arizona locations. At any given time, approximately 20% of all UA third- and fourth-year medical students are enrolled at Phoenix sites. Likewise, a significant portion of the College of Nursing and the College of Pharmacy’s clinical training takes place at remote sites.

The teaching hospitals affiliated with the UA College of Medicine that participated in the connectivity project were Good Samaritan, St. Joseph’s, and Mar-
icopa Medical Center in Phoenix; Tucson Medical Center and the Department of Veterans Affairs Medical Center in Tucson; and the U.S. Indian Health Service Hospital in Sells, Arizona. Also participating were the Arizona Area Health Education Centers (AzAHEC), with program headquarters at the UA College of Medicine in Tucson. The five centers—in Nogales, Flagstaff, Phoenix, Yuma, and Globe—provide continuing education to health professionals and rural training sites for health sciences students.

WORK PLAN

Two different connection strategies were outlined in the proposal. One strategy, direct connection via leased communications lines, would provide Internet connectivity to major institutions involved in the education and training programs of the AHSC. The potential number of users affiliated with these institutions justified dedicated leased line connections to the Internet. The second strategy, connection via modems for dial-up access, would provide network services to infrequent and remote users in cases where the cost of leased lines was not justified by the amount of network traffic generated. Dial-up connections (with toll-free number availability) via modem to a networked computer at the AHSL would provide these users with access to all the services available on the Internet.

The leased line connection strategy made use of the existing Internet infrastructure in the state. The three state universities are connected to the Internet via a link at UA. The lines from Phoenix institutions are connected to Arizona State University, and the lines from Tucson institutions are connected to UA. All the institutions selected dedicated leased lines with transmission speeds of 56 kbps. One institution adopted frame relay technology for its leased line connection.

NSF grant funds were used to purchase some electronic equipment, including Channel Service Unit/Data Service Unit and router equipment needed at either end of the leased lines. The institutions paid for equipment the grant did not cover as well as the installation and lease of their lines. The cost of the leased line varied widely depending on the geographical area, the telecommunications provider, the speed selected, and the distance between the two points connected.

Each institution had to resolve a number of internal issues concerning networking. At most institutions, the staff needed time to become familiar with wide-area networking topics, such as how to implement domain name services for the Internet, what Transmission Control Protocol/Internet Protocol software package to use, and how best to connect their heterogeneous in-house computer systems to the router providing Internet access. Each contacted the WestNet Network Information Center to obtain Class C Internet addresses. All gave attention to security issues.

To provide Internet connections to smaller health-related organizations statewide, NSF grant funds were used to purchase a multi-user Unix computer housed at the AHSL. Accounts were created for remote users. A bank of eight 14.4-kbps dial-in modems attached to a terminal server, also purchased with NSF grant funds, was installed at AHSL, so remote users could dial in to the computer. A terminal server with sixteen ports also was installed. The 800 number supported by AHSL since 1990 (for access to its online catalog) was redeployed for Internet access.

Users in small organizations now have access to Internet resources, such as health information databases, electronic mail, and gopher servers. These users, compared to those directly connected to the Internet, have slightly slower data transmission and receipt and must employ extra steps when loading files to or from a personal computer and the Unix computer. Care was taken to provide dial-in users with user-friendly software, such as the PINE e-mail program, because few were familiar with the Unix operating system. Dial-in users see the menu shown in Figure 1.

NSF funds also were used to purchase seven stand-alone modems for each remote demonstration site listed in the proposal. Future users in the state will be expected to provide their own modems and communications software. Network connectivity can be provided to users with low-speed modems by setting the central modem bank to autobaud. But because slow speeds tie up a modem for longer periods, new users will be encouraged to purchase high-speed modems.

The technical staff at the AHSL manages the computer, and they add and remove users when necessary. This prototype information network can be expanded and upgraded easily to accommodate higher speeds, expanded capacity, additional users, and new applications.

To supplement the NSF funds, UA and other participants contributed resources to the project to cover initial and continuing costs. These resources supported all individuals working on the project, provided CCIT’s consulting support and technical assistance, covered ongoing maintenance costs, con-
tributed to defraying the costs of the 800 number, and delivered outreach and training activities to stimulate network expansion and use throughout Arizona.

OUTCOMES OF INFRASTRUCTURE DEVELOPMENT

Mechanisms enabling Internet connectivity are now in place. The NSF project unites large and small, public and private, clinical and educational institutions in a limited but important one-time undertaking that will have permanent effects. The project links institutions with disparate technical expertise and levels of communication technology into an electronic community, creating a focus for mutual assistance and problem solving. By providing connectivity equipment directly in some institutions and stimulating internal steps toward connectivity in others, the project established common means of communication and information access.

NSF project funds clearly hastened the creation of an enhanced health information network in Arizona. Even before the completion of the NSF connectivity project, the co–principal investigators and participants began to discuss the many uses for the infrastructure established by Internet connectivity.

THE HEALTH INFORMATION NETWORK

The widespread interest in resource sharing and communication led the AHSL director and the UA College of Medicine associate dean for Phoenix programs to approach the Flinn Foundation of Phoenix for a planning grant to explore further collaboration. Funding from the foundation supported a consultant who conducted a needs assessment and helped participants organize a consortium, which provided a common communication platform with widely distributed access to information and education products. Subsequently, the consortium obtained Flinn Foundation support of more than $300,000.00 to cover start-up costs. Today the consortium is the Arizona Health Information Network (AZHIN).

Although AZHIN is not a library project per se, much of its design and leadership come from medical librarians. Senior hospital administrators, directors of medical education, and systems administrators contributed significantly to planning the consortium, and they participate in governance.

AZHIN has three components: the organization that funds the network, sets policy, monitors system performance, and acts in its members’ interests to provide service; the technical environment consisting of the staff, the telecommunications system, and AZHIN services; and the education and promotion effort, which aggressively informs members of AZHIN’s great potential and shows them how to use AZHIN and Internet information and resources.

The education component is the most important. By teaching users how to access information, electronic communication channels, and education products, this component serves Arizona’s health sciences educators and researchers, health care providers, health sciences students, and continuing education consumers. It is anticipated that these opportunities will improve directly the quality of health care and health sciences education in Arizona.

Some institutional members of AZHIN were connected to the Internet before the NSF funds were obtained and chose to join the organization (and pay dues) to ensure their participation in developing the network and using its resources. AZHIN membership offered a significant means of fulfilling their community role of providing the best health care and education possible.

During 1994, AZHIN’s first year, the hardware platform will become operational, linking eleven health care and education institutions: hospitals, clinics, university units, and research and training centers. Access to four health sciences literature databases will be provided directly or by dial-up to AZHIN members across the state. Networked access to AZHIN within each member institution will be expanded, and a formal, not-for-profit corporate structure will evolve from the present consortial agreement.

Historically, AZHIN member institutions have been interconnected at several levels. Information resource sharing and professional association membership linked medical librarians across the state for many years. Directors of medical education in the various teaching hospitals have worked together and with the UA College of Medicine for twenty years. Researchers have used BITNET and the Internet to communicate. Hospital purchasing groups and professional associations linked managers and administrators. AZHIN builds on these organizational and technical connections among its members to create a system of communication and a group of information resources for education and clinical practice. AZHIN can be expanded to reach all entities delivering health care and health sciences education in Arizona.

CONCLUSIONS

The establishment of Internet connectivity for the core of the Arizona health sciences education system clearly was catalyzed by the availability of NSF funds. The network infrastructure now in place demonstrates the efficacy of seed money and programs. The use of familiar technologies and existing equipment limited technical problems. This approach also con-
tributed to early project success in the form of rapid installation in most institutions, high user satisfaction, and broad support for AZHIN.

Arizona participants in the NLM/NSF Connections Program moved quickly from managing the mechanics of connectivity to planning for a computing and communications platform to access information and resources. Arizona institutions were ready to move in this direction, because their library, information, and education officers were sufficiently knowledgeable about the necessary technology, already had experienced many benefits of cooperation and information sharing, and recognized technology’s potential for meeting the state’s needs.

The availability of funds to purchase equipment to achieve connectivity provided an immediate means of facilitating access by health sciences students and professionals in Arizona to education, research, and information resources. While the hospital environment here long has been highly competitive, the benefits of cooperation in the support of information and education stimulated collaboration among institutions and improved the possibilities for savings in cost and effort.

The competitive award from the NLM/NSF Connections Program also enhanced the credibility of the consortium’s proposal to the Flinn Foundation. In discussions about the emerging network, foundation staff were eager to know about the progress of the application for NSF funds and were pleased with the actual award. The AZHIN then was able to leverage the small NSF grant to influence the award of a much larger grant.

Together, the Arizona connectivity project and AZHIN exemplify institutional change originating with the librarians and medical educators that is adopted by the organization as a whole. As initiators of this change, librarians have become more visible in their institutions and are perceived as professionals possessing influential, future-oriented expertise.

The infrastructure now in place in Arizona can be expanded to bring educational resources to all in the state who need them. It is anticipated that broad access to AZHIN information and resources through Internet connectivity will support the teaching of health sciences and the delivery of health care in Arizona in new and far-reaching ways.

REFERENCE


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