PRODUCTION NOTE

University of Illinois at Urbana-Champaign Library
LIBRARY TRENDS
SUMMER 1993

Libraries and Information Services in the Health Sciences
Prudence W. Dalrymple
Issue Editor

University of Illinois
Graduate School of Library and Information Science
Library Trends, a quarterly thematic journal, focuses on current trends in all areas of library practice. Each issue addresses a single theme in-depth, exploring topics of interest primarily to practicing librarians and information scientists and secondarily to educators and students.

Editor: F.W. Lancaster
Managing Editor: James S. Dowling
Publications Committee: Leigh Estabrook, Selma Richardson, Rhonda Arsenault, Betsy Hearde, Robert Wedgeworth

Library Trends is published four times annually—in summer, fall, winter, and spring—by the Graduate School of Library and Information Science at the University of Illinois, Urbana-Champaign, 249 Armory Building, 505 E. Armory Street, Champaign, IL 61820-6291.

Subscriptions: Rate is $60 per year (plus $7 for overseas subscribers). Individual issues are $18.50 for the current volume year; back issues other than those from the present volume year are $10. Claims for missing numbers should be made within six months following the date of publication. All foreign subscriptions and orders must be accompanied by payment. Address orders to: University of Illinois Press, Journals Department, 54 E. Gregory Drive, Champaign, IL 61820. For out-of-print issues, contact University Microfilms International, 300 North Zeeb Road, Ann Arbor, MI 48106. Postmaster: Send change of address to University of Illinois Press, 54 E. Gregory Drive, Champaign, IL 61820.

Copyright © 1998 by The Board of Trustees of The University of Illinois.
All rights reserved. Printed in the U.S.A. ISSN 0024-2594
Second class postage paid at Champaign, Illinois.

Authorization to photocopy items beyond the number and frequency permitted by Sections 107 and 108 of the U.S. Copyright Law is granted by the Board of Trustees of the University of Illinois provided that copies are for internal or personal use, or for the personal or internal use of specific clients and provided that the copier pay a fee of 10 cents per page directly to the Copyright Clearance Center (CCC), 27 Congress Street, Salem, MA 01970. The CCC code for Library Trends is 0024-2594/88 $0.00 + .10. To request permission for copies for advertising or promotional purposes, or for creating new works, please contact the Graduate School of Library and Information Science, Publications Office, 249 Armory Bldg., 505 E. Armory Street, Champaign, IL 61820.

This journal is abstracted or indexed in Current Contents, Current Index to Journals in Education, Information Science Abstracts, Library and Information Science Abstracts, Library Literature, PAIS, and Social Sciences Citation Index.

Procedures for Proposing and Guest Editing an Issue of Library Trends

We encourage our readers to submit ideas for future Library Trends themes; issue topics are developed using reader suggestions and recommendations from members of the Publications Committee. We also encourage readers to volunteer to be issue editors or to suggest others who may be willing to be issue editors.

The style and tone of the journal is formal rather than journalistic or popular. Library Trends reviews the literature, summarizes current practice and thinking, and evaluates new directions in library practice. Papers must represent original work. Extensive updates of previously published papers are acceptable, but revisions or adaptations of published work are not sought.

An issue editor proposes the theme and scope of a new issue, draws up a list of prospective authors and article topics, and provides short annotations of the article’s scope or else gives a statement of the philosophy guiding the issue’s development. Please send your ideas or inquiries to F. W. Lancaster, Editor, Publications Office, 249 Armory Building, 505 E. Armory Street, Champaign, IL 61820-6291.
Libraries and Information Services in the Health Sciences

Prudence W. Dalrymple
Issue Editor

University of Illinois
Graduate School of Library and Information Science
This Page Intentionally Left Blank
# Libraries and Information Services in the Health Sciences

## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Authors</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td><em>Prudence W. Dalrymple</em></td>
<td>1</td>
</tr>
<tr>
<td>Developments in Health Sciences Libraries Since 1974: From Physical Entity to the Virtual Library</td>
<td><em>Frieda O. Weise</em></td>
<td>5</td>
</tr>
<tr>
<td>Shaping Medical Library Education</td>
<td><em>Fred W. Roper</em></td>
<td>25</td>
</tr>
<tr>
<td></td>
<td><em>M. Kent Mayfield</em></td>
<td></td>
</tr>
<tr>
<td>The Educational Role of Health Sciences Librarians</td>
<td><em>Jocelyn A. Rankin</em></td>
<td>45</td>
</tr>
<tr>
<td></td>
<td><em>Jean Williams Sayre</em></td>
<td></td>
</tr>
<tr>
<td>Library Services and Health Care Administration</td>
<td><em>Holly Shipp Buchanan</em></td>
<td>62</td>
</tr>
<tr>
<td>Issues in Clinical Information Delivery</td>
<td><em>Joanne G. Marshall</em></td>
<td>83</td>
</tr>
<tr>
<td>Dissemination of Medical Information: Organizational and Technological Issues in Health Sciences Libraries</td>
<td><em>Nancy K. Roderer</em></td>
<td>108</td>
</tr>
<tr>
<td>Access to Biomedical Information: The Unified Medical Language System</td>
<td><em>Stephen J. Squires</em></td>
<td>127</td>
</tr>
</tbody>
</table>
Introduction

Prudence W. Dalrymple

Nearly two decades have passed since the publication of the last issue of *Library Trends* devoted to health sciences libraries. During those decades, many far-reaching changes have occurred. Arguably, most of these changes can be summarized in two words—technology and economics. The increasing numbers of microcomputers in the early 1980s, followed by the growth of facsimile transmission and the advent of Internet, have facilitated the delivery of information and documents not just to the library, but to that most convenient of all locations, the requester's workstation. Technological advances in medicine have produced a health care system that improves and prolongs health but whose cost has created serious inequities in distribution and access. In the 1990s, the economics of health care in North America occupies national attention and the pace of technological innovation continues to accelerate. It appears today that this decade will be characterized by too few resources—and too much information. Decisions about allocating resources and selecting among abundant information sources are two of the greatest challenges facing libraries today.

Twenty years ago, Harold M. Schoolman (1974) speculated about how libraries and librarians would move into the future. In his 1974 article which concluded the *Library Trends* issue on Health Sciences Libraries, he identified three important themes: (1) changes in education for the health sciences professions, (2) increased accountability in an era of scarce resources, and (3) advances in the production, recovery, and synthesis of information. Schoolman's 1974
ideas are still remarkably pertinent, and many of the issues he identified are addressed by the authors in this volume. In the first article, Frieda Weise provides an overview of developments in health sciences libraries and describes in particular the evolution of the National Network of Libraries of Medicine (formerly the Regional Medical Library Network). She notes many of the same issues that Schoolman identified and discusses the ways in which the National Library of Medicine and the Lister Hill Center have affected academic and hospital libraries.

Two articles in this volume focus on educational issues. Fred Roper and M. Kent Mayfield describe how the Medical Library Association (MLA) identified the knowledge and skills needed by entrants into the profession of health sciences librarianship. Platform for Change, MLA's educational policy statement, takes a cue from medical and allied health education and its commitment to a continuum of learning throughout a practitioner's professional lifetime. The document states clearly and unequivocally that health sciences librarians must take responsibility for their own learning, including updating and enhancing their knowledge and skills.

Jocelyn Rankin and Jean Sayre discuss the librarian and the library in the context of the learning environment for all health professionals. Harking back to Schoolman, they call for an increased understanding of educational theory and techniques among librarians so that they can more easily address the learning needs of both students and clinicians. With several reports on medical education providing the background rationale, it has become increasingly clear that librarians must establish links with their colleagues in the health education environment. Rankin and Sayre provide examples in which substantial progress has been made in this direction.

Beginning in the 1970s, the government, the insurance industry, and the medical and allied health professions themselves began calling for greater accountability. Librarians, too, responded to the need to justify their existence, to document their impact, and to scrutinize their operations. The need to be financially responsible for the use of resources is coupled with greater pressure to be accountable for the outcome of the care delivered. Addressing service to health care administration, Holly Buchanan traces the development of what is today known as the "quality movement" and shows how it can be used to demonstrate accountability both in libraries and in the overall health care environment.

Joanne Marshall describes services to clinicians—perhaps the most dramatic aspect of medical librarianship. Accountability here is linked to patient care outcomes. She points to ways in which librarians have documented and demonstrated that providing
information to clinicians at the time and place of need can make a visible and measurable ("life and death") difference in the outcome of patient care. Similarly, access to information is essential in the provision of economically efficient health care delivery.

Other articles in this volume concentrate more specifically on various aspects of health information resources—their organization, dissemination, and synthesis. Nancy Roderer focuses on the dissemination of biomedical information. In addition to the technological advances represented by telecommunications networks, she discusses the organizational and structural changes that have accompanied them.

Stephen Squires's article on the Unified Medical Language System (UMLS) shows how the UMLS is a tool for total medical information management that is not limited to bibliographic control. The UMLS provides access to many types of biomedical data and information to a variety of users—not just library users but health care professionals working in the health care and biomedical arenas.

The emphasis on user needs, so clearly reflected twenty years ago, continues into the present. This user focus, so often articulated by health sciences libraries, takes on an additional dimension, however, in two of the articles contained in this volume. Karen Dahlen traces the growth and development of consumer health information—an issue hardly addressed twenty years ago. She projects new and expanded roles for librarians in ensuring that consumers have access to the information they need to take more responsibility for their own health care. David Ginn, in his discussion of AIDS information centers, describes a type of information need not anticipated earlier. AIDS information centers are an example of how library and information professionals can respond to a need identified by society. While the establishment of such centers is not new, each time another devastating disease such as AIDS appears, the need for such a concerted effort is reemphasized.

The concluding article in this volume, by Nina Matheson and Valerie Florance, describes an evolving role for health sciences librarians as designers and producers of information products and services to meet client needs. Drawing upon their experience at Johns Hopkins University's Welch Medical Library to illustrate their points, Matheson and Florance provide a fascinating glimpse into the future of health sciences librarians as knowledge workers.

In planning this issue of Library Trends, leaders in medical libraries were polled for their suggestions on topics and authors. The final selection is the result not simply of personal preference but of a conscious effort to reflect the perspective of the most thoughtful of today's health sciences librarians. The authors were
selected for their broad experience as health sciences librarians, for their vision, and for their intelligent and thoughtful observation. Working together over these months, we reminded ourselves that our purpose was not to produce a literature review in the traditional sense, nor to compete with the well-established and highly respected *Handbook of Medical Library Practice* (soon to appear in its fifth edition) or *Hospital Library Management* whose second edition is currently in preparation. Rather, this collection of articles is intended to reflect the state of health sciences librarianship today from the unique perspective of each of the authors. It is intended to serve as a resource and a stimulus for health sciences librarians today and in the future.

**REFERENCE**

Developments in Health Sciences Libraries
Since 1974: From Physical Entity to the Virtual Library

FRIEDA O. WEISE

ABSTRACT
This article provides an overview of the shaping forces in health sciences libraries during the last two decades and a discussion of selected developments which had a profound effect on their evolution from the physical entity to the virtual library. These developments include the advent of online searching, the development of integrated library systems and networked resources, the expansion of interlibrary loan and document delivery systems, and the concept of the Integrated Academic Information Management System (IAIMS). The contributions of the National Library of Medicine (NLM) to health sciences libraries and biomedical communications are described. Conclusions and observations suggest that libraries and librarians will play a greater role in information access and management than they have in the past as networked information continues to expand.

INTRODUCTION
When the Ptolemies created the Alexandria Library around 300 B.C., they could not have imagined in their wildest dreams that civilization's store of knowledge would someday reside on microchips and be instantly retrievable by computers. They created something entirely new in their day; a general reference library where scholars could come and study books they themselves could not afford in their personal collections. To create a usable library, however, they also had to invent library science, a system for organizing and cataloging the collections. This work was accomplished by appointing a chief

Frieda O. Weise, Health Sciences Library, University of Maryland, Baltimore, MD 21201
LIBRARY TRENDS, Vol. 42, No. 1, Summer 1993, pp. 5-24 © 1993 The Board of Trustees, University of Illinois
librarian, Zenodotus of Ephesus (Casson, 1985, p. 162). Unfortunately, the library at Alexandria was destroyed in 42 B.C. when fighting ensued between Julius Caesar's forces and opponents of Cleopatra. The idea of the "library," however, had been born and has flourished throughout the world's civilizations until this day and will likely continue, albeit perhaps in a different guise than in the past.

The Alexandria Library was part of a complex where students could carry on varied pursuits. It had a dining hall, private studies, laboratories, and a promenade for thoughtful strolling. In short, it was a place people would want to go to learn, reflect, and study, as well as create. Until fairly recently, perhaps until the last ten years, the library was still largely considered a place. But all things change, and the library is now often referred to as the "virtual library," a term coined in 1990. A "virtual library" is described as "a system by which a user may connect transparently to remote libraries and databases using the local library's online catalog or a university or network computer as a gateway" (Saunders, 1992, p. 66). In the "virtual library," it is not necessary to come to a specific place to use the library's materials.

**Shaping Forces**

Libraries have undergone many changes during the last twenty years. Several societal forces which have worked to shape health sciences libraries during the last two decades are the information explosion, computer technology and telecommunications, and economic pressures. The incredible rate of new scientific publications has been well documented. In *Science Since Babylon*, Price (1961) charted the growth of science in published form and found it to be exponential rather than linear. A recent article in the *Chronicle of Higher Education* stated that: "Publication of scientific journals began in about 1665.... In 1800, there were about 100 journals; there were 1,000 by 1850, and some 10,000 by 1900. Currently there are close to 100,000 journals, and, since the seventeenth century, their number has doubled every 15 years" (Gifford, 1992, p. A24).

Since no library can hope to store or purchase this vast amount of material, there is an increasing shift from ownership of materials to access—the shift from the physical entity to the virtual library. Fortunately, computing and telecommunications technologies are providing rapid electronic retrieval and document delivery systems to the vast reservoirs of knowledge available.

Advances in technologies in the 1970s and 1980s created a new infrastructure for health sciences libraries and changed the way they function and provide services. The introduction of MEDLINE in 1971, the development of end-user searching systems, and the advent of
national networks have altered the service roles of health sciences libraries radically, just as the introduction of integrated library systems changed the way internal library functions are performed. As the librarian's world has changed, so has that of the client, the researcher, the educator, and the clinician. Personal computers have become commonplace, campuses are "wired," and sophisticated computerized diagnostic tests are the norm in hospitals and academic medical centers.

Since World War II, the burgeoning health care industry and its rising costs have had a marked impact on health sciences libraries in both academic medical centers and hospitals. In 1978, the health care industry accounted for 9.1 percent of the gross national product (GNP), up from 6.8 percent ten years earlier (Crawford, 1981, p. 2237). By 1990, health spending comprised 12.4 percent of the GNP (U.S. Department of Health and Human Services, 1991, p. 4). How has this affected health sciences libraries? An analysis of several surveys (Crawford, 1983, p. 17) shows that, during the 1970s, medical school libraries increased by 25 percent from 101 to 126. Hospital libraries also increased by 13 percent from 1,727 to 1,949. Other types of health sciences libraries, such as those of state or county medical societies, decreased by 59 percent.

During the 1980s, however, the trend in growth of hospital libraries began to reverse. Changes in patterns of health care delivery, from hospitals to outpatient centers, for example, in combination with limits on hospital income caused by government regulations, began to decrease the money available to support library services. At the same time, the spiraling costs of publications and the increased use of computer technology raised the costs of running hospital libraries. A recent survey (Glitz et al., 1992, p.179) indicates that, in the period 1984-89, hospitals have closed their libraries or cut library staff and services in an attempt to control costs. Hospital libraries today must continually struggle to define the role of the library and its contribution to health care and to the bottom line.

Although academic health sciences libraries have not been eliminated to control costs, they have been forced to reduce purchases of books and journals, and, in some cases, staff, to balance their budgets. Increased pressure to purchase new electronic services and products adds an additional burden.

This situation has been well reported in the literature and has been a topic in the *Chronicle of Higher Education* on numerous occasions during the last several years. For example, "Rising Costs and Dwindling Budgets Force Libraries to Make Damaging Cuts in Collections and Services" (Nicklin, 1992, P-A1) and "Setting Budgets for Libraries in Electronic Era" (Gherman, 1991, P-A36) reflect the
concern of the world of higher education as the recession forced higher education to reduce and control expenditures.


developments in the evolution of health sciences libraries

The previous brief overview touched on several of the major societal forces which influenced the development of health sciences libraries over the last two decades. In this limited space, it is not possible to review all the factors which have had an impact on their evolution. What will be examined in this article are several selected developments which had a profound effect on their evolution: the advent of online searching, the development of integrated library systems and networked resources, the expansion of interlibrary loan and document delivery services systems, and the concept of the Integrated Academic Information Management System (IAIMS). Other developments, such as the growth of instructional and educational services and clinical library services, are discussed elsewhere in this issue.

Special attention must be given to the leadership and the contributions made by the National Library of Medicine (NLM) to health sciences libraries and to the world of biomedical communications throughout the years. The role of the NLM will be included as appropriate in various issues discussed as well as in a section devoted solely to it.

the online revolution

When MEDLINE was introduced by the National Library of Medicine in October of 1971, no one could have predicted the revolutionary impact it would have on access to health sciences information. Today the most remote corner of the world, with a telephone line, can access a multitude of databases. The decade of the 1970s was one of rapid growth in the online industry; new vendors emerged, databases were developed, timesharing and new communication
methods reduced access costs, and search and retrieval systems were improved.

Initially, MEDLINE was made available through the Regional Medical Libraries. In 1981, there were more than 1,800 users of the twenty MEDLARS databases. By 1991, 60,000 access codes had been assigned to access the now more than forty databases (Lindberg, 1992, p. 1). Additionally, commercial vendors such as DIALOG Information Services and Bibliographic Retrieval Services (BRS) offered hundreds of databases in many subjects.

For the health sciences librarian, proliferating online information resources created a whole new role—that as a search intermediary. To some, online searching provided increased visibility and respect for librarians as professionals. In the early 1980s another revolution occurred with the introduction of user-friendly systems which allowed the end-user to perform database searches with little or no training. Even though the NLM did not introduce its own system for end-users, GRATEFUL MED, until 1986, the phenomenon had become widespread through such commercial systems as BRS AFTERDARK, Dialog's Knowledge Index, BRS Colleague, and Paperchase, an NLM grant-developed system.

As libraries became more automated internally, and as librarians became more sophisticated in the use of computers to deliver services, the idea of mounting bibliographic databases locally emerged. In 1984, the NLM announced the availability of MEDLINE subsets which could be licensed for local use with either commercial or locally developed retrieval software. Early models of local systems were the mini-MEDLINE system developed at Georgetown University (Broering, 1985) and MaryMED, developed at the University of Maryland at Baltimore.

By the late 1980s more than forty such local systems existed in health sciences libraries. Another milestone was reached in 1987 when the NLM licensed MEDLINE to commercial vendors for distribution on CD-ROM products. This increased the end-user searching population even more. What has all this meant for libraries? There were, and still are, many debates about whether end-user searching would eliminate the need for librarians. As the number of mediated searches tumbled, librarians feared for their livelihood. Looking back on this debate of only a few years, one can say that their fears were unfounded. What has occurred is an enormous increase in the need for education and training of the end-user. The database search intermediary has now become the consultant, the teacher, and even the navigator through the maze of databases and networking. The need for the librarian to take on this new role is further supported
by the movement of many medical schools from traditional lecture to problem-based learning curricula.

Two reports of the Association of American Medical Colleges in 1984, *Physicians for the Twenty-First Century* (the GPEP Report), and the *Symposium on Medical Informatics* in 1986, both recognized that students must become lifelong learners. In order to do this, they must be able to locate, retrieve, and analyze new information which resides in databases and other sources. Librarians now face the challenge of becoming full partners with educators in the process so that the acquisition of information science skills will become an integral part of the curriculum.

**INTEGRATED LIBRARY SYSTEMS AND NETWORKED RESOURCES**

Goldstein (1983) noted that some of the truly pioneering work in library automation occurred within the biomedical community. The development of the integrated library system for use in a single library is such an example. Central to this concept is the master bibliographic file around which all functions, such as cataloging, circulation, and serials check-in, and the online catalog, revolve.

Experiments with large-scale integrated library systems in the 1960s were found to be too costly for individual libraries. During that time, however, two major events occurred that would have a profound effect on libraries in the future—the establishment of OCLC in 1967 and the adoption of the MARC II format and distribution service of the Library of Congress in 1968 (Goldstein, 1983). Access to networked cataloging resources, such as OCLC, allowed the cost of automation to be shared by many and changed the way internal resources for bibliographic control were allocated, facilitating the introduction of the online catalog into integrated library systems.

The advent of powerful inexpensive minicomputer systems in the 1970s spurred the development of integrated library systems, although early efforts using minicomputers focused on single functions such as circulation and serials control. The National Library of Medicine supported an early experiment with an integrated library system at Minnesota in 1972 (Brudvig, 1975). By 1978, the NLM had begun the development of an integrated library system (ILS) at the Lister Hill National Center for Biomedical Communications which was designed as a demonstration project for all sizes of libraries. This ILS was subsequently made available for purchase through NTIS, and, in 1983, OCLC decided to market the system under the LS/2000 trademark (U.S. Department of Health and Human Services, 1984). This proved to be a very popular system for medium-sized health sciences libraries as they sought to automate
their functions. The University of Maryland at Baltimore was the first academic health sciences library to install the ILS developed by NLM in 1981 (Feng et al., 1983). Additionally, during the early 1980s, both Washington University (St. Louis) and Georgetown University developed minicomputer-based integrated library systems independently—BACS and LIS respectively (Broering, 1983).

Integrated library systems have evolved over the last ten years from handling basic internal library functions such as serials control and cataloging, to systems which provide public access to numerous types of services. In addition to the online catalog, clients may find access to locally based MEDLINE and other databases, to the Internet via a gateway, and to electronic mail with services such as interlibrary loan and article reproduction. Early models of such systems include the LIS already mentioned and Electronic Access to Reference Services (EARS) at the University of Maryland (Weise & Borgendale, 1986). The idea of the “library without walls” became widespread during the 1980s as a result of new networking and telecommunications capabilities especially in academic settings. Now access to information may no longer require clients to come to the library physically—merely to access it electronically. The virtual library is definitely becoming a reality.

This thumbnail sketch of the history of integrated library systems cannot be viewed in isolation from other developments. Improvements in bibliographic control during the 1970s and 1980s allowed increased networked resource sharing and thereby improved access to information for library clients through automated interlibrary loan and document delivery systems. These developments are discussed in the following section. Furthermore, the Matheson and Cooper report (1982), also discussed in a later section, gave the impetus for health sciences libraries to become involved in information management beyond their walls and to expand automated services in Integrated Academic Information Management Systems.

INTERLIBRARY LOAN AND DOCUMENT DELIVERY SYSTEMS

Health sciences libraries today can choose among a variety of interlibrary loan systems and networks to obtain materials for their clients. They may, in fact, be members of several consortia or networks. The Regional Medical Library Network, now the National Network of Libraries of Medicine (NNLM), supported by the National Library of Medicine, has been the foundation for interlibrary loan among health sciences libraries since its inception in 1965. It is worth noting some of the milestones in bibliographic control which led to today's sophisticated online interlibrary loan request routing system, DOC-LINE, supported by the NLM and used by members of the NNLM.
In 1973, NLM developed the SERLINE database, which originally included information on serials owned by NLM but later was expanded to include holdings information for the regional medical libraries and resource libraries (Bunting, 1987, p. 24). In 1976, NLM began to develop DOCLINE, the automated interlibrary loan request routing system widely in use since its national introduction in 1985 (U.S. Department of Health and Human Services, 1985, p. 34). The NLM had also supported the development of OCTANET in 1980-81, an automated routing system among libraries in six states in the Midwest (Johnson & Pride, 1983). The basis for the success of DOCLINE rests on the development of SERHOLD, formerly the National Biomedical Serials Holdings Database (NBSHDB), which contains the serials holding statements of all participating network libraries. Plans to create the NBSHDB were announced in 1981 by the NLM (Bunting, 1987, p. 40). The first step was to have the RMLs coordinate collection of the serial holdings from libraries in the region and submit this information in machine-readable form to the NLM. This turned out to be a time-consuming and expensive process for all concerned due to the lack of machine-readable data and the variety of formats that exist. Until now, most health sciences libraries have contributed their serials holdings via data processing centers such as the Union Catalog of Medical Periodicals in New York. Most recently, the OCLC Union List Subsystem has been used as an alternative by some libraries (Battistella, 1991, p. 370). The addition of NLM serial control numbers to OCLC records was begun in 1983 to facilitate this process (National Library of Medicine Programs and Services, 1984).

There is no doubt that the most important factors in delivering information to health professionals are speed and accuracy. DOCLINE eliminates the time-consuming steps of locating a source for the required documents. The ultimate goal however—to get the document into the user's hands directly—is still evolving. NLM's newest endeavor to create this link is LOANSOME DOC, a module of GRATEFUL MED, NLM's microcomputer-based front end for searching MEDLINE and other databases. LOANSOME DOC allows the end-user to request documents identified in a search directly from a library which has agreed to serve clients through this mechanism.

During the last several years, experiments have begun that provide direct access to journals which are in machine-readable form. Private industry, professional societies, and government all have projects in various stages of development.

The Elsevier Science Publishing Group is involved in a collaborative venture with a number of research libraries in the electronic distribution of journal articles via Internet (Wilson, 1992).
It is considered the first real attempt to make published copyrighted material available in this fashion. Known as TULIP, The Universities Licensing Program will make available forty-two journals in materials science for a trial period of three years. The purpose of the project is to study the economic, technical, legal, and behavioral issues involved in distributing journals this way.

A different approach is being taken by the American Association for the Advancement of Science (AAAS). Its venture, *The Online Journal of Current Clinical Trials*, is being published (jointly with OCLC) only in electronic format rather than simultaneous paper and electronic versions as in the TULIP project. This means that the author must be convinced to publish in a new format that is yet unproven; difficulties in attracting quality manuscripts have been noted even though it is a peer reviewed journal.

The National Library of Medicine's Lister Hill Center has also initiated a research project dubbed SAIL, System for Automated Interlibrary Loan, which would allow direct access to machine-readable databases of journal articles for interlibrary loan through DOCLINE (NLM, 1991, p. 27).

Progress in document delivery services during the last twenty years has certainly been made with the NNLM being the premiere interlibrary loan network for health sciences libraries. LOANSOME DOC has added a new dimension by providing documents directly to the end-user. In addition to this system, there are, in fact, now nearly thirty commercial companies which provide document delivery services for a fee (Khalil, 1993). The promise of full-text electronic storage, retrieval, and delivery, however, is still in the developmental stages. Issues of ownership, copyright, indexing, and fees for access are all knotty problems waiting to be resolved before this type of document delivery can become universal.

**IAIMS and New Relationships**

The concept of the Integrated Academic Information Management System was introduced in the 1982 report of the Association of American Medical Colleges (AAMC) sponsored by the National Library of Medicine (Matheson & Cooper, 1982). As originally conceived, the library was to play the lead role in bringing disparate institutional databases and systems into a single institution-wide network. In the last ten years, the idea has evolved from concentration on the library's role in information management to information management in the total organization. In fact, the concept has now gone beyond the "academic" and has been renamed Integrated "Advanced" Information Management System since it applies to hospitals and other organizations as well. The goal is to
create organizational mechanisms within health sciences institutions to manage information more effectively and to provide for a system of access to those engaged in patient care, research, education, and administration. The applications of IAIMS concepts in health sciences institutions have been significant in improving information management and in using new technologies and, as Lindberg et al. (1992) note, they have placed health sciences institutions in the forefront of information systems integration and communications networking.

Although the original intent of placing libraries at the center of IAIMS activities has been realized in only a few institutions, the significance of the concept to libraries is evident when one sees that the *Bulletin of the Medical Library Association* has featured four symposia on the subject during the last ten years. The latest, "A Decade of IAIMS," includes papers which show the continued growth of IAIMS and the library's role (Lorenzi, 1992b).

By 1991, eighteen institutions had been awarded grants or contracts by NLM to assist institutions in planning and developing models for implementation (Lindberg, 1992, p. 245). The impact of IAIMS and "IAIMS-like" developments on the organizational structure of health sciences institutions has not been fully documented. It is apparent that neither libraries nor computing centers alone are able to support the technology required for IAIMS but must have close ties with telecommunications. Some institutions have already brought libraries, computing, and telecommunications under the same umbrella. Feng and Weise (1988) discussed the evolution of this partnership at the University of Maryland at Baltimore (UMAB). Since that time, the health sciences library, academic computing, administrative computing, and telecommunications report to a single vice president for information services at UMAB. Additionally, as seen at a number of other institutions, academic computing has become a part of the library or the library and computing report to a chief information officer. Telling signs of this emerging new type of organization were the subjects at the twenty-third Annual Seminar on Academic Computing in 1992. Topics included discussions and talks on OCLC, IAIMS, new models for libraries and computer centers, and questions such as, Is there a future for academic computing?

It seems natural to pool the technical skills of computer centers with the library's skills in organizing knowledge, teaching, and marketing services. What remains unclear is how the two cultures will merge, how competition for scarce resources will be resolved, and how the gulf in the salaries of the two groups will be addressed.
THE ROLE OF THE NATIONAL LIBRARY OF MEDICINE

The NLM is renowned for having the largest collection of biomedical literature in the world and for its role in organizing and indexing this literature as well as disseminating authoritative bibliographic records. Many of its contributions—such as MEDLINE, ILS, DOCLINE, and SERHOLD—have already been described. It plays an enormous role in coordinating resource sharing among its constituents through the National Network of Libraries of Medicine. Moreover, the research and development programs of its Lister Hill National Center for Biomedical Communications (LHNCBC) apply state-of-the-art computer and communications technologies to the management of biomedical knowledge.

THE NLM LONG-RANGE PLAN

Like all libraries, the NLM has been affected by the societal forces that have shaped libraries over the last twenty years. It has had to consider its future role in light of the accelerated growth of the medical literature, the advances in information technology and communications, the challenges presented by the scientific revolution in molecular biology, and the advent of AIDS. In reviewing these developments, the NLM Board of Regents requested that NLM undertake a long-range planning process to develop strategies for the library's future. Five panels were appointed to address the future in each of the five domains that encompass NLM's programs and activities. The five domains were: (1) "Building and Organizing the Library's Collection" (National Library of Medicine, 1986b); (2) "Locating and Gaining Access to Medical and Scientific Literature" (National Library of Medicine, 1986c); (3) "Obtaining Factual Information from Data Bases" (National Library of Medicine, 1986c); (4) "Medical Informatics" (National Library of Medicine, 1986d); (5) "Assisting Health Professions Education through Information Technology" (National Library of Medicine, 1986a). The official NLM Long Range Plan (NLM, 1987) presents detailed and specific recommendations for accomplishing the library's long-range goals and includes the five panel reports on each of the principal domains of NLM programs. The plan embodies a central challenge to the NLM to "strive to be certain that health care in America and the advancement of biomedical research toward this end will benefit from the dazzling technological discoveries that are available to us now from computer and information science, telecommunications engineering, physics and chemistry" (NLM, 1987, preface). It is important to note that the report also recognizes that NLM's fundamental priority is to sustain its collections and to provide better access to its resources.
During the last five years, NLM has been working toward the goals embodied in its long-range plan. The plan has had a marked impact on the National Network of Libraries of Medicine (NNLM), the research and development efforts of the LHNCBC, and has led to the establishment of the National Center for Biotechnology Information. The following discussion will describe the evolution of the NLM, several LHNCBC programs, and the National Center for Biotechnology Information, all of which have important implications for health sciences libraries.

**Evolution of the National Network of Libraries of Medicine (NNLM)**

New health sciences librarians and information professionals perhaps take the NNLM for granted and may even be unaware of the many contributions it has made in the delivery of information to health professionals and in the introduction of technological developments to health sciences librarianship. Bunting’s (1987) excellent history of the Regional Medical Library (RML) Program chronicles its evolution from 1965 to 1985; she provides a detailed account of its development that is not possible to describe here. Rather, this section will describe several major changes in programs and services as the network matured and faced new challenges through the 1970s and 1980s.

The impetus to create the RML network originated with the President’s Commission on Heart Disease, Cancer and Stroke in 1965. The goal to achieve control of the medical literature concerning these diseases and to make it available to researchers, educators, and practitioners was articulated and made the responsibility of the NLM by Congress. The Medical Library Assistance Act of 1965 was enacted to assist in the achievement of that goal through the NLM by grants and contracts to the country’s biomedical libraries. The early years of the RML network focused on the development of library resources, consortia, networks, training of basic library managers, and supporting interlibrary loan.

Several major shifts occurred during the late 1970s which changed the operation of the RML network and the relationships of libraries to the network and to each other. This included moving from subsidized interlibrary loan to cost sharing and finally to phasing out contract support by 1982. Also during this period, all RMLs became funded through competitive contracts rather than grants. As mentioned earlier, access to MEDLINE first became available through the RML structure, but, by 1974, the implementation of MEDLINE was initiated by local libraries, and NLM also instituted a charge for the service, prompting the online centers to pass charges on to
their users. Over the years, online training was decentralized and became a part of the responsibility of three RMLs in different geographic areas of the country. The initiation of fees for interlibrary loan and search services caused debate and controversy between the RMLs and NLM; however, these charges were deemed necessary if the funding available was to further other necessary developments.

Another aspect of the RML program, which was eventually phased out, was consultation and training for nonlibrarian managers of libraries. NLM's decision proved to be a controversial one since some felt this was a successful program and continuous training was necessary for new managers, particularly at hospital libraries.

As discussed earlier, technology significantly improved the operation of the resource-sharing component of the RML network during the latter 1970s and 1980s. A strong library network had been built during the twenty-five years of its existence; yet the primary mission of bringing equal access to information to all health professionals had not been realized. Many health professionals unaffiliated with a medical library were not informed about information services available or did not have access to them in a timely fashion. In 1987, Congress recognized this need and encouraged NLM to develop an outreach program aimed at rural and other isolated areas. The mission of NLM was also amended to add the function of publicizing its products and services.

In response to this charge and the recommendations of the long range plan, the NLM Board of Regents convened the Planning Panel on Outreach to formulate a plan to guide the library's efforts to improve access to its information services by every health professional regardless of setting.

The recommendations of the planning panel, presented in its report *Improving Health Professionals Access to Information* (Board of Regents, 1989, p. 11), targeted the following four areas:

- The individual and the RML network.
- Strengthening hospital access to national information sources through resource grants to small hospital libraries, support for the Integrated Academic Information Management Systems (IAIMS) program, and participation in the emerging national electronic communications networks.
- Expanding training, fellowships, and demonstration grants.
- Expanding intramural R&D at NLM.

The recommendations of the panel had a significant impact on the requirements of the new RML contracts covering the years 1991-1995 as 60 percent of the budget was earmarked for outreach. Moreover, the name of the network was changed in 1991 to the National Network
of Libraries of Medicine to reflect its national focus; the regions were reconfigured from seven to eight in light of the increased responsibilities in outreach.

The current emphasis of the NNLM is on outreach to health professionals in rural, inner city, and minority populations who are unaffiliated with a medical library and do not have ready access to information. The goal is to create awareness of NLM products available to them either through libraries or directly to them through such products as GRATEFUL MED and LONESOME DOC. The network is the foundation for these expanded efforts which include training for health professionals in information access, exhibiting at national and local meetings of health professional organizations, and assisting local medical libraries to develop outreach programs. The latter includes financial assistance through grants or subcontracts with the RML in its region. Additionally, the NLM has funded outreach projects directly to local libraries primarily to provide training in GRATEFUL MED.

Although the basic structure of the network has remained unchanged, it has been expanded to include health professionals as well as libraries. The strict lines of the hierarchical structure are becoming blurred as health professionals who are unaffiliated seek services from libraries at any level in the network. The mission of the network—to provide equal access to biomedical information to all U.S. health professionals in order to advance the progress of medicine and improve public health—is a challenge for not only the NNLM, but also for all health sciences libraries.

**Lister Hill National Center for Biomedical Communications**

The Lister Hill National Center for Biomedical Communications was established by Congress in 1968. It serves as the intramural research and development division of the NLM; its programs fall into the following three categories: (1) computer and information science as applied to the problems of the library, of biomedical research, and health care delivery; (2) biomedical image engineering, including image acquisition, processing, storage, retrieval, and communications; and (3) use of computer and image technologies for health professions education (NLM, 1992, p. 22). Several of its projects which are important to health sciences libraries, such as the ILS and SAIL, have already been mentioned. Others which are in progress and which have major implications for health sciences libraries include, but are not limited to, the Unified Medical Language System (UMLS), expert systems such as AI/RHEUM, and the Visible Human Project.
The goal of the UMLS is to give users easy access to diverse information sources through the development of "knowledge sources" that can be used to compensate for the variety of ways concepts are expressed and accessed in different sources. The three UMLS Knowledge Sources are: a Metathesaurus of concepts and terms from several biomedical vocabularies, a Semantic Network of relationships among broad categories to which all concepts in the Metathesaurus are assigned, and an Information Sources map that describes the content and access available for human and machine-readable databases. Several experimental projects are underway including an NLM grant-supported effort at the University of Maryland at Baltimore which seeks to use the knowledge sources in accessing local databases. These types of applications will eventually simplify end-user access to multiple databases.

The Expert Systems Program objective is to facilitate access to knowledge through artificial intelligence techniques. AI/RHEUM, the flagship project of the program, seeks to provide an expert consultant system in rheumatology. The system currently offers online access to text definitions, still images, motion sequences, automated MEDLINE searches, and disease criteria tables which are the heart of its knowledge base (NLM, 1992, p. 23). In the future, one can imagine that the use of expert systems will become widespread in the practice of medicine and will likely be made available through national high speed networks to local health sciences libraries.

Since 1989, the NLM has been involved in undertaking the first project in building a prototype digital image library. Known as the Visible Human Project, the program will build a digital image library representing a complete normal adult human male and female (NLM, 1992, p. 31). Since images are such an important part of biomedical knowledge, it is hoped that these pictures will facilitate the understanding of biological structure and function and ultimately improve health care. They are an extremely important adjunct to the written and two-dimensional information available now in textbooks and radiographs. The goal for the future is to distribute the libraries of digital images and bibliographic and factual databases over high speed computer networks to the nation's health care practitioners, libraries, and institutions.

THE NATIONAL CENTER FOR BIOTECHNOLOGY INFORMATION

The National Center for Biotechnology Information (NCBI) was established in 1988 as a division of the NLM. Its responsibility is to create automated systems for storing knowledge about molecular biology, biochemistry, and genetics; to perform research into advanced
methods of computer-based information processing for analyzing the structure and function of biologically important molecules and compounds; to facilitate the use of databases and software by biotechnology researchers and health care personnel; and to coordinate the efforts to gather biotechnology information worldwide (NLM, 1992, p. 33).

The major project of the NCBI is to manage GenBank, the National Institute of Health DNA sequence database, and to integrate the literature component into the database. Comprehensive coverage of all sequence data, protein as well as DNA, will be provided along with MEDLINE bibliographic information and abstracts. GenBank is a key component of an integrated database system called GenInfo which will be a key source of DNA and protein sequence information. NCBI supports the research process by developing software to access the growing volume of gene data and new methods for disseminating the information to the biomedical community.

As the previous discussion illustrates, the NLM, through its various divisions, plays a leading role in the health sciences community to develop biomedical information services and systems and to make it available to libraries and health care personnel engaged in education, research, and clinical care. Health sciences librarians must be aware of these developments and use them appropriately in providing information services to their clients.

CONCLUSIONS

The Library

There is no doubt that the traditional role of the library has changed over the last two decades from that of a repository of information (the physical entity) to that of an information broker (the virtual library). The information explosion prohibits libraries from collecting everything; technology provides the means to access information electronically from remote locations. The role of the library is now more active rather than passive; its success can no longer be measured by the size of its holdings but rather by the quality of access and information services it provides to its clients. The role that information technology and communications have played, and will continue to play, in libraries can hardly be overestimated.

The automation of internal library functions and access to shared cataloging resources had a major impact on staffing patterns. Fewer staff are now devoted to these functions while more staff are devoted to library systems support and information services. Access services, such as interlibrary loan and direct document delivery to clients, are growing.
As networked access to information becomes more and more common, the library must play a major role in institutional planning for information resources management. The library has been accepted as the heart of the university in the past; information technology facilitates the library's role as the natural gateway to the "extremities," the remote sources.

IAIMS projects in many institutions are demonstrating that the library has the staff with the skills and capacity to provide the piloting necessary to navigate the array of disparate information sources available. National and international networks offer a bewildering array of information resources and services. It is a pity that librarians are not more involved in developing the indexing and cataloging control mechanisms to organize the overwhelming amount of information available through networks. This should definitely be a focal point for future endeavors.

During the past twenty years, health sciences libraries have been in a unique position. They have benefited from the leadership of the NLM in providing bibliographic control of the biomedical literature, in providing access to the literature through online databases produced by the NLM, and in supporting resource sharing through the NNLM. NLM grants programs have aided many health sciences libraries to develop resources, to automate, and to link to other information sources. The research and development efforts of the Lister Hill Center, such as the ILS, have added immeasurably to the library's ability to manage biomedical information.

That is not to say that librarians have been waiting around for NLM to show the way. Librarians have developed innovative services to meet and anticipate their clients' needs as well as to take advantage of information technology.

The Librarian

It may be useful to view the library and librarians separately for a moment. In budget crises, librarians have often been considered expendable, while the library's collection was protected. Today there is a perception that administrators view information technology as more worthy of support than librarians. As a result, the last twenty years have been a tumultuous time for librarians as they perceived their positions threatened. The advent of end-user searching was such a perceived threat and, some would argue, has had a terribly damaging effect on the professional role. This is a rather narrow point of view since the librarian's role has become more and more complex.

First, librarians play an active role in incorporating information acquisition, management, and appraisal skills into health sciences curricula. Second, librarians are skilled "knowledge navigators" and
can guide users through the plethora of information sources available. Third, they must be thoroughly familiar with information systems and telecommunication to access these sources; and fourth, they are increasingly involved in institutional planning for information systems.

It is hard to imagine this as a diminished role. Librarians must aggressively educate administrators about their skills, abilities, and role in institutional information management. Where are health sciences libraries going? It is indeed difficult to predict where the next twenty years will lead. If the changes of the past two decades are any indication, librarians are in for a roller coaster ride. As the "virtual" library becomes a reality, librarians will probably play a greater role in quality filtering. A recent study indicates that librarians can recognize and select clinically useful articles as effectively as physicians (Kuller et al., 1993). Librarians should pursue this service to assume a greater role in providing value-added services to their clients. And what of the library as the physical entity? Chances are the physical entity will remain for at least twenty years with both print and electronic resources. Clients and librarians will probably find their workstation to be more and more useful as they tap into the world's information sources. The High Performance Computing and Communications Act (HPCC), which established the National Research and Education Network (NREN), will provide libraries with access to high-speed and high-capability communication facilities, but these technologies will also be accessible to many individuals and organizations in the future. Librarians must again emphasize their skills and role in developing roadmaps for these many electronic highways. They must work closer with other units in their institutions which deal with technology, whether this be academic computing, patient information systems, or telecommunications, so that the place of the library and what it has to offer will continue to be the "heart" of the information system. Health sciences librarians have a brilliant future ahead of them if they build on the past tradition of being in the forefront of innovative applications of technology.

The Alexandria Library was an idyllic place, no doubt, where scholars gathered for discourse and study. The virtual library may be such an entity if the potential of networked information and technology are harnessed as tools in the creation and dissemination of knowledge for the benefit of all.

REFERENCES


Shaping Medical Library Education

FRED W. ROPER AND M. KENT MAYFIELD

ABSTRACT

Considerable change is occurring in the health information environment, signaling a need for change in the roles of health information professionals and in the knowledge and skills expected of them. This article reports the results of a survey of knowledge and skills in the health information sciences conducted by the Medical Library Association (MLA) and relates those results to MLA's educational policy statement, Platform for Change.

INTRODUCTION

We must educate for the problems of a generation hence, not for the problems of today...librarians must be imbued with the psychological ability to handle change and to live with ambiguity. Without this they will be performing tomorrow's tasks with yesterday's concepts. (Brodman, 1979, p. viii)

"Tomorrow's tasks" will be considerably different from those of today. The exponential growth in biomedical knowledge and the new information technologies are redefining the infrastructure of health care, education, and research. An array of professional specialties has developed, reworking what was a well-defined arena of information service. Changes in the health information environment signal change in the roles of health information professionals and in the knowledge and skills expected of them. Health sciences librarianship may not exist as a profession in the
next century unless health information professionals begin to accept responsibility for their own destinies by seeking lifelong education and professional development opportunities from a variety of sources.

The key to developing the full array of needed educational opportunities is the leadership of the Medical Library Association (MLA). By reaching out and developing partnerships with other institutions and organizations to strengthen its programs and policies in support of the health sciences librarian, MLA can provide individuals with opportunities that will prepare them for a world that continues to change radically in response to the rapid growth of biomedical knowledge and technology.

This article focuses on the Medical Library Association and its activities resulting from the work that MLA has already sponsored and because of its unique position of being able to affect medical library education and to serve as a catalyst for change.

According to the Council on Library Resources (1989), "At the heart of many of the present problems facing librarians and library education is the failure to describe the profession and its present role in terms that are compelling, expansive, and accurate. The principles, the responsibilities, and the body of knowledge that shape the profession are real and of great importance...but they are either implicit or incompletely formed and are certainly not widely understood..." (p. 26). Over the past twenty years, MLA has cited the need for a coalition of expertise and resources within the profession to define the competencies needed for professional practice and to support their acquisition in graduate school and beyond.

In May 1989, MLA's Knowledge and Skills Task Force (see Appendix A) was appointed in response to a number of different initiatives. First was MLA's own strategic plan and the strategy which seeks to influence curricula of academic institutions in the areas of design, development, and management of information systems. In order to achieve this, it seemed necessary, first, to validate what it is that health information professionals do and then to determine what is going to be needed in the future. A second impetus, closely related to the first, was the revision then underway of the American Library Association's (ALA) Standards for Accreditation of master's programs in library and information science. As a part of that revision process, each of the major library and information science associations was asked to provide the ALA Committee on Accreditation with educational and other policy statements pertinent to the needs of that organization so that they could be shared with the educational programs.

The Task Force determined that the best approach to gather the data necessary to carry out these objectives would be to survey a
sample of the MLA membership with two goals in mind: (1) to define the knowledge and skills required for competent professional performance now and in the future; and (2) to enable MLA to establish educational policies which would assure the acquisition and maintenance of those activities throughout a professional career. When tabulated and analyzed, these data would provide an inventory of knowledge and skills described in two major ways: scope—what are these skills?—and setting—where is the learning most likely to be applied and where is the learning most likely to occur?

In January 1990, an application was submitted to the Council on Library Resources for assistance in funding this survey and some other activities related to the survey. The Task Force received a grant of slightly more than $9,300 from the council. In addition, support was received from the Medical Library Association and from the University of South Carolina.

MLA's (1992) educational policy statement, Platform for Change, which resulted from the survey, was adopted by the MLA Board of Directors in December 1991 (see Appendix B for a portion of that statement). The document describes the need for lifelong interdisciplinary learning for the field. It suggests that health care information will continue to grow exponentially and that health care will be one of the nation's most critical information issues. The document also provides concrete guidelines for graduate programs and insists that strong professional development roles be assumed by MLA and the National Library of Medicine.

Prior Work on Knowledge and Skills

As society has moved into the information age, the need for people with a clear understanding of the many facets of the information process and with the technical skills to support that process becomes obvious. The literature of library and information science certainly does not lack for statements on what should constitute the basic body of knowledge and skills for information professionals.

Millicent Abell (1979), Toni Carbo Bearman (1984), Anthony Debons (1981), and Patricia Battin (1983) have been outspoken in identifying a baseline of knowledge and skills for information professionals that keeps pace with the rate of accelerated change that will take place in information environments. Each has expressed concern that the changing role of the professional in those environments will require a fresh look at library education and strategies to assist librarians in acquiring new knowledge and skills throughout their careers.
Woodsworth and Lester (1990) add further evidence that librarians are envisioning a new type of library and describe the following elements needed for the education of future librarians:

- A strong technical and technological base.
- Understanding of the characteristics of information transfer, including users' information-seeking behavior.
- Skill in identifying and analyzing the information needs of various constituencies served.
- Skill in evaluating information and a willingness to make relevant decisions based on expertise in both information management and subject areas or disciplines.
- Knowledge of small group dynamics.
- Understanding of the organizational culture and environmental context of higher education.
- Understanding of and ability to analyze information policy issues.
- Understanding of the impact of both the national and international economy on information access.
- Ability to analyze the political processes within the higher education environment.
- Understanding of the generation, production, and distribution of information and of the changing paradigm as shifts occur from print-based information production to other modes of production and dissemination.
- Competency in instructional design and adult education programming.
- Communication theory and its application to information repackaging. (pp. 207-08)

The Woodsworth-Lester article points to a common ground of education for librarianship, as does the work of Robert Taylor (1986), whose *Value-Added Processes in Information Systems* builds a framework of knowledge and skills that has six foci:

- Information Use Environments
- Intellectual Technologies
- Availability of Data, Information, and Knowledge
- Information Systems and Services
- Information Technologies
- The Economics of Information Provision and Use (p. vii)

In its *Position Statement on Graduate Education*, the Special Libraries Association (SLA) (1988) arranges the competencies, skills, and attitudes that are needed in any information environment into a set of five categories:

1. Provision of information services
2. Technology
3. Management
4. Information resources, including methods of organization
5. Information service/product evaluation

There is considerable congruence at a conceptual level among leading librarians on the expanded array of competencies required
for information specialists. However, there is little empirical evidence in the literature of the knowledge and abilities necessary to work effectively as a librarian, and research documentation is limited.

Creth and Harders's (1980) 1979 survey of personnel administrators, followed by an Association of Research Libraries (ARL) (1981) survey of library administrators in research libraries, alerted the field to needs for skills in other than traditional areas of librarianship, especially automation, systems analysis, and computer-related competencies. King Research further validated the need for these skills and cited changes in the skills and knowledge needed by librarians at points along a career path (Griffiths & King, 1986).

Atkins and Georgantas (1989), studying "Knowledge and Skills Suitable for Entry in the Information Industry" (p. 81), analyzed survey data using a multidimensional scaling methodology to map relationships between nine technical skill categories and eighteen principal organizational or functional activities. The data revealed a set of complex interrelationships which shared a common emphasis on highly developed interpersonal communication skills.

In a preliminary study to assess the level of knowledge and skills development of significance to employers of health information science graduates in Canada, Protti (1984) conducted a limited survey of senior officials in health organizations and agencies across Canada. In general, the data confirmed that employers were looking for people who are able to work and communicate effectively with others, have analytical and problem-solving skills, possess the ability to rigorously analyze and determine organizational information needs and understand the health care environment.

In their report, Academic Information in the Academic Health Sciences Center: Roles for the Library in Information Management, Matheson and Cooper (1982) assert that technological advances not only provide greater efficiency and allow for new approaches to the accomplishment of tasks, but that they also transform both the library and the role of the professional manager of biomedical information resources with a concomitant requirement of new skills and knowledge among health information practitioners. Recent reports of the Panel on the General Professional Education of the Physician (GPEP) and College Preparation for Medicine (1984), "Physicians for the Twenty-first Century" and the NLM Long Range Plan (National Library of Medicine, 1986-87) as well as the proceedings of the 1986 symposium on medical informatics, Medical Education in the Information Age (1986), underscore the need for new skills in information processing, biomedical subject knowledge, consumer service, and education; the reports voice concern that new models
for professional education are essential to address changes in the social and technological environment of the future.

Similarly, documents from the Medical Library Association have focused attention on issues in education. Roper (1979) described a critical role for graduate education in the preparation of health sciences information professionals. In 1981, the report of the Study Group on MLA's Role in the Educational Process for Health Sciences Librarians called upon the association to reassess the education needed for practice in a changing environment, drawing particular attention to alternative pathways into the profession (Mirsky et al., 1982). The MLA Ad Hoc Committee on Professional Development (1984) followed with strong recommendations to work closely with graduate schools of library and information science to develop curricula which incorporate the knowledge and skills needed by health information professionals. "Shaping the Future" (Medical Library Association, 1987), the 1987 strategic plan of the Medical Library Association, further acknowledged the necessity to define the knowledge and skills needed by the field.

In 1988, MLA endorsed a new program of credentialing, the Academy of Health Information Professionals. Qualifications for the academy include documented competence in ten areas of essential knowledge:

1. Health Care Environment
2. Medical Concepts and Terminology
3. Information Needs of Health Professionals
4. Computer Hardware, Software and Information-related Applications
5. Basic Research Techniques
6. Basic Management Principles
7. Acquiring and Organizing Information
8. MeSH and NLM Classification
9. Information Sources in the Health Sciences
10. Online Searching, including MEDLINE

The MLA curriculum for continuing education reflects a commitment to those areas as well.

Mayfield (1985, 1986), Anderson (1989), and Messerle (1990) have emphasized the need for a new coalition of expertise and resources within the profession to define the skills and competencies needed for professional practice and to support their acquisition in graduate school and beyond.

Nonetheless, the literature of health sciences librarianship includes little research to support recommendations about what knowledge and skills are required to function in the environment
so compellingly described by leading information professionals, the GPEP studies, and the several reports of the Medical Library Association.

The survey conducted by MLA's Knowledge and Skills Task Force sought to remedy, in part, this lack of a research base for decision making and provides a foundation on which to develop a new consensus within the health sciences information community on the knowledge and skills required to meet the needs of health care, medicine, research, and education in technologically alert, user-driven, and rapidly changing organizational environments.

The Knowledge and Skills Survey

The basic objective of this study was to gather data which would provide answers to the following questions:

1. To what extent do health sciences librarians consider identified areas of knowledge and skill important to effective professional performance in the environment of the future?
2. To what extent do health sciences librarians perceive that they now possess these skills?
3. Where do health sciences librarians tend to acquire knowledge in these areas?
4. Where do health sciences librarians consider such knowledge best acquired?

In addition to these questions, the study was designed to explore possible relationships among the answers to the foregoing questions and the health sciences librarian's institutional setting, level of responsibility, and years of experience in the field.

For the purposes of this study, health sciences librarians were defined as practicing librarians or students enrolled in programs of study leading to careers in health sciences librarianship. The population was further limited to include only librarians or students in the United States and Canada. The study population was not stratified by educational background, duration of experience, or level of job responsibility. It was, however, stratified by geographical area and institutional setting, as identified in the membership database of the Medical Library Association, which provided the population from which the study participants were selected. A sample of 750 health sciences librarians was used.

A four-section survey instrument was designed to gather the data needed to answer the major research questions. The first two sections of the questionnaire consisted of twelve questions requesting information about current position, institutional affiliation, primary area of responsibility, education, and assessment of educational activities.
The third section was presented in a matrix format. Respondents were asked to provide information on sixty-three knowledge bases identified in an expert review of the literature in health sciences librarianship representing the following seven broad areas:

- Health sciences environment & information policies
- Health sciences information services
- Health sciences resource management
- Information systems and technology
- Management of information services
- Instructional support systems
- Research, analysis, and interpretation

While it was anticipated that it would be a formidable task for participants in the study to respond to sixty-three knowledge bases, it was concluded that such specificity was needed to generate meaningful useful data.

Demographic information about participants was gathered in section four of the survey instrument.

Following a pretest, copies of the survey questionnaire were mailed to 750 health sciences librarians. A total of 375 usable questionnaires, representing 50 percent of the sample population, was returned. Eighty-eight percent are employed full time and 12 percent part time. Thirty-nine percent are employed in academic health sciences libraries; 33 percent in hospital libraries; and the remainder in commercial, government, and other types of libraries. The breakdown by sex is 88 percent female and 12 percent male.

A "graying" of the field is indicated by age and years of experience. Sixty-seven percent of the respondents are age forty or older. Forty-nine percent have had more than fifteen years of experience in the field. Forty-four percent have spent five or fewer years in their present positions.

Health sciences librarians are not alone in considering the knowledge and skills required both to maintain and to improve the management of biomedical information in coming years. The knowledge explosion occurring in medicine and the basic biomedical sciences, coupled with new developments in health care management, dictates that physicians, students, researchers, health care administrators, and consumers learn to use new strategies for managing the information and knowledge available to them. Medical information science, technological change, and a growing understanding of the processes of clinical decision making may be powerful factors in information management and analysis.

The investigators thought it essential, therefore, to give experts from medicine, health care, and librarianship an opportunity to
review and comment upon the preliminary survey results, considering especially the degree to which health sciences information professionals coincided in their expectations and citing points of critical difference.

Discussions were scheduled in Washington, Los Angeles, Boston, Denver, Phoenix, and Chicago with key figures in medicine and health care administration. Leaders in library and information science were interviewed. While a number of issues were raised for further investigation, these discussions confirmed that the findings and recommendations of this study provide a sound base from which to develop a new consensus for the preparation of health information professionals.

Survey Results

A complete report on the results of the survey will appear in the Bulletin of the Medical Library Association ("Surveying Knowledge and Skills in the Health Sciences," 1993). Presented here is a summary of the major findings and conclusions from the survey.

For each of the sixty-three knowledge bases, respondents were asked to indicate how important each was for effective performance in their current positions, how important the knowledge or skill was to effective performance in the health information profession now, and how important it would be in the future. The importance of each knowledge or skill was measured on a five-point scale (5, essential; 4, very important; 3, important; 2, little importance; and 1, no importance).

Table 1 displays the ten knowledge bases considered to be most important to the respondents' current positions. Health sciences information services and management of information services are the areas most heavily represented in the ten skills deemed most important now.

Table 1
Importance of this Knowledge or Skill to Effective Performance in Your Current Job

<table>
<thead>
<tr>
<th>Knowledge Base</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral and written communication</td>
<td>3.67</td>
</tr>
<tr>
<td>Health sciences practitioners' needs</td>
<td>3.55</td>
</tr>
<tr>
<td>Interpersonal relations</td>
<td>3.47</td>
</tr>
<tr>
<td>Health sciences information resources</td>
<td>3.46</td>
</tr>
<tr>
<td>Retrieval techniques</td>
<td>3.37</td>
</tr>
<tr>
<td>Planning</td>
<td>3.27</td>
</tr>
<tr>
<td>Selection of information resources</td>
<td>3.23</td>
</tr>
<tr>
<td>Computer software</td>
<td>3.22</td>
</tr>
<tr>
<td>Methods of information delivery</td>
<td>3.18</td>
</tr>
<tr>
<td>Information needs assessment</td>
<td>3.17</td>
</tr>
</tbody>
</table>
Table 2 shows considerable consistency between importance in respondents' present position and importance to effective performance in the profession now.

<table>
<thead>
<tr>
<th>Knowledge or Skill</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral and written communication</td>
<td>3.75</td>
</tr>
<tr>
<td>Health sciences practitioners' needs</td>
<td>3.67</td>
</tr>
<tr>
<td>Health sciences information resources</td>
<td>3.66</td>
</tr>
<tr>
<td>Retrieval techniques</td>
<td>3.64</td>
</tr>
<tr>
<td>Selection of information resources</td>
<td>3.44</td>
</tr>
<tr>
<td>Planning</td>
<td>3.41</td>
</tr>
<tr>
<td>Budgeting</td>
<td>3.40</td>
</tr>
<tr>
<td>Interpersonal relations</td>
<td>3.38</td>
</tr>
<tr>
<td>Computer software</td>
<td>3.37</td>
</tr>
<tr>
<td>Development of services for information needs</td>
<td>3.36</td>
</tr>
</tbody>
</table>

Budgeting and development of services replace methods of information delivery and information needs assessment in the top ten knowledge and skills deemed most important for the profession at large.

There is a fairly high level of correlation between the level of importance of the top knowledge bases "now" and "in the future." Table 3 indicates the importance of knowledge bases for the twenty-first century.

<table>
<thead>
<tr>
<th>Knowledge or Skill</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral and written communication</td>
<td>3.80</td>
</tr>
<tr>
<td>Health sciences practitioners' needs</td>
<td>3.78</td>
</tr>
<tr>
<td>Retrieval techniques</td>
<td>3.71</td>
</tr>
<tr>
<td>Health sciences information resources</td>
<td>3.66</td>
</tr>
<tr>
<td>Budgeting</td>
<td>3.58</td>
</tr>
<tr>
<td>Computer software</td>
<td>3.57</td>
</tr>
<tr>
<td>Telecommunications and networking</td>
<td>3.57</td>
</tr>
<tr>
<td>Planning</td>
<td>3.56</td>
</tr>
<tr>
<td>Health sciences environment</td>
<td>3.49</td>
</tr>
<tr>
<td>Methods of information delivery</td>
<td>3.49</td>
</tr>
</tbody>
</table>

Seven of the knowledge bases considered most important for the profession now are also considered to be of great importance in the future. Other areas of great importance in the future included telecommunications, methods of information delivery, and the health sciences environment.
Respondents were asked to assess their present knowledge or skill level in each of the sixty-three knowledge bases listed. The assessment was measured on a four-point scale (4, extensive; 3, moderate; 2, slight; 1, none). Table 4 provides a list of the ten knowledge bases with which the respondents indicated the most familiarity.

<table>
<thead>
<tr>
<th>TABLE 4</th>
<th>AMOUNT OF THIS KNOWLEDGE OR SKILL NOW POSSESSED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oral and written communication</td>
<td>2.61</td>
</tr>
<tr>
<td>Health sciences information resources</td>
<td>2.55</td>
</tr>
<tr>
<td>Retrieval techniques</td>
<td>2.50</td>
</tr>
<tr>
<td>Health sciences practitioners' needs</td>
<td>2.49</td>
</tr>
<tr>
<td>Bibliographic tools</td>
<td>2.49</td>
</tr>
<tr>
<td>Selection of information resources</td>
<td>2.40</td>
</tr>
<tr>
<td>Methods of information delivery</td>
<td>2.39</td>
</tr>
<tr>
<td>Health sciences environment</td>
<td>2.38</td>
</tr>
<tr>
<td>Interpersonal relations</td>
<td>2.36</td>
</tr>
<tr>
<td>Identification of materials and sources</td>
<td>2.34</td>
</tr>
</tbody>
</table>

Of importance may be the relative ranking of amount held in contrast to the level of importance accorded to the knowledge bases in Tables 1 through 3. Among the top ten areas of knowledge or skills held, four (bibliographic tools, methods of information delivery, health sciences environment, and identification of materials and sources) are ranked below that level for the profession now. Three (bibliographic tools, health sciences environment, identification of materials and sources) rank below that for the present position. Four (bibliographic tools, selection of information resources, interpersonal relations, and identification of materials and sources) rank below that projected for the twenty-first century. Only bibliographic tools and identification of materials and sources did not appear in the top ten most important knowledge bases for current position now and in the future.

There is a fairly high level of correlation between the level of importance of each of the knowledge bases "now" and "in the future." That is, if a knowledge base were considered important "now" it was found to be important "in the future," and, conversely, a knowledge base of low importance "now," was generally found to be of low importance "in the future." However, when the focus shifts to the twenty-first century, some changes are notable, although the top four areas of knowledge and skill remain consistent with present priorities of the profession.
Those skills and knowledge which health science information professionals claim to possess least (Table 5) are in the areas of information systems and technology, instruction, and research.

<table>
<thead>
<tr>
<th>Least Held Knowledge Bases</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Artificial intelligence and expert systems</td>
<td>0.78</td>
</tr>
<tr>
<td>Computer programming</td>
<td>0.89</td>
</tr>
<tr>
<td>Systems analysis</td>
<td>1.03</td>
</tr>
<tr>
<td>Statistical theory</td>
<td>1.04</td>
</tr>
<tr>
<td>Fund-raising</td>
<td>1.05</td>
</tr>
<tr>
<td>Curriculum development</td>
<td>1.21</td>
</tr>
<tr>
<td>Evaluation of learning outcomes</td>
<td>1.23</td>
</tr>
<tr>
<td>Instructional design</td>
<td>1.24</td>
</tr>
<tr>
<td>Bibliometric techniques</td>
<td>1.25</td>
</tr>
<tr>
<td>Resource preservation</td>
<td>1.31</td>
</tr>
</tbody>
</table>

It is noteworthy that the skills least held by health sciences librarians are also among those considered by the respondents to be least important to the professional now and in the future.

Participants in the survey were asked to report the sources of their knowledge and skill. Six response categories were provided: library school, other formal academic programs, internship, continuing education, on-the-job, and other.

For the knowledge bases cited as important to the profession now, a majority of knowledge and skills were acquired in continuing education and on the job, with a smaller percentage of the responses representing library school. However, library school remains a strong source of knowledge and skills in areas of traditional librarianship, including selection of information resources, bibliographic tools, methods of information delivery, evaluation and synthesis of information, identification of materials and sources, and serial publications.

When plotted against the listings of either the knowledge and skills most important to current position or the list of knowledge bases projected to be most important in the twenty-first century, a similar pattern exists. Again, in areas of traditional librarianship, library school is a strong source of knowledge and skill. However, in no case is there a substitute for on-the-job experience.

Respondents were also asked to indicate where each of the knowledge bases might best be acquired. Once again, most of the knowledge and skills important to the profession now are judged to be best acquired from one of three sources: on the job (27 percent), library school (26 percent), and continuing education (25 percent).
In addition to strength in traditional librarianship, library schools are seen as a source of knowledge and skills in some areas of management, an area shared with continuing education. In reference to knowledge and skills important to current position and to the priorities for the future, the pattern is maintained. In general, the data suggest that library schools are seen as preferred sources of learning in areas other than those experienced by the respondents and well beyond the arena traditionally assigned to librarianship.

CONCLUSIONS

Many librarians practicing in the early years of the twenty-first century are currently employed in health sciences libraries. Any strategy which focuses primarily on education and training at the master's level ignores the reality that the pipeline into the profession is already full, with the bulk of the librarians already employed in health care institutions and likely to be there for the next fifteen years. This is a mature group which will need to assume greater responsibility for its own continuing education needs. In addition, it will look to its employer for support of training and continuing education both on site and from other organizations and institutions. It will demand from its professional association, MLA, programs and services which strengthen its professional competence.

Survey respondents did not identify any knowledge bases that are important now that would not be considered important in the twenty-first century. Only one knowledge base not among the top twenty for the present is cited on the top twenty list for the future: computer hardware. It is significant that the skills least held by health sciences librarians are also among those considered by the respondents to be least important to the profession now and in the future.

As with all such exercises, it is very difficult for those close to an operation to predict very far into the future. The rapidly changing health care environment coupled with the explosion of technological capabilities will certainly bring changes to how health sciences libraries and librarians operate. MLA and its partners must develop programs and services which assist MLA members in adopting technology and adjusting to the environment. MLA members must create their own vision of the future and work toward attaining that vision.

There is no clear consensus among the respondents as to the “best” place to acquire specific skills or knowledge. For skills closely connected with library functions and/or the processing of information, graduate programs are recommended. However, many respondents felt that continuing education and on-the-job training were reasonable approaches for attaining this knowledge and skill.
MLA must assist its members in identifying appropriate methods for acquisition of these skills and knowledge. Some of these specific skills are most appropriately acquired on the job. Employers will need to acknowledge their responsibility in developing training programs to support this need. Library schools have an opportunity to develop post-master's institutes, workshops, and other outreach programs in support of currently employed professionals. The National Library of Medicine can provide support for a variety of post-master’s educational opportunities.

Feedback from the non-MLA participants to the Task Force on Knowledge and Skills yielded some disturbing results. The “outsiders” had a much more expansive view of what they thought health sciences librarians should and could be doing in the future. Health professionals seemed willing to delegate to librarians a greater role in the health information arena than librarians themselves seem willing to assume. If health sciences librarians are not willing to take on the responsibilities which their clientele feel are appropriate, they will be replaced by other professionals who can and will. Individual health science librarians must provide professional vision and work toward attaining it.

It is essential that health information professionals understand that individual responsibility is the key to moving the profession forward. MLA has its own role to play, and it is one for which it is uniquely qualified. It must speak forcefully and eloquently for its members. It must provide the vision and focus for other organizations and institutions which will serve as its partners in the education arena. MLA is the linchpin for developing a full array of educational opportunities because MLA is the only entity which can easily and appropriately relate to all the players.
## APPENDIX A

### MEDICAL LIBRARY ASSOCIATION TASK FORCE ON KNOWLEDGE AND SKILLS

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fred W. Roper, Chair</td>
<td>College of Library and Information Science</td>
</tr>
<tr>
<td></td>
<td>University of South Carolina</td>
</tr>
<tr>
<td></td>
<td>Columbia, SC 29208</td>
</tr>
<tr>
<td>Kent Mayfield</td>
<td>Second Wind</td>
</tr>
<tr>
<td></td>
<td>5653 State Highway 150</td>
</tr>
<tr>
<td></td>
<td>Dodgeville, WI 53553</td>
</tr>
<tr>
<td>Rachel K. Anderson</td>
<td>Arizona Health Science Library</td>
</tr>
<tr>
<td></td>
<td>University of Arizona</td>
</tr>
<tr>
<td></td>
<td>1501 North Campbell Avenue</td>
</tr>
<tr>
<td></td>
<td>Tucson, AZ 85724</td>
</tr>
<tr>
<td>Judy Messerle</td>
<td>Countway Library of Medicine</td>
</tr>
<tr>
<td></td>
<td>Harvard University</td>
</tr>
<tr>
<td></td>
<td>10 Shattuck Street</td>
</tr>
<tr>
<td></td>
<td>Boston, MA 02115</td>
</tr>
<tr>
<td>Rick B. Forsman</td>
<td>Denison Medical Library</td>
</tr>
<tr>
<td></td>
<td>University of Colorado Health Science Center</td>
</tr>
<tr>
<td></td>
<td>4200 East Ninth Avenue</td>
</tr>
<tr>
<td></td>
<td>Denver, CO 80262</td>
</tr>
<tr>
<td>Phyllis S. Mirsky</td>
<td>Central University Library</td>
</tr>
<tr>
<td></td>
<td>University of California-San Diego</td>
</tr>
<tr>
<td></td>
<td>C-075 G</td>
</tr>
<tr>
<td></td>
<td>La Jolla, CA 92093</td>
</tr>
<tr>
<td>Carolyn Lipscomb</td>
<td>Health Sciences Library</td>
</tr>
<tr>
<td></td>
<td>CB #7585</td>
</tr>
<tr>
<td></td>
<td>University of North Carolina at Chapel Hill</td>
</tr>
<tr>
<td></td>
<td>Chapel Hill, NC 27599</td>
</tr>
<tr>
<td>Reneta Webb</td>
<td>Medical Library Association</td>
</tr>
<tr>
<td></td>
<td>Suite 300</td>
</tr>
<tr>
<td></td>
<td>Six North Michigan Avenue</td>
</tr>
<tr>
<td></td>
<td>Chicago, IL 60602-4802</td>
</tr>
<tr>
<td>Lucretia W. McClure, Board</td>
<td>Edward G. Miner Library</td>
</tr>
<tr>
<td></td>
<td>liaison</td>
</tr>
<tr>
<td></td>
<td>University of Rochester School of Medicine and Dentistry</td>
</tr>
<tr>
<td></td>
<td>601 Elmwood Avenue</td>
</tr>
<tr>
<td></td>
<td>Rochester, NY 14642</td>
</tr>
<tr>
<td>Ellen R. Westling</td>
<td>Countway Library of Medicine</td>
</tr>
<tr>
<td></td>
<td>Harvard University</td>
</tr>
<tr>
<td></td>
<td>10 Shattuck Street</td>
</tr>
<tr>
<td></td>
<td>Boston, MA 02115</td>
</tr>
</tbody>
</table>
Health sciences librarianship is multifaceted. The profession acknowledges the need for knowledge and skills that intersect equally important areas: the knowledge bases of the health sciences, the application of general information principles to the health sciences setting, specific health information systems, and management and personal skills.

Health information professionals will possess varying levels of knowledge and skills in seven broad areas. No one individual can achieve mastery of all knowledge and every skill, but every organization will require collective expertise in all areas. Individuals will emphasize different areas at different points in their career, with specific needs varying over time from assignment to assignment and by institutional setting. The knowledge and skills are not listed in priority order and may be applicable to more than one area.

**Health Sciences Environment and Information Policies**

Health sciences librarians must understand the contexts in which the need for biomedical and related information emerges and the unique ways of perceiving and interpreting those environments. Therefore, they should be alert to the changing information and health care environments and the major program and policy sources, including

- legal, ethical, economic, and legislative issues;
- health sciences professions: system and structure, terminology, education and training patterns, and associations and organizations; and
- purpose, programs, and activities of MLA, the National Library of Medicine (NLM), and related information associations and organizations.

**Management of Information Services**

Leadership in the application of library and information science to the handling of health sciences information resources in complex institutional environments requires specialized knowledge, skill, and understanding of management, including

- the institution’s mission and the specific mission of the information resource center;
- institutional and functional planning processes;
- decision-making strategies;
- human resources management and labor relations;
- staff development;
- project and program management and evaluation;
- organizational structure and behavior;
- interinstitutional relations;
- numerical literacy and computational proficiency;
- finance and budgeting, cost analysis, and price setting;
- fund-raising and proposal writing;
- public relations and marketing;
facilities planning and space allocation; oral and written communication; and interpersonal relations.

**Health Sciences Information Services**

Health sciences librarians require knowledge of the content of information resources and skills in using them. They must understand the principles and practices related to providing information to meet specific user needs and to ensure convenient access to information in all forms, including

- information needs of health practitioners, researchers, educators, students, and consumers;
- information-seeking and transfer characteristics of user groups and individuals;
- assessment of identified information needs;
- health sciences and other information resources and their relevance to specific information needs;
- retrieval strategies and techniques;
- analysis, evaluation, and synthesis of information for identified needs;
- methods of information delivery and access;
- development of services tailored to meet needs of individual and group users; and
- resource sharing.

**Health Sciences Resource Management**

Health sciences librarians must know the theory of, as well as have skills in, identifying, collecting, evaluating, and organizing resources and developing and providing databases, including

- identification and selection of materials and their sources;
- acquisition of materials;
- bibliometric techniques;
- thesauri construction;
- bibliographic tools;
- cataloging and classification theory;
- national and international standards and conventions, including cataloging and filing rules;
- indexing, abstracting, and classification systems;
- inventory control techniques;
- serial publications;
- resource conservation and preservation;
- publishing industry;
- trends in information formatting, production, packaging, and dissemination; and
- copyright issues.

**Information Systems and Technology**

Developments in technology have reshaped the goals and systems of health sciences librarianship and changed the way information professionals function. Health sciences librarians must be able to understand and use technology and systems to manage all forms of information, including
basic principles of automated systems:
- record and file construction,
- computer hardware and software,
- telecommunications and networking,
- database management software,
- systems analysis, and
- artificial intelligence and expert systems;
- human behavior and technology;
- design, use, and evaluation of information technologies; and
- integration of systems and technologies into the long-term information management needs and plans of the institution.

INSTRUCTIONAL SUPPORT SYSTEMS
Teaching ways to access, organize, and use information to solve problems is an essential and ever-widening responsibility of the health sciences librarian. Effective instruction entails not only knowledge of the structure and content of specific courses and technology but also an understanding of:
- learning theory and cognitive psychology,
- curriculum and instructional development,
- instructional systems design,
- educational needs assessment and analysis,
- learning style appraisal,
- instructional methodologies, and
- evaluation of learning outcomes.

RESEARCH, ANALYSIS, AND INTERPRETATION
Few dispute the library's responsibility to explore the "fundamental nature of biomedical information storage, organization, utilization, and application in learning, patient care, and the generation of new knowledge" (Matheson & Cooper, 1982). In order to conduct and interpret research, the health sciences librarian is called upon to apply knowledge, skills, and understanding of:
- theoretical bases of health sciences information, education, and clinical practice;
- information structure, transfer, and processing;
- analysis, evaluation, and application of research results;
- methods for evaluation of system effectiveness and efficiency;
- statistical theory; and
- research methodologies.

In the future, the profession is likely to need an array of knowledge and skills, not all of which are envisioned in this list. Developments in the field will require librarians to continue to acquire new knowledge and skills. At the same time, the profession will continue to define its mission and scope, reshaping the body of knowledge and skills—adding new ones and increasing and decreasing the importance of others.
REFERENCES


Association of Research Libraries. (1981). Education for the research library professional (Published in the minutes of the October 1980 ARL meeting) (pp. 28-35). Washington, DC: ARL.


The Educational Role of Health Sciences Librarians

JOCelyn A. RANKIN AND JEAN WILLIAMS SAYRE

ABSTRACT
THE EDUCATIONAL ROLE of health sciences librarians in both academic centers and in hospitals is expanding due to influences of new educational models and growing use of technology. Innovative health sciences curricula are being applied in undergraduate and continuing education and often incorporate new technologies. The health sciences librarians' educational responsibilities include teaching access to the literature and other information resources, teaching use of technology as a means to access and manage information, and teaching skills in information organization and critical appraisal. Integration of teaching activities into the health sciences curriculum is a promising trend. The many changes in the health sciences environment present numerous teaching opportunities but also require flexibility, adaptation, and creative solutions on the part of practicing librarians.

INTRODUCTION
The only man who is educated is the man who has learned how to learn; the man who has learned how to adapt and change; the man who has realized that no knowledge is secure, that only the process of seeking knowledge gives a basis for security. (Rogers, 1983, p. 120)

Today's dynamic health sciences environment is constantly incorporating advances in biomedicine, technology, and educational
practices that are related to patient care. This changing environment, particularly in education and technology, is creating expanded educational roles for librarians (see Figure 1). The new roles require health sciences librarians to be knowledgeable about innovative and evolving models for undergraduate health sciences curricula and for continuing education of health sciences practitioners. Librarians also must be current with new applications of technology especially in the emerging discipline of medical informatics. Most important, librarians must understand the implications of these advances in order to teach information management skills in a meaningful way to students and practitioners.

<table>
<thead>
<tr>
<th>Environment</th>
<th>Instructional Activities</th>
<th>Educational Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Sciences Curricular Reform</td>
<td>Library Orientation</td>
<td>Lifelong Learning</td>
</tr>
<tr>
<td>Problem-Based Learning</td>
<td>MeSH, Other Thesauri</td>
<td>Problem Solving Skills</td>
</tr>
<tr>
<td>Independent Learning</td>
<td>End User Systems</td>
<td>Information Management Skills</td>
</tr>
<tr>
<td>Computer-Assisted Instruction</td>
<td>Microcomputer Basics</td>
<td>End User Searching</td>
</tr>
<tr>
<td>Computer-Based Clinical Decision Making</td>
<td>E-mail and Internet</td>
<td>Computer Literacy</td>
</tr>
<tr>
<td>End User Searching</td>
<td>Information Management</td>
<td>Critical Use of the Literature</td>
</tr>
<tr>
<td>Medical Informatics</td>
<td>Critical Appraisal</td>
<td>Quality Patient Care</td>
</tr>
</tbody>
</table>

Figure 1. The educational role of the health sciences librarian

Health sciences librarians are responding to the challenges for new educational roles by providing a wide variety of formal and informal instructional programs. Librarians are teaching information management, microcomputer basics, software packages, telecommunications, database searching, Internet access, research methods, and other related topics. Also, librarians are spending more time one-on-one with library clients who are wanting to use the latest technology to answer their questions. Education is becoming a central function in many libraries, a function that demands new skills and discipline awareness.

Changing Models for Education in the Health Sciences

"Lifelong learning," "problem-based learning," "independent study," "information literacy," and "medical informatics" have
become commonplace terms in health sciences educational institutions. These terms reflect not only changes in educators' thinking but also in the recommendations from special commissions and accrediting bodies. Because the size of the health sciences knowledge base is growing exponentially, the traditional lecture and memorization format is becoming increasingly inadequate to prepare health sciences professionals for their careers. The new educational processes recognize that there is too much information in biomedicine to learn in a short period of time. Since the half-life of much of this information is about five years, learning must continue throughout professional careers. Experts in health sciences fields—including medicine, pharmacy, dentistry, and nursing—have called for educational reform in order to better prepare health professionals for the twenty-first century. Two reforms in particular are greatly affecting the role of the librarian: changes in the curriculum requiring students to learn information retrieval and management skills, and the new emphasis throughout the curriculum encouraging the acquisition of lifelong learning skills.

Undergraduate Health Sciences Education

In response to a perceived need for change in health sciences education, an increasing number of programs, both in the United States and internationally, have introduced problem-based learning (PBL), independent study, and informatics into teaching programs. Many of the recent changes in medical education have their philosophical roots in the 1984 publication of the Association of American Medical Colleges (AAMC) entitled Physicians for the Twenty-First Century (Report of the Panel on the General Professional Education of the Physician [GPEP] and College Preparation for Medicine) (Association of American Medical Colleges, 1984). The GPEP report addressed the full spectrum of undergraduate medical education. The report emphasized that information skills are fundamental for effective patient management, both in the collection and analysis of data for patient care and in the critical appraisal and synthesis of information from the published literature. However, as John Cooper, then president of the AAMC, stated in the report's conclusion: "Perhaps the most important concept emanating from this study is that medical students must be prepared to learn throughout their professional lives. This learning must be self-directed, active and independent" (p. 34).

A subsequent AAMC report, Medical Education in the Information Age (Association of American Medical Colleges, 1986),
responded to another AAMC concern: organizing and accessing the scientific knowledge base in an effective and timely manner to support research, patient care, and education. This report recommended that:

Medical informatics should become an integral part of the medical curriculum. The challenge to medical schools will be to make students literate in the specialized area of medical computing. At a minimum, this means use of bibliographic retrieval systems, consideration of alternative techniques in computer storage of clinical information, exposure to clinical databases and decision support systems, and explicit consideration of problem-solving and decision-making techniques. (p. 4)

The recommendations contained in both AAMC reports reflect the growing awareness that a fundamental change in educational content and teaching methods is necessary to prepare medical students for practice in today's dynamic health care environment.

Educational reform is occurring in other health sciences disciplines as well. Many nursing programs are experimenting with problem-based learning and, at the University of Calgary, for example, faculty are advocating that nursing informatics be taught to both faculty and students (Hannah, 1988). Pharmacy education and dentistry programs, such as those at the University of Missouri—Kansas City (Reed, 1990), are moving to PBL curricula. Physical therapy educators are also experimenting with PBL and evaluating its benefits (Van Langenberghe, 1988). The Pew Commission summarized the call for changes in all health professional schools in *Healthy America: Practitioners for 2005* (Shugars et al., 1991). This report emphasized competencies which must be taught to prepare practitioners to function in the present health care environment, among them the use of appropriate technology and the maintenance of professional competency throughout one's practice life (Shugars et al., 1991).

**Continuing Education**

Because of the focus on lifelong learning in the health sciences, continuing education* (CE) is recognized as an important part of the educational continuum. In a rapidly changing health care environment where expectations, even in the smallest communities, are for a national standard of care, CE for physicians and other health professionals is essential. Since the 1960s, a growing number of states, as well as physician, nurse, and other health professionals' specialty associations (including the Medical Library Association) and licensing boards, have required regular CE. The result has been a growing market of CE offerings. While appropriate roles for commercial, academic, and other sponsors of CE are still being sorted

*Abbreviated as CME for physicians and CE for other health professionals; for purposes of this article, the abbreviation CE is used for both categories.*
out, health professionals are nonetheless the beneficiaries of a multitude of CE opportunities.

Many continuing education offerings still center around courses and conferences, but there is a trend toward a more sophisticated approach to CE for the health professional. Principles of adult education are being used to differentiate types of learning needs, identify appropriate educational strategies, provide for active rather than passive learning, tailor the content to the needs of the practitioner, and evaluate outcomes (Davis et al., 1992).

The changing milieu of continuing education emphasizes bringing information to the practitioner and teaching at the point of need. This philosophy has encouraged innovative approaches. One of the earliest of these efforts was the establishment in the 1970s of the AHECs (Area Health Education Centers) by the federal government. The AHEC program's goal is to help minimize shortages and maldistribution of health care personnel by improving educational and collegial services in isolated and medically underserved areas. AHECs typically are developed through partnerships between universities and local communities and generally have been successful in decentralizing health professional training and CE programs (Fowkes et al., 1991). Health sciences librarians have played a prominent role in the AHECs.

Other new methods of continuing education include educational programs broadcast through the hospital satellite network and teleconferencing courses delivered by state hospital associations. Computer-based CE has been an option for some time; it has been used most successfully with nonphysician groups as individualized programs for workstations and occasionally as the means for teleconferencing and formal course offerings (Oeffinger et al., 1992; Tempus Consortium..., 1992). Consultation and library services have been integrated into the CE process through such efforts as the University of Alabama's MIST (Medical Information System via Telephone) service (Holt & Crawford, 1992), the University of Calgary's MIS (Medical Information System) system (Jennett et al., 1990), and experimental telemedicine projects such as that pioneered by Texas Tech's MEDNET project (U.S. Congress, Office of Technology Assessment, 1991).

Because it is individualized and often targeted to a need, professional reading is one of the most important methods of continuing education. The King and Rochester studies documented the direct effects of literature on patient care management (King, 1987; Marshall, 1992). Several recent proposals have been made to incorporate the literature more closely into professional CE (Williamson et al., 1991; Manning & DeBakey, 1987). A perennial
difficulty in formalizing credit for CE has been evaluation. A few efforts have been made in this regard, such as a report from British Columbia where delivery of individualized CE through group offerings was considered unsuccessful for rural isolated physicians when compared to a visiting librarian program and direct access to MEDLINE (Craig et al., 1992).

The future of continuing education involves a coalition of educators, discipline specialists, librarians, and innovative technological applications to focus on individualized practice-centered educational needs. It will require a team approach to arrive at creative meaningful solutions for continuing education in the health sciences.

NEW TECHNOLOGY AND MEDICAL INFORMATICS

A second major influence on the educational role of the health sciences librarian has been recent technological advances and the application of technology to manage the growing amount of health sciences information. Literature searching has evolved from mediated online searching to a diversity of end-user search approaches; library automation has advanced from home-grown mainframe catalog and circulation systems to complex vendor-supplied integrated library systems; the microcomputer and its applications programs have allowed individuals to have extensive power over the management of personal information. The widespread use of the Internet and the promise of the National Research and Education Network (NREN) are transforming the world of scholarly communications and allowing disparate systems throughout the world to be linked. New technologies, including telefacsimile, are replacing the transfer of documents through the mail. Multimedia systems are available in libraries and learning resource centers, and the electronic journal is finally here with all of its implications. All these technologies, each with new parameters for information management, represent additional teaching opportunities for the health sciences librarian.

Medicine, too, has been undergoing its own technological revolution. One area which affects the health sciences library is medical informatics. Medical informatics encompasses a developing body of knowledge and techniques concerning the management of medical information through applied technology. It includes bibliographic retrieval systems, decision support systems, medical information systems such as hospital management systems, research support systems, and computer-based education systems. At Erasmus University in The Netherlands, medical informatics is integrated progressively into the four years of the medical school curriculum (van Bemmel et al., 1989).

Interest in the field of medical informatics, as well as the National Library of Medicine's promotion of its Integrated Academic Information Management Systems (IAIMS) initiative in the 1980s,
has brought information issues to the forefront in many health sciences institutions. Libraries in these institutions have been positioned to act as partners in institutional-wide efforts to organize and provide access to a variety of information resources. An early example of this partnership was described in a position paper on the goals and responsibilities of the health sciences libraries within the framework of the university's changing perception of information management (Walter et al., 1984). Expanded educational roles have been a by-product of almost all academic environments where information management has been addressed at an institutional level. The result has been increased opportunities for librarians to be more closely involved with the curriculum and to be major players in the introduction of technological innovations on campus. Libraries in these institutions typically offer a rich array of instructional opportunities.

**Library Educational Programs**

Institutions using new technologies and employing new educational models and values create many opportunities for libraries to participate in educational activities for students and health care practitioners. The old focus on teaching the use of the library as a facility has expanded to include teaching access to the literature and other information resources; teaching the use of technology as a means to access, organize, and manage information; and teaching skills in critical appraisal of the literature.

Because today, more than ever, health sciences librarians' teaching roles are closely tied to institutional missions and curricular opportunities, the content and methods of instruction are tremendously varied among health sciences libraries. Most health sciences faculty and students agree, however, that there is need for instruction in information skills. The DaRosa et al. study (1983) highlighted the fact that students and practitioners have demonstrated only limited skills in accessing library resources. As recently as the mid-1980s, many medical students were still not using MEDLINE as a method for accessing the literature (Kaluzsa, 1985).

Most librarians believe that an increase in information skills training will change the information use behavior of health sciences students and practitioners. While such training generates increased responsibilities for health sciences librarians, recent reports of results are encouraging. Schwartz and Schwartz (1992) found that unrestricted access to MEDLINE and training in its use resulted in 96 percent of clerkship students using MEDLINE to prepare a pediatrics thesis. After a year-long evaluation study, Hennessey and colleagues (1992) concluded that computer literature search training should be an
integral part of an internal medicine clerkship. There also is some evidence that these educational programs may convey long-term benefits, as reported by Ikeda and Schwartz (1992) in their follow-up study of pharmacy students. However, more research is needed to investigate the relationships among library-based instructional programs, use of the literature by practitioners, lifelong learning, and the behavioral changes which may ultimately affect patient care.

What Librarians Are Teaching

The fundamental elements of educational programs in library use are in place at most health sciences libraries. Formal orientation almost always is provided to new students. These sessions generally introduce students to library services and provide an overview of the structure of the literature. Orientation may differentiate among the types of information to be found in textbooks, journals, and other resources. Introductory tours of health sciences libraries may be live or via videotape or audiotape. In addition to orientation for students, new staff and faculty are introduced to the library through a variety of methods including presentations incorporated in routine institutional orientations for new employees, or individualized orientation and handbooks.

Because of the availability of CD-ROM reference sources, in-house databases, and end-user MEDLINE interfaces such as GRATEFUL MED, much effort in library instruction centers on teaching computer searching skills. These courses are tailored for students and practitioners. Instruction in accessing the literature almost always includes teaching the basics of Index Medicus' MeSH (Medical Subject Headings), the structure of search logic and use of Boolean operators, and fundamental searching skills and techniques. Even the smallest health sciences libraries generally offer several end-user interfaces for the MEDLINE database so that instruction in searching techniques has become quite complex. Instructional formats vary from brief compact overviews to more in-depth courses. At the University of Rochester, a basic searching curriculum has been divided into modules so that the material can be presented in courses as needed and in time periods ranging from eight to twenty hours (Sollenberger & Smith, 1987).

In addition to this baseline instruction in information access, health sciences librarians also are providing an impressive array of other educational activities. Because the emphasis on independent learning has encouraged use of computer-assisted instruction (CAI), computer-based question banks for self-assessment, and other audiovisual and computer-based learning tools, many academic health sciences libraries operate microcomputer learning centers. Inherent
in the management of these centers is an expanded instructional role. Microcomputer learning centers typically offer regular instruction in basic and advanced use of microcomputer operating systems, word processing, bibliographic management software, graphics and statistics packages, local electronic mail, and Internet. In addition, training is provided in use of curriculum-related instructional programs. A comprehensive microcomputer course at Northwestern University begins with introductory material and, responding to an overall goal of teaching information management principles, progresses through a number of software applications including decision support systems and patient management software (Tawyea & Shedlock, 1986). As Ellis and Hannigan (1986) pointed out in their discussion of computer learning centers, hardware upgrades and new software releases, as well as an increasing number of products and vendors, complicate management and instructional activities in these centers.

Instruction in literature searching and microcomputer applications focuses on the acquisition of techniques and skills. Responding to the educational principles articulated in the GPEP report, some health sciences librarians also teach the structure and organization of biomedical knowledge and the storage, retrieval, and assessment of information for patient care and clinical decision making. These knowledge domains require understanding of the management of information and application of critical appraisal skills to the published literature. Information management, typically presented as organization of personal reprint files and bibliographies, requires both conceptual and technical organization of the literature. While more traditional courses examine the benefits and drawbacks to various nomenclature and vocabulary systems such as the International Classification of Diseases and MeSH, other courses spend more time introducing the variety of bibliographic management software now available. With the new software packages, retrieval is simplified yet they allow multiple points of access.

Critical appraisal skills enable students and practitioners to sift through the large amount of health sciences literature to identify published reports that are scientifically valid and relevant. These skills may be acquired by students as part of epidemiology or biostatistics courses or during a clinical clerkship. The integration of literature retrieval and critical appraisal skills was effectively achieved in a course presented by the Department of Medicine and the library faculty at the University of Illinois at Peoria (Dorsch et al., 1990).

Timing of the Instruction

While most health sciences libraries share broad educational goals, each library's actual instructional activities may be quite
different. Librarians at Ohio State developed elective mini-module courses for second-year medical students which could be tailored to students' interests (Bradigan & Mularski, 1989). An innovative series of electives at Texas Tech address a range of information management issues (Moore, 1989). A long-standing model of successful library education is the information skills curriculum at the University of Tennessee—Memphis. This program is integrated into the regular medical school curriculum and provides sequential learning opportunities in each of the four years (Graves & Selig, 1986).

The most effective library instruction is coordinated with other educational programs and integrated into the curriculum. In this approach, the relevance of the library instruction is clear to the students. Emphasis can be placed on problem-solving strategies in addition to actual information-seeking skills. Also, retention of information methods is improved because the application is associated with a "teachable moment." Librarians at the University of Miami School of Medicine, in collaboration with medical school faculty, applied these principles in the development of an information skills instruction continuum which is part of the freshman and sophomore curriculum (Burrows et al., 1989).

Because effective access to drug information is critical to the field, pharmacy education has a tradition of strong bibliographic instruction that is well integrated into the curriculum. Wood described the library's active role in the pharmacy curriculum at the University of California—Los Angeles where information skills instruction becomes increasingly complex as it is developed through the four-year curriculum (Wood et al., 1990). In a problem-based learning medical curriculum, instruction in information skills may be incorporated in tutorial settings. At the University of New Mexico, library instruction is provided through a problem-based methodology; at other PBL schools, specific problems within the regular sequence of learning may have acquiring library skills as a primary learning objective.

As the trend toward greater integration of information skills instruction into the regular curriculum continues, several observations can be made about the role of the health sciences librarian in the academic health sciences library. Instructional opportunities are increasing for health sciences librarians. The educational programs which seem most effective are those taught at the point of need; that is, they capitalize on the "teachable moment." This teachable moment almost always occurs within the context of the curriculum. The trend in library education programs toward greater collaboration with discipline experts is a promising one. Taken to the extreme, the librarian trains the discipline expert who then conveys
the library educational content to the students. This, however, is a costly solution unlikely to be adopted by many institutions. A more practical approach places the librarian as a partner on the teaching team, an effective position from which to convey the value of information services in the health sciences.

Teaching in the Practice Milieu

Although located in a setting quite different from the academic center, the hospital librarian also has many teaching opportunities that correspond with the numerous constituencies within the hospital. In addition to permanent employees—including medical staff, administration, and allied health personnel—teaching hospitals traditionally sponsor third and fourth year medical student clerkships and electives, and medical residency programs. Many hospitals also have clinical experiences available for students in pharmacy, occupational and physical therapy, and other allied health programs. Some hospitals still sponsor nursing schools or have an affiliation with a university-based program in nursing. To function effectively, the hospital librarian must maintain close communications with the hospital's clinical staff, administrators, and educators. The challenge to the hospital librarian is to balance responsibilities for meeting the immediate information needs supporting clinical decision-making with the educational requirements of students and practitioners and the new opportunities for expanding the librarian's role within the hospital.

In addition to providing information for direct patient care in a fast and efficient manner, the traditional role for the hospital librarian has been to offer educational support services for students and practitioners. Formal hospital library educational programs have focused on orientation and instruction in the use of bibliographic tools. Established programs such as LATCH (Literature Attached to Charts) and clinical medical librarianship, described in Marshall's article in this issue of Library Trends, were designed to meet the critical education and information needs of physicians and residents. As a participant in these programs, the librarian functions as a central member of the health care team integrating information services into both the patient care and educational activities of the hospital. More recently, hospital librarians began offering classes on end-user searching of the literature and microcomputer hardware and software operations as well as providing individualized tutorials in these areas.

Continuing Medical Education

Hospital librarians take an active role in formal CE programs by providing library clients with tapes and satellite broadcasts
approved for continuing education credit. Simply by making information accessible and responding to information requests, librarians are contributing informally to the clinicians' continuing education. A recent trend toward implementing total quality management (TQM) or continuous quality improvement (CQI) in U.S. hospitals is providing librarians with a unique opportunity to contribute to the quality process as well as continuing education according to Chris Jones (1992). Jones maintains that the literature, when provided in response to an identified need or unfamiliar situation, is recognized as an effective educational tool which can improve practitioners' performance. Improved practitioner performance is a central part of continuous quality improvement and results in enhanced patient care. The hospital librarian's role in the quality process is to work with others on the health care team to provide a continuous infusion of current literature into the organization. The librarian on the CQI team provides the intellectual linkage of information sources and packages the information in response to an expressed or unexpressed need. In this proactive manner, "the librarian is communicating state-of-the-art information to practitioners as they update their practice patterns" (p. 2).

In their article on the changing paradigm for continuing education, Leist and Kristofco (1990) advocate librarians implementing a literature selection and synthesis role and making decisions about the information clinicians might need. The authors also state that library information requests can be analyzed to determine needs for formal CE programming. By adopting a proactive stance, librarians become learning consultants for physicians, acting as guides and instructors for access to information and information technology.

Patient Education

Expanding their educational roles to that of learning consultant, many hospital librarians also are becoming providers of patient and consumer health information. Hospitals are recognizing the need to provide patients and the community with health information and are establishing patient information centers within the hospital. Hospital administrators know that providing this service not only benefits the community but also attracts patients. Providing education and information services to patients requires developing collections and services specifically for patients either within the hospital library or by developing a separate patient education library or resource center. Patient education services include providing pamphlets,
articles, or audiovisual information directly to patients; selecting and scheduling audiovisual programs for general broadcasts; and providing support for patient education departments and committees.

Outreach

Hospital librarians in larger centers may provide outreach services to small hospitals without access to information services and to underserved or isolated health care practitioners. Outreach responsibilities can be the result of institutional ties through hospital management corporations or may be implemented to establish or reinforce patient referral patterns. Hospitals affiliated with Area Health Education Centers or large hospitals surrounded by less populated areas also provide library and educational outreach services to small and isolated hospitals and clinics. Services vary according to the region. Librarians may ride "circuits," making regular visits to hospitals without access to information services, or they may act as consultants when needed. Their "home base" library acts as a resource center for the smaller institutions. Outreach librarians assume an important teaching role, one that is often overlooked. They must not only teach the staff of small hospitals how to use information sources and services, but often they must promote the value of information services to hospital administrators and medical staff.

Technology has provided an important communications vehicle for outreach services. Library-sponsored information networks that offer rural practitioners dial access services to a computer-based information system provide end-users with fast access to information. An early example is GaIN (Georgia Interactive Network for Medical Information), which was developed in response to the need to provide rural practitioners with medical information (Rankin et al., 1987). In recognition of the effectiveness of professional literature in meeting individualized CE needs at the "teachable moment," practitioner use of GaIN MEDLINE, as well as other GaIN functions, qualifies for CE credit. A variety of GaIN services support educational needs of the practitioner including GaIN MEDLINE, the online catalog of network libraries, the CE bulletin boards and current alert services, electronic mail and conferencing, and others. This kind of applied technology brings the value of information and educational services directly into the office or small hospital which cannot support these programs at the local level.

In these times of economic retrenchment when traditional library services are coming under increasing scrutiny by hospital administrators, hospital librarians are assuming greater teaching responsibilities to integrate their services more fully into the life of
the hospital. It is sometimes difficult to separate the teaching role of the hospital librarian from the information provider, learning consultant, patient information provider, or outreach services roles. Within each of these roles, there is an element of teaching, not necessarily in a formal educational setting but always tailored to the needs of the constituency being served.

RESPONDING TO THE CHALLENGE

Certainly advances in technology and the institutional-wide focus on information management have given health sciences librarians opportunities to take a more central role in the educational process. Also, because the curriculum revision models such as problem-based learning and independent study rely heavily on effective use of information resources, librarians have additional opportunities to exert their leadership in education.

During the past twenty years, libraries have evolved along with the technological revolution into centers of information exchange. Librarians today are guides to a growing number of complex electronic and print resources; they are teachers of information structure and access; they often are leaders of technological change within their institutions. Librarians are reaching beyond the boundaries of the library to anticipate needed services and provide information when and where it is needed.

Appropriate teaching roles for health sciences librarians are becoming more diverse and closely tied to institutional needs and priorities. In order to accomplish the changes necessary to meet the challenge of an expanded educational role, The Association of Academic Health Science Library Directors (AAHSLD), in their publication Challenge to Action: Planning and Evaluation Guidelines for Academic Health Sciences Libraries (Joint Task Force..., 1987), recommended assuring that the library's mission statement reflect the educational priorities for the institution, integrating the library's educational activities into the curriculum, expanding educational databases to off-site locations, and designing programs which reflect changes in technology, among others.

The new challenges require librarians to be involved in the "people" business; good communication skills are critical in order to teach and to relate to numerous and varied constituencies. In a service industry within the information society, librarians' expertise is becoming more highly valued and sought. Within health sciences, librarians are playing an increasingly important role as members of the health care team, and, within academic institutions, as faculty members.
To respond to the challenges, librarians should continually update their skills, learning as much as possible about new technologies, new educational theories, and advances in the health care field. Also, by being innovative, by incorporating ideas from other disciplines into their work, by trying new ideas, librarians can move away from a reactive mode and adopt a more successful proactive stance. As educators, librarians need to anticipate instructional needs, look for the "teachable moments," work with other professionals to provide effective learning experiences for students and practitioners, and find opportunities to integrate library education into existing curricula and hospital practices and procedures. A librarian who can face uncertainty and challenge will not only adapt to the changes presented by the current environment but will succeed as an effective information provider and educator.

REFERENCES


Library Services and Health Care Administration

HOLLY SHIPP BUCHANAN

ABSTRACT
This article reviews the progress made in meeting the information needs of health care administrators within a health care environment that is continuing to undergo major changes. Health care economics, a shifting power structure within the industry, and quality improvement initiatives are discussed in light of their shaping of the health care environment. Also discussed are the library's role in providing information for administrative decision making, how that role has been communicated to administrators, and the partnerships between health care librarians and administrators that can ensue. Future research needs are identified including: (1) improving the understanding of the administrator's information needs; (2) identifying their information-seeking and using patterns; (3) developing specialized services to meet these needs; and (4) developing indicators to measure the provision of quality library services.

INTRODUCTION
The health care industry and the libraries operating within it have changed significantly over the past twenty years. Change is not always synonymous with progress as the following exchange illustrates: "'But, my dear,' said the Hatter, 'Was there progress?' 'Well,' said Alice earnestly, 'There was change'" (Dunkin, 1968, p. 367). This article will focus on the progress made in providing library services to health care administrators. The 1970s were years of
collaboration, expansion, and diversification in the health care industry. As resources shrank in the 1980s, competition for patients accelerated and the number of multihospital systems increased. Meanwhile, health care costs skyrocketed in spite of voluntary as well as federal regulatory initiatives such as the prospective payment system (PPS). At the same time, hospitals came under fire from consumers and accrediting agencies for declining quality. In response, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) initiated, in 1986, a move toward continuous quality improvement which was called the Agenda for Change.

These developments set the stage for a fundamental change in the structure, funding, and management of health care. According to a Harris Poll, ninety percent of Americans now believe that the U.S. health care system should be restructured (Healthcare Forum Leadership Center, 1992). Controlling costs while at the same time expanding access to affordable health care was a major platform in federal and state political campaigns of the early 1990s. The winner of the 1992 presidential election pledged to make sweeping reforms in the health care industry (Clinton, 1992). How extensive these reforms may prove to be and when they will be implemented depends on many factors. One thing is clear. These changes, and their impact, will certainly affect the next twenty years of health sciences librarianship and services to health care administrators.

Because preparing for the future first requires examining the past, this article will review the health care administration environment of the past twenty years and the ways libraries sought to serve that environment. It will also identify emerging questions and new developments in the health care industry. Proactive health science librarians understand and are sensitive to these directions in order to focus clearly on future needs of health care administration. While librarians understand their fundamental role in clinical health care decisions, their understanding of administrative information needs is less clear. This article attempts to identify the issues associated with administrative information needs and encourages future research in that area. It may well be that specialized services such as those developed for clinicians are not needed by administrators. Yet health sciences librarians have an important commodity to offer; they just have to learn how to communicate its value to the health care system.

HEALTH CARE AND LIBRARY ENVIRONMENTS

Health care administrators are found in a wide range of settings and receive information services from many sources, including hospital and university libraries and the American Hospital Association (AHA). Other types of hospital associations also provide
library services to health care administrators and their organizations. Poole's (1982) survey of local, state, regional, and national hospital associations found at least twenty that offered some type of regular library services.

Since the majority of service to health care administrators is provided by the hospital library, basic descriptive data on hospital libraries may be helpful in understanding the context in which the librarian strives to serve the administration. In 1973, the American Medical Association identified 1,957 health sciences libraries in hospitals and 144 in other nonhospital, health care organizations (Crawford & Dandurand, 1974). The 1989 survey, conducted by the American Hospital Association Resource Center (1991) identified 2,167 U. S. hospitals (out of 6,853 registered in January 1990) with on-site libraries meeting the American National Standards Institute definition of a library: (1) organized collection; (2) trained staff; (3) established schedule when services are available; and (4) existence of appropriate physical facilities.

Since 1990, the AHA has collected data on libraries through its Annual Survey of Hospitals. Wakeley and Foster (1993) report on the AHA survey in the context of environmental issues facing hospitals in the 1990s and identify challenges and opportunities for hospital libraries. The 1991 annual survey reported 6,634 registered hospitals and 2,602 libraries—39.2 percent (American Hospital Association [AHA], 1992). Although longitudinal comparisons are not possible with the above surveys, the 1989 AHA survey provides a snapshot of hospital libraries. The Survey of Health Sciences Libraries in Hospitals, 1989: Executive Summary (American Hospital Association Resource Center, 1991) includes various facts about the hospital library respondents. Table 1 provides a selective list of data. Of particular note is the fact that almost all respondents identified administrators as a user group for the library.

### Table 1
**Selected Characteristics of Hospital Libraries—1989**

- 69.3% are separate departments
- 53.7% of library managers have a master's degree in library/information science
- 77.8% reported increases in use of services
- 57.2% reported budget increases
- 13.3% reported staffing increases (71.7% reported no change)
- 50% reported square footage of 1,083 sq. ft. or less; the largest number of respondents clustered between 2,000-3,000 sq. ft.
- 98.4% are used by administrative staff, 98.8% by technical staff, and 95% by other hospital personnel
- 34.1% formally participate in the institution's quality assurance program

Over the years, various regional surveys, typically funded through the National Library of Medicine's National Network of Libraries of Medicine, have described changes in libraries serving health care administrators (Van Toll & Calhoun, 1985; Glitz et al., 1992). Review of several of these survey reports will provide the reader with additional insight into the change associated with hospital libraries.

Economic pressures have affected hospital libraries in various ways. The development of cooperative relationships, such as library consortia, was considered a positive trend of the 1970s (West Suburban Hospital Association, 1975). The long-term effects on hospital libraries of the current economic retrenchment are not yet known. Several studies have investigated the short-term effects of these changes. Wos and Oddan (1987) surveyed multihospital systems formed from mergers, finding that of fifty-three respondents only one library was eliminated. Stevens (1990) surveyed Michigan hospital libraries to investigate changes in staff size and services between 1985 and 1988. Among the eighty-two respondents, total library full-time equivalent (FTE) employees decreased 6.1 percent.

Several key external factors have influenced the health care environment over the past twenty years and have affected how libraries provide services to their users, especially nonclinical users. Writing specifically about the development of hospital libraries, Wolfgram (1985) identified several environmental forces behind library trends: (1) government action; (2) scientific advances and the growth of publications; and (3) rising health care costs.

Librarians writing about the past twenty years consistently point to several driving forces that have influenced the development of health sciences libraries. Walker and Due (1986) credit the National Library of Medicine and its Regional Medical Library Program (now called the National Network of Libraries of Medicine), the Integrated Library System, the Integrated Academic Information Management System (IAIMS), and microcomputer technology. These influences have enabled health sciences librarians to respond to the environmental pressures transforming the health care industry by creating new ways to serve library users.

The use of the computer may have done more during the 1970s and 1980s to enhance the development of libraries within hospitals than any other trend. On-site MEDLINE and other databases provide access, even by small rural facilities, to resources found typically only in a large medical center library. The hospital librarian running a MEDLINE search was viewed as a highly trained professional at the leading edge of this new technology. "Overnight the librarian could contribute directly to the growth area in health care: the application of computers to medicine" (Hardy et al., 1985, p. 48).
More fundamental than the computer though is the concept of an integrated information system, called an Integrated Academic Information Management System by Matheson and Cooper (1982). In 1986, the Rhode Island Hospital became the first hospital library (and still the only one as of this writing) to be awarded an IAIMS grant by the National Library of Medicine. Klein (1989) reported on the use of existing technology to adapt the IAIMS concept to a hospital setting. Other implementation examples in hospitals are summarized by Buchanan and Fazzone (1985).

Within this issue of *Library Trends*, several chapters discuss these trends more fully. The reader is referred to the article by Weise for a review of the programs and initiatives of the National Library of Medicine and to the article by Roderer for a discussion of the IAIMS concept. Marshall, also in this issue, discusses the effect of these trends on the delivery of services to the health sciences library's other main client group, clinicians.

The factors identified earlier influenced library services to health care administration over the past twenty years. Currently, three major trends have emerged to shape health care for the next twenty years. These are health care economics, the shifting power structure within the health care industry, and the quality improvement movement.

**Health Care Economics**

Various authors have reviewed the historical antecedents for the U.S. government's involvement in health care, charting developments since World War II (Atkinson, 1987; Messerle, 1987). Based on the recent analysis by the American Hospital Association (1992) of trends affecting U.S. hospitals, it seems likely that economics will continue to shape the health care industry.

An article in *Newsweek* reported that health care expenditures have been greater than expenditures for defense since 1973. In 1992, the Pentagon's part of the Gross National Product (GNP) was 6 percent while health care had increased to 13 percent, the largest per capita share of any country in the world. In 1990, hospital spending roughly equaled the Pentagon's budget (Easterbrook, 1992).

Strategies to address the high cost of health care have included shifting the delivery of care to less costly delivery mechanisms and developing fee schedules for hospitals as well as physicians. Because hospitals account for the largest percentage of total health spending, initial cost controls have focused on ways to shift consumers' use of health care services to less expensive alternatives such as health maintenance organizations (HMOs) and preferred provider organizations (PPOs). By 1990, 43 percent of employer-sponsored plans were either HMOs or PPOs (American Hospital Association, 1992).
An early strategy to control the rapid rise of hospital costs was the shift from retrospective reimbursement by third party payers to a prospective payment system. With implementation of PPS for inpatient Medicare patients in 1984, health care facilities were paid based on preapproved budgeted charges rather than on their actual costs of providing the service. Since physician services account for an increasing percentage of health spending, Medicare recently extended its prospective payment system to physicians. Under the resource-based relative-value scale (RBRVS) that became effective in January 1992, all physicians are paid by Medicare based on a national fee schedule. This funding change is projected to have a profound effect on academic medical centers and large tertiary care centers that have traditionally charged more for physician services in order to subsidize the cost of medical education and to compensate clinicians for the longer time that is required with more seriously ill patients (Sandrick, 1992).

Shifting Power Structure Within the Health Care Industry

Power shifts are underway throughout the health care industry, driven largely by conflicts over costs and quality. Messerle (1987) discusses the shift from physician power to growing administrative control. Holst (1991) suggested that it was the clinical rather than the administrative side of the dual authority found in hospitals that was generally responsible for the establishment of hospital libraries.

Other changes relate to the health care delivery system itself. The delivery point of health care is changing as a result of economic pressures. Hospitals are no longer the sole delivery point and health care administrators are no longer associated just with hospital settings. Today, growing numbers of administrators are found in diverse settings—HMOs, hospices, nursing homes, and home health care agencies. Yet hospitals remain the largest segment of the health care industry and retain the focus and the power. Although the number of hospital closings has slowed recently, 603 hospitals closed between 1980 through 1991 (Burda, 1992). In order to survive, however, hospitals began merging in the 1980s to form multihospital systems and, by 1990, 48 percent of all community hospitals were part of a multi-unit system (Johnson, 1992).

Quality

The third trend affecting the future is the health care industry's focus on quality. While this mirrors the current global emphasis on quality, health care organizations have a long tradition of concern with quality. This is partially a natural outgrowth of the search to improve health conditions. But the health care industry has also used self regulation to counteract consumer criticism of rising health
expenditures coupled with a perceived decline in quality. These quality initiatives have taken the form of national standards as well as initiatives at the local provider level.

Standards

Various forms of standards have affected libraries in hospitals and other types of provider organizations. A comprehensive list of organizations sponsoring standards and guidelines for hospital library services appeared in *Hospital Library Management* (Foster, 1983). The Medical Library Association (1984) also developed quantitative standards covering hospital libraries (these are currently under revision). Of all these organizations, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO; previously called Joint Commission on Accreditation of Hospitals—JCAH) has played the most influential and pivotal national role.

During the past twenty years, the role of the Joint Commission on Accreditation of Healthcare Organizations in the development and molding of hospital library services has been indirect but pervasive. The first hospital library standards developed by the commission in 1953 described library services as desirable rather than as a requirement for accreditation (Foster, 1983). In 1975, Koughan, a hospital administrator, remarked on the "unimpressive and virtually meaningless state of the current standard. It lacks both quality and substance" (p. 589). JCAHO standards for "Professional Library Service" have been strengthened since those of the early 1970s. Various actions by JCAHO have addressed Koughan's issues of quality and substance for hospital library standards (see Table 2).

<table>
<thead>
<tr>
<th>Year</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978</td>
<td>Accreditation manual included revised standards for hospital libraries</td>
</tr>
</tbody>
</table>
| 1989 | 1) Hospital library standard was identified as a key factor in the accreditation process  
  2) The on-site responsibility for surveying the library was transferred from the physician surveyor to the administrator surveyor |
| 1992 | Accreditation manual identified additional library standards as key factors in the accreditation process |
| 1993 | Standards added relating to patient and family education, staff training and education, and responsibilities of department directors |
| 1994 | New information management standards will become effective |

In 1978, revised standards for hospital libraries became effective, and the accreditation manual was revised accordingly. Among the substantive changes was the definition of a qualified medical librarian. In the 1980s, various steps were taken within the profession
to expand JCAHO's knowledge of the role of the hospital library and to open formal communication channels between JCAHO and the profession. As an example, the Medical Library Association (MLA) developed the "JCAH Guide to Professional Library Services for Surveyors" (1980). As an outgrowth of MLA's strategic plan, collaboration with various external agencies was emphasized and responsibility for standards was placed with each special interest section. The Hospital Library Section of MLA, supported by the MLA headquarters, developed strong proactive linkages with JCAHO (Medical Library Association, 1987).

In 1989, the hospital library standard was identified as a key factor in JCAHO's accreditation process and the on-site responsibility for surveying the library was transferred from the physician surveyor to the administrator surveyor. This was followed in 1992 by changes in the accreditation manual that targeted additional library standards as key factors in the accreditation process. Although not exclusive to the library, new JCAHO standards added in 1993 have the potential to affect library services and relate to patient and family education, staff training and education, and responsibilities of department directors.

An outgrowth of MLA's continued proactive communication was an invitation by JCAHO to participate with representatives from the medical records and information systems disciplines in designing new accreditation standards. The information management standards will become effective in 1994 (Doyle, 1993). Koughan stated in 1975 that standards serve as an indicator to the hospital administrator of the relative importance of a hospital service. The projected 1994 standard is the culmination of a series of accreditation changes that have affected hospital libraries over the past twenty years. The 1994 standard will change profoundly how hospital administrators perceive the library during the next twenty years. Jones (1991) has provided an overview of these changes and defined the librarian's potential contribution to quality improvement.

While JCAHO standards have continued to emphasize the role of the library in serving clinical and administrative decision making, others have not. The other major standard that affected libraries since the 1970s was that of the Health Care Financing Administration (HCFA) which regulates Medicare and Medicaid funding. Since 1966, hospitals seeking Medicare/Medicaid funding were required to maintain a medical library to meet the needs of the hospital. Despite protest from various health care groups, including librarians, HCFA eliminated that requirement in its 1986 regulations (Health Care Financing Association, 1986). Individual states are now free to reduce or eliminate similar library requirements. Most librarians have
recognized that the quality indications needed to measure information services go well beyond a requirement based on physical facilities. Still, the potential impact of the regulation change may be substantial in those organizations where health care administrators have not understood the added value the library contributes to the organization's bottom line.

**Local Quality Improvement Initiatives**

Beginning in the 1980s, the health care industry began to investigate the use of quality improvement processes found in manufacturing and the military, often called total quality management (TQM). This search was intensified when the Joint Commission on Accreditation of Healthcare Organizations announced its Agenda for Change and outlined a philosophy of continuous quality improvement (CQI). As an additional encouragement of the quality movement, the first national health care award for quality, the Healthcare Forum/Witt Award, was presented in 1988. By 1992, in a survey published in *Hospitals*, almost 60 percent of responding hospital chief executive officers reported having TQM/CQI programs in operation. Seventy-five percent of those who had not implemented TQM/CQI programs indicated an intention to begin one within a year (Grayson, 1992).

While various definitions and versions of TQM and CQI exist, several common components are typically found. Included are a customer focus, continuous improvement using data and facts, and employee empowerment or involvement in decision making, often in teams. It is the continuous improvement aspect that emphasizes an information management process. The process is information intensive, forcing managers and employees alike to collect, compare, and monitor information relating to key organizational processes. Library managers within such a quality improvement environment have recognized this opportunity to position the library as an integral part of the health care information management process needed to support the institution's quality improvement processes. The next section will discuss specifically the library's role and value in providing services to health care administrators.

**The Library's Role and Value**

The role and value of the hospital library has been discussed in general in a wide range of sources since 1974, primarily from the management perspective. Representative are MLA's *Hospital Library Management* (Bradley et al., 1983) and the guide published by the Midwest Health Science Library Network, *Basic Library Management for Health Science Librarians* (Wakeley & May, 1982). Most of these
texts have recognized parallel lines of authority within the health care institution.

Holst (1991) described the outcome of dual lines of authority (medical staff versus administration): "Variations aside, it is safe to conclude that hospital libraries owe their origins to the clinical side of the equation" (p. 3). These roots of origin help to explain why libraries have rarely developed specialized services for the other side of the equation.

According to Langner (1974), one of the distinguishing characteristics of health sciences libraries is their emphasis on personalized assistance to library users. She recognized that these types of services were "especially evident in clinical areas where emergency 'spoon-fed' service was offered to busy practitioners in their patient care activities" (p. 14). The 1974 Library Trends issue that emphasized health sciences libraries recognized the shifts in funding support and authority governing health sciences libraries and the broadening user base in health care libraries (Brodman, 1974). Publications prior to that, while acknowledging that the library is used by a variety of users, emphasized the physician user (Cunningham, 1943).

The first edition of Hospital Library Management, published in 1983, recognized the need for hospitals to provide a variety of information services needed by the hospital in all aspects of its organizational operation. Providing total information services, however, means extending the standard library services beyond the subject matter of the health sciences to include any information needed by hospital personnel in the performance of their jobs. (Bradley, 1983, p. x)

Librarians extending services to health care administrators have been enabled by the American Hospital Association in accomplishing the above purpose. A number of services and products targeting the information needs of health care administration have been developed by the American Hospital Association and its Resource Center.

The Resource Center provides a wide range of services and products to administrators and to the health sciences libraries that serve them, including reference and referral services and document delivery. Most notable of its accomplishments is the production, in cooperation with the National Library of Medicine, of the Health Planning and Administration database (HEALTH), introduced in 1978, and the publication since 1945 of the Hospital Literature Index, a quarterly author-subject index to the periodical literature of health care administration. Access to HEALTH enhanced the librarian's ability to respond quickly to administrative information requests with an impact similar to that of moving from Index Medicus to MEDLINE for clinical questions.
Staff of the Resource Center have also prepared for administrators a list of resources to use in planning information services. The guide covers standards, organizing services, innovative and specialized services, collections, and facilities (Wakeley et al., 1985). Publications to aid in the development of health care administration collections have also been prepared (Kiger, 1985; American Hospital Association Resource Center, 1989). In addition to its current comprehensive collection of materials in the field of health services administration, the Resource Center also offers historical materials through its Center for Hospital and Healthcare Administration History.

Although a few reports have occurred in the literature or in presentations at professional conferences, the development of specialized services for health care administration has been largely ignored during the past twenty years. Few specialized services, comparable to those offered to clinicians (e.g., clinical medical librarianship, LATCH, and GRATEFUL MED), have been designed for busy health care administrators. All too often, products and services have been simply an extension of traditional general health sciences library services. Promotion of health science library services to health care administrators has focused on selective dissemination of information (SDI) or expanding the clinical collection to include health care administration. Health science libraries are beginning to realize this should change.

Communicating the Role and Value of Library Services

Serving a diverse user population, including administration users, requires developing multiple communication channels to carry the message of the library’s role. Logsdon (1970) acknowledges that: "One of the very special aspects of librarianship in relation to users of libraries is that almost every user very soon considers himself an expert fully capable of running the show better than the establishment” (p. 2873). In addition, most students in a master's program in health care administration (MHA) do not learn about the health science library and its role in clinical and administrative decision making; training and education of staff; patient or consumer health services; and recruitment of new physicians to the medical staff. In addition, most texts to which administrators might refer, such as Goldberg and Buttaro's 1990 text, Hospital Departmental Profiles, are all too often silent about the library.

In this lack of awareness lies an opportunity. Usually the librarian and library department are seen as "low risk.” Assertive but tactful librarians have helped these "novice" administrators become knowledgeable about how health care organizations work. One
administrator has been direct and asked the hospital librarian to "help me not look stupid." To do this, the librarian had to understand the viewpoint of the health care administrator and that the administrator is in a high risk role. Seeing the organization through the administrator's eyes has helped librarians to find better ways to communicate the benefits of the library. When that happens, administrators begin to understand the library's role in keeping the organization in business, "the timeliness of their service creates the advantage I need to effectively communicate with various publics such as vendors, physicians, and senior managers" (Margaret Sullivan quoted in Teschke, 1990). Strong administrative support and respect is evident in those situations where a working partnership has emerged between the administrator and the librarian.

The development of partnerships between librarians and health care administrators has been inhibited for several reasons. First, in some ways librarians seem to be afraid of administrators. According to White (1989), writing about the corporate political process:

Librarians are usually not participants in the corporate political arena but, like innocent bystanders at a bank holdup, they sometimes get shot in the process. Despite our frequently expressed paranoia, librarians do not have enemies in the corporate decision battles. They have no power base and, lacking this they are not considered important enough to attract enemies. They are the victims who do not control and, largely, do not even understand." (p. 146)

Fear inhibits the development of partnerships. Hospital librarians who view administrators as colleagues find it easier to develop partnerships with administrators—and be viewed as colleagues in turn (R. Ben-Shir, personal communication, June 1992). As an example, a case study profiling the partnership between the library staff and administration at MacNeal Hospital describes how together they tackled the issue of a new "off-campus" location for the library (LaRosa, 1992).

Second, failure to understand the information needs of administrators inhibits the development of partnerships. Three tools have improved knowledge of the health care environment, offering a framework for the development of specialized services. Librarians interested in understanding the context within which they operate might review AHA's annual environment assessment (American Hospital Association, 1993). The "News You Can Use" column appearing in National Network published by the Hospital Libraries Section of MLA, provides a summary of the latest articles dealing with issues affecting health care administrators and, therefore, librarians. Beginning in 1992, Medical Reference Services Quarterly began a special column targeting hospital and corporate information
services. Jajko (1992) explained that the column would focus on strategies for success and providing services to decision makers.

Developing and communicating partnerships between librarians and administrators requires placing librarians beyond the "operational box" in which librarians are commonly regarded. One program that addressed how to develop and communicate partnerships between librarians and administrators was produced by LaRosa (1992b) and funded by Mead Data Central, Inc. Entitled "The Information Partnership: Communicating with Upper Management," the educational videocassette was designed to help information professionals "in acquiring and sharpening the communication skills needed to win management support for information center programs and services." Techniques used by three special librarians for positioning, packaging, and presenting information are discussed.

A useful tool to aid the librarian in promoting the library's role and potential services is the American Hospital Association's (1991) management advisory, Library and Information Services. Profiled in the advisory is the library's role in management decisions in such areas as marketing, purchasing, and organizational restructuring. The advisory indicates that the "importance of library services to the hospital lies in the ability to cost-effectively identify information needs and provide timely access to relevant information in a useful format" (p. 1).

The JCAHO standards serve as another way to communicate the role of the library to administrators. However, as Koughan (1975) pointed out, to be effective (to get and keep the administrator's attention), good standards must be "coupled with careful public relations by the librarian" (p. 590).

Foster, Poole, and Wakeley (1987) have increased the role of the library as well as the administrator's awareness of the library by writing specifically to the administrator audience. Their chapter in Health Care Administration summarizes for the administrator reader the roles and complexities of the modern health sciences library. It also includes a list of additional readings which offers an indication of the depth and creativity of how libraries manage what the authors call the organization's corporate information assets. Although reaching administrators on both local and national levels has been a problem for librarians, several articles focusing on the services libraries provide to health care administrators have been published in administrative journals. Representative are those by Ben-Shir (1989) in Hospitals and Palmer (1991) in Hospital Topics. A series written by Buchanan and Englander (1990-1991) in HIMSS News (a publication of the AHA's Hospital Information Management and
Management Systems Society) targeted the health care information systems executive. Topics covered included library resources of interest to the society's membership, hospital applications of IAIMS concepts, and local area networks implemented in the hospital library.

In 1989, the director of the National Library of Medicine (NLM) communicated directly to hospital administrators to promote NLM's GRATEFUL MED and product (D. A. B. Lindberg, personal communication, November 2, 1989). This awakened hospital librarians to the need to communicate and promote directly to administrators the role and value of the library. Several audiovisual products are now available to do that. The MLA slide program, "The Library's Contribution to Quality: The Bottom Line," (Smith & Grossman, 1992) was designed specifically for use with various types of user groups, including administrators and hospital boards, to promote the role of the library in decision making. The National Library of Medicine sponsored satellite broadcasts on October 22 and November 5, 1992 that profiled the critical roles that health information professionals play in improving hospital quality and cost effectiveness. Health care administrators and physicians were the target audience. This four-hour program, produced by the Healthcare Informatics Telecom Network, Inc. (1992) is now available in a package that includes videocassettes, transcripts, and CME credit from the American Academy of Medical Administrators, American Medical Association, and the Medical Library Association.

Documentation is mounting on the library's value in clinical decisions. Similar studies on the information needs of health care administrators and the library's value or economic contribution to health care managerial decision making are available. Studies supported by the Special Libraries Association do document the role of the special librarian in managerial decision making. Three studies are based specifically on administrative perception of library services. Corporate Library Excellence (Matarazzo, 1990) profiles excellent corporate libraries nominated by chapters of the Special Libraries Association. Valuing Corporate Libraries (Matarazzo et al., 1990) presents the results of a survey of 164 companies in which evidence from corporate officials about the value of libraries and information centers was solicited. Marshall's 1992 study of Canadian bank managers studied the financial impact of providing information services to managers. These studies provide models for the health sciences community and point to the need for targeted studies on both the information needs of health care administrators as well as their perception about the value of library services to the health care organization.
The Library's Role in Continuous Quality Improvement

As librarians have recognized that the person on the other side of the administrative desk is a professional colleague faced with making complex high risk decisions, librarians have begun to demonstrate objectively the value of the library to the health care institution in all its facets. Ultimately, librarians have had to demonstrate the value of the library by getting results. The health care librarian has also begun to explain the library's contribution to quality patient care (Jones, 1991) and to corporate decision making. In addition, librarians are learning how to talk about value in ways that are meaningful to the administrator (Menzul, 1993).

One tool currently being adopted by manufacturing as well as health care is called the "cost of quality" (COQ) or "cost of poor quality" (Bemowski, 1992, p. 21). The cost of quality is generally defined as the cost of not doing something right the first time. Its costs are composed of three parts: (1) cost of conforming to customer requirements—sometimes called prevention and detection costs; (2) cost of nonconformance to customer requirements—otherwise known as failure costs; and (3) the cost of lost opportunities. The astute librarian will be able to state value in financial terms of what it will cost the institution not to have timely access to up-to-date information. As more and more hospitals implement total quality management or continuous quality improvement techniques, such tools as COQ will be used and demanded increasingly by the health care administration.

A second communication tool between the librarian and the health care administration is benchmarking. Benchmarking is defined as "the search for industry best practices that lead to superior performance" (Camp, 1989). The advice Koughan gave in 1975 is still pertinent: "An administrator cannot be coerced or clubbed into being interested in library activities by stringent standards or harassment by the librarian" (p. 590). But, because benchmarking is built upon facts that compare outcomes, processes, and costs (stated in terms the administrator can understand), the health sciences librarian may find it more useful than emotionalism in appealing to administrators. Although benchmarking typically is meant to compare processes, few sources of benchmarking data exist for libraries, much less health care libraries or their processes. Using White's (1991) analogy of "hewers of wood and drawers of water" (p. 52), most of the library data that are collected deal with the number of cords of wood cut or the number of pails of water drawn. The benchmarking data that are needed focus on processes and allow comparing how long it took to cut the wood or fill the pail of water.
Readers are referred to the annual statistics of the Association of Academic Health Sciences Library Directors (AAHSLD) (1992) for several examples of performance data that could be used for benchmarking comparison (e.g., gifts and endowments to total recurring expenditures; total collection use to volumes added). Fischer and Reel (1992) offer an example of how to collect customer focused data that can be used for internal and external benchmarking studies.

Without benchmark data, the health sciences librarian must revert to communicating descriptive statistics about libraries and library services. Throughout the library profession, research is needed to determine better generic indicators of the quality and value of library services that would be accepted by both librarians and the institutions they serve. Specific indicators are especially needed as well for libraries serving health care administrators.

THE FUTURE

Society's approach to health is changing as the mysteries of genetics and immunology unfold through developments in biotechnology (Goldsmith, 1992). The health care delivery system itself is changing. Futurist Leland Kaiser (1992) has projected numerous changes by the twenty-first century. Included in his list are: (1) an integrated health care campus with a planned patient care environment; (2) genetic engineering as a product line; (3) nanotechnology centers where noninvasive technology replaces invasive ones such as surgery and radiology; (4) usage of microrobotic computerized diagnosis and holographic imaging; (5) holistic high-touch health care; (6) emphasis on regenerative medicine; (7) focus on lifestyle changes to promote high-level wellness; (8) incorporation of psychoarchitecture into health care facilities design; and (9) virtual realities that influence patient care.

More economic pressures will come from various political levels. As an example, Weissburg and Conn (1992) identify trends in state legislative activity, including the addition of provider taxes, restrictions on self-referrals, and resurgence of cost containment mechanisms.

Within this context, the health care administration is also changing. A national study by the Healthcare Forum Leadership Center, "Bridging the Leadership Gap," has identified the leadership styles and skills that will be necessary in the administrator of the future (The Healthcare Forum Leadership Center, 1992). Key among these competencies are: (1) mastering change; (2) systems thinking; (3) shared vision; (4) continuous quality improvement; (5) redefining health care; and (6) serving public-community. The study also pointed out that the largest gap between current practice and future needs
was found in the areas of mastering change, systems thinking, and continuous quality improvement. These three areas are highly dependent on information and information management to enable the leadership transformation process.

These trends may profoundly affect how librarians feel about their work environment. Holst (1991), in her Janet Doe lecture at the Ninetieth Annual Meeting of the Medical Library Association, discussed reasons why librarians enjoy working in a hospital library: (1) "the service orientation"; (2) "the work environment"; (3) "the nature of the work itself"; and (4) "the people we work with" (p. 7).

Many of these reasons are grounded in a belief by librarians of the altruistic purpose of serving as a member of the patient care team. However, health care today is being treated and is acting more like a business than a service. The work environment has become traumatic and chaotic rather than dynamic and flexible. The nature of the work is changing due to staff reductions from downsizing or "rightsizing" as it is called euphemistically. While in retrospect the promises of the 1970s may not have been realized in the 1980s, the next twenty years do look promising. Computer technology has become affordable for even the small library, thus facilitating access to all forms of information regardless of geographic location. The process of total quality management and its tools and techniques of statistical process control, benchmarking, and cost of quality offer a means to translate library services into a value that is understood by health care administrators. Librarians are learning to use these tools.

Librarians have long emphasized services to meet customer needs. The library has proactively broadened its mission to serve the administrative decision makers along with the patient care decision makers. Patient centered care, an outgrowth of the customer centered service advocated by TQM (Sherer, 1993), offers a model for librarians interested in developing specialized services targeted for administrative users. Even if librarians never develop specialized services, they do offer a valuable unique contribution to health care, and promotion of this role is needed. Librarians in the 1970s gained new knowledge and skills by incorporating marketing concepts into the hospital library. In the pressures of the 1980s, marketing and advertising of library services may have fallen by the wayside as staff tried to maintain service levels in the face of staffing reductions and volume increases (Glitz et al., 1992). Correcting this requires personal accountability by each librarian. The library profession may need to develop additional support mechanisms to enable librarians to do so.
Library service to health care administration has changed, even progressed, over the past twenty years. However, a fundamental problem surfaces. Librarians do not know the needs of the administrative user group as well as they understand the needs of clinical information users. Librarians do not understand the differing information needs of administrators in hospitals, academic medical centers, or HMOs. Wakeley and Foster (1985) surveyed university programs in health administration as a means of identifying ways the AHA Resource Center could better meet information needs of that audience. However, librarians' knowledge of administrative information needs is mostly intuitive rather than factual. Local marketing studies targeting the information needs of administrators seem to be conducted by librarians only rarely. Other empirical studies of health care administrators as a group are absent. A prerequisite to developing specialized services for administrators is to understand their information-seeking and use patterns. Therefore, future research needs to document the information requirements of administrators in the field as they wrestle with the changing health care structure (Kaiser, 1992) and gain the skills they need within their own discipline (The Healthcare Forum Leadership Center, 1992).

SUMMARY

The health care industry continues to offer an energizing and enabling environment in which librarians can practice. Library service to health care administrators has progressed during the past twenty years; librarians are more aware of administrators as a user group with special needs. Future research needs to focus on better understanding the information needs of health care administrators, their information-seeking and use patterns, the development of specialized services to meet these needs, and the development of indicators to measure the provision of quality library services.

REFERENCES


LaRosa, S. (1992a). For the answer, just phone or fax! MLS: Marketing Library Services, 6(6), 1-4.


Issues in Clinical Information Delivery

Joanne G. Marshall

Abstract
Although the professional literature continues to be a major source of continuing education for health care providers, and although libraries are often excellent sources of information that can benefit patient care, the problems in information delivery to clinicians have not yet been solved. The ever-increasing amount of information available and the time and effort required to obtain the appropriate piece of it when required both act as barriers to information use by busy clinicians. The following library-related services are discussed as important contributors to clinical information delivery: clinical librarianship; LATCH (Literature Attached to the Chart); end-user searching of computerized databases; quality filtering of the literature; and clinical information systems that integrate internally generated patient care information, such as the patient record, with access to library and information services. An important new role for the librarian is emerging in quality improvement programs that use the literature to assist health professionals in prospectively improving patient outcomes. Ongoing research into both information needs in clinical settings and the impact of library services is required as a basis for effectively meeting practitioners' information needs.

Introduction
Clinical information needs are of special importance because they relate directly to the ultimate purpose of the health care system—the care and treatment of the patient. Clinical information needs
are different from those related to research, education, and administration because clinicians require rapid access to practical knowledge that can be applied to patient care. The purpose of this article is to review past studies of clinicians' information-seeking behavior as a basis for discussing various library programs and services designed to deliver information to clinicians. Particular attention is paid to the impact of information on clinical decisions and patient care and to developments in end-user searching of health care databases. The growing relationship among expert systems (such as decision support systems), health care data (such as patient records), and data from factual and bibliographic databases is also discussed as a future trend.

Although the discussion of clinical information delivery in this article deals with health care providers as opposed to consumers, the ideal clinical information delivery system includes service to both sides in the professional-client relationship. Informed clinicians as well as informed patients and family members are needed if the most effective and appropriate care is to be provided. Valiant efforts are being made by librarians to meet the growing need for consumer health information; however, the funding for library and information services in hospitals and other health care facilities continues to be mainly for services to providers. For a detailed discussion of consumer health information needs and services, the reader is referred to Dahlen's article in this issue of Library Trends.

In preparing this article, the author was reminded of the lack of research on the information-seeking and use patterns of health professionals other than physicians. Over the last two decades, librarians have responded to the trend toward interdisciplinary health care by broadening their collections and services, but this trend is not similarly reflected in the research literature. There are a great many user studies on physicians, some of which take an interdisciplinary approach, and relatively few studies on other health professional groups such as nurses, nutritionists, physiotherapists, and occupational therapists. Wherever possible, studies of these groups have been included in this article.

Information Seeking and Use by Health Professionals

Within the field of library and information science, studies of information seeking and use by clinicians fall into the category of "user studies." This broad research category includes studies of what information needs are perceived, what information-seeking channels are used, as well as what information is actually applied to patient care. As might be expected, library science researchers have been
primarily concerned with studies of the use of the library and its resources and services.

In the health sciences field, there is a substantial literature dealing with information needs and uses in the context of the education of health professionals—in particular, continuing education needs and preferences. These education-oriented studies provide an opportunity for librarians to view their collections and services as one of a number of formal and informal information sources that clinicians use to meet their information needs.

The rapidly changing world of health care knowledge and the problems experienced by clinicians in keeping up to date has led to a third group of studies on methods of disseminating health care knowledge and changing practice behavior to reflect new trends and treatments. The results of these studies are also extremely valuable to librarians. Like the education studies, the practice behavior research allows librarians to examine the information sources used by health professionals as part of the change process.

The following review integrates a selection of studies from the three literatures described earlier: (1) library and information science, (2) health professional education, and (3) practice behavior change. Readers who are seeking additional references may wish to consult the reviews prepared by Osiobe (1985) and Elayyan (1988). The studies are presented in chronological order to illustrate the parallel development of relevant research from the three areas.

Studies of clinicians' information-seeking patterns and use have a considerable history. Sherrington (1965) identified 162 studies on the flow of medical information, many of which were sponsored by medical journals or pharmaceutical companies. A recurring theme in several of the early studies (Menzel, 1966; Mayada, 1969; Friedlander, 1973) was that the information use patterns of clinicians differ from those of scientists and researchers. Clinicians had very practical information needs that were often best served by informal consultation with colleagues. As a result, clinicians consulted the research literature less frequently. Scientists and researchers, on the other hand, were more extensive users of the literature and libraries because of their need to be aware of new published research findings as a basis for their own work. Mayada (1969) suggested that clinicians required information in different forms and amounts than teachers and researchers. Most clinician literature searches focused on diseases or treatments with drug information being the most frequently requested topic. Textbooks were used most frequently by medical students and residents while medical journals were preferred by staff physicians (Neufeld & Woodsworth, 1972).
A sociological study in the diffusion of innovation by Coleman, Katz, and Menzel (1966) provides a very detailed view of how physicians adopted a new antibiotic drug. Although physicians became aware of the new drug through the medical literature and from pharmaceutical representatives, this knowledge alone was not usually sufficient to persuade the physician to start prescribing the new drug. Sharing of personal experiences by physician opinion leaders in the community about prescribing the drug turned out to be a key element in the adoption process. This study had a major impact on future diffusion studies which continued to investigate the role of interpersonal networks in adopting innovations (Rogers, 1973).

Subsequent research efforts tend to confirm the findings of earlier studies. Strasser's (1978) study of practicing physicians in New York State found that involvement in research or teaching correlated with greater use of the medical literature and the library. Stinson and Mueller (1980) found that, for a group of 402 randomly selected health professionals, the literature was the most common source of information followed by information from professional colleagues. Health professionals in urban areas made more use of professional colleagues than those in rural or semi-urban areas; clinicians in institutions made more use of colleagues than those in solo or group practice; and physicians in general practice made more use of pharmaceutical representatives than did specialists. Younger clinicians were more likely than older ones to use professional colleagues as information sources.

In a study of medical students, residents, and physicians, Northrup et al. (1983) found that the participants relied heavily on their personal libraries because of convenience and the need to obtain the information quickly. A study of physicians in office practice by Covell et al. (1985) showed that physicians formulated an average of six questions related to patient management during an observer's half-day visit or about two questions for every three patients seen. One of the most remarkable findings in the study was that the same physicians had previously reported on a questionnaire that they needed information related to patient care only once a week. Of the questions raised by the physicians during the observation period, only 30 percent of the clinicians' information needs were met during the patient visit and most often by another physician or health professional. A number of barriers to the effective use of print sources were identified in the study, including out-of-date textbooks in the office, poorly organized journal articles and files, inadequate indexing of books and drug information sources, and lack of time to find the needed information.
Parboosingh et al. (1984) measured physicians' perceptions of the sources of information that helped them decide to change their clinical practice. While medical journals, continuing medical education, and communications with colleagues were most often cited as the initial source of information, an average of over three sources—or change agents as they were referred to by the authors—were required to initiate a change in practice. The sources could include hearing about a new treatment at a conference, discussing the treatment with a colleague who had used it, and reading an article from the medical literature on the treatment.

Recurrent themes in studies of clinicians' use of information sources include the reliance on clinical judgment to solve patient problems because of the time pressures of the practice setting and clinicians' preferences for informal information sources such as colleagues. Nevertheless, several studies have found that reading of professional journals is cited as a primary mechanism for continuing medical education and that practicing physicians spend three to five hours a week reading journals (Currie, 1976; Curry & Putnam, 1981). Despite this reading for continuing education purposes, clinicians still report difficulties in applying the medical literature to patient care problems.

Fletcher et al. (1981) suggest that, in order for the medical literature to be useful to clinicians, it must answer questions that arise in patient care, measure clinically relevant variables, and use research designs most likely to yield valid conclusions. In a thirty year review of the medical literature covering 1946 to 1976, the authors note that, despite the rapid growth in publishing, there had not been frequent reports relating to the foremost questions asked by physicians, namely, those dealing with diagnosis, prognosis, and treatment. Other frequently asked, but infrequently addressed, questions relate the etiology of illness, the frequency of medical conditions, clinical presentations of illness and the differentiation of normal and abnormal human biology. Fletcher et al. (1981) also comment upon the lack of reports of studies that have used research designs that they consider rigorous enough for answering clinical questions. These more rigorous designs include randomized controlled trials, cohort studies, and case control studies.

Information seeking and use by physicians in particular has continued to be a topic of research interest in more recent years, and some of the same findings and problems persist. A study conducted for the New York Academy of Medicine by Louis Harris and Associates (1987) found that medical professionals and students were still primarily dependent on the printed word as opposed to the newer computerized sources of medical information, and they continued
to rely mainly on their personal collections of books and journals. Of particular concern was that office-based physicians were less well informed than those in teaching or research settings based on their reading habits and use of online medical databases.

In a study of medical information needs of internists and pediatricians at an academic medical center, Woolf and Benson (1989) found that both faculty and house staff most frequently required information related to treatment recommendations and differential diagnosis. The information needs of house staff differed significantly from those of faculty in several areas: house staff needed information more often for patient care and preferred to use textbooks and handbooks. Faculty more often needed basic science information.

Williamson and Associates (1989) conducted a survey on behalf of the Massachusetts Medical Society to determine whether, and to what extent, practitioners who were involved in primary care, such as general internists, pediatricians, family and general practitioners, and obstetricians and gynecologists, perceived a problem in managing their science information needs. Opinion leaders, including leaders of professional societies and members of certification and editorial boards, were also included in the survey. In reviewing previous studies, Williamson and his collaborators (1989) found only three articles relating to information seeking, information dissemination, and information implementation that they considered relevant and scientifically sound. The first study by Weinberg et al. (1981) on informal advice and information seeking between physicians found that colleague interaction occurred on a regular and frequent basis and was of considerable value to the clinician. A few physicians in the local county, regarded as the opinion leaders or educational influentials, were nominated by 92 percent of their peers as good sources of information. The second study by Stross and Harlan (1979) on the dissemination of information on hypertension found that journals were listed as a source of information by 80 percent of the family physicians and 50 percent of the internists. The third study by Bergman and Pantell (1986) did not relate to information sources but to the interpretation of information contained in a newly published clinical article on treatment of an infant with high fever. The authors found that physicians had difficulty in using probability data and appeared to base management decisions on intuition rather than on calculation.

The Williamson et al. (1989) study, which is one of the most methodologically rigorous to date, concludes that physicians are facing a serious problem in trying to keep up with medical advances and the expanding medical literature. The authors also state that science information management is a critical professional skill that
is not adequately taught in undergraduate medical education, and that very often clinicians "'don't know what they don't know'" (p. 159). Williamson et al. call upon education planners and information disseminators, including librarians, to make a concerted effort to help solve the information problems of clinicians. In his editorial, Huth (1989) discusses some of the reasons why the medical literature is not used more extensively by practitioners. Although the unmanageable size of the literature presents problems, Huth states that the bigger problem is that papers relevant to particular clinical issues are not concentrated in journals with subject boundaries but are scattered more widely now than thirty years ago. Huth also cites the heavy cost in time of searching and retrieving articles and the fact that much of the retrieved literature is not relevant to clinical problems. A great deal of time is required to digest and synthesize the content that is worthwhile, and most physicians do not have specialty training in critical analysis of articles which would allow them to judge the validity of the findings.

In 1991, Osheroff and his colleagues published a study analyzing questions posed by physicians during clinical teaching. The authors make the point that physicians cannot accurately estimate their own needs, and yet the majority of studies on physicians' information needs have been based on self-report. This observational study found that, on average, five clinical questions were raised for each patient discussed, a finding similar to that of Covell et al. (1985). Of the 337 requests that were gathered by the Osheroff group, 74 percent concerned patient care and answers to about half (52 percent) of the 337 questions could have been found in a medical record. Almost one-quarter (23 percent) of the questions were potentially answerable by information contained in a library, a textbook, a journal, or MEDLINE. The proportion of questions that required synthesis of patient information and medical knowledge was 26 percent. The authors suggest a framework for physicians' information needs based on the general concept of "comprehensive information needs" (p. 580). These needs are divided into three subgroups: currently satisfied information needs, consciously recognized needs, and unrecognized needs.

Another recent study of knowledge resource preferences of family physicians (Connelly et al., 1990) found that respondents used the commercial drug handbook Physicians' Desk Reference (PDR) more often than daily and colleagues more frequently than weekly to obtain information on clinical questions. The study found little use of Index Medicus or computerized bibliographic retrieval systems such as MEDLINE. A report on the reading habits of medical students (Taylor, 1992) calculated that students would spend over seventy hours a week reading if they were to read all assigned books, handouts, and class
notes. In his editorial, Kassirer (1992) comments that few medical students read journals regularly even though journals are essential for keeping up adequately with advances in medicine. These studies indicate that the habits observed in practicing physicians likely begin in medical school where the amount of expected reading is unreasonable and textbooks are relied upon for synthesis.

As mentioned earlier, compared to the amount of literature on physicians and medical students, there is relatively little written about information-seeking and use patterns of allied health professionals. Stinson and Mueller's (1980) work, discussed earlier, included several different health professions. Summers et al. (1983) study of educators as information users identified colleagues as a primary information source and indicated that availability and ease of use were major determinants of the information sources used. Salasin and Cedar (1985) published a study of information-seeking behavior in the applied research and service delivery field that includes nurses, social workers, and psychologists working in rural mental health. The authors found that the respondents rarely sought information from outside their own workplace. Of the information-seeking episodes that were identified among the rural mental health workers, 80 percent included seeking information from colleagues within the respondent's work unit and 85 percent from colleagues outside the work unit. Research reports were used in 55 percent of the episodes and journals in 65 percent. Pelzer and Leysen (1988) used a questionnaire to measure library use and information-seeking behavior of veterinary medical students. The authors cite a number of earlier studies of veterinarians and veterinary students. The results were similar to Taylor's (1992) medical student study in showing that the veterinary students relied on course textbooks and handouts.

Corcoran-Perry and Graves (1990) studied supplemental information-seeking behavior of cardiovascular nurses. They found that nurses sought patient-specific data most often, followed by institution-specific data and domain knowledge, which included nursing knowledge and knowledge from related disciplines. Nurses needed a lot of information but of the type that would allow them to track people, equipment, medications, and reports. The authors make the point that most user studies have focused on library use on the assumption that knowledge about information needs can be translated into a service that people will use. Little research has been done on actual information needs in the work setting and the actual information-seeking behaviors of health professionals in general or nurses in particular.

In summary, the studies on clinical information seeking and use, when seen as a body of literature, do provide some consistent and
useful findings that can be used by librarians in the design of information services for clinical groups. It appears that there is still a great deal to be accomplished in providing information and information services that will meet the special needs of clinicians. In the future, librarians should consider doing additional research on the needs of nonphysician groups as well as research which examines actual information needs that occur in the clinical settings.

**Library and Information Services for Clinicians**

In April 1990, a symposium entitled “The Evolving Role of the Health Sciences Library in Continuing Education” (Hackleman & Bischoff, 1990) appeared in the *Bulletin of the Medical Library Association* (Hackleman & Bischoff, 1990). The symposium contains a number of papers that provide excellent guidance for developing the future role of library and information services for clinicians. In reviewing recent research that identified the context in which physicians seek information and advice from external sources, Gruppen (1990) points out that physicians vary in their information needs, preferences, motivations, and strategies for seeking information. The author remarks that, in contrast to the easy-to-use and readily accessible commercial information sources, like the *Physicians’ Desk Reference*, and its Canadian counterpart, the *Compendium of Pharmaceuticals and Specialties* (CPS), institutional libraries represent something of an unfamiliar and potentially threatening environment that demands mastery of new skills and technology by health professionals. He urges librarians to consider doing “market research” (p. 165) to determine the needs, preferences, and use patterns of various targeted physician and other health professional user groups and to explore alternative methods of improving access to resources. In addition to this informational needs assessment, the author suggests two other general strategies for librarians: (1) augmenting accessibility to information for clinicians, and (2) targeting the opinion leaders.

The following discussion of specific services is intended to highlight certain approaches that librarians are currently using to meet the information needs of clinicians and to relate these approaches to the research findings that have been discussed so far in this article. The services described include:

- clinical librarian services in which the librarian joins the health care team to provide enhanced information services to clinicians;
- LATCH (Literature Attached to the Chart) services in which clinicians request literature searches and articles from the library related to a specific patient care problem;
end-user searching of computerized databases in which clinicians can personally search MEDLINE and other health care databases in the library or in clinical settings;

• quality filtering or critical appraisal of the literature in which the librarian or clinician evaluates the quality as well as the content of the literature and its applicability to patient care;

• clinical information systems which integrate internally generated patient care information, such as the patient record, with access to library and information services.

CLINICAL LIBRARIAN AND LATCH SERVICES

Cimpl's (1985) review of the literature on clinical medical librarianship traces the origin of the services back to the early 1970s when Gertrude Lamb identified a gap between the medical literature and its application to patient care. At the time, Lamb was located at the University of Missouri-Kansas City where an innovative medical school curriculum was being developed. In this environment, Lamb pioneered the concept of the librarian as an information specialist who works in patient care settings to provide clinicians with rapid access to information related to current clinical problems. In this service model, the librarian is an important member of the health care team along with the physician and allied health professionals. Lamb continued her efforts at Hartford Hospital in Connecticut and numerous clinical librarian programs sprang up across the United States, Canada, and England in the 1970s and 1980s.

Clinical librarian programs have the advantage of being able to respond to the concerns raised by both Williamson et al. (1989) and Osheroff et al. (1991) about health professionals' unrecognized information needs. Marshall and Neufeld (1981) found that both direct and perceived information requests were met by clinical librarians. Direct requests were situations in which health professionals made a specific request for information on a particular topic and situations in which the clinical librarians perceived a need for information based on questions raised during patient rounds. The proportion of perceived requests was higher when the clinical librarians first joined a patient care team, but the proportion decreased as health professionals became more familiar with the service and the types of questions that could be addressed through the clinical librarians' services. Harmon et al. (1982) developed a series of problem-oriented preclinical primers designed to aid clinical librarians in anticipating practitioners' information needs. The authors state that their clinical librarian program placed considerable importance on the ability of the librarian to anticipate and satisfy a need for information before the need had actually been recognized by the clinician.
In his book, *The System of Professions*, Abbott (1988) argues that the claim to professional status on the part of the information professions depends, in large part, on the ability of its members to select information for their clients. Clinical librarianship appears to represent an ideal professional model in the sense that clinical librarians have learned to: identify unrecognized information needs; formulate specific searchable questions independently or on the basis of negotiation with health professionals; and provide a manageable amount of information directly related to the clinician's question. The clinical librarian role fulfills all of Gruppen's (1990) suggestions for library service: it allows for market research on the target population; it augments access through rapid searching related to clinical questions and provides document delivery; it makes use of opinion leaders or key members of the health care team for support and application of health care knowledge; and it provides a friendly face in the form of the clinical librarian who can reduce the sense of unfamiliarity associated with the use of the library and information technology.

In recent times, the growth of clinical librarian programs has suffered because of the pressures to reduce health care costs; however, many programs continue to thrive and, more important, the ideas behind this specialized clinical information service continue to inspire health sciences librarians and to guide service priorities. One of the greatest contributions of the clinical librarian role is the support that it provides for hospital librarians who want to spend at least some of their time outside the library in the settings where information needs occur. Clinical librarianship also moved the hospital library beyond the support and service role toward a more direct role in patient care. It is notable that many of the studies cited in support of the library's role in patient care are actually evaluations of clinical librarian programs.

Literature Attached to the Chart (LATCH) is another service that attempts to link relevant information contained in the health care literature to direct patient care. The service was developed at the Washington Hospital in the mid-1960s (Sowell, 1978). Librarians placed several key articles with a chart at the request of an attending health professional. This service eventually resulted in over 1,000 LATCH packages that were kept and updated in the hospital library for continuing use. The original LATCH programs did not have the advantage of direct librarian participation in patient care rounds and, as a result, the librarians did not anticipate information needs to the same extent as clinical librarians. Various permutations of LATCH and clinical librarian programs have since evolved; for example, Clevesy's (1980) activities in a community hospital combined
librarian participation with a LATCH service and, in Kansas City, a publication called *Current References* was developed as a result of a combined LATCH and clinical librarian program (Algermissen, 1974). There have also been reports of librarian involvement in practice-based continuing medical education programs which deserve attention (Christensen et al., 1978; Clintworth et al., 1979).

**End-User Searching of Computerized Databases**

The availability of MEDLINE, as well as other computerized databases, has greatly increased the speed and flexibility of bibliographic searching in recent years. When MEDLINE was first introduced by the National Library of Medicine (NLM) in the late 1960s, the developers anticipated that physicians would perform their own searches on data terminals in their offices. Limitations on hardware availability and difficulties experienced by novices in using the early search software made this plan unworkable, and librarians began to act as search intermediaries. Librarians' familiarity with bibliographic indexing and search techniques and more frequent use of the terminals and databases continues to allow them to provide efficient and effective searches for health professionals.

While intermediary searching is still an important part of reference service in health sciences libraries, a major change is taking place in database search services. As library markets became saturated in the 1980s, database vendors began to expand their market to end-users or the persons who will actually make use of the information retrieved from the database. Health professionals are seen as an ideal end-user group because of their need for rapid access to information, the availability of microcomputers in most health care settings, and the number and comprehensiveness of health databases.

The early attempts at reaching the end-user market simply involved making training in the use of online systems such as MEDLARS, BRS, and DIALOG more widely available to end-users. For example, NLM produced a manual, *The Basics of Searching MEDLINE* (1989), for end-users as well as a self-instructional computer program known as MEDLEARN. As the new end-users, particularly those who searched infrequently, complained about the "user hostile" nature of the original command language software, a number of more "user friendly" interfaces were developed such as PaperChase, GRATEFUL MED, BRS Colleague, and DIALOG's Knowledge Index. Today, the proliferation of databases and the availability of the same databases through increasing numbers of different online systems and services continues to create a bewildering array of choices for the end-user.
In a study of early adopters of end-user online searching in practice settings, Marshall (1989a) identified a number of barriers to the effective use of online databases by busy clinicians. The clinicians found the systems more difficult, time consuming, and expensive to use than they expected. They also commented that the database content and indexing were not always suitable for their needs. Most of the clinicians in the study were also involved to some extent in administration or research. The study found a positive correlation between the amount of time respondents spent in research activities and the implementation of end-user searching and a negative correlation between implementation and the amount of time spent in patient care, suggesting that online searches were more relevant and useful in the research context than they were in the clinical context.

In an investigation of end-user searching at the New York Hospital—Cornell University Medical Center, Poisson (1986) found that 8 percent of the sixty-five physicians who responded to her survey were doing their own searches, 65 percent were interested in learning how to search, and 29 percent were not interested. Poisson's research also indicated that end-user training did not necessarily translate into frequent searching behavior. Half the staff at a rehabilitation center had attended a training session and, of those, over half had not searched. Only 18 percent became frequent searchers. Marshall (1989b) found that there was a positive relationship between the number of training events reported—use of printed guides and manuals, informal demonstrations, courses and use of online help—and the implementation of end-user searching. Variability in the implementation levels of Marshall's 124 respondents suggests that end-users are a diverse group with different information needs and different levels of searching expertise, and the various types of formal and informal training opportunities were needed by end-users.

Sewell and Teitelbaum (1986) reported on observations on end-user online searching by pathologists and pharmacists over an eleven-year period. They found that volume of searching was directly related to the convenient placement of the terminal in the workplace and that fewer than half the potential searchers actually searched on their own. Both the Marshall (1989a) and Sewell and Teitelbaum (1986) studies found that end-users tended to perform relatively simple searches using only the AND operator. Although Poisson (1986) found relatively high recall and precision ratios in a small sample of end-user searchers, a more recent study by Haynes et al. (1990) of 158 physician trainees and attending staff at McMaster University had different results. The participants used GRATEFUL MED software and were offered a two hour introduction to online searching and
two hours of free search time. Over 80 percent of the participants did 2.7 GRATEFUL MED searches per month. On comparison searches, the clinicians retrieved only 55 percent of the relevant articles found by the reference librarians and 50 percent more irrelevant articles. The authors conclude that, although searching from clinical settings is feasible with brief training, inexperienced searchers miss many relevant citations and search inefficiently. A second study by the McMaster group (McKibbon et al., 1990), comparing clinician and librarian searches, found that librarians scored significantly better than novices on both the recall and precision of their searches, and that they had equivalent recall and better precision than experienced end-users; nevertheless, there was also substantial nonoverlapping retrieval of relevant citations by searchers in the different groups. More research is needed in this area to assist in improving the quality of end-user searches and to monitor the impact of the information retrieved on patient care.

Whatever the quality of end-user searches, the trend seems unlikely to be halted. End-user searching makes more health care information accessible to more health professionals in a way that is not possible through intermediary searching alone. In the 1990s, the availability of MEDLINE and other health care databases on compact disc—read only memory (CD-ROM) is strongly reinforcing the trend toward end-user searching. CD-ROMs allow local storage and retrieval of information from large databases through the use of a microcomputer and attached CD-ROM reader. Unlike online services which charge on the basis of connect time and usage, a CD-ROM annual subscription allows unlimited access for the year. CD-ROM is ideal for the health professional's office or the small hospital library where a single user workstation is sufficient to meet demand; however, it is less than ideal in settings where there are likely to be a number of concurrent users. The use of multiple CD-ROM products on the same workstation also poses challenging technical problems for libraries. Various solutions involving "juke boxes" and access to CD-ROMs through local area networks are being tried. The use of CD-ROM MEDLINE as a mode of information transfer in clinical settings has been described by Dalrymple (1990).

Larger academic libraries are now mounting bibliographic databases as part of their online public access catalog (OPAC). Such systems may be available on a dial-in basis to clinicians affiliated with teaching hospitals. The addition of numerous local database storage options to the already burgeoning online selection once again presents a confusing set of options. While it might be expected that CD-ROM and other forms of local storage would eclipse online systems, this does not appear to be happening. The National Library
of Medicine is continuing to develop and promote its end-user GRATEFUL MED software with the addition of a document delivery service feature called LOANSOME DOC. (Burroughs, 1989). A new electronic journal, the *Online Journal of Current Clinical Trials*, is also challenging some of the traditional methods of publishing and disseminating scientific results (Kassirer, 1992). Electronic information delivery to end-users is still evolving and such services will continue to develop rapidly in the future, especially as greater numbers of professionals start accessing electronic networks such as the Internet and the National Research and Education Network (NREN).

**Quality Filtering and Critical Appraisal of the Literature**

Bergman and Pantell's (1986) study, cited earlier, demonstrates the difficulties that clinicians experience not only in accessing the literature but also in evaluating its content on a scientific basis. The idea that health professionals need to develop quality filtering or critical appraisal skills has been suggested by a number of authors, and guidelines have been developed (see, for example, Fletcher et al., 1982; Fowkes & Fulton, 1991; Goldschmidt, 1986; Haynes et al., 1983; Krogh, 1985; Riegelman & Hirsch, 1989). Guidelines for structured journal article abstracts have also been prepared by the Ad Hoc Working Group for Critical Appraisal of the Medical Literature (1987). The critical appraisal needs of clinicians are different from researchers because clinicians need to establish the relevance of the study findings to the care of their particular patients as well as the scientific validity of the results.

There are important roles for the library in quality filtering and critical appraisal. Since it is the health care literature that is being appraised, librarians can assist health professionals to develop effective literature search skills. There are also well-documented examples of library instruction geared to the needs of various health professional student groups such as nurses (Tyler & Switzer, 1991), occupational therapists (Mularski et al., 1989), physicians (Reidelbach et al., 1988; Graves & Selig, 1986), and health administrators (Smith & Salisbury, 1985). Librarians have joined a multidisciplinary team to teach a course in the selection, evaluation and application of information to patient care (Dorsch et al., 1990). By becoming familiar with critical appraisal criteria, librarians can incorporate such criteria into mediated computer searches and teach the search techniques to health professional end-users. The application of study methods terms found in Medical Subject Headings (MeSH) to critical appraisal MEDLINE searching has been described by Marshall (1992b). Librarians have also applied critical appraisal criteria to the selection of records for locally produced databases (Moore, 1989; Pugh & Moore, 1988).
Clinical Information Systems

A major trend in the delivery of information to clinicians is the integration of a variety of electronic information resources into a unified clinical information system that is capable of meeting the variety of clinical information needs described in this article. Although such systems are still in their early stages in most healthcare settings, a number of prototypes exist, and the National Library of Medicine (NLM) has provided development funding under its IAIMS (Integrated Academic Information Management Systems) program. The bibliographic databases familiar to librarians will form a component of these information systems together with full-text databases, factual databases, expert systems, patient records, and statistical health care data. Rennels and Shortliffe (1987) categorize medical computer systems as either communications systems which include databases, such as MEDLINE, and picture archiving and communications systems or as advice systems that provide consultation, monitoring, and critiquing functions.

Expert systems are intended to provide physicians with advice on patient problems through the use of artificial intelligence software that draws conclusions or problem solves through logical inference. NLM has several expert systems under development including AI/RHEUM. The system consists of two major parts: a diagnostic consultant system and a patient management consultant system for cases of rheumatoid arthritis. Another system, known as AI/COAG assists clinicians in diagnosing and managing problems in hemostasis, a medical specialty with few experts. The Unified Medical Language System (UMLS), also being developed by NLM, will eventually provide a basis for development of truly integrated systems by acting as a bridge between the different vocabularies used in medical settings (Schoolman, 1986). In a review of knowledge bases in medicine, Perry (1990) describes a variety of electronic information sources, such as electronic textbooks and expert systems, which she calls knowledge-based systems, rule-based systems, causal models, and hypothesis or frame-based systems.

While some aspects of integrated clinical information systems are unfamiliar to librarians, the types of information contained in the print and electronic resources traditionally provided through libraries will form an important component of such systems. As these clinical systems develop, it will be important for librarians to participate in planning and implementation and to bring their particular knowledge and expertise to bear on the content and structure of the systems. Many of the services that librarians have developed in the past—clinical librarianship, LATCH, support and training for end-user searchers, the production of quality-filtered
databases and even document delivery—provide good models for services that could be offered in a modified, more cost-effective form with the aid of electronic clinical information systems.

**THE IMPACT OF THE HOSPITAL LIBRARY ON PATIENT CARE**

In today's environment of cost constraint, librarians are being challenged more than ever to demonstrate both the cost effectiveness of their services and their impact on patient care. It is important that librarians continue to develop a body of research in this area so that they can evaluate the impact and develop new services to fill the gaps that exist. Fortunately, there are already a number of studies that have examined the role played by library and information services in patient care.

One group of impact studies comes from the evaluations of the clinical librarian programs discussed earlier (Roach & Addington, 1975; Scura & Davidoff, 1981; Barbour & Young, 1986; Halsted et al., 1989; Veenstra & Gluck, 1992). These studies, which have appeared periodically since the mid-1970s, have documented direct cost savings and patient care benefits. Library-supported continuing medical education programs have also documented changes in physicians' practice behavior—e.g., literature packets prepared by the librarian stimulated changes in prescribing habits (Manning et al., 1987; Manning et al., 1986). The critical incident study sponsored by the National Library of Medicine provides evidence on the benefits of timely information applied to patient care through both mediated and end-user MEDLINE searches (Wilson et al., 1989).

The clinical librarian and continuing medical education studies described previously are evaluations of specialized services or projects, however there are also studies that have examined the impact of regularly provided hospital library services (King, 1987; Marshall, 1992a). Both of these studies began as initiatives of the local health library community whose members approached university-based researchers for assistance in designing a study to address the issue of the impact of the hospital library. In the Chicago study conducted by King (1987), 310 randomly selected health professionals were asked to make a request to their hospital library for information related to a current clinical case. In Rochester, 448 physicians and residents were similarly approached (Marshall, 1992a). After receiving the information from the library, the respondents were asked to complete a brief questionnaire.

In both studies, the respondents rated the information provided highly. A large proportion of the physicians (77 percent in the Chicago study and 80 percent in the Rochester study) indicated that they probably or definitely handled some aspect of their patient care.
differently as a result of the information received. The Rochester study went further to try to pinpoint specific aspects of patient care that were affected such as diagnosis, choice of tests or drugs, and advice given to the patient. Marshall (1992a) pointed out the similarity between the events that Rochester physicians said they were able to avoid with the assistance of information from the hospital library and the adverse events identified by the Harvard medical practice study (Leape et al., 1991). The authors of the Harvard study found that a high proportion of adverse events in hospitalized patients are due to patient management errors rather than the unavailability of medical knowledge and are thus potentially preventable. The results of the Chicago and Rochester studies confirm that information provided by the hospital library is frequently perceived by clinicians as having a substantial impact on patient care. The studies summarized here have begun to address the impact question, but additional studies are needed of not only hospital library services, but also of the other clinical information system components.

Another way in which hospital libraries can have a positive impact on patient care is related to current attempts to control health care costs. A U. S. General Accounting Office report (1991) stated that, in 1989, health care costs consumed 11.6 percent of U.S. national income even though millions of Americans were uninsured. In Canada, where the problems of uncompensated care, the burdens of catastrophic illness on families, and the problems created by large groups of uninsured have been largely avoided through a national medicare program, the cost of the system in 1989 still consumed 8.9 percent of the national income. As government officials and policymakers strive to control health care costs, quality management programs, in particular continuous quality improvement (CQI), are being adopted to address the cost issue while, at the same time, improving patient care. The goal of quality management programs is to maximize the probability of desired patient outcomes and to reduce the probability of undesired outcomes given the current state of health care knowledge (Joint Commission on Accreditation of Healthcare Organizations, 1988, 1991). CQI efforts require that the current state of health care knowledge be ascertained and one of the major mechanisms for this is very familiar to librarians—the literature search. A quality improvement program developed by Christiane Jones, librarian at the Veterans Administration Medical Center in Biloxi, Mississippi, uses the literature prospectively as an educational tool for health professionals to improve patient outcomes. This program was described in the 1992 satellite broadcast sponsored by the National Library of Medicine entitled Information Stat: Rx for Hospital Quality. The librarian evaluates the quality improvement
data, determines information needs based on those data, and develops information packages. The use of such information by health professionals can result in corrective actions as well as the prevention of future occurrences. The steps in the quality improvement process involve: identifying patient care processes in need of improvement; analyzing the process; making the problems in the process apparent to the health care team; improving the process; and holding onto gains once improvement is achieved. The availability of accurate and up-to-date information supplied by the librarian is a key part of the quality improvement process. Since the state of health care knowledge is constantly changing, quality improvement is a continuous process which requires the librarian's skills on an ongoing basis. A major role for the hospital librarian in the future may relate to the CQI process and the use of the health care literature to develop clinical practice guidelines.

**Summary**

This discussion of clinical information delivery has described clinicians as a group with different information needs from those of researchers and educators. In reality, the distinction among clinicians, researchers, and educators as mutually exclusive types working within the health care system is often a false one. Many of today's health professionals combine clinical practice with teaching or research or both. Thus, when speaking of the information needs of clinicians, it is best to define these needs not according to the individual but according to the setting in which the needs occur—e.g., a clinical setting—and the purpose for which the information is required—e.g., for application to patient care. From this perspective, the dynamic that occurs among clinical care, education, and research, particularly in teaching settings, becomes evident. For example, the same health professional might initiate an information request relating to clinical, research, or teaching activities at different times and information resources provided in response to one type of request could eventually be used for another purpose. The multiple roles played by health professionals and the uses of information at various points in time does not alter the different and special character assigned to the clinical information needs mentioned at the beginning of this article.

Although reading continues to be a major source of continuing education for professionals and although libraries can often provide information that benefits patient care, the information problems of clinicians have not been solved. The ever-increasing amount of information available and the time and effort required to obtain the appropriate piece of it when it is needed both act as barriers for
busy clinicians, particularly those in solo practice or those outside of major centers. Studies such as the Harvard medical practice study cited earlier (Leape et al., 1991), indicate that meeting the information needs of physicians who must apply new medical knowledge to the care of their patients is critical to maintaining and improving the quality of health care. The work of Osheroff and his colleagues (1991) suggests that information services for clinicians should take into account consciously recognized needs as well as unrecognized needs. The need for patient-specific and institution-specific data, particularly by allied health professionals, suggests that these types of information requirements need to be considered as future clinical information systems are developed. Osheroff et al.'s (1991) finding that over one-quarter of clinical questions require synthesis of patient information and medical knowledge indicates that integration of internal and external information sources into clinical information systems is desirable.

The importance of colleagues as information sources for clinicians needs to be considered in the context of developing future information systems. It seems unlikely that practicing professionals will stop consulting colleagues no matter how effective the formal information system, and it may be possible to incorporate some of the advantages of the colleague connection into clinical information systems as they develop. Menzel (1981) explains the practical advantages of informal communication with colleagues such as the promptness of the response; the screening, evaluation, and synthesis function carried out by the colleague; the possible extraction of action implications which can be explored through discussion; the transmittal of informal "know-how" based on personal experience with a particular procedure or technique; and the opportunity for instantaneous feedback and interaction that can be used to modify or facilitate the information exchange. Greene (1978) had words of caution about the limitations and pitfalls of verbal communication alone as a means of obtaining accurate information for application to patient care. He cites several examples in which false information was verbally transmitted along with accurate information and points out that, while there are established controls, such as peer review, over the information published in books and journals, there are no such controls over the content of informal conversations. Another lesson from the literature review is that, in order to apply information from the health care literature appropriately, health professionals require help in organizing their own personal libraries, identifying and synthesizing useful knowledge, and developing critical appraisal skills.

A number of library and information services for clinicians have been discussed in this article including: clinical librarian and LATCH
Dissemination of Medical Information: Organizational and Technological Issues in Health Sciences Libraries

Nancy K. Roderer

Abstract

This article describes five programs that have been particularly significant to the evolution of biomedical communications over the last twenty years: the National Network of Libraries of Medicine (NNLM), Integrated Academic Information Management Systems (IAIMS), National Research and Education Network (NREN), Unified Medical Language System (UMLS), and the electronic journal. In addition to the changes that these programs have already brought about, each will continue to have major implications for health sciences librarianship.

Introduction

From a patient's bedside, a physician calls up the patient's chart, orders tests, consults a clinical data system, and examines relevant professional literature. Back at the office, the same physician consults with colleagues from the same institution and around the world with equal ease, sharing pertinent records and images, and consulting with the literature as needed. Carrying out research is facilitated by easy access to patient data, research calculations and findings, and the descriptions of earlier research results. To keep up to date, the physician reviews a personal database tailored to his or her interests that contains such things as notices of grants, new research findings, new reviews of clinical and research issues, and news of the institution. As large or small information needs arise, these too are met by the


Dissemination of Medical Information: Organizational and Technological Issues in Health Sciences Libraries

Nancy K. Roderer

Abstract

This article describes five programs that have been particularly significant to the evolution of biomedical communications over the last twenty years: the National Network of Libraries of Medicine (NNLM), Integrated Academic Information Management Systems (IAIMS), National Research and Education Network (NREN), Unified Medical Language System (UMLS), and the electronic journal. In addition to the changes that these programs have already brought about, each will continue to have major implications for health sciences librarianship.

Introduction

From a patient's bedside, a physician calls up the patient's chart, orders tests, consults a clinical data system, and examines relevant professional literature. Back at the office, the same physician consults with colleagues from the same institution and around the world with equal ease, sharing pertinent records and images, and consulting with the literature as needed. Carrying out research is facilitated by easy access to patient data, research calculations and findings, and the descriptions of earlier research results. To keep up to date, the physician reviews a personal database tailored to his or her interests that contains such things as notices of grants, new research findings, new reviews of clinical and research issues, and news of the institution. As large or small information needs arise, these too are met by the
physician's information system with its access to a wide variety of clinical, research, administrative, and general information.

Views of extensive and readily available information sources and services have been with us for decades, going back to Vannevar Bush's 1945 vision of Memex—the library in a desk (Nyce & Kahn, 1991). The scenario of the physician adds detail to the picture, incorporating examples of the types of information sources needed and the ways in which they might be used. Over the years, these scenarios of "information when and where it is needed" have been used to stimulate thinking about steps toward the development of such a vision. Also to be considered, and the central focus of this article, is the role of the library in achieving such a vision.

In the previous Library Trends issue on health sciences libraries, Louise Darling (1974) wrote of the changes in information delivery in health science libraries through the 1960s and early 1970s. She concluded that developments in those years pointed health science libraries toward "one still distant goal" (p. 57), that of the library as "communications center working actively with informational materials of all kinds, close at hand or distant, for health professions users in the community as well as in the institution" (p. 58). In 1993, the goal remains the same, and health sciences librarians can report that significant progress has been made toward that goal. At the same time, there have also been major changes in the activities that libraries perform in support of biomedical communication.

Progress has been made in extending the range of materials that librarians handle, in improving the delivery of information and materials, and in reaching out to users in and beyond the local institution. Organizational and technological changes have been key to many of these improvements. Many new technologies are available, and libraries continue to be early adopters of the new technologies, applying them in innovative ways for the improvement of services. At the same time, librarians have built on and increased collaborative efforts, using this form of organization to create linkages with other libraries and with other information providers both internally and externally.

This article describes five programs that have been particularly significant to the evolution of biomedical communications over the last twenty years: the National Network of Libraries of Medicine (NNLM), Integrated Advanced Information Management Systems (IAIMS), the National Research and Education Network (NREN), the Unified Medical Language System (UMLS), and the electronic journal. In addition to the changes that these programs have already brought about, each will continue to have major implications for health sciences librarianship.
A MODEL OF BIOMEDICAL COMMUNICATION

Orr et al. (1964) have described the biomedical information complex as a system, in the same sense that a living organism is a system. Both have evolved in response to needs, and both are self-organizing and were not intentionally designed. Society has institutionalized communication patterns for knowledge transfer, such as professional meetings and their recorded proceedings and the publication and distribution of papers. Each of these communication methods became institutionalized when there was a significantly large group to require a common service.

The system that has evolved is a complex one, including many functional activities that are essential to communication. There are also several groups of players in the system, each participating in the overall dissemination of information but acting with individual goals and constraints (King et al., 1981).

As shown in Figure 1, the biomedical communication system begins and ends with the research generation function. The form of the model, a spiral, suggests the continuous and regenerative nature of the communication process. As a result of research, manuscripts are composed—i.e., written, edited, and reviewed, and then recorded. These two functions are currently carried out by authors and publishers.

Reproduction and distribution are traditionally the role of the publisher, but authors and libraries can also play an important role. Once ready for use, materials are sometimes distributed directly but more often are acquired and stored for later use. Individuals, libraries, and other information centers perform this function.

Libraries and abstracting and indexing services carry out the organization and control function, describing materials so that they can be identified and located by the user. The descriptive or bibliographic material, too, must be distributed for use, generally by libraries or database vendors. The physical access function includes direct distribution between authors or publishers and users as well as indirect distribution through the libraries and information centers where they are stored. The final function in the spiral, assimilation, represents the user's activity of reading and understanding the information transmitted in the material.

While some of the functions may sometimes be combined into a single activity, each is required in the overall system of biomedical communication. The functions and the players are important to keep in mind as we consider recent developments affecting the communication system.
NATIONAL NETWORK OF LIBRARIES OF MEDICINE

For more than twenty-five years, the National Library of Medicine (NLM) has been providing special support for the dissemination of medical information across the United States through its Regional Medical Library Program (RMLP), now known as the NNLM. The Medical Library Assistance Act (MLAA) of 1965 (Public Law 89-291) authorized NLM to provide grant funding for the development of a national system of regional medical libraries, and, since that time, the act and associated funding have been extended several times (Bunting, 1987).

"The goal of the NNLM is to improve and equalize access to biomedical information by linking U.S. health professionals and researchers to the information resources they need, irrespective of geographic location" (National Institutes of Health, 1992, p. 10). As of fiscal year 1991, the network included more than 3,600 members, including health science libraries of every size and type located in
all parts of the country. NLM's Network Office oversees and coordinates activities throughout the network.

The basic structure of the NNLM is hierarchical, consisting of activity at the local, regional, and national levels. Health professionals and researchers get materials through their (usually) local NNLM member library. Materials not available locally are provided within one of eight regions, and the NLM provides backup document delivery services at the national level. Activities are coordinated nationally, but the major focus of the NNLM is on the eight Regional Medical Libraries (RMLs) which receive contract funding to plan and coordinate network activities within specified geographic regions. With this arrangement, the RMLs can tailor their services to regional circumstances while taking advantage of NLM support.

The NNLM provides a variety of programs and services, most of which contribute, directly or indirectly, to the health professional's access to biomedical literature. Chief among these programs and services is interlibrary loan (ILL). In the years just prior to the passage of the MLAA, NLM processed a significant number of interlibrary loan requests for the nation's libraries. With the NNLM program, materials are borrowed first from resource libraries or other member libraries within the region. The number of documents delivered by the NNLM network has grown significantly over the years. The number of documents delivered by the NLM, the RMLs, and the resource libraries went from less than 200,000 in 1969 to more than 1.1 million in 1984 (Bunting, 1987), and recent figures for the total network, which show a volume of over 2 million loans suggest a continued increase.

To assist in the identification of libraries holding a particular journal title, the NNLM has supported a number of union list efforts, concentrating primarily on the submission of serials holding data from as many network libraries as possible to SERHOLD (SERials HOLDings, formerly known as the National Biomedical Serials Holding Database). SERHOLD data are available online and can be manipulated to produce regional union lists in various formats.

Significant increases in interlibrary loan traffic came about with the implementation of the DOCLINE request management system in the mid-1980s. DOCLINE allows a borrowing library request to be automatically routed to a library which, based on SERHOLD, holds the title.

Within some regions, cooperative acquisition programs have been developed to address the issue of the availability of appropriate resources within the region. In the Greater Northwest, for example, interlibrary loan requests were used to identify subject area and serial title gaps, and resource libraries were funded to purchase these needed
materials. The same region has also developed a serials acquisition and retention program called Regional Coordination of Biomedical Information Resources (RECBIR), through which larger libraries in the region have agreed to maintain subscriptions to specified journals.

The last twenty years have seen significant increases in the use of online searching as a way of identifying journal articles of interest. The National Library of Medicine was among the first providers of an online database—MEDLINE—and today provides more than forty databases. Over the years, the RMLs have had a significant level of involvement in the training of searchers, librarians, and, more recently, individual health professionals.

NLM's mid-1980s long-range planning activities included a panel on locating and gaining access to medical and scientific literature (National Library of Medicine, 1986). The Outreach Planning Panel, convened in 1988, extended this work, looking specifically at improving access to health information for the individual health professional (National Library of Medicine, 1989). Among the recommendations of the panel were the use of the RMLs "as a 'field force' for NLM products and services, providing information and services to health professionals directly and through network libraries, and providing feedback from health professionals to NLM" (p. 6) and the acceleration of "intramural R&D on products and services that are optimally responsive to the information needs of health professionals" (p. 8). Since that time, NLM has improved its GRATEFUL MED software, used primarily by individual health professionals to search MEDLINE, and added to it LOANSOME DOC, a feature that allows the individual health professional to submit automated document requests to a specific NNLM library. In 1991, the responsibilities of the RMLs were modified to support increased outreach to individuals through exhibits, training sessions, and the development of specific outreach projects.

The NNLM has had a significant effect on all its member libraries and on the individual health professionals that they serve. Database searching has been fostered and millions of journal articles have been delivered. With the NNLM, health sciences libraries have an organization that supports cooperation and collaboration both within the NNLM regions and nationally.

INTEGRATED ADVANCED INFORMATION MANAGEMENT SYSTEMS (IAIMS)

The IAIMS program of the National Library of Medicine has as its overall goal the creation of mechanisms for effective management of, and access to, medical information within the individual academic
medical center (Goldstein, 1983; Broering, 1986; Lunin & Ball, 1988; Lorenzi, 1992).

The concept of integrated academic information management was originally described in a 1982 study report developed by the Association of American Medical Colleges (AAMC) and sponsored by the National Library of Medicine (Matheson & Cooper, 1982). The study united NLM's questions about how to meet the information needs of health professionals with the emerging reality of the potential benefits of computer and communications technologies and with the value of strategic planning for the better management of health science centers. The report recommended that libraries should lead in supporting the development of prototype information network systems; of programs that encourage the rapid integration of information technologies into health professions, education, and practice; and of programs that attract and retain people in medical information and knowledge base development in academic centers.

In response to AAMC's recommendations, NLM requested proposals to begin IAIMS planning, and four institutions received contracts in the fall of 1983. In 1984, an IAIMS grant program was announced as a part of NLM's extramural programs activity. Grants provided assistance for three sequential phases of: (1) institution-wide IAIMS planning (two years), (2) IAIMS model development and testing (three years), and (3) full-scale implementation of IAIMS projects (five years). In 1992, the IAIMS program was revised to include only two phases: (1) planning (one to two years) and (2) operational (five years) (Lindberg et al., 1992).

Through the end of 1991, forty institutions had made seventy applications for funding of one phase or another of IAIMS activity. From among these, thirty-one awards were made to seventeen institutions and organizations. Currently, five institutions are engaged in funded full-scale implementation activities: Columbia University, Georgetown University, Baylor College of Medicine, Duke University, and the Oregon Health Sciences University. Seven other institutions are in the planning or model development stage: the American College of Obstetricians and Gynecologists, University of Pittsburgh, Yale University, University of Michigan, Tufts University, University of Washington, and Vanderbilt University.

Even more importantly, the concepts of IAIMS have spread beyond the funded institutions. According to Lindberg, West, and Corn (1992): "It appears that the majority of health science centers are beginning to examine the role of information in their institutions, and many are investing resources in systems development and networking. The term IAIMS is becoming a generic acronym for the carefully planned information system" (p. 244).
While IAIMS was created in response to the needs of the academic medical center and remains primarily an activity of those organizations, it may also have relevance to others. A hospital, the Rhode Island Medical Center, received funding for IAIMS planning, and the American College of Obstetricians and Gynecologists is currently in the model development stage. These projects suggest a wider applicability of the IAIMS concept, and, in 1992, the National Library of Medicine changed the name of the IAIMS program to Integrated Advanced Information Management Systems.

The original IAIMS concept placed the library at the center of the program, coordinating and encouraging developments among all units involved in the management and distribution of medical center information. While this has been the case in some institutions, in other institutions, other departments—such as academic computing, clinical computing, or medical informatics—have taken the leadership role. Access to reference material and other information traditionally associated with libraries, however, is a constant feature of all programs.

Each IAIMS is different, although there appears to be a trend toward convergence of objectives and types of solutions as the program matures. Having said that, a description of one of the oldest and most comprehensive IAIMS can nonetheless elucidate the concept.

The Columbia-Presbyterian Medical Center, which includes the Columbia University Health Sciences division and the Presbyterian Medical Center, was one of the initial Phase I IAIMS sites in 1983 and received funding for Phase II in 1986 and Phase III in 1988 (Roderer & Clayton, 1992). Presbyterian Hospital's need to find a better solution to meeting clinical information needs was a major factor in the initial decision to seek IAIMS funding, and clinical systems-related activities have remained a key element of the program. The principal investigator of the IAIMS project, beginning with Phase III, holds the titles of Director of Clinical Information Services for the Hospital and Professor of Medical Informatics and Director of the Center for Medical Information Services for the University, thus representing both clinical systems and medical informatics units. The director of the Health Sciences Library at Columbia was instrumental in deciding to seek IAIMS funding and has played a major role in all three phases.

The goal of Columbia's IAIMS is expressed as "one-stop information shopping" (Roderer & Clayton, 1992, p. 253), that is, access from a single workstation to clinical, research, and library resources; university and hospital administrative systems; and utility functions such as word processing and electronic mail. An extensive network and a variety of host computers/servers provide access to
Clinical results reporting
- laboratory
- pathology
- operative reports
- obstetrics
- admit-discharge history cardiology
- head and neck
- GI endoscopy
- clinical profile (physician data entry and review)
- radiology
- discharge summary
- neurophysiology
- labor and delivery
- demographic profile

Clinical decision making
- surgery scheduling
- medical records DRG coding
- medical records
- chart tracking/chart deficiencies

Scholarly information systems
- Galen MEDLINE
- Columbia Textbook of Medicine
- Columbia Library Information Online
- Concise Electronic Encyclopedia
- anatomy textbook
- Physician's Desk Reference
- NIH Clinical Trial Alerts

Other
- mail
- phone directory
- word processing/spreadsheets
- grants and contracts newsletter
- hospital and university administrative systems
- laboratory-supported research initiatives

Figure 2. IAIMS resources and applications at Columbia-Presbyterian Medical Center. (Source: Roderer, N. K. & Clayton, P. D. (1992). IAIMS at Columbia-Presbyterian Medical Center: Accomplishments and challenges. Bulletin of the Medical Library Association, 80(3), 256.)

A growing number of databases and applications; Figure 2 shows the available items as of January 1992. At that time there were more than 2,700 active users of the system, making more than 7,000 data inquiries on an average workday. Also on an average workday, there were about 160 logons to MEDLINE, the most frequently used of the scholarly information sources available.

The IAIMS experience of other sites as well as Columbia supports the hypothesis that IAIMS programs can improve information
delivery to the health professional. These early experiences suggest
that health professionals will make more extensive use of information
when it is readily available from a convenient workstation, and that
there is value in the ease with which multiple resources can be
consulted. IAIMS brings together the many organizational units
involved in information, allowing them to work together in providing
coordinated access to their multiple resources.

The role of the library is somewhat different in each of the IAIMS
programs, but most include major library contributions (Lorenzi,
1992). As noted earlier, the library at Columbia has been playing
a significant partnership role in the IAIMS program there. At
Georgetown, the other site nearing completion of its Phase III
funding, the director of the library serves as principal investigator
for the grant, and initial services were concentrated in the areas of
library and other educational support materials, later adding clinical
sources. At the University of Washington, a site now in the Phase I
planning stage, the director of the library is also the principal
investigator and initial projects are broadly addressed to meet needs
in the areas of bibliographic retrieval, curriculum support, clinical
systems, and campus-wide information systems. At Yale, a site now
in Phase II, the library plays a significant partnership role, working
closely with the Center for Medical Informatics in a project involving
the provision of library information, curriculum support, and clinical
information.

**National Research and Education Network**

Key to the rapid and widespread dissemination of biomedical
information is effective communication and delivery channels. We
are rapidly moving from a scientific and technical information system
in which publication time is measured in months and years to one
in which new information is available in hours or days, and from
a system where access to materials is measured in days and weeks
to one of almost instantaneous access. These changes will not be
possible without the widely available communications infrastructure
anticipated by the NREN (Lynch & Preston, 1990; Parkhurst, 1990).

Communication among computers was first demonstrated in the
1940s, and, by the 1960s, there was widespread access to remote
computers and databases via telephone lines. In the medical world,
this capability led to the development of MEDLINE, allowing
libraries with terminals and modems to access that large bibliographic
database. The 1970s and 1980s were the time for new levels of
networking development with the proliferation of local- and wide-
area computer networks (LANs and WANs), with LANs linking
computers within a limited geographical area via a common
A major networking activity in the 1970s was ARPANET, developed by the Advanced Research Projects Agency (ARPA) of the Department of Defense. Here the concept of the Internet, a loose collection of multiple wide-area networks connecting myriad institutional LANs, was developed and institutionalized. By the late 1980s, the National Science Foundation put into place a new national wide-area network called NSFNET, which took the place of ARPANET as a critical part of the Internet backbone and signaled a role for the Internet as supporting the research and educational community. By 1990, the Internet included hundreds of institutional or corporate local-area networks, a series of NSF regional networks, the NSF backbone as the primary transcontinental traffic path, and a range of agency-specific or experimental networks. It provided connectivity among perhaps half a million computers and over 1 million people, most of them within the research and higher education community.

The concept of national networking continued to expand, first with the introduction of a series of legislative proposals for the NREN, and, more recently, with the High Performance Computing and Communications (HPCC) Program. NREN is envisioned as a high-capacity national research and education network combined with an information infrastructure of databases, services, and knowledge banks. HPCC is a multi-agency program initiated by the President's Office of Science and Technology to strengthen research and education nationwide. One of HPCC's four components is NREN; the others are advanced computer hardware design, advanced software technology, and basic research and human resources, which focuses on training in the design and use of high performance computing systems. HPCC was authorized in late 1991 under Public Law 102-194, which mandates the creation of NREN as an experimental test bed for high speed computer networking by 1996.

To coordinate these efforts, the National Coordination Office for High Performance Computing was established in summer 1992 and National Library of Medicine Director Donald Lindberg was named director. This appointment intensifies the role of the National Library of Medicine, already heavily involved in the HPCC program. Other libraries and librarians are also heavily involved in NREN planning. In 1990, EDUCOM (a consortium of colleges and universities combining the technology of computers with higher learning), CAUSE (an association for the management of information
technology in higher education), and the Association of Research Libraries (ARL) announced the formation of a joint coalition to promote and address issues related to the availability and role of information resources on the NREN, and this group provides a good forum for collaborative efforts to define the NREN and to address related issues. Librarians can, and should, participate in addressing such NREN-related issues as intellectual property rights, standards, licensing and service arrangements, charging algorithms and cost recovery fees, economic models, and the identification of information resources for the network (Peters, 1992).

**Unified Medical Language System (UMLS)**

Articles, or other information of interest, can be identified in many ways—from the health professional’s prior knowledge of an item in his or her files, from a reference by a colleague or other article, by browsing through potentially relevant materials, or by using an index. Indexes were developed when the volume of the journal literature reached the point that a more sophisticated scheme of organizing the literature was required (Price, 1961). A second significant development in the area of tools for finding journal articles came as the paper indexes were computerized. While early online databases were essentially replications of the printed indexes, today’s bibliographic databases allow increasingly extensive searching to be done much more quickly, and the online databases are used much more frequently than were the print indexes.

The effectiveness of online searching depends heavily on the search techniques used, with probably the most important element being the vocabulary used for describing and searching for articles. The National Library of Medicine is the author of a very sophisticated controlled vocabulary, Medical Subject Headings (MeSH), but there are also many other controlled vocabularies related to biomedical topics, each designed with particular subject areas and purposes in mind. Thus the same concept can be addressed in a variety of ways in different machine-readable databases (as well as by different individuals), and the health professional seeking information in those databases must approach each with the appropriate vocabulary terms. A second barrier to effective use of online databases is the difficulty of addressing which of many databases have information relevant to particular questions; with more and more databases readily available, this is increasingly a problem.

In 1986, the National Library of Medicine began a long-term project to address these issues. The goal of the UMLS effort is to give practitioners and researchers easy access to machine-readable information from diverse sources—which include scientific literature,
patient records, factual databanks, and knowledge-based expert systems—by building an intelligent automated system that "understands" the meaning of biomedical terms and their relationships (National Library of Medicine, 1991, 1992).

UMLS is an ongoing project of the NLM that includes participation from an internal NLM research and development team and several contractors, currently Lexical Technology, Inc.; Massachusetts General Hospital; Brigham and Women's Hospital; the University of Pittsburgh and its subcontractor the University of Utah; Yale School of Medicine; and Columbia University.

Three knowledge sources make up the UMLS:

1. a Metathesaurus containing information about biomedical concepts and their representation in different vocabularies and thesauri;
2. a Semantic Network containing information about the types or categories (e.g., physiologic function, body system, health care activity) of terms in the Metathesaurus and the sensible or permissible relationships among these types (e.g., injury or poisoning disrupts physiologic function);
3. an Information Sources Map or directory containing information about the scope, location, vocabulary, and access conditions and protocols of biomedical databases.

The strategy for development of the UMLS is to build successive approximations of the capabilities ultimately desired. The knowledge sources have thus been issued in several experimental editions to date, and experimentation on a wide variety of information problems is encouraged. The first experimental edition of the UMLS Knowledge Sources was issued in 1990, containing initial versions of the Metathesaurus and the Semantic Network. During fiscal year 1991, NLM distributed 160 copies of this edition to medical libraries, university research groups, and commercial companies in the United States for their review and use.

To date, a wide variety of projects have used the knowledge sources for such activities as linking patient records to relevant MEDLINE citations, analysis of medical and dental school curricula, user query interpretation, and natural language processing. NLM itself has applied the UMLS components in its COACH expert system and to research in natural language processing.

In late fiscal year 1991, the second experimental edition of the Knowledge Sources, containing the first version of the Information Sources Map plus second versions of the Metathesaurus and Semantic Network, was sent again to interested organizations. Ongoing efforts of NLM and its UMLS contractors are directed at expanding the
content of the knowledge sources, establishing production systems for ongoing expansion and maintenance of the knowledge sources, and developing and implementing applications that rely on these knowledge sources.

Many of the groups working with the experimental editions of the Knowledge Sources are libraries, including the University of Maryland, which has an NLM grant to develop a Metathesaurus browser. Library experimentation is especially appropriate since libraries and their users will be among the major beneficiaries of operational Knowledge Sources and applications based on them. In a future scenario of the user's effort to identify a source of interest, for example, that user (or a computer system acting on his or her behalf) might consult the Information Sources Map to identify and connect to relevant resources and then consult the Metathesaurus and Semantic Network to develop queries in the vocabularies of those resources. This process, of course, closely parallels traditional library activities, and librarians have a role to play both in the development and testing of the UMLS.

The Electronic Journal

A large set of organizational and technological issues cluster around the electronic journal. This last of the program areas described as having a significant impact on medical libraries over the last twenty years is not, like the first four, a government-sponsored effort but is rather a collection of initiatives by different groups seeking to take advantage of technology to improve the reporting and distribution of research results and other information.

Journals have existed for over three centuries, and a complex system of support has evolved. As noted earlier, this system involves a number of players—publishers, abstracting and indexing services, database vendors, and libraries and other information centers as well as the users themselves.

As the number of users and articles has grown substantially, the system has been strained, and identifying and accessing relevant materials in a timely fashion has become increasingly challenging. An early response to the demand for a range of articles was interlibrary loan, which has been formalized and extended through new organizations and technologies. Medical libraries led the way here, and the existence of the NNLM and of DOCLINE have played a significant role in improving interlibrary loan within the biomedical community. In recent years, delivery of both requests and the actual articles has been speeded up by the use of facsimile machines, and projects such as the Research Libraries Group's ARIEL, which provides computer-to-computer transmission of scanned articles, offer
even greater potential for quick transmission of high-quality copies (Research Libraries Group, 1991).

Another development involves the use of computer technology to make an initial distribution of journal articles in electronic form, providing the advantages of reduced storage space and ease of duplication. One such system, highly relevant to the health sciences, is ADONIS.

ADONIS is the result of efforts by a consortium of publishers, and is a system that provides a large number of journal articles in electronic format, currently CD-ROM. A CD-ROM is distributed each week, and the system also includes software for searching the CD-ROM and the ability to print articles, with graphics, as they appear in the original print journal. Costs for a library subscribing to ADONIS include a subscription fee plus copying fees.

These developments are all concerned with the delivery of the traditional published-on-paper journal article. Other developments move toward elimination of the paper copy and, in at least some cases, use of the capabilities offered by computers to make changes in the form of the publication.

A few journals are published exclusively in electronic form. In the biomedical arena, The Online Journal of Current Clinical Trials, a project of the American Association for the Advancement of Science and OCLC, provides online access to reports of new clinical trials as soon as they are published. Abstracts of all sources cited as references are readily available, and corrections, retractions, and letters to the editor are connected to the original reports.

Another journal of note published only in electronic form is The Public-Access Computer Systems Review, developed by the University of Houston Libraries (Bailey, 1991). The Review grew out of PACS-L, a computer conference set up to allow librarians to discuss issues related to computer systems. It was established, in part, to help librarians explore the many issues associated with electronic publications. These issues, ranging from the practical considerations of how to identify, control, and provide access to the new journals to more complex issues of intellectual property rights and economics, will require both extensive discussion and experimentation before it becomes clear how the electronic journal will best fit into the array of library services.

Going yet another step beyond the totally electronic journal, there has long been discussion of an electronic alternative to journal publication, in which articles would be maintained in, and distributed from, a central electronic store. This concept was explored extensively as long ago as the late 1970s, as the federal government sought to consider what might be the long-term effects of the then-emerging
technologies (Ackoff, 1976; King & Roderer, 1978). More recently, Rogers and Hurt (1989), writing on "How Scholarly Communication Should Work in the 21st Century"; envisioned a "Scholarly Communication System," an electronic network on which scholars in all disciplines could publish their articles and read those of others. As a scholar completed an article, he or she would submit it to the system. After a period of being available for comments, the article would be reviewed by peers and categorized, as a "Logical extension of research in a field," "Restatement or interpretation of existing research," or "No scholarly contribution" (p. A56). Management groups would supervise each content area, specifying and arranging the review process. Authors would receive royalties, and these and the other costs of the system would come from membership fees and usage charges.

Such a system would radically change articles as we know them—the articles would no longer be packaged together into regularly distributed issues and volumes nor as a particular journal title. Additional features could be available—provision for notes and comments on articles, citation tracking, usage logs, searching of the full text of articles, and links among related articles.

Schatz (1991) extends the concept of a research reporting system even further, building on the capabilities of computer networking to describe a community systems project that collects "all" the knowledge of a scientific community—articles, data files, images, bibliographic citations, bulletin board messages, and others—into a digital library and developing the system's technology to transparently manipulate the library over nationwide networks. The community system that he envisions would encode all of this knowledge into an information space, with the goal of supporting retrieval and annotation of formal and informal data and information for any individual with a personal computer and network access.

Librarians are heavily involved in developing and testing these new forms of journals and must continue to be involved if their users are to be well served. The library provides an important test bed through which users can be reached, and the librarian's perspective on the overall journal communication system will help to ensure that the evolving journal forms bring continuing improvements.

CONCLUSION

The last twenty years have seen extensive changes in biomedical communications, and librarians have been active players in incorporating new developments into their organizations. Health sciences librarians have extended the range of materials handled,
particularly through the IAIMS emphasis on integration of information sources and with the emergence of new forms of journals. We have improved the delivery of information and materials through the interlibrary loan and search training activities of the NNLM and through the information workstation concept of IAIMS, and delivery is beginning to be affected by the search assistance developed under the UMLS program and by the rapid communications capabilities of the Internet and the NREN. NLM's emphasis on outreach has focused attention on the provision of library services to users beyond the local institution. Significant technological and organizational changes have come with all these new developments and will no doubt continue.

With the many changes in health sciences libraries over the last twenty years has come a significant level of speculation and concern about the future of the library and of the librarian. It is certainly true that many of the specific activities carried out by librarians have changed, and it seems inevitable that there will be more changes to come. At the same time, the mission so aptly described by Louise Darling (1974)—that of communications center working actively with information materials of all kinds, close at hand or distant, for health professional users in the community as well as in the institution—still remains critical and continues to challenge us.

REFERENCES


alternative to communication through paper-based journals. Rockville, MD: King Research, Inc.


Access to Biomedical Information: 
The Unified Medical Language System

STEVEN J. SQUIRES

ABSTRACT
THE NATIONAL LIBRARY OF MEDICINE (NLM) is engaged in a long-term project to develop a Unified Medical Language System (UMLS) that will retrieve and integrate information from a variety of information resources. Two UMLS components use fundamental aspects of controlled vocabulary structure and management and their relationship to information retrieval that have general interest for librarianship. The UMLS project is described along with its initial deployment in retrieval environments.

INTRODUCTION

Bibliographic control of information has traditionally focused on locating and describing published documents, and indexing these in useful ways. In every subject domain, the problem of erecting a complete record of existing information is more or less acute, depending on the available support for and interest in comprehensive collections and provision of access. In the biomedical domain, due to its societal importance and to generous government support, the problem of finding and describing the published literature is not great in spite of the size of that literature. As chronicled by Adams (1981) and, more recently, as listed by Tilley (1990), massive government and private efforts are in place for building and maintaining bibliographic and reference databases and online systems that describe and index the biomedical literature.
More and more, however, important information has developed in forms other than the published record. In biomedicine, these include clinical databases and patient records. In these databases, the mechanisms for record creation, maintenance, access, and exchange are not as structured as for bibliographic data. The focus of bibliographic control has had to include describing and structuring records and retrieval tools that permit effective use of information in a large number of diverse information sources.

In spite of the ability of machines to search on any element of stored data, controlled vocabularies are still widely used to index information and to produce effective retrieval. Many different terminologies exist, even within the same subject domain, that have been created to organize and retrieve data for specific purposes. The Unified Medical Language System (UMLS) is conceived as a means of navigating among a disparate array of databases organized using different terminologies. Except perhaps for work in automated indexing, to which the UMLS is not unrelated, this effort is possibly the most important development in biomedical bibliographic control in recent years. This article will describe UMLS components, their potential uses, and some current efforts to incorporate them into retrieval environments. Efforts to evaluate UMLS are noted along with areas for future development.

Purpose of the Unified Medical Language System

In the mid-1980s, as the growth and development of electronic means of storing information progressed, and as computational and telecommunications resources for using that information proliferated, the National Library of Medicine recognized a need to assist the biomedical world in using the new resources and capabilities now more or less easily at hand. Its Long Range Plan of 1986 presents a comprehensive program of research, resource development, and educational endeavors to provide that assistance. A central part of that plan is the Unified Medical Language System.

Humphreys and Lindberg (1989) and Lindberg and Humphreys (1990) make the case for a UMLS. Their argument starts with the observations that useful biomedical information can be found among an increasingly large number of machine-readable databases, that these databases are different in important ways, and that these differences are among the barriers to effective use. Databases differ by content and by how that content is represented and described. They also differ by means of access. As users are confronted by the ever larger array of different databases, it is increasingly difficult to identify which databases have information relevant to a particular query. Users, too, have different ways of expressing the many concepts
represented in databases and, as a result, formulate queries about those concepts differently. There is a lack of a universally recognized and accepted standard vocabulary for expressing biomedical phenomena and for recording health care events and transactions. Once information is found in a database, the need arises to organize it and possibly evaluate it for its intended use. The UMLS is meant to compensate for these problems, not by imposing uniformity on the diverse world of terminology and databases, but by minimizing the differences about which a user of information sources has to be aware (Lindberg & Humphreys, 1990, p. 121).

These problems are, of course, not new in the information world. Perhaps the most important aspect of the UMLS approach is its "unified" nature, its attempt to provide a single utility through which access to the variety of biomedical databases can be gained, and by which information from them can be easily retrieved and integrated.

**Development of the UMLS**

The UMLS project was initiated in 1986 by two years of investigation involving research at NLM and research contracts awarded to academic institutions. The initial research resulted in decisions to create three new knowledge sources: a Metathesaurus, a Semantic Network, and an Information Sources Map. The Metathesaurus combines and integrates existing biomedical nomenclatures and relates them to each other. The Semantic Network is a scheme of general categories to organize the terms of the Metathesaurus. The Information Sources Map is a directory of information about biomedical databases that will support source selection and automatic connection and retrieval from them. Each of these will be described in some detail later.

The next three years saw the creation and testing of the three knowledge sources. In 1990, the first versions of the Metathesaurus and the Semantic Network were issued. Revised versions of the first two knowledge sources appeared in 1991 along with the first version of the Information Sources Map. New versions of each component are anticipated annually. The components are issued in multiple formats and in both unit record form and relational form (Cimino et al., 1992, p. 1502). They can be used in MS-DOS, Macintosh HFS, and UNIX environments. The Macintosh version includes MetaCard, a hypercard application for browsing the Metathesaurus (Sherertz et al., 1989), and NET, a graphical browser for the Semantic Network, to facilitate use.¹

Interest will naturally focus on the new knowledge sources and their eventual use in a fully developed UMLS, but the development strategy itself and the extent of its success should also be evaluated.
as an example of cooperative endeavor shared by the public and private sectors. To encourage experimentation and feedback, the UMLS components are being made available free of charge to anyone agreeing contractually to provide feedback and suggestions for improvement (Humphreys & Lindberg, 1992, p. 1496). Based on this feedback, the components will undergo iterative development but will be available in successive if incomplete stages for use. As of January 1993, more than 300 institutions and individuals had asked for copies. Included were universities, hospitals, government research centers or health care agencies, and commercial companies. About 20 percent of the recipients are outside the United States. The usefulness of the UMLS components will be explored by copy recipients in a variety of patient care, medical education, library service, and research environments. Specific applications will involve indexing and coding of data, knowledge representation, natural language processing, user interface development, and information retrieval from multiple databases.

Reports about the project from NLM and from experimental users have appeared since its inception and have included conceptual discussions underlying the creation and content of the knowledge sources, descriptions of the knowledge sources as they appeared, and reports of experimental uses to which the knowledge sources have been put. These reports have largely been made at medical informatics conferences (Annual Symposium on Computer Applications in Medical Care, World Congress on Medical Informatics) and in medical computer journals and not in the general library literature. However, UMLS development makes use of, and has general application for, fundamental concepts about thesaurus construction and the organization of information by means of controlled vocabulary and classification that have long been a part of standard library practices. The UMLS developers have had to confront and resolve problems involving the distinction between word and phrase, the notion of concept, the definition of synonymy, the effectiveness of pre-coordination versus post-coordination, organization through hierarchy, the “relatedness” of concepts, and the usefulness of all of these both for retrieving information and for creating knowledge sources. Lessons learned in this effort could influence nomenclatures and their use everywhere.

It is important to recognize that the knowledge sources being created do not, by themselves, constitute a UMLS system. They are only tools to be exploited by systems developers who, in response to local needs or for enterprising reasons, will create functional components. For example, Lindberg and Humphreys (1989) include among possible functional components a query interpreter capable
of using natural language understanding systems to translate the natural language of user queries or from clinical records into standard expressions. For the next steps in an information quest, a search formulator and transmitter could turn a query into search statements appropriate for a chosen database and would then communicate the search to the database. Following that, information retrieved from databases could, through an output processor, be merged, ranked, and displayed according to parameters defined by the user. Any such components would interact with the UMLS knowledge sources in appropriate ways.

The UMLS Metathesaurus

The first UMLS knowledge source to be created was the Metathesaurus (Meta). As with the UMLS as a whole, it is equally important to realize what the metathesaurus is not. Though its name might imply otherwise, it is not created to be a monolithic universally accepted vocabulary to replace all existing biomedical nomenclatures. It is rather a synthesis of existing vocabularies, achieved by linking, merging, and integrating them. Using existing vocabularies gives Meta an empirical grounding. The Metathesaurus is comprised of biomedical terminology “as it is used” (Tuttle et al., 1988). Thus, Meta endeavors to represent only the meanings of terms that are implicit in the sources from which it was constructed. This means preserving the contexts established for those meanings by the source vocabularies in their structures, including the use of definitions, hierarchies, and other term relationships.

Integrating the thesauri serves two further purposes (Bicknell et al., 1988). It maps them to one another, thereby creating pointers from every concept in the separate thesauri to the most appropriate equivalent concept in the others. This addresses the UMLS objective of translating a user query into a search strategy for a given database that is indexed by a given thesaurus and making this process transparent to the user. Integration also merges the thesauri, thereby creating a more comprehensive knowledge base with a deep level of synonymy. This addresses the UMLS goal of providing an adequate knowledge base for interpreting natural language user queries and linking those queries with appropriate databases.

The biomedical terminologies chosen for integration into the first two versions of the Metathesaurus fell into two sets (Lindberg & Humphreys, 1990, p. 123). The first set included Medical Subject Headings (MeSH), Diagnostic and Statistical Manual of Mental Disorders (3d rev. ed., American Psychiatric Association, 1987), and the 400 most frequently used terms representing clinical problems and manifestations in clinical records at three COSTAR (Computer
Stored Ambulatory Record) sites. All nonequivalent terms from these sources became the base set of terms in the Metathesaurus. Terms from the second set of sources that could be related to the base set were then included. Thus, not all terms from these vocabularies became Meta entries. This second set of sources were the Systematized Nomenclature of Medicine (SNOMED) (2d ed., College of American Pathologists, 1986), the International Classification of Diseases, 9th Edition, Clinical Modification (2d rev. ed., Washington, DC, 1990), and Physicians' Current Procedural Terminology (4th ed., American Medical Association, 1989). Finally, the first two versions of Meta included selected terms from Library of Congress Subject Headings mapped to MeSH by NLM staff. Successive iterations of the Metathesaurus will include fuller integration of all source vocabularies.

BUILDING THE METATHESAURUS

The means by which the selected thesauri were integrated incorporated semi-automated lexical matching combined with knowledge of the relationships among terms explicit in the structures of the source vocabularies. Tuttle et al. (1988, 1989), Sperzel and Tuttle (1989), and Sherertz et al. (1989b) demonstrate the utility of automated lexical matching for finding equivalencies among a diverse set of vocabularies. Machine versions of the source vocabularies were obtained and the terms from those vocabularies were expressed in a uniform manner to facilitate lexical matching among them. The terms from the first set of source vocabularies were compared and a single preferred term, or canonical term, was selected for any identical terms, lexically variant terms, or lexically variant synonyms of terms. Lexical variants can be terms that are different only because of case, number, word order, spelling, or punctuation. When terms from different source vocabularies were found to be identical, or only lexically variant forms of one another, the preferred term for the Metathesaurus entry was established by an order of precedence. If a term from among a set of identical or lexically variant terms was a MeSH term, that term became the Meta entry. The vocabularies following MeSH in order of precedence were DWM-IIIR, SNOMED, ICD, CPT, LCSH, and COSTAR. Once a canonical term was determined, other terms from the set of equivalent terms could be labeled as lexical variants, synonyms, or lexical variants of synonyms.

Though the term relationships and information about terms that result from the processes described earlier and the human editing that followed are stored in several relational database files, a database management system could be devised to present all the information about a single term as a comprehensive entry or record for that term.
This conceptual record structure of Meta would then consist of entries for concepts with fields or slots that contain terms related to the concepts or that describe or name attributes of concepts. Tuttle et al. (1989) enumerated the essential slots, as follows:

- Concept Name
- Meta Unique Code(s)
- Syntactic Category (part of speech)
- Lexical Tag (if term is an abbreviation, acronym, etc.)
- Semantic Type (assigned from Semantic Network)
- Source Vocabulary or Vocabularies
- Source Hierarchical Contexts
- Source Definition(s)
- Lexical Variants
- Synonyms
- Related Terms
- Broader Terms
- Narrower Terms

Other attributes of terms include use data, described later, data necessary for thesaurus maintenance, and, if the Meta term is a MeSH term, up to twenty-five data elements derived from the annotations in the MeSH vocabulary.

After the first version of Meta was compiled, the result was subjected to human editing, described by Sperzel et al. (1990). Semantic types and lexical categories were assigned at this step. Editors also evaluated the automated assignments of synonyms, related terms, broader or narrower terms, and lexical variants if these appeared obviously incorrect. The results of human editing had to have their own audit trail, so that new versions of the Metathesaurus computed from updated versions of the original source vocabularies would have the desired result (Sherertz et al., 1990). Tuttle et al. (1992) warn local users of Meta about the consequences of adding local terms to it, since these enhancements would have to be maintained over new releases. He calls for a standard updating method generally adopted that would facilitate both local maintenance and Meta improvement.

Three versions of Meta have been released to date (Meta-1, Meta-1.1, Meta-1.2). The number of concepts grew from approximately 63,000 in Meta-1 to more than 67,000 in Meta-1.1, to approximately 130,000 in Meta-1.2 that was issued in October 1992. Whereas the first two versions contained three kinds of entries—for concepts, related terms, and synonymous terms—the third version has only a single kind of entry, that for concept. Responding to feedback from the first two releases, Meta developers structured the information in Meta to simplify its extraction and manipulation and to make it
easier to conceive of Meta as an abstraction (Tuttle et al., 1993, p. 301). The data that were once distributed in more than fifty separate tables are, in the third version, distributed among only twelve tables. The twelve tables fall into four categories: concepts (one table), relations between concepts (two tables), attributes of concepts (eight tables), and a word-based index Metathesaurus string. In the future, the simplified format may be expressed using the ASN.1 (Abstract Syntax Notation 1) standard, part of the Open System Interconnection Standard. It is hoped that adopting this standard will encourage its use, particularly among the source vocabulary developers, thereby facilitating future collaboration and Meta enhancement (p. 303).

USE DATA IN THE METATHESAURUS

One other attribute of Meta entries remains to be discussed. For those terms in Meta derived from MeSH, "use" data have been gathered and recorded in Meta. This is perhaps the most unique kind of term information in the Metathesaurus. These data may be of three types: occurrence data, data on subheadings used with a term, and co-occurrence data (Humphreys & Schuyler, in press). These kinds of data were originally only computed from MEDLINE but now are included for PDQ (Physician's Data Query), OMIM (Online Mendelian Inheritance in Man), DxPlain, and QMR (Quick Medical Reference). Occurrence data consist of the number of citations to articles in which the concept was a main point, thereby representing that a specific concept is present in an information source and to what degree. Subheading data list which MeSH subheadings have been applied to the concept in indexed citations and the frequency with which each subheading was applied. Such information provides insight into the important separate aspects of a concept. Co-occurrence data record the number of citations in which two terms co-occur as primary concepts. Such data tell us that two terms have been used together in a database and with what frequency. In the Metathesaurus, these co-occurring terms to a concept can be arranged by the semantic type of the co-occurring terms.

Co-occurring data are another example of the empirical nature of Metathesaurus data. That two concepts have been observed in some context to occur together suggests that a relationship exists between them (Nelson et al., 1992, p. 212). That this information has some potential usefulness in information retrieval is suggested by the fact that only a very small percentage of the possible co-occurrences of MeSH terms have actually occurred. A potential use of the different sets of use data will be in determining in what database a query is likely to be successful. Subheading information can be used in interactions with a user to focus or to expand a query (Humphreys
& Schuyler, in press). As effective retrieval use is made of this kind of data, future versions of the Metathesaurus will tabulate use data for more databases, and local implementers may want to add it for local databases or hospital patient records.

Some experimenters have already found interesting applications for the use data. Merz et al. (1993) have developed Question & Answers (Q & A), a system that matches user query terms to Meta to find appropriate retrieval terms and then uses the occurrence data of the Meta terms to estimate the number of articles that would be retrieved by the terms. Depending on this estimate, the program may attempt to improve the search strategy. Q & A is thus a procedure that interacts with Meta for performing retrieval estimation and query refinement before a search.

Miller et al. (1993, p. 88) make use of co-occurrence data to link terms found in patient charts to bibliographic retrieval in MEDLINE. Words from a patient chart are matched to Meta terms. For each identified Meta term so matched, its co-occurring terms are then matched to the other Meta terms from the chart. The list of terms resulting from this two-step matching process represents terms that both appear in the chart and are related via MEDLINE indexing. Searches using these terms are guaranteed to produce retrieval.

THE UMLS SEMANTIC NETWORK

Each concept in the Metathesaurus derives one of its attributes from the second of the UMLS knowledge sources, the Semantic Network. The purpose of this component is to provide a consistent categorization of all concepts in the Metathesaurus and to supply a set of useful relationships among them (McCray, 1989, p. 504). It defines the types of categories to which all concepts in Meta can be assigned and the permissible relationships that can exist between the types.

The work of Miller et al. (1988a, 1988b) established the utility of semantic relationships in medical bibliographic retrieval. They found that vocabularies capture some semantic relationships, in pre-coordinated terms or by applying term subheadings, but that many more are possible. Individual terms may be present in documents or in their indexing that may yield the desired bibliographic retrieval, but often a specific relationship between terms most precisely expresses the topic. Some ability to make use of these relationships in bibliographic retrieval is desirable. Good information retrieval is limited by the lack of such an ability and it is one not handled by Boolean capability (Appel et al., 1988, p. 152). Knowing how two terms are related to each other in a document allows specification of a topic in ways unexpressed by the mere co-existence of terms.
or even by terms in close proximity. Also, knowing which relationship between two terms that is operable in each document of a set of documents in which the two terms occur can usefully partition that set (Miller et al., 1988). In the face of an acute need for improving retrieval relevance, pursuit of term relationships as a retrieval device is promising. It is to this goal that the Semantic Network is addressed.

The primary relationship between terms in Meta is a hierarchical one, sometimes called the "is-a" link. Therefore, the types of the semantic network are arranged in a hierarchy. The value of such a structure lies in the inheritance property (McCray, 1989, p. 504). By this property, a category is understood to inherit the "is-a" relationship to each category higher than itself in the hierarchy. A computational advantage of this feature of hierarchical organization is one of efficiency; information about terms or categories found at higher levels need not be repeated at lower levels.

To take full advantage of possible term relationships in information retrieval requires that other nonhierarchical relationships also be identified. Here is where the UMLS differs from other nomenclatures, where only the "is-a" relationship is implied or where associated terms are merely identified as being related. The relationships that are important to define depend on the subject domain of the vocabulary. Therefore, not all possible linguistic relationships between semantic types are in the Semantic Net (McCray & Hole, 1990). Some of the relationships important for the biomedical domain are illustrated by the following general formulations: A causes B, A is a process of B, A is a property of B, A uses B, A treats B, A is exhibited by B, A evaluates B. These relationships will be organized in the Semantic Net into four broad categories: physical relationships (e.g., part of, consists of, contains), temporal relationships (precedes, co-occurs with), functional relationships (causes, produces, affects), and conceptual relationships (measures, assesses) (McCray, 1989, p. 505). In contrast to the hierarchical "is-a" relationship, these other relationships are not necessarily inherited and they may not even hold between any two instances of semantic type terms.

As with terms in the Metathesaurus, types in the semantic net constitute conceptual entries or records, having fields that define them. The slots in each record include the name and system identifier for the type, a positional number from the hierarchy of types, a definition, and the hierarchical links to a type's parents or children. If the semantic type is itself a relationship, the slots comprise the name of the relation, the name of the inverse of the relation, a definition, and the semantic types that can be linked by this relation (Lindberg & Humphreys, 1990, p. 124).
Following are examples of records for a semantic type and a semantic type relationship (McCray & Hole, 1990):

<table>
<thead>
<tr>
<th>Type</th>
<th>Relation</th>
<th>Identifier</th>
<th>Identifer</th>
<th>Position</th>
<th>Inverse Relation</th>
<th>Definition</th>
<th>Definition</th>
<th>Links</th>
<th>Type Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animal</td>
<td>exhibits</td>
<td>T008</td>
<td>T136</td>
<td>A.6</td>
<td>exhibited-by</td>
<td>An organism with</td>
<td>Shows or</td>
<td>is-a conceptually-related-to</td>
<td>Organism-Behavior</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>eukaryotic cells, lacking</td>
<td>demonstrates</td>
<td></td>
<td>(p. 130)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>stiff cell walls, ...</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The first version of the Semantic Network consisted of 133 types. The 1992 version contains 134 types and 47 relationships. A semantic network of this small size consists of categories that are necessarily broad in scope, and it may consequently have limited effectiveness. The types are assigned, after all, to over 130,000 Meta terms. For example, looking at the set of terms having the same semantic type may not be very useful. The broad scope may have been necessary because the biomedical domain itself is wide, including not only the life sciences and their medical application, but also the social, economic, and demographic aspects of health care delivery. Another characteristic of the network is that the depth of its hierarchy varies—i.e., some categories are not subdivided to the degree possible. The need for hierarchical depth varies, again, depending on the domain. Knowing a term's semantic type along with the level that type occupies in a conceptual hierarchy gives some clues about a term's importance and meaning relative to its domain. It remains to be seen whether hierarchical scope and depth can be usefully exploited for information retrieval.

The possible uses for the information embodied in the Semantic Network are easy to imagine but difficult to realize in an automated environment and await software development for full exploitation. The semantic types should, nevertheless, make it possible for computer systems to organize biomedical concepts effectively and to reason about the possible and probable relationships among different types of concepts (Lindberg & Humphreys, 1989). Such systems may employ linguistic parsing techniques for automated indexing of biomedical literature or automated analysis of clinical data. Use of the Semantic Network may assist in query formulation, interactive query refinement, or simply graphical browsing of the Metathesaurus (McCray & Hole, 1990).

Future editions of the Semantic Network may see additional relationships among existing semantic types and the addition of new...
semantic types. Adding new semantic types naturally involves possible reassignment of semantic types to Meta concepts, increasing the complexity of the updating program.

Bishop and Ewing (1992) have suggested that the UMLS developers missed an important link between the Metathesaurus and the Semantic Network by not relating Meta unique term identifiers to semantic types in some way. Meta does not use a hierarchical coding scheme, as do most of the vocabularies being merged. Coding of concepts is helpful for establishing consistent recognition of concepts as opposed to the names for concepts (names may change over time and among environments), for recognizing concepts in different languages, and for efficiently maintaining compatibility between systems. Meta uses random coding, that is, a coding that carries no information about how one concept is related to another. Were the coding itself to reflect in some way the hierarchical relationships among terms as represented by the semantic types, users could more easily extract classes of concepts. Bishop and Ewing (1992) further suggest that, even though most existing coding schemes differ stylistically, the hierarchies they are based on are quite similar and could form the basis of an ideal arrangement of medical knowledge for the future. The UMLS developers might have extended the idea of thesaurus integration, with its empirical founding, to the Semantic Network that purports to organize the concepts in them.

**The Property of Semantic Locality**

Because it functions as a thesaurus, the Metathesaurus is fundamentally a device for organizing meanings. It should do this in a way that permits a user seeking a term for a meaning to find that term by navigating its relationships to other terms. A thesaurus makes this possible by giving to each of its terms a semantic locality. Semantic locality has other uses as well, including establishing what is generally relevant to a given concept, or what may be relevant in a given situation (Nelson et al., 1992, p. 213).

The provision of semantic locality in the UMLS is particularly generous and goes beyond other thesauri. It is provided by semantic types; by term information that includes synonyms, related terms, and lexical variants; by co-occurrence data; and by contextual data, or, a term's parents, siblings, and children derived from the source vocabularies (Nelson et al., 1992, p. 210). Even though the contextual data may differ or even conflict, the differences may reflect the different intentions and viewpoints of the source vocabularies, and may have value as such. All of these elements help to establish meanings, locate more general and more specific terms, and find potentially useful relationships between terms.
Nelson et al. (1993) attempted to evaluate the semantic locality of UMLS by observing its completeness and redundancy. Redundancy could be said to be high if two Meta terms were found as related terms, as co-occurring terms, and as hierarchically related terms (parent-child or siblings). That the degree of overlap was found to be small suggests that each of the dimensions of semantic locality is unique and valuable (p. 653). To get an idea of whether expected important relationships among terms were indeed expressed by Meta's semantic locality, the authors tested whether concepts linked to an entry by their presence in the definition of that entry were related by other dimensions of semantic locality. Here, only slightly better than half of the direct links between concepts in definitions and the entries they defined were found to exist. Also, about one-fifth of the important concepts in definitions had no corresponding Meta entry. This suggests that enhancements to Meta have to include not only new terms, but also, and just as importantly, new relationships between terms other than those provided by their source thesauri.

INFORMATION SOURCES MAP

The third UMLS knowledge source is called the Information Sources Map. According to Masys and Humphreys (1992), it will address the problem of determining which electronic information sources may be relevant to particular questions and will assist a UMLS user in accessing and using the information found in them. It is comprised of records describing electronic information sources, supplying information on each source's scope, type of information (citation, full text, reference text), language, size, probable utility, access conditions, and updating schedule. In order to make an automatic connection and conduct a successful search, it will contain the data element definitions of each source and the scripts necessary for traversing the communications paths to them. Also, data elements in different information sources which may contain the same value are noted. This information should be useful in retrieval programs designed to conduct automated searches for the same information among multiple information sources.

The first version of the Information Sources Map contains fifty information source records, including those for all the NLM databases, DxPlain from Massachusetts General Hospital, QMR (Quick Medical Reference) from CAMDAT Corporation, and OMIM (Online Mendelian Inheritance in Man) from Johns Hopkins University. Local users of this UMLS component can add records for their own local databases.

The information source records will be indexed using MeSH terms and subheadings, semantic types from the UMLS Semantic
Network, and relations between pairs of semantic types (Semantic Type Relations). Information about relationships among the different information sources will be noted, such as that a database is a superset of, a subset of, or contributes to another.

Masys (1993) has attempted to evaluate the indexing of the records in the Information Sources Map in terms of recall and precision. Fifty clinical medicine queries were translated into MeSH terminology and linked through the Metathesaurus to their semantic types and semantic type relations. The resulting list of semantic types and relations were matched to the indexing terms in the Information Sources Map. Optimal results would have matched queries with all the appropriate databases for searching them. It is not surprising that very high recall or very high precision was achieved only at the expense of the other. The study noted that elements other than the indexing terms that describe the databases of the ISM may prove useful additional filters for matching databases to specific queries. Additional elements include those that denote the intended user audience or the type of content in a database.

Miller et al. (1992), after building a prototype ISM, concluded that additional coding of information sources for “axes of use” would help match resources with queries. Such axes of use included whether the resource was commonly used, possibly used, or unlikely to be used for patient care, clinical research, basic research, or health services research, and whether its coverage in those areas was at a slight, intermediate, or comprehensive level. He went on to say that other possibly useful descriptive attributes to include in the records for sources would be the depth of the material likely to be found in a source (review level, reference level, consensus report level), and the type of content in the source (bibliographic, textual, patient records, directory). In fact, the 1992 version of the Information Sources Map includes axes of use and type of content information.

Following are the textual values of some of the fields in the ISM record for the Developmental and Reproductive Toxicology Database (not the complete record):

Name: Developmental and Reproductive Toxicology Database
Producer: National Library of Medicine
Alternate Names: DART, DAR
Type of Content: Bibliographic Database
Indexed Citations
MeSH Indexing: Abnormalities—chem. induced, epidemiol., etiol.
Abortion—etiol.
Alcoholic Intoxication  
Fetal Development—drug effects, radiation effects  
Maternal-Fetal Exchange  
Prenatal Exposure Delayed Effects

Semantic Type: Teratogens  
Indexing: Congenital Abnormality  
Injury or Poisoning  
Hazardous or Poisonous Substance

Semantic Relationship: Injury or Poisoning disrupts Embryonic Structure  
Indexing: Hazardous or Poisonous Substance causes Congenital Abnormality  
Biologically Active Substance affects Biologic Function

Types of Publications: Journal Articles, Technical Reports

Users: Health Care Professionals, Biomedical Researchers

Axes of Use: Basic Research/commonly  
Health Services Research/unlikely  
Patient Care/commonly  
Environmental Monitoring/possibly

EVALUATION OF THE METATHESAURUS

Many users of the initial versions of Meta have focused on its completeness, asking of it whether important biomedical concepts and relationships are present or asking how well it represents a particular subdomain of biomedicine. These studies typically matched terms from an existing local or official nomenclature for a particular subject domain to Meta to determine the degree of overlap.

Cimino (1992) studied the coverage of clinical laboratory terminology and found Meta to be adequate in terms of concepts represented but inconsistent and insufficient in terms of semantic types for laboratory procedures. Similar studies found the Meta terminology inadequate for the domains of nursing (Zielstorff et al., 1993), clinical radiology (Friedman, 1993), and hypertension (Campbell et al., 1993).

Several studies have focused on the utility of Meta for representing clinical information. A great mass of data are recorded about patients and clinical activity in health centers everywhere. There is great interest in merging and exchanging this information that could become important for outcomes research and cost control research.
The problem is that no standard means of electronically communicating this data has gained widespread acceptance and no existing terminology is recognized as completely adequate to describe it. Experimenters are assessing Meta for this task.

Huff and Warner (1990) attempted to match terms used at the LSD Hospital of the University of Utah for representing clinical data to words and phrases in Meta. Words matched reasonably well, but phrase matching was low. Unsuccessful matching at the phrase level was found to be due primarily to the presence in clinical data of modifiers and qualifiers (examples are high, low, increased, decreased, red, painful, increasingly, left, right). Chute et al. (1990) and Friedman (1993) have concurred in this discovery. These and other studies insist that modifiers and qualifiers attached to concepts represent important and distinct information in clinical arenas. They can significantly alter the meaning of a concept but are not distinct concepts by themselves. Clearly a means must be found for expressing modifying attributes within UMLS. Suggestions for addressing this need have included adding Meta concepts for such modifying concepts as quality, severity, pattern of occurrence, duration, frequency, trend, onset, site, occurring with, movement (all possible modifying concepts for symptoms). Chute et al. (1990, p. 164) suggest representing such modifiers as relationships within the semantic network. Friedman (1993) suggests that new semantic types be added, perhaps under the present Qualitative Concept type, to categorize the needed modifiers. These would need to include the idea of degree of certainty, degree of severity, degree of change, and current status for describing patient observations. Perhaps Meta should provide a way to construct terms out of existing Meta terms in some systematic way that would incorporate modifiers and duration.

**Future Developments for the Metathesaurus**

That these studies have proven influential is borne out by the ongoing developments and future plans for the Metathesaurus (Humphreys & Lindberg, 1992). The 1992 (3d) version of the Metathesaurus provides more complete integration of vocabularies and classifications already represented, as well as the addition of other controlled vocabularies. These additions provided for expanded coverage of clinical terminology, hazardous chemicals, diagnoses and procedures, and terms from the domains of radiology, epidemiology, and nursing. Medical device terminology, added from ECRI's Universal Medical Device Nomenclature System, are important for health services research and technology assessment. Additional data from ChemID, the chemical identification file that provides information about the chemicals cited in the many factual and
bibliographic databases produced by NLM's Toxicology Information Program, will be added to already existing Meta chemical terms, as well as new terms from that file. These data will help direct users to most appropriate databases for questions about the care, handling, and effects of toxic substances.

To increase Meta's ability to facilitate information retrieval in other languages, translations of Meta terms will be added, beginning with selected translations of MeSH developed by international MEDLARS centers. The 1992 edition includes the French translation of MeSH main headings (Thesaurus Biomédical Français / Anglais, 1992), prepared by the Institut National de la Santé et Recherche Médicale (INSERM). This of course introduces into Meta the complexities of multilingual vocabularies and their automatic manipulation, particularly regarding character sets. Walker et al. (1992b) have called for the internationalization of health care terminology by suggesting that UMLS incorporate terminologies that are standard outside the United States, making the Meta a multilingual, multiterminology resource. Many of these international vocabularies already contain mappings to International Classification of Disease, SNOMED, and other vocabularies—e.g., the Read Clinical Codes, a British terminology, and the German BIAK (Befunddokumentation und Arztbriefschreibung im Krankenhaus). It is argued that such an international terminology resource would facilitate automated language translation and exchange of clinical data and perhaps encourage consistency in health care delivery and development of machine products.

**Projects Using the UMLS**

As stated earlier, each of the UMLS components will undergo continual evaluation, development, and enhancement. Their initial versions, however, are already serving as knowledge sources in an array of projects designed to link users and electronic information or to index medical knowledge. As part of its Natural Language Systems Program, the National Library of Medicine is using UMLS in SPECIALIST, a system for parsing and accessing biomedical text (National Institutes of Health, 1992). SPECIALIST uses linguistic and biomedical knowledge for parsing queries and free text in titles and abstracts. NLM will compare retrieval based on this technique compared with standard retrieval using index terms only. To understand the biomedical language it parses, the system requires knowledge of important biomedical concepts, relationships among them, and rules to process the concepts and relations (McCray, 1992, p. 194). The UMLS Metathesaurus is the source of concepts and has been found to improve the quality of the parser and to provide needed
additional search terminology lacking in queries. Knowledge of the UMLS semantic types has aided the parser in identifying what may sensibly co-occur with a concept and helps reduce the number of questionable or invalid parses that are present when only grammatical information is available to SPECIALIST. The system includes a menu-based browser for Meta that allows viewing of term information and display of global searches, such as for all concepts with particular characteristics or all acronyms.

Another NLM expert system under development that will use UMLS components is COACH, a system for assisting GRATEFUL MED users to improve their retrieval from MEDLINE (Kingsland et al., 1992). Though the system will eventually address the problems of too much retrieval and of inappropriate retrieval, the intent of the first version of COACH is to focus on the problem of null retrieval—the search that yields no hits. Extensive analysis of GRATEFUL MED searches has, not surprisingly, confirmed widespread librarian observations of end-user search behavior. GRATEFUL MED users often get no retrieval because of "ANDing into nullspace," using terminology seldom employed in indexing, using terms too specific or not specific enough, using MeSH specialty headings inappropriately, and by using stop words. To address some of these problems, COACH provides a PC-based browser for the Metathesaurus. Using it, one can search Meta using Boolean capabilities to find MeSH headings, hierarchical contexts, child and sibling terms, semantic types, and definitions, all designed to help a user choose additional or replacement terms. Meta, being a rich source of related terms and lexical variants, can be used to augment or replace a user's terms or to map to new terms in accordance with goals of either more or better focused retrieval. COACH is now in alpha test phase with beta release expected soon. To realize its additional goals, the developers intend for COACH, in the future, to incorporate use of semantic type information and co-occurrence data.

High on the list of interests in biomedicine is vocabulary control of patient records, to facilitate their exchange, to more easily retrieve information from them, and to link them to the medical literature. Research has shown that patient encounters often generate questions that could be addressed to machine-readable sources. UMLS could be used for interpreting terms present in patient records, converting these to the vocabularies of information sources, and selecting and connecting automatically to them. It might help to summarize or collocate data from patient records. It might serve as the mapping mechanism between user queries or vocabulary from other sources to patient record databases. Lindberg and Humphreys (1992) propose steps to achieve better structured and maintained automated patient
records that would facilitate their use with UMLS. These proposals include adopting a standard format for recording patient data, using only full terms rather than abbreviations or shorthand expressions, and imposing some vocabulary control over the most standard elements of a record, with minimal use of locally developed vocabularies or extensions of existing ones. Though driven primarily by needs for cost control and outcomes research, the push for standardization of patient data may be helped by the promise of unified mechanisms for information use and retrieval as represented by the UMLS.

Several projects have been inspired by the UMLS paradigm of linking user queries directly to automated searches of databases. The program, Psychtopix, described by Powsner and Miller (1989), uses the machine-readable text of a psychiatry consult as the basis for an automated search of MEDLINE. Words in the consult are matched to a set of predetermined clinical "topics" which then invoke "canned" MEDLINE searches. This method, going from terms to topics rather than from terms to searches, is also used by Interactive Query Workstation (Cimino & Barnett, 1990) and Medline Button (Cimino et al., 1993). These programs depend on Meta for appropriate query interpretation and formulation. In the latter program, *International Classification of Disease, 9th ed., Clinical Modification* terms used to record patient information are mapped to MeSH terms through Meta when MEDLINE searches related to patient care are desired.

In a similar way to the COACH browser, Nelson et al. (1990) used MetaCard to permit a searcher to identify concepts in Meta, post them to a clipboard, and then incorporate them in a search of MEDLINE.

Powsner and Miller (1992) also use Meta to look up words selected by a user from the text of clinical records. After automatically matching the user-selected terms, the user is presented with a set of MeSH terms relevant to his or her input. The user can then select terms from the set and choose Boolean connectors to combine them to form a MEDLINE search.

The structure of Meta inspired Fu et al. (1990) to create a similarly structured patient database where entries describe not medical concepts but medical events. This database of events can then be used to index and accumulate patient information from a variety of sources and may serve as a means of mapping between different clinical databases. Meta is used as the source of terms to fill the attribute slots in medical event entries.

**CONCLUSION**

The UMLS Metathesaurus and Semantic Network constitute an empirically based taxonomy of biomedicine capable of linking and
mapping to diverse information sources. They provide dimensions of semantic locality that have potential for new ways of information retrieval, and perhaps for new ways of knowledge presentation. Term use data and structured nonhierarchical term relationships, particularly, show promise for managing the ever-growing problem of retrieval relevance. The UMLS components, still under development, are only in their initial stages of implementation, but some useful applications have already been devised for them, as described earlier. It is certainly only in these applications that their real efficacy can be assessed. If that assessment proves to be positive, it will be interesting to explore whether the UMLS approach to terminology management can be usefully applied in other subject domains.

NOTES

1 The browsers are representative of software tools being developed for classifications and terminologies. Their creators promote their use as essential displays of the features, scope, and usefulness of the complex arrays of associated information present in thesauri that are less easily grasped in printed form (Walker et al., 1992a).


REFERENCES


Humphreys, B. L., & Lindberg, D. A. B. (1992). The Unified Medical Language System project: A distributed experiment in improving access to biomedical information. In K. C. Lun, P. Degoulet, T. E. Piemme, & O. Rienhoff (Eds.), *MEDINFO 92*


Lindberg, D. A. B., & Humphreys, B. L. (1992). The Unified Medical Language System (UMLS) and computer-based patient records. In M. J. Ball & M. F. Collen (Eds.), Aspects of the computer-based patient record (pp. 165-175). New York: Springer-Verlag.


The Status of Health Information Delivery in the United States: The Role of Libraries in the Complex Health Care Environment

KAREN HACKLEMAN DAHLEN

ABSTRACT
Dissemination of health information is governed by complex social issues, structured pricing, and information technology. Factors comprising a new paradigm for examining Consumer Health Information (CHI) are presented. The provision of CHI services in libraries (public, academic, hospital) and services provided by health information networks are described in relationship to specific programs. Problems related to the provision of information services are outlined. Outcomes of the Raven Study which provided baseline data for understanding early CHI networks including a description of the "Utopian Health Information Network" are summarized. Print and electronic current awareness resources have been included as an appendix.

INTRODUCTION
Public health issues in the United States can trace their beginnings to a law passed in 1798 to provide for the "care and relief of sick and disabled seamen." Concerns were largely limited to the health of merchant seamen and the prevention of disease epidemics. In 1912, this service formally became the Public Health Service (PHS) with functions expanded to include biomedical research, regulation of health products in interstate commerce, and studies of environmental hazards. The dissemination and delivery of health information to the public and the role of libraries in this endeavor is less clearly defined. In fifteen years, libraries have experimented
with demonstration projects and innovative services but have not integrated health information into the mainstream library programming.

This article discusses the current environment in which health information is disseminated; components of an emerging paradigm affecting the dissemination of health information; the status of libraries and library networks in distributing such information; and problems of delivering health information. Suggested current awareness resources available to enhance library collections have been appended to the article.

Health Information Versus Patient Education

Health information is of two types: (1) information needed to make informed decisions related to disease prognosis (patient information), and (2) information needed to support a healthy lifestyle (consumer health information). Often these terms are used interchangeably. In the United States, patient information is produced by organizations affiliated with conditions and diseases, for example, cancer (the American Cancer Society). Information supportive of healthy lifestyles is primarily produced and distributed by the PHS.

Consumer Health Information (CHI) is a broad term which refers to aspects of a healthy lifestyle and implies improved knowledge and understanding of one's own personal health. If the knowledge and understanding changes the person's behavior (e.g., smoking cessation), an educational process takes place. Consumer health education is a process that informs, motivates, and helps people adopt and maintain healthful practices and lifestyles (Fogarty, 1976). A later definition describes health education as a strategy to "bring about voluntary adjustment of behavior conducive to health" (Green, 1978). While attainment of a minimum base of information is required before a health education strategy can be adopted, behavior change requires more than health information. Green also raised information policy issues and warned about health information fallacies: equating information giving with information utilization. This theory includes the notion that anything is better than nothing; more information is necessarily better; exposure can be equated with impact; and what motivates some will motivate others. How and where information is communicated is also a factor. To be effective as a part of health education, information must be transmitted locally where the sources of information are more trusted (local radio and television, for example, allow for variation, clarification, and adaptation). The idea is that information disseminated locally results in active, rather than passive, behavioral change.
Patient education is a well-defined term implying that a person has a sickness or disease and needs to be educated about the condition. Most hospital-based information services are designed to react to the patient's need for information rather than fostering a proactive approach to improved lifestyle. As individuals take more responsibility for making decisions related to their own health care, a new paradigm is being created through which CHI can be examined.

A Paradigm for Examining Delivery of CHI

The emerging paradigm for communicating and disseminating consumer health information includes the following factors:

- proactive government and industry health care initiatives;
- structured financial transactions have forced individual health care decision making;
- information is a commodity;
- limited aggregated information resources are accessible to empower the consumer to make intelligent choices;
- communication governs informed consent;
- libraries are a nonthreatening, inexpensive channel through which health information can be distributed;
- an aging society has multidisciplinary information needs;
- improved mechanisms for translating research summaries, abstracts, and results into popular formats are needed;
- information technology can improve access and decision making (half of these factors were previously identified [Rees, 1992], others were added by the author).

Proactive government and industry health care initiatives. Healthy People 2000 is a national initiative to improve the health of all Americans through prevention. It is driven by 300 specific national health promotion and disease prevention objectives targeted for achievement by the year 2000. Healthy People 2000's overall goals are to increase the span of healthy life for Americans, reduce health disparities among Americans, and achieve access to preventive services for all Americans. Progress reports and updates are published for program planners and educators. The Office of Disease Prevention and Health Promotion (ODPHP) collects and reports prevention activities related to the nation's health promotion and disease prevention objectives. Progress of committees attached to this initiative, such as the National Coordinating Committee on Clinical Preventive Services, is reported in Prevention Report, an ODPHP administrative publication that is not made available through general distribution. Reports and updates are in the public domain and can be easily reproduced by libraries for distribution to the public.
U.S. companies have increasingly recognized that working too many hours a day can result in burnout. A two-year study by Minneapolis-based Northwestern National Life Insurance Company found that the best low-stress workplace had open communication, flexible leave policies, and competitive benefits. Many had adopted wellness programs. Health clubs, hospitals, and adult-education centers also offer stress reduction programs. The American Institute of Stress (Yonkers, New York) and the American Institute for Preventive Medicine (Farmington Hills, Michigan) are good sources of recognized programs. The Health Insurance Association of America (Washington, D.C.) has actively promoted "wellness at the worksite" for more than ten years.

Structured financial transactions have forced individual health care decision making within a complex health care environment. Accelerated costs and complex reimbursement schedules associated with traditional medicine have created a demand for health information resources which have not traditionally been a part of library collections—e.g., the volumes of analyzed Medicare data related to coverage and limitation of hospital services. Under traditional fee-for-service health insurance plans, doctors and hospitals are paid regardless of the services or tests they perform. Over the past two decades, costs have accelerated from 7.3 percent of the Gross National Product (GNP) in 1970 to 13.4 percent in 1992; it is projected to reach 16.4 percent in 2000 or $6,616 billion (Faltermayer, 1992). Faltermayer also describes five paths to universal health insurance.

The two primary government-financed programs, Medicaid (for the poor) and Medicare (for those 65 or older) already exceed price ceilings—including a new 7,000 item revision in what doctors can charge for treating the elderly. In addition to regular visits to doctors' offices in 1990, Americans made an estimated 425 million visits to nontraditional providers of therapy, such as those who administer acupuncture and chiropractic treatments. Expenditures associated with these visits amounted to approximately $13.7 billion (Eisenberg et al., 1993). Cost as a factor in patient decision making is just beginning to make an impact, especially for large purchasers of health care.

Cost and reimbursement information, such as that contained in the Medicare Provider Reimbursement Manual, is constantly being updated (HCFA-Pub. 15-1 thru Rev. 353, January 1990) and is often processed in libraries months after being issued (this particular item was processed by the University of Illinois at Chicago [UIC] Library of the Health Sciences [LHS] on March 14, 1991). The difficulty in disseminating this type of information lies both in locating and
retrieving the document. For the consumer, the problem is further complicated by technical language and the lack of interpretive summaries. Although these resources do exist, they are difficult to locate and no evaluative guidelines exist to assist patrons in filtering the literature.

*Information is a commodity.* A positive correlation between information and satisfaction and between satisfaction and compliance has been described (Rees, 1993). Benefits of improved information dispensing for the patient include refined articulation of questions to determine health concern, enhanced dialogue between patient and doctor to improve medical history taking, greater understanding of risks and rewards, improved therapy compliance, and, in the end, greater satisfaction with decisions made. Benefits of improved information dissemination for the well person include more productive and independent lifestyles.

*Limited aggregated information resources to empower the consumer to make intelligent choices* in choosing health care or resolving conflict. The absence of a central system to coordinate the dissemination/integration of existing information creates confusion and limits access to information. Data accumulated by government agencies should be made available in more meaningful formats. Health is the primary mission of the PHS, and its principal components—the Food and Drug Administration (FDA); the Centers for Disease Control (CDC); the Alcohol, Drug Abuse, and Mental Health Administration (ADAMHA); the Health Resources and Services Administration (HRSA); and the National Institutes of Health (NIH). NIH, with its seventeen institutes and affiliates, serves the public through its information arm, the Office of Disease Prevention and Health Promotion (ODPHP). Each institute also has an information officer to deal with public requests and facilitate communication among institutes. The federal government, directly or indirectly, generates by far the greatest volume of consumer health information and generally disseminates such information via mail or telephone hotlines.

Federal agencies support at least thirteen information clearinghouses that distribute information related to diseases and health care conditions. A listing of these clearinghouses is available through the ODPHP. Designed for distribution to the public, these materials are usually in the format of fact sheets (one- or two-page statements about specific diseases and their treatment, care, or prevention); booklets that describe diseases in a more comprehensive way and indicate what can be done to help patients; and research reports which, even when adapted for public use, may be difficult to understand.
Adding to the confusion of government parceling of information is the creation of new information centers and clearinghouses by private industry. An example is the National Vaccine Information Center in Vienna, Virginia. A half century ago, the bacterial ailment known as whooping cough killed up to 7,000 people a year in this country. Although fewer than ten have died annually since 1981 according to the CDC, the vaccine introduced in the 1940s contains a dead pertussis cell that fosters antibodies to fight the disease. This cell also carries a neurotoxin that can cause side effects, swelling, fever, or high-pitched crying. Parents, doctors, and drug makers reported about 7,200 adverse reactions and 250 deaths after pertussis vaccinations for the twenty months ending July 31, 1992 ("Thousands Sue Over Effects of Major Vaccine," 1992). Immediate retrieval of information related to side effects is crucial in determining subsequent health actions. Only a morphogenesis interconnecting a vast network of clearinghouses and information centers using computer visualization will enhance retrieval of specific information.

Another source of confusion for the consumer is obtaining early reports of ongoing research. Immediate applications of new knowledge to disease states are not always communicated in meaningful ways. A report published by the National Commission on Orphan Diseases (U.S. Department of Health & Human Services, 1989) describes the difficulty patients with diagnosed orphan (rare) diseases have in obtaining information to assist them in making decisions. Not only could patients not find needed information, but in documenting physician access to information, nearly half of the 247 physicians studied could not find printed information for their patients, and more than one-third could not find information summarizing ongoing research (U.S. Department of Health & Human Services, p. 18). If library collections were enhanced to include resources on rare diseases for practitioners and their patients, or if requests could be adequately referred, this problem could be ameliorated.

*Communication governs “informed consent.”* Informed consent has become an integral part of health care decision making. During the 1980s, topics reflected treating minor children without parental consent, medico-legal matters, and right to know issues. Discussions of the 1990s include the right to refuse medication, liability issues related to dementia and AIDS, uses of human tissue, and mental competency. The dialogue regarding consent that does or does not take place in the doctor/patient encounter has a direct relationship to the ethical and legal interpretation of medical regulations. Informed consent preserves two values, self-determination and personal well-being (Hollander, 1984). Individual well-being in the
philosophical sense includes personal values and preferences, and choice often includes compromise. Communicating probabilistic information to patients is vital knowledge to those making decisions.

Although hospital libraries are positioned to disseminate needed information to patients and their families, many hospitals continue to restrict access to professional library collections. Hospital libraries were first established to support their physician staff and then evolved as a support service for all professional staff. Subsequently, collections and services were developed to educate the professional staff. Few progressive services developed during the past fifteen years remain in existence. The question could be raised as to why more hospital libraries have not become cost centers given that information is a commodity and is vital to decision making.

Libraries are a unobtrusive inexpensive channel through which health information can be obtained. Because health information comes in all sizes, shapes, and with little or no frequency, it is difficult to maintain and manage. At the present time, health information resources are intermittently produced on topics in a variety of print and electronic formats, and access is fragmented. These resources are usually not indexed, nor are they regularly updated. If central or regional repositories maintained CHI resources on a LISTSERV, information could be easily distributed through library networks. Libraries have experience in creating electronic records and authority files, assigning subject headings, and providing annotations and cross references to other resources. Selected documents in the public domain—such as reprints from FDA Consumer on safe use of medicines, arthritis, stroke, generic drugs—could be scanned into a relational database for use by the public and would be an ideal library project.

Libraries can assist patients and consumers alike in scripting specific questions to be asked, refining aspects of those questions, or providing options for expanding queries. Such preparation could result in more efficient use of time in a typical office or telephone encounter. Libraries are acceptable vehicles for disseminating information produced by federal, state, and local governments. They could also serve as depositories for information produced by associations, foundations, and private industry. In conclusion, health information that libraries provide is a cost-effective way for consumers to gain understanding of a given condition prior to making decisions.

Improved mechanisms for translating research summaries, abstracts, and results into popular formats. Paul Elwood of InterStudy (Minneapolis Research Organization) believes future computer databanks will track patients medically. InterStudy currently studies sixteen illnesses such as diabetes and hypertension. To date, 20,000
patients in twenty-three states have completed a survey intended to identify individual health views, such as, "does your health limit you in climbing several flights of stairs."

Only three years old, the Agency for Health Care Policy and Research (AHCPR) has a budget of $74 million (1993) to study guidelines for treating disease. AHCPR finances twelve "patient outcomes research teams," which assess medical outcomes and technologies primarily based on reviews of the literature (not new research). Guidelines have been issued on four conditions—pain control after surgery, control of urinary incontinence, control of bedsores, and treatment of cataracts. Guidelines are unique, as they are summarized for both the health care professional and the patient. Libraries are positioned to make guidelines available as part of print collections (reprints or pamphlet files) or accessible electronically in summary or full-text format.

Longitudinal research, such as the Framingham studies, Baltimore Longitudinal Study, and the Alameda County studies, are ongoing projects which measure physiological and psychological functions and report risk factors that alter lifestyle. Risk factors described in the literature include personal habits, nutrition, exercise, cholesterol intake, or demographic and genetic characteristics. Findings of these studies appear as reports by the supporting government agency. Few are written in popular style or in a manner to change behavior. Health sciences libraries are in an ideal position to repackage research summaries for consumer understanding.

Multidisciplinary information needs of an "aging society." Two factors that will affect the information needs of an aging society are few research studies on which to evaluate treatment of older adults, especially older women, and the absence of integrated information treatises to illustrate how lifestyle interacts with therapy (e.g., medication). Preventive measures taken early in life have always been an acceptable way to defer or prevent chronic diseases or functional problems encountered in later life (Stults, 1984). Only recently has society directed health promotion initiatives at persons already old. Despite the wide availability of communication technology and assistive devices to improve safety and quality of life, the average older person lives without using any of them. Lack of research funding to evaluate such devices, limited reimbursement, inadequate knowledge of health professionals to match products with individual problems, and inadequate translation and delivery of knowledge about such products impede their use and understanding. Libraries with access to databases, such as ABLEDATA, help diffuse this information. Although health professionals are beginning to recognize the need to include older persons in activities aimed at
preventing disease and reducing disability, there remains a serious lack of scientific data to direct change. Agencies producing and distributing information related to seniors' health are the National Institute of Aging (NIA), the American Association of Retired Persons (AARP), the National Council on Aging (NCOA), the Food and Drug Administration (FDA), and the Food and Nutrition Information Center (FNIC), one of ten information centers administered by the National Agricultural Library. Only large academic and public libraries that are government depositories are likely to routinely collect reports and documents produced by these agencies. Rarely do these materials reside in health sciences libraries.

Working with state departments on aging, libraries can assist patrons in finding local resources and structure referral services to satisfy the multiple aspects of requests related to the elderly. Redesigned user-friendly reference tools are needed to support the interdisciplinary information needs of the elderly. Needed tools include directories of care providers, manuals describing housing and transportation alternatives, and access to improved information networks to reach the ever-changing governmental and state guidelines.

Impact of information technology in improving access and decision making. Information stored and distributed in electronic form provides additional avenues through which CHI can be disseminated. Avenues include databases, CD-ROM products, and bulletin boards. Databases contain bibliographic, full-text, or summaries of documents. They are produced and maintained by major vendors, such as BRS, DIALOG, and the National Library of Medicine (NLM). Examples include NLM's DIRLINE, an online directory of health care associations, and BRS's National Newspaper Index. Concerns about drug interactions and recalls, legislation, and new medications under development are contained in FDA's Bulletin Board. As the Internet becomes more accessible for institutional use, LISTSERVs are popular vehicles to communicate the existence of health resources. For example, PDQ, a database containing information about cancer treatment produced by the National Cancer Institute, is available through the Internet as Cancernet. Information in PDQ is reviewed by cancer experts and provides up-to-date information for people with cancer, their families, and for doctors and other health care professionals. PDQ includes information about research on new treatments (clinical trials), a directory of doctors who treat cancer, and hospitals with cancer programs.

Newspapers provide the first line of communication for reporting information about AIDS, cancer, heart disease, respiratory ailments, and epidemics, such as Legionnaire's Disease. Brief summaries of
research studies and surveys frequently appear in newspapers before articles appear in the journal literature. A logical progression of further inquiry is illustrated in Figure 1. Electronic tools accessing newspapers include: VU-Text (covers Knight-Ridder newspapers from 1983 to date); National Newspaper Index, accessible through BRS, which covers selected newspapers—e.g., The Wall Street Journal and The New York Times from 1979 to the present; national and international sections of The Washington Post, and The Los Angeles Times from 1982 to present; and File Papers (accessible through DIALOG), a more comprehensive listing of newspapers. A sample search (nutrition and the elderly) retrieved 1,585 references in 1991.

There are a number of CD-ROM products available. Health Periodicals Database is a recently developed hybrid database directed at the layperson. It covers all aspects of health, medicine, fitness, and nutrition. Abstracts are "consumer summaries" from about 100 professional medical journals, and full text is available for approximately 120 professional and consumer health publications (Tenopir, 1992). Health Index Plus, a part of InfoTrac (Information Access Company), contains about 130 professional and consumer publications on medicine, public health, disease, occupational health and safety, nutrition, and fitness. Full-text articles from over eighty publications and consumer-oriented summaries of key scientific papers translated by medical professionals are contained in the product as well as health-related information from about 3,000 general magazines and newspapers. Health Index Plus is updated monthly and contains about four years of information (Alloway et al., 1992). Medical Data Exchange (MDX) is a CD-ROM product offered by SilverPlatter, Inc. The file contains summaries of current articles on health issues from 37 medical journals from MEDLINE and includes about 200 other consumer publications, including wellness newsletters. Additional CD-ROM health care reference products, including The Family Doctor (Creative Multimedia Corporation), PDR (Physicians' Desk Reference) with the Merck Manual (Medical Economics Data), and Scientific American Medicine (Scientific American Medicine) have been reviewed by LaGuardia (1993).

Role of Library Professional Associations

Library associations, such as the American Library Association (ALA) and the Medical Library Association (MLA), have traditionally assumed roles for continuing education of librarians. At one time, ALA responded to such issues within the Library Service to Special Populations Section (Cooperative Library Systems Division). Health information is the topic of a roster course within the MLA Continuing Education platform. MLA also supports a section dedicated to
Fibroids in the Uterus

Q: I have a fibroid on my uterus, and my gynecologist recommends that I have a hysterectomy because of its size. It's not giving me any problems, but he thinks it would be best to have it out now while I'm still healthy. I'm 48. Are there any guidelines about when surgery is needed for fibroid tumors of the uterus? Couldn't I just live with it and reconsider surgery if it started to bother me in some way?

A: There are a few good studies that give solid answers to your question. But in general, I think you have some flexibility in deciding about surgery. A fibroid is a benign enlargement or growth of the muscular tissue of the uterus. Its size may range from as small as a golf ball to as large as a softball or even a soccer ball. Fibroids are common. About one in four women over 30 have one....

As with an elective operation, if you have some questions about whether it's worth having, getting a second opinion can help. Two recent medical articles discussing indications for hysterectomy are in the March 1993 issue of the American Journal of Obstetrics and Gynecology and the March 25, 1993, issue of the New England Journal of Medicine.

WASHINGTON POST HEALTH SECTION, TUESDAY, APRIL 6, 1993, P.15


RESULTS: Hysterectomized women, especially those aged 39 to 41 years, report significantly more vasomotor complaints, vaginal dryness, and atypical complaints than do normal climacteric women of the same age. The higher prevalence of typical climacteric complaints in hysterectomized women largely explains their higher level of atypical complaints.

CONCLUSION: Physicians should be alert to typical climacteric complaints after hysterectomy with ovarian conservation, especially in young women, because the literature indicates that hysterectomized women with ovarian conservation are overrepresented with regard to osteoporosis, cardiovascular disease, osteoarthritis, depression, and sexual problems. (Am J Obstet Gynecol 1993;168:765-771)

Figure 1. Logical progression of information query

c consumer health issues. Within the Special Libraries Association, selected divisions have health-related concerns. Examples include chemistry, food, agriculture and nutrition, and pharmaceutical.

In 1979, a CHI continuing education course was developed by Rees for the MLA. Course objectives emphasize trends in medical consumerism, design and development of health information programs in a variety of settings, and the creative applications of library cooperatives in the provision of CHI. The number who have attended this course is estimated to be about one-fourth of the MLA
INRODUCTION: Hysterectomy is second only to cesarean section as the most frequently performed major operation in the United States. Data from the National Hospital Discharge Survey (NHDS) indicate that approximately 390,000 hysterectomies are performed annually. Although there appears to be a downward trend in the rate since the mid-1980s, it is not yet known whether a true decline has occurred, because there have been recent changes in the NHDS sampling method. By the age of 60, over one third of U.S. women have undergone hysterectomy. The annual hospital costs for the operation currently exceed $5 billion.

New techniques of performing hysterectomy and new alternative treatments have been developed in recent years. This review summarizes the indications for the operation, considering current knowledge of the benefits and risks of hysterectomy and alternative treatments, costs, and the importance of the patient's preferences in the treatment decision.

Self-Help Organizations*

Hysterectomy Educational Resources and Services Foundation
422 Bryn Mawr Avenue
Bala Cynwyd, PA 19004
(215-667-7787)

The HERS Foundation has a number of publications on hysterectomy, post-hysterectomy, and common pelvic disorders. A reading list is available for $3.00. The quarterly HERS Newsletter contains an in-depth research article, a review of current scientific journal articles, correspondence, and a calendar of events. HERS is a nonprofit organization founded in 1982 for the purpose of providing information about the alternatives to and after effects of hysterectomy and/or oophorectomy.

Books**


*DIRLINE strategy: Hysterectomy (MH) or Hysterectomy (NW)
**CATLINE strategy: Popular Works and Hysterectomy

Figure 1. (Cont.). Logical progression of information query

membership (or about 1,000 librarians). Since the MLA tracks only courses held at the annual meeting and chapter meetings for the current year, the impact on librarians taking this course compared to other core continuing education courses is not measurable. Experience teaching this course indicates that a significant number of members have reached a basic understanding of the complex issues related to the provision of consumer health information services.
The idea of CAPHIS (Consumer and Patient Health Information Section) as a special interest group of the MLA began in 1981 at the Montreal Annual Meeting. In 1982, the potential CAPHIS section held a meeting attended by more than fifty librarians. In 1984, provisional status was granted, officers were elected, and, by December 1992, the section reported 303 active members.

At the 92nd Annual Meeting of the Medical Library Association (MLA) in Washington, D.C., Alan Rees presented the Janet Doe Lecture, a lectureship traditionally given by a major contributor to health sciences librarianship. In his address, Rees emphasized the importance of communication in the doctor/patient relationship and argued that society has shifted from a physician-oriented to a patient-centered environment (Rees, 1993). The selection of Rees to present this prestigious lecture endorsed the importance of Consumer Health Information by the MLA and the need to identify information access problems. Well-known to librarians for his works, *The Consumer Health Information Source Book* (1990) and *Managing Consumer Health Information Services* (1991), Rees has also raised the awareness of librarians about the provision of health information services to consumers.

**National Libraries**

While not producers of health information, national libraries already share areas of health responsibility, and they are intrinsically tied to the virtual library concept in expanding access to nonprofessional health literature. The National Agricultural Library (NAL) administers ten information centers including the Food and Nutrition Information Center (FNIC). FNIC routinely collects information regarding nutritional requirements and dietary habits for all ages. Bibliographies are selected and evaluated by a team of nutritionists and are distributed upon request. The Library of Congress (LC) administers Resources for the Blind and Physically Handicapped. Given the passage of the Disabilities Act and the multidisciplinary needs of an aging society, the network through which these resources are distributed should be reassessed and expanded for greater effectiveness. Although health information for the public is not part of the mission of the National Library of Medicine (NLM), it currently maintains online directories, such as DIRLINE (directory of health care organizations) and DBIR (directory of biotechnology information resources).

**Public Libraries**

In the United States there are approximately 8,900 public libraries ranging from the largest metropolitan libraries in New York City,
Chicago, and Los Angeles to small branches. Public librarians have reported health information access concerns, such as ethics and problems of medical reference and currency issues related to up-to-date medical sciences collections (Powers, 1979; Everhart, 1991). Guides have been prepared to assist public libraries in developing and maintaining CHI collections (Jennings, 1980; Bain, 1984; Rees, 1991). Consumer health pilot projects completed by two New York state public library systems, the Nioga Library System and the Onondaga County Public Library have been reported (Bain, 1984). Projects were designed to distribute information centrally through a health education system.

In an attempt to evaluate how effectively libraries are responding to the needs of the public, researchers at the University of Illinois at Chicago (UIC) have designed a study to evaluate three library pathways through which consumers seek information—public libraries, health libraries (both academic and hospital), and library networks. As part of this project, thirteen large public libraries in the United States and one in Canada were surveyed in December 1992. Preliminary results indicate that large public libraries actively disseminate health information to patrons. Even with recent budget restraints, more than 70 percent of the libraries studied added to their health collections during the first six months of 1992 (Dahlen & Cogdill, 1993).

With the exception of recent Canadian studies, few national studies can be found comparing access to health information with other types of information—e.g., legal, environmental (Marshall, 1991). In 1971, a national survey of library services to the aging was completed by the Cleveland Public Library. Recommendations included special recognition of the aging in library legislation and coordination of services to aging as a discrete program of library agencies.

Literature of the past ten years examines problems by age group (Alloway, 1983); collections and services in single library settings (Defoe, 1991); the scope of information by topic or disease (Powers, 1979); the service (reference) perspective (Berk, 1985); or describes policies and procedures from an administrative point of view. Although collections reflect population health concerns, provision of service is still managed in a haphazard way.

**Hospital Libraries**

Activities of seventeen hospital-based consumer health centers in the United States have been described (Kernaghan & Giloth, 1991). Many of these programs operate active telephone information services; in fact, some provide only phone contact. Many of these programs are tied to hospital marketing programs. Five hospital-based services
are also described by Rees (1991), including origins, operations, funding, and collections. Two innovative newer programs are those based at St. Joseph's Hospital in Denver, Colorado, and the Planetree Health Resource Centers in California.

The Patient Health Research Library was established at St. Joseph's Hospital in Denver, Colorado, in July 1985. This service has responded to an average of sixty-seven patients per year. Total patrons numbered 540 for a four-year period (1985-1989) including family, friends, and community patrons. The proposal developed to justify support of this service was based on the concept that patients consistently cited inadequate explanation of various aspects of their diagnosis as the most stressful aspect of hospitalization (Volcer, 1977). Planning activities included a patient needs assessment, environment competitive analysis, review of alternative solutions and implementation issues. Bandy provides a case for patients having access to the medical literature. Finding answers to questions about infectious diseases leads to discovery about treatment options, risks, and gives the patient a sense of control in making an informed decision. An item from the consumer collection is supplemented with one from the professional collection. Databases, such as CHID (Consumer Health Information Database [BRS]) or the Disease Database on Development, have been used to satisfy such requests (Bandy, 1991).

The Planetree Health Resource Center is a California-based, nonprofit consumer health organization founded in 1978. Named for the tree that Hippocrates sat beneath when he taught his first medical students, the organization is dedicated to empowering people to become active participants in maintaining their own health and medical care. The first Planetree Health Resource Center opened in 1981. A range of services provides access to reference assistance, clipping files, lecture series, publications, support groups, and an on-site bookstore (Cosgrove, 1991).

A program with greater longevity is Overlook Hospital in Summit, New Jersey. Over ten years old, the consumer health library serves a two-county area, contains 2,000 books, hundreds of pamphlets, twenty-five journal subscriptions, and 1,500 vertical files. About two-thirds of the users of the service were hospital staff (64 percent) and about one-third were telephone/walk-in patrons (36 percent). Moeller (1991) has reported that an important outcome of the Overlook experience was the realization that the service could survive with a reduced number of journals.

Compared to the number of hospitals in the United States, only a small percentage has expanded library services to include patients or families of patients. Competition in the health care environment
has resulted in single institutions providing services as compared to the library networks of the late 1970s and 1980s.

**Academic Health Sciences Libraries**

Clientele of academic health sciences libraries have traditionally been students, faculty, and researchers, and academic collections were developed to support the curriculum, clinical research, and practice. Model projects stemming from health sciences libraries during the 1980s—networking public libraries with academic medical libraries—included CHIRS, based at McGooagan Library of Medicine at the University of Nebraska at Omaha (Reidelbach, 1991); MEDINFO, based at the Harley E. French Library of the Health Sciences in Grand Forks, North Dakota; and Healthnet, an outreach program of the University of Connecticut Health Center Library (Arcari & Richetelle, 1991).

During a ten-month period in 1992, information services librarians at the University of Illinois at Chicago sampled patrons seeking health information. The purpose of this pilot project was to test a survey instrument and to capture data on who was asking these questions, whether or not requesters were being referred to LHS and by whom; the general nature of the request; and whether or not patrons had consulted other libraries or agencies prior to contacting LHS. More than 25 percent had consulted other resources prior to coming to LHS. Half of the requests were related to diseases or medical conditions, and about one-fourth were related to specific procedures, therapy, or tests.

Most academic CHI programs have been demonstration projects; once outside funding stopped, services were curtailed. Few projects were based on market or service research. Although numbers were collected to illustrate volume of activity, further analysis was not conducted.

**Library Networks as Providers of Consumer Health Information**

Library networks thrived during the late 1970s to mid-1980s. Attempts were made to link hospital libraries to medical centers. Public libraries and hospital libraries agreed informally to work together to serve clients. Multitype library consortia were sharing resources and extending collections to meet common resource goals. Newer CHI programs are structurally based on the models examined in 1980 by Raven Systems & Research, Inc.

This study, known as the Raven Study (1982), was funded by a contract awarded by the Center for Health Promotion and Education, Centers for Disease Control, to investigate library/health
education networking as a means for improving the availability and use of health information and health promotion resources and services. The long-range goal of the project was to identify, describe, and facilitate the development of state and local library networks and resources supportive of better services to library staff, health workers, and consumers. Overall objectives of the project were accomplished by examining ten programs in different settings.

The sites represented diverse geographic, organizational, and clientele characteristics. Information networks in cities on both coasts, with population ranges from 175,000 to 2.8 million were included. Part of this study assessed "leaderless" networks and consortia. Although individual members were often doing interesting work, leaderless networks lacked an ongoing systematic planning process. Final reports submitted in 1982 revealed that health-related ready reference questions were most likely to be disease related (60-80 percent) and quite specific. Women were far more likely to use the library for health-related purposes than men. Of the ten projects examined, four received initial LSCA (Library Services and Construction Act) funding. Four others were embedded in health care delivery systems, and one project was funded locally. Even when projects were primarily funded by grant monies, the parent institution had considerable influence over what funds were applied for and how those funds were ultimately used. By far the largest expenditures were for personnel. Average costs for personnel were $175,697, and the average costs for acquisitions were $39,011. Daily activities were hard to document since many were vested in a single person.

The greatest weakness of all the library networks studied was the lack of a broad base of cooperation. None developed a viable ongoing relationship with public and private health agencies. Time was also a serious constraint in the development of cooperative arrangements; and benefits to the library were not readily apparent. Consequently, nonlibrary network development received very little attention. Professional relationships must be developed and institutionalized. Public health agencies were involved with three of the programs; private agencies informally with four; projects which had public libraries as a central component (CHIPS, CHIN, Tulsa) were more likely to be involved informally with private agencies, such as the American Cancer Society. AHEC (Area Health Education Center) projects did have formal ties to physicians and physicians' groups, and physicians were involved on an advisory basis in other projects.

The Summary Report described a "Utopian Health Information Network" having five components:

1. Libraries supporting health professionals and the public are the major component of the "Utopian Network." These libraries are linked to one another using all the technology of library services,
including computerized database searching and preparation of union lists. Health information should be arranged in a hierarchial structure so that a patron entering the Network at the public library level has immediate access to health information whatever level is needed.

2. Formal agreements comprise a primary aspect of the "Utopian Network" (to ensure compliance without dependency).

3. Shared operating procedures which would allow any librarian at any point in the network access to the entire network. Private physicians have two roles in the network. First, they serve in a monitoring and advisory capacity to health information providers, reviewing resources and assisting libraries in the assessment process. "Second, they benefit by having health information providers as a referral source. Within the Utopian Network, the private physician can refer patients to a wide variety of supportive elements, depending on the patient's needs."

4. Schools and educational institutions should train librarians to be better providers of health information "through formal classes and workshops. They should conduct research aimed at discovering trends and improving practice in librarianship."

5. Public schools have the job of ensuring that students are aware of the Utopian Network and teaching them how to use it (Raven Systems & Research, Inc., 1982, pp. 23, 24).

Raven projects were surveyed in January 1993 to see if programs were still in existence, whether organization and governance had changed, and what cooperative arrangements had been extended to the community. Sites studied, their location, and current status are included in Table 1.

Follow-up on the Raven Study after ten years proved difficult. People involved with the original projects have since left. Telephone interviews were able to capture the current status and whether programs had evolved or been absorbed into other services. For most, services declined after the funding stopped. Factors cited as contributing to the demise of the programs included limited funding, reduced personnel, and downsized collections. Professional librarians at two sites noted the increased availability of CHI as one reason why services were discontinued. Kaiser-Permanente is one of two sites studied by Raven Systems which continues to provide a full range of health information services to Kaiser patients, their families, and the walk-in public. The Tulsa City-County Library is the other. Four of the sites were absorbed into other services or structures, and four no longer exist.
<table>
<thead>
<tr>
<th>Project</th>
<th>Location</th>
<th>Existence (Y/N/A)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHIN (Consumer Health Information Network)</td>
<td>Mt. Auburn Hospital</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Cambridge, MA</td>
<td></td>
</tr>
<tr>
<td>CHIPS (Consumer Health Information Program</td>
<td>Los Angeles County</td>
<td>A</td>
</tr>
<tr>
<td>and Services)</td>
<td>Harbour</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Los Angeles, CA</td>
<td></td>
</tr>
<tr>
<td>The Health Library</td>
<td>Kaiser-Permanente Medical Center</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Oakland, CA</td>
<td></td>
</tr>
<tr>
<td>InfoHealth</td>
<td>Case Western Reserve University</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Cleveland, OH</td>
<td></td>
</tr>
<tr>
<td>The North Dakota AHEC Library System</td>
<td>Harley E. French Library</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Grand Forks, ND</td>
<td></td>
</tr>
<tr>
<td>CHIC (Consumer Health Information Consortium)</td>
<td>Onadaga County Public Library</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Syracuse, NY</td>
<td></td>
</tr>
<tr>
<td>Health Information Service</td>
<td>Tulsa City-County Public Library</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>Tulsa, OK</td>
<td></td>
</tr>
<tr>
<td>Statewide Outreach Program</td>
<td>The University of New Mexico</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>Medical Center Library</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Albuquerque, NM</td>
<td></td>
</tr>
<tr>
<td>School of Public Health Library</td>
<td>The University of Pittsburgh</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>School of Public Health</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pittsburgh, PA</td>
<td></td>
</tr>
<tr>
<td>Library/Learning Resource Center Network</td>
<td>The North Carolina AHEC Program</td>
<td>N</td>
</tr>
<tr>
<td></td>
<td>Chapel Hill, NC</td>
<td></td>
</tr>
</tbody>
</table>

*Y = Still in existence/ N = No longer in existence/ A = Absorbed into other services or structures

PROBLEMS DELIVERING INFORMATION

The provision of health information in Ontario public libraries and the problems experienced by librarians was discussed by Marshall in 1991. Findings included a significant proportion of user enquiries related to health in public libraries. Over half the libraries surveyed (56 percent) reported an increase in the last three years. Problems
faced by Canadian public librarians in dealing with health requests include the sensitive nature of the reference interview, inadequately trained librarians, and inadequate resources. In the Marshall study, 94 percent of the librarians participating in the study stated they relied extensively upon on-the-job experience as a basis for providing health information service.

Public libraries participating in the University of Illinois at Chicago study also reported difficulty in handling the sensitive nature of health requests (60 percent). Others had problems with the medical vocabulary, and about one-third cited a lack of appropriate resources as a problem in delivering health information. Approximately 75 percent of the UIC sample said librarians are trained to respond to health requests, and that they are trained by senior staff librarians.

Other problems encountered in delivering health care information via libraries include little cooperation among libraries in sharing consumer resources, inadequate collections, and bibliographic control (health materials such as pamphlets or fact sheets); collections can easily become dated as advances in medicine constantly change. Professional medical literature continues to be used to satisfy consumer requests even though these resources are written for a different level of understanding.

Inadequate collections have also been cited as a problem in disseminating consumer information related to AIDS (SantaVicca, 1987). Although background information is frequently found in books, decisions related to health care are probably not going to be found in published books given printed information is from one-to-three years old by the time it is published. Proportionately, public libraries seem to spend more money on books than journal literature. Although published guidelines for referral are nearly nonexistent, results of the UIC LHS sample of public libraries in the United States indicate that large public libraries routinely refer patrons to other libraries or agencies in responding to health requests that cannot be satisfied within the library.

Cooperative planning among public, academic, and hospital libraries and community health organizations has been discussed (Defoe, 1991; Arcari, 1991; Reidelbach, 1991). Every consumer health service or health information network has developed core resources. One of the most recent was compiled by Arcari and Richetelle (1991).

**Future Trends**

The pressing need for health information is heightened by the absence of a coordinated national health information dissemination system. If the consumer or patient is not directed to existing resources, information centers and clearinghouses will be underutilized, and
the patient's ability to make informed decisions will be affected. Current awareness resources most often are stored in vertical files with limited access. Like government documents, these items normally are not retrievable through the library's online catalog.

Public libraries are conveniently positioned to disseminate health information to the consumer seeking information related to health and wellness. Hospital libraries are closest to the physician/patient encounter and present an ideal environment to provide resources and services to patients and their families. In the 1980s, multitype library networks limited resource sharing to interlibrary loans of the printed page. Libraries collecting pamphlets and other peripheral resources restricted the sharing of these resources to primary clientele. Referrals were based on established relationships with few specified guidelines. Today few libraries routinely search health information databases as part of a reference protocol when assisting patrons needing information regarding treatment options. In the 1990s, libraries must rethink cooperation and extend collaborative relationships to other health care agencies and professional organizations. Shared database development will provide more efficient and expanded access. Databases like PDQ are already available through the Internet. Campus computing systems in academic centers make hundreds of resources available (through menuing devices, such as Gopher) to every person working in an academic environment. Access to information, however, does not necessarily translate to "item in hand."

Pilot studies reveal that public libraries are doing a commendable job serving the public's interest in health care. Many subscribe to health care newsletters; the majority subscribe to popular professional journals such as JAMA (Journal of the American Medical Association), New England Journal of Medicine (NEJM), Science, and Nature. Even in the economically depressed early 1990s, large public libraries added to their health collections. In analyzing health-related requests, a majority of the patrons seeking health information in public libraries are high school or college students working on assignments and adult users seeking personal health information. Fewer businesses, researchers, or health professionals seek such information in public libraries, indicating they may have other avenues for locating this information. Public and hospital libraries are extending service not only to walk-in patrons but also through active telephone service. During a six-month period in 1992, the Buffalo and Erie County Public Library (Science and Technology Department) received 3,358 telephone reference calls. Of that number, 22 percent (730) were medical or health related.

Library communication networks exist with different administrations and dissimilar geographic boundaries. The Centers for the
Blind and Physically Handicapped, administered by the Library of Congress, do not geographically coincide with the National Network of Libraries of Medicine. Government-funded AIDS and geriatrics programs are also regionally based with similar education and information goals but have dissimilar boundaries. The NLM has successfully administered the National Network of Libraries of Medicine (NNLM), distributing information about their products (e.g., MEDLINE) and services for more than twenty-five years. Using this network, CHI could be disseminated through 142 resource libraries in major medical centers to more than 3,500 primary-access libraries in hospitals and health care facilities.

Strengths and weaknesses identified with the Raven demonstration projects either have not been communicated or have been ignored. The Utopian Health Information Network described has never materialized. The greatest weakness of all the projects studied was the lack of broad-based cooperation. Libraries cooperate with libraries, but they have not successfully networked to other health agencies and organizations. Leadership and formal agreements were key factors identified by this study, yet programs remain undervalued by administrators.

Information is a commodity and should be analyzed as such by libraries. The Medicare Provider Reimbursement Manual provides a list of approved accrediting organizations and activities. Although approved educational programs include nearly every imaginable profession (from physical therapy and medical technology to nursing), there are no health information programs listed, nor is there an approved organization such as the Medical Library Association or American Society for Information Science listed.

The potential for librarian involvement in the dissemination of CHI is dependent on the vision of the institutions where they work and their potential to see beyond the library as an organization. Creative services will evolve as libraries change their breadth and scope to encompass university and hospital outreach goals. Unlike the demonstration projects studied by Raven Systems, libraries need to foster and maintain links to community and state organizations producing and distributing information resources. Libraries need to take a proactive approach to collecting and disseminating information generated as a result of Healthy People 2000.

Access to information means more than providing the bibliographic citation. Librarians are trained to locate information resources. To comply with the consumer's demand for health information, a logical role for librarians is to develop databases comprised of important segments of documents (abstracts, summaries, results) to begin to filter the important aspects of the literature.
Librarians engaged in research projects with their health professional counterparts can change the way health information is valued. Expanded networks, improved communication, perception of librarians, and applications of information technology will virtually influence change in the ways libraries disseminate health information.

ACKNOWLEDGMENTS

The author would like to acknowledge the following people and their contributions to this article: Keith Cogdill, Resident Librarian, University of Illinois, Library of the Health Sciences for summarizing the public library sample and providing technical assistance; Laura Sklansky, Reference Librarian, University of Illinois at Chicago, Library of the Health Sciences, for conducting a pilot study involving health information requests coming into the academic medical center library and for summarizing the collected data.
Appendix

Current Awareness Techniques and Resources

Since 1985, resources have been designed to communicate information about risk factors and lifestyle. Documentaries air regularly on television, and commercials broadcast health messages. Other resources available to the public include newsletters, newspaper health sections, information clearinghouses (government and nongovernment), consensus conferences, self-help groups, and publications generated by the National Center for Health Statistics (NCHS) and the Office of Disease Prevention and Health Promotion (ODPHP).

Newsletters. Those designed to raise the health consciousness of the consumer include: the Harvard Medical Letter, the University of California at Berkeley Wellness Letter, the Mayo Clinic Health Letter, Tufts University Diet and Nutrition Newsletter, and Prevention Report, a publication of the Public Health Service (PHS). Newsletters communicate information designed for special populations. More than twenty newsletters have been identified that relate to the needs of the elder consumer. AFB News carries information on resources and assistive devices for the blind and physically handicapped. CANE Exchange reports services responsive to elder abuse and Medication Trends for Older Adults communicates developments in medication management, biotechnology, and pharmaceutical innovation from thirty research-based pharmaceutical companies. Elder Care News (published by the University of Maryland at Baltimore School of Pharmacy) synthesizes literature related to medications, nutrition, and oral health of the elderly; the AARP Bulletin carries articles about health insurance and legislation. Newsletters of other advocacy groups, such as United Seniors (United Seniors Health Report) and the Alzheimer's Association (AD Newsletter), serve as vehicles to disseminate information and services.

Newspaper Health Sections. The Washington Post Tuesday Health Section has been published regularly since October 10, 1984. This section carries news on health care issues (e.g., "Shopping for a Health Care Plan," November 17, 1992, p. 17) and includes a weekly calendar of activities, articles on health care topics, vital statistics, and treatment trends. Information contained in weekly health sections are sometimes accessible via database vendors, such as LEXIS, DATATIMES, and DIALOG. Libraries can also access newspaper information via VU-TEXT. Unfortunately, the printed "health" section of the Washington Post is not available as a separate subscription.

Information Clearinghouses. One of the newest national clearinghouses is NAIC (National AIDS Information Clearinghouse). In addition to maintaining a hotline (1-800-AIDS), this organization monitors a number of AIDS-related organizations—e.g., the Minority Task Force on AIDS, Mothers of AIDS Patients (MAP), National Association of People with AIDS, and the National Coalition of Gay Sexually Transmitted Disease Services. NAIC also produces resource guides dealing with such topics as AIDS and deafness. Other national clearinghouses include the Cancer Information Service, the National Rehabilitation Information Center, the National Information Center for Orphan Drugs & Rare Diseases; the National Diabetes Clearinghouse; the National Clearinghouse for Alcohol & Drug Abuse; the National Digestive Diseases Information Clearinghouse; and the Clearinghouse on Health Indexes.
Consensus Conferences. These conferences and their subsequent reports are designed to produce accessible and readily understandable consensus recommendations that summarize the implications of existing research evidence. The need for such summaries has been facilitated by the burgeoning scientific literature; the inadequacy of traditional journal articles as sources for direct decisions; awareness that a significant proportion of care is inappropriately provided; a shift from expected benefits to actual benefits; demands by third-party monitors for succinct recommendations about appropriate practice; and pressure from the public for increased input to medical and technological decision making. Consensus recommendations are used as the criteria for evaluation and appraisal aimed at changing practice behavior, making administrative decisions on resource allocation, or defining research protocols. Lomas discusses current methodologies, a framework for evaluating the consensus process, and controversies surrounding "resolution of conflict" (Lomas, 1991). Consensus conferences are included in the MEDLINE database as a publication type and can be searched with a heading qualified by (pt).

Clinical Alerts. Clinical alerts are released periodically and are available through an NLM database called ALERT. The scope of the database includes research findings from NIH-funded clinical trials and presently contains about eight 1-2 page summaries. Full-text or bibliographic information is available to MEDLINE and GRATEFUL MED subscribers.

Electronic Tools. Databases, such as the NLM's DIRLINE and the NCI's PDQ, provide useful directories (e.g., health care associations and cancer experts). DIRLINE entries include service descriptions, hours of operation, as well as toll-free telephone numbers and other pertinent information. PDQ (Physician's Data Query) is the National Cancer Institute's (NCI) database which provides information on cancer treatment, research protocols, and a directory of physicians and organizations involved in cancer care. NCI also maintains a toll-free telephone service (1-800-4-CANCER). The FDA's Bulletin Board provides information on new drugs under development as well as information about food and drug recalls. VU-TEXT (covering newspapers 1-800-258-8080) and CD-ROM products, such as Health Index Plus, contain full-text articles and consumer-oriented summaries. The AIDS Book Review Journal made its debut in March 1993. Accessible through the Internet, it allows viewers to browse pertinent resources about AIDS, safer sex, and sexually transmitted diseases (LISTSERV@UICVM).

Self-Help Groups. At least two self-help clearinghouses profile support organizations and make them accessible. These are the National Self-Help Clearinghouse (City University of New York, 212-840-1259) and the Self-Help Clearinghouse of Greater Washington (Mental Health Association of Northern Virginia, Falls Church, VA, 703-536-4100).

The Office of Disease Prevention and Health Promotion. The ODPHP, the information support branch for the Public Health Service, enhances the public's access to information and works with national and local organizations having common goals. In addition to publishing a series of healthfinders (bibliographies related to current topics in health), the ODPHP provides lists of clearinghouses and toll-free numbers for health information.

The National Center for Health Statistics. The NCHS, part of the Centers for Disease Control, is the only federal organization established specifically to collect and disseminate data on health in the United States. NCHS publications provide statistical validity to health studies including the
ongoing National Health Interview Survey. The National Health Interview Survey is a continuing nationwide survey of the U. S. civilian noninstitutionalized population conducted in households. Each week a probability sample of households is interviewed by trained personnel of the U. S. Bureau of the Census to obtain information about the health and other characteristics of each living member of the sample. The sample is composed of 36,000 to 46,000 households including 92,000 to 135,000 persons (depending on the year). Publications are inexpensive and usually found in government document sections of public or academic libraries.

National Technical Information Service. The NTIS supplies technical reports and analyses from foreign national and local government agencies. Foreign reports now comprise 20 percent of the NTIS collection. NTIS distributes federally-generated computerized datafiles, databases, and software; it is the licensing agency of U. S. patents, and manages the Center for the Utilization of Federal Technology. About 70,000 items of information from U. S. and foreign governments are added to the collection annually. Individuals seeking the latest technical reports may subscribe to one of NTIS' current awareness bulletins. The NTIS Bibliographic Database is searchable through major online vendors, such as DIALOG, ORBIT, and STN. NTIS Customer Services can be reached at 703-487-4660 during business hours.
REFERENCES


The Development of Specialized Biomedical Information

DAVID S. GINN

ABSTRACT
Specialized biomedical information comprises most of the information found in hospital and academic health sciences libraries and has also become the focus of a growing number of specialized information services and centers. The trends we see in the development of biomedical information have been duplicated, and sometimes extended, in the development of specialized information. The emergence of AIDS during the past decade has created a complex set of information dynamics, which has led to the development of new sources, services, systems, and modes of dissemination. These new information dynamics have been accompanied by, and are the result of, the involvement of new participants in the AIDS information equation. The solutions and strategies brought to bear on the AIDS information problem have demonstrated the progress made by the biomedical information community over the past two decades. However, AIDS has also demonstrated the challenges we face in striving to participate effectively in an information environment which is increasingly complex.

INTRODUCTION
Over the last two decades, several trends have characterized the development of biomedical information and its management. These trends include the proliferation of information, production in new formats, rising costs, and new methods of dissemination and transfer. The specialized information found in biomedical libraries and
information centers and the growing number of libraries, information centers, and services which collect, provide, and disseminate specialized biomedical information also show evidence of these developments. Beyond their ability to demonstrate these changes and trends, an examination of specialized biomedical information may also provide a better understanding of the complex interactions and dynamics between biomedical information and the many and varied participants who produce, seek, share, disseminate, and manage that information.

Specialization in care and treatment, and the focus of organizations and populations on specific health-related concerns, have created the need for, and spawned the development of, libraries and information centers which address a more specialized subject matter. Specialized information centers and services may concentrate on a specific health concern or disease such as alcoholism, Alzheimer's disease, cancer, or otitis media. These centers and services may also focus on solutions to health concerns such as biotechnology; on a specific drug such as lithium; on a category of diseases such as rare disorders; on education or prevention such as cesarian prevention; or on a particular population such as retired persons. Specialized information centers and services frequently support the internal information needs of the organizations they serve, while providing information services to the external population(s) most concerned with the focus of their organization. These information services may be concerned with disease advocacy, may serve as research centers, may be provided by or serve health care professionals, or may be government affiliated.

No specialized health concern in the last two decades has challenged both the biomedical and information communities as much as acquired immune deficiency syndrome (AIDS). The emergence of new information sources and formats, of new producers and users of information, of new methods for dissemination of information, and of new dynamics among the various professions and persons concerned with the disease, have all been a critical part of the AIDS information equation. AIDS information has reflected, demonstrated, and, in some instances, caused the present trends in biomedical information and information handling. The complexity and richness of the AIDS information environment makes it the ideal health concern to use in an examination of the development and evolution of specialized information centers and services and of their coping strategies.

**Participants in the AIDS Information Equation**

Any analysis of the development of AIDS information and the strategies devised to cope with it must necessarily include a discussion of the participants involved in the production, seeking, sharing, and
management of that information. The advent of AIDS has seen multidisciplinarity extended to another level where medical information is produced, shared, and disseminated not only by the clinician, psychiatrist, neurologist, and sociologist, but also by those outside of the medical field. The "Medical News" section of *JAMA* acknowledged, in 1985, that: "Homosexual and bisexual men, who account for approximately 75 percent of reported AIDS cases in this country, were the first—and remain among the most active—organizers of resource centers for information, counseling and support for persons who are in high-risk groups for AIDS" (Goldsmith, 1985, p. 2522). The development of AIDS information and literature has been characterized by an increase in sources outside of the traditional biomedical literature and produced by those who are outside the biomedical establishment (Ginn, 1987; Huber, 1991).

This active involvement in the information equation by nonhealth professionals may be most closely related to the consumer health movement. Still, the information involvement in AIDS differs in its intensity if not its cause. The support organizations which assumed responsibility for the collection, organization, dissemination, and, in some cases, the production of AIDS information, did so in direct response to the perception of a vacuum in the traditional biomedical community. This perceived vacuum initially related to care and treatment but was extended to the provision of information. Two factors probably contributed to this "pre-empting" of the central information role of health care professionals. The first was the stigma attached to the populations most directly effected by the disease—homosexuals, Haitians, and drug abusers. The conviction that the affected groups would need to provide for themselves was particularly prevalent in the early 1980s. Another factor was the concentration of AIDS knowledge in a relatively small number of cities by a relatively small number of "AIDS experts" with the largest caseloads. While a small number of these "AIDS doctors" were being overwhelmed with both treatment and information demands, they may have felt minimal discomfort in yielding the information provider role to the support and service organizations. Related to these factors was the reality that a large percentage of the AIDS focus was on education, prevention, and the provision of information as primary weapons in dealing with the disease. These were arenas in which nonhealth professionals, particularly those in the gay community, considered themselves to be at least as effective as the medical community.

The same conditions which coalesced around AIDS to create a new health information equation and new participants in the information process may not be reproduced exactly in other disease
or health concerns. Still, the levels of involvement by participants in the AIDS information crisis have provided both the professional and nonhealth professional communities with some valuable lessons. The most obvious lesson is that those most affected by a disease or health concern are willing and able to provide leadership in the development, provision, and dissemination of information about that disease or health concern. It is likely that this more aggressive approach to participation in the information equation will be seen in the future. Both the medical and information professions will need to work within this expanded framework or environment in which health care information is available and used beyond the traditional biomedical collection.

SERVICES TO A SPECIALIZED CLIENTELE OR USER GROUP

Specialized information centers necessarily serve a specialized clientele and user group, but that clientele and user group may also be extremely diverse. Most AIDS information centers provide information to a wide spectrum of different users, regardless of who they define as their primary user group. Most of the largest community-based support organizations, such as Gay Men’s Health Crisis in New York, San Francisco AIDS Foundation, and Health Crisis Network in Miami, provide information services to anyone interested in AIDS information. This includes the general public; those who are HIV positive; people with AIDS; family, friends, and spouses of those with AIDS; health care workers, ranging from clinicians, to sociologists, to psychologists, to health care financial advisors; and to the vast cadre of nonprofessionals who work for, or are affiliated with, the organization, providing care, treatment, and support for those concerned with AIDS. Both the newness of AIDS and the diffusion of AIDS information makes any AIDS information provider a potential resource for much of the population.

In spite of this diversity of clientele using the larger AIDS information centers, there has also been a splintering of services, including information services. In the larger cities, in particular, several groups have split off to form specialized services, including information services. AIDS organizations which focus on women, African-Americans, Haitians, and Hispanics are examples of the specialized groups that have formed separate organizations to provide information services.

Specialized populations have received considerable attention regarding their AIDS information needs. Researchers have examined the importance of language and culture in the dissemination and seeking of AIDS information, reaching the conclusion that information for Hispanics, African-Americans, and other racially or
culturally diverse groups needs to be culturally and linguistically appropriate to be effective (Aruffo et al., 1991; Hu et al., 1989; Marin & Marin, 1990). Others have examined information dissemination, seeking and behaviors in the workplace (Barr et al., 1991; Farnham, 1991), or the AIDS information-seeking patterns and behaviors of college students (Cline & Engel, 1991; McDermott et al., 1987; Shelnutt, 1989). The literature indicates that specialized populations do exhibit information needs and behaviors specific to those groups, affecting the design and provision of information services appropriate to these populations.

The diversity in specialized information center users may be based on their demographics or interests but may also be based on their knowledge or reading level. Many of the individuals belonging to high risk populations (adolescents, IV drug users, minorities) are not well-educated about AIDS or may lack the ability to read at a level sufficient to educate themselves (Huber, 1992b). A study presented at the Sixth International Conference on AIDS (Halleron-Tweedley & Ranieri, 1990) asserted that reading levels of materials are too high for many target audiences and that translations and cultural sensitivity of materials are inadequate. Greenblatt (1990) asserts that, “considering the disproportionate representation of racial and ethnic minorities and youth among AIDS victims, couching information in such technical terms is tantamount to supplying no information at all” (p. 175).

Health professionals are among the specialized groups for whom AIDS information centers and services have been designed. The Regional AIDS Education and Training Centers (E.T.C.s), are administered by the Health Resources and Services Administration (HRSA), Bureau of Health Professions, Division of Medicine, and have the responsibility and mission of improving the education of health professionals in AIDS health care and support. The seventeen E.T.C.s provide training and information for health professionals in their particular service area. The Pennsylvania AIDS Education and Training Center has targeted primary care providers—physicians, dentists, nurses, nurse practitioners, and dental hygienists. In addition to providing collections of materials, educational programs, and conferences, the Pennsylvania E.T.C. focuses on programs which support clinical training.

Specialized information services provide many of the same challenges seen in more general collections. These services and centers also have to determine or define their primary clientele and mission, keeping in mind that the services they provide need to be responsive to those of varying cultures and backgrounds or varying levels of knowledge, intelligence, or reading ability. With an increased
understanding and recognition of the multidisciplinary and multifaceted nature of most diseases or health concerns, these concerns will likely be manifested in diseases other than AIDS.

**Development and Evolution of AIDS Information**

AIDS information has been produced in a variety of formats, by a variety of producers, in prolific amounts. The media, government, health care profession, consumers, and support organizations have all contributed substantially to the information and knowledge base on AIDS (Ginn, 1987).

The nontraditional information sources have come primarily from support organizations and consumers, including those who have AIDS, are HIV positive, or are in high risk groups. In the first years of the epidemic, particularly from 1982 to 1984, information hotlines, newsletters, and publications from the alternative press, such as *The Advocate* or *The New York Native*, were among the first to provide information about the disease. These nontraditional information sources have continued to serve as a primary information source for many.

The proliferation of AIDS information over the past ten years has been clearly visible and documented through research. Sengupta and Kumari (1991) observed that the number of AIDS cases doubles every ten or eleven months, with the body of literature concerning AIDS doubling in volume every twenty-two months. This dramatic increase was also explored by Roberts, Shepherd, and Wade (1987), who found annual increases in the number of MEDLINE articles published in the mid-1980s to be as high as 75 percent in 1984. The explosion of the AIDS biomedical journal literature is further evidenced by the National Library of Medicine's *AIDS Bibliographies*, which were first published semiannually, then quarterly, and then monthly. It has been estimated that, from 1983 through mid-1991, more than 200,000 MEDLINE entries were AIDS-related, that almost 60 percent of the journals indexed in MEDLINE published at least one article on AIDS during the past ten years, and that the literature of AIDS has grown to encompass at least twenty-nine languages and sixty-five countries (Pratt, 1992). There appears to be no research, bibliometric or other, which compares the growth of this literature to that of literature for other diseases or medical topics. Still it is clear that those providing AIDS or other specialized information services will likely have to cope with ever-increasing amounts of information.

AIDS specialty journals proliferated during the 1980s (Gluck, 1989), but the scattering and seepage of the AIDS literature to a wide range of biomedical journals continues to be significant (Sengupta
Specialized AIDS-related databases also proliferated during this time period (Branch, 1988; Rosenthal, 1990). The development of AIDSLINE from the National Library of Medicine in 1988 provided a bibliographic database that brought together citations from multiple disciplines and databases such as BIOETHICSLINE, POPLINE, CATLINE, AVLINE, and others (DuPont & Dutcher, 1990).

Centers and services providing AIDS information face a difficult task. The task extends beyond coping with the volume of information, to the evaluation of the information, and to the problems inherent in the organization and management of information in multiple formats.

**Selection, Collection and Evaluation**

Librarians have alternately embraced and shunned the role of information evaluator (Kuller et al., 1993). Reasons for this reticence range from a lack of subject expertise to the very small number of information malpractice suits directed toward librarians or information specialists. The dynamics involved in the development and production of AIDS information have added to librarians' and information specialists' responsibilities in collecting, selecting, and evaluating AIDS information.

The criteria typically used by librarians in evaluating medical information and information sources may also be used in evaluating AIDS information; they include audience, coverage, scope, timeliness, accuracy, source credibility, purpose, cost, and organization. In the evaluation of AIDS information, some of these criteria assume a new meaning and present a more difficult challenge than other medical topics.

Between 1982 and 1987, timeliness was particularly crucial in selecting, evaluating, and weeding AIDS information. The first five years of the epidemic saw a rapid curve in the identification of the syndrome, its opportunistic diseases, its modes of transmission, the retrovirus that caused it, and the first drugs that could slow or control it. Since 1987, the information has stabilized somewhat, but timeliness of AIDS information remains an important criterion.

The accuracy of AIDS information presents perhaps the greatest challenge to evaluation. In spite of epidemiologic data to the contrary, mosquito transmission of AIDS was strongly suggested in the mid-1980s (EIR Biological Holocaust Task Force, 1986). In spite of a lack of substantive evidence, the theory that HIV was introduced by the government as a form of genocide is still being suggested (Snead, 1992). Somewhat more subtle controversies surround the issue of whether HIV is really the "cause of AIDS" or whether AIDS is actually
a form of syphilis (Adams, 1989). For librarians and others evaluating AIDS information, determining what constitutes misinformation and what constitutes an “interesting theory” will continue to be problematic.

Source credibility may also be difficult to establish in an ever-changing knowledge base. As indicated earlier, although the number of AIDS experts is still relatively small, increasing numbers of authors are writing about the disease. Knowledge of disciplines or fields related to AIDS has not uniformly been accepted as ensuring credibility about AIDS. When Masters et al. (1988) published a work on heterosexual transmission of AIDS, his expertise on sexual behavior was noted, but his knowledge of AIDS was also questioned.

The criterion which has perhaps grown most in importance with the emergence of AIDS is that of “purpose, agenda or perspective.” Those reading, selecting, or evaluating information must have a heightened awareness that AIDS information operates in the same political environment as the disease itself, and that this affects its content and presentation (Ginn & Stevens, 1988). Those who simultaneously call for quarantine of AIDS patients and cite studies that the virus can “live” in saliva, provide an example of information which may be affected (or contaminated) by purpose, agenda, or perspective.

Terminology and Language of AIDS

In addition to the proliferation of AIDS information in its variety of formats and producers, the growth and evolution of AIDS terminology has been noted (Roberts et al., 1987; Ginn & Stevens, 1988). AIDS and AIDS literature was in existence for over two years before receiving its initial Medical Subject Heading (MeSH), Acquired Immunodeficiency Syndrome in 1983, while other indexes or databases, such as Reader’s Guide or Psychological Abstracts, assigned terms earlier. This was consistent with the National Library of Medicine’s policy of waiting to ensure that a concept, technique, instrument, or disease would last more than just a year or two. Still, the National Library of Medicine did recognize the uniqueness of the situation and, deviating from its standard practice, established the AIDS heading in mid-year (March 1983).

The MeSH headings grew with the terminology of the disease, with the term AIDS-Related Complex established in 1987, terms for the family of HIV Infections in 1990, and terms for HIV Antigens, HIV Antibodies, HIV Envelope Protein GP120 and other concepts now available. The headings available to those searching the literature have grown with the scientific and medical community’s knowledge of the disease itself.
While the headings available to MEDLINE searchers have grown, those responsible for collecting and organizing materials and information continue to face a formidable challenge. Specialized AIDS information collections provide both broader and deeper AIDS coverage than general biomedical collections. They require a more extensive terminology or thesaurus than MeSH headings offer. Most support organization libraries and information centers have chosen not to use MeSH headings, developing their own headings and methods of organization instead. For example, the Pittsburgh AIDS Task Force provides its own non-MeSH heading and subheadings for information on costs:

**Costs**
- Education
- Foreign Spending
- Federal Spending/Medicare
- Hospitalization
- Research
- Insurance
- State/Local Spending
- Testing
- Treatment

Other organizations, such as the library of the AIDS Information Network in Philadelphia, have developed a substantial number of non-MeSH AIDS and AIDS-related headings (approximately 600), which include definitions or scope notes and a classification scheme which provides for see references to assist in the organization and retrieval of information:

(46) **Cofactors in HIV Infection**—other than substance abuse/drug use, nutrition, sexual behavior.

SEE 97.10 Drug use/Cofactor
181 Disease progression
217.17 Nutrition/Cofactor
222.55 Opportunistic infection, conditions/Vitamin deficiencies
(277) Sexual behavior
(280) Sexually transmitted diseases
292 Stress

The organization of AIDS materials is complicated by large amounts of ephemera, including newspaper articles, unpublished reports, and internal documents. Those providing electronic versions of their AIDS information and holdings have generally been limited to using automated systems for small collections or libraries, or
bibliographic management software such as ProCite, Reference Manager, and EndNote.

No authoritative thesaurus for AIDS terms has yet been adopted for specialized AIDS collections. However, Huber (1992b) has recently published *Dictionary of AIDS-Related Terminology*. The monograph represents the first attempt to meet the need for a dictionary in comprehensible language for the layperson and seeks to address some of the complexities and unique attributes of the vocabulary. It contains approximately 1,500 terms identified through clinical and popular presentations of AIDS-related information. The definitions attempt to be as useful as possible without sacrificing medical, scientific, or popular accuracy, with lengthy technical definitions preceded by a simplified condensed version. Huber's work acknowledges one of the more important information dynamics surrounding AIDS; the vocabulary of AIDS is used by a diverse group of individuals with varying degrees of education and knowledge about medicine in general or AIDS specifically. The terminology and language of AIDS presents problems for those who need to find AIDS information and those who collect, organize, and disseminate that information.

**Recent Developments in Specialized Information Dissemination**

The dynamics surrounding AIDS resulted in the application of existing modes of information dissemination and the development of new dissemination modes. Newsletters produced by support organizations and others assumed new forms and levels of importance. Several newsletters, such as the *AIDS Medical Update* from the UCLA AIDS Clinical Research Center, provided editor generated abstracts or editorial comments to either supplement or replace the abstracts provided by the author. This type of external input to the analysis of journal articles is additional evidence of the desire to provide multiple and varied perspectives and interpretations of the biomedical information.

The concept of an "invisible college" among the producers of traditional AIDS literature (health professionals and basic scientists) has been studied by Self (1990). She found that the AIDS literature is written predominantly by the collaboration of two or more individuals, although the data did not allow for definitive conclusions regarding relationships between authorship and the authors' patterns of informal communications.

CD-ROMs appeared fairly early in the provision of AIDS information, with the introduction of the AIDS Compact Library from the Medical Publishing Group in 1988. This tool provided access to MEDLINE references on AIDS, AIDD (an international AIDS
database, produced in England), the full text of AIDS articles from several biomedical journals, and the AIDS Knowledge Base produced by experts from San Francisco General Hospital and the University of California at San Francisco. The knowledge base provided the ability to continuously update information (bimonthly), particularly important in a disease where information was changing rapidly.

Phone services and electronic bulletin boards have also assumed a heightened importance in the dissemination of AIDS information. In addition to providing a newsletter, San Francisco's Project Inform provides information on the availability and effectiveness of antiviral and immunomodulating drugs. Project Inform was one of the first organizations to provide information on drugs which were not federally approved. Without providing recommendations or endorsements of treatments, this organization provides information on AIDS therapies using physicians and other health care professionals as part of their organization. Electronic bulletin boards and mail systems emerged to facilitate information exchange and communication about AIDS and AIDS therapies. Huber (1992c) lists over a dozen bulletin boards or messaging systems, including AIDS Info BBS, Computerized AIDS Information Network (CAIN), FOG CITY Bulletin Board System, and AIDS Teleforum.

Beyond these new methods of information transfer, there is another phenomenon which cannot be ignored when discussing AIDS. There is an informal underground network of AIDS information which focuses primarily on therapies, some of them alternative, some unproven, and some potentially dangerous. This underground network extends beyond the provision of information about AIDS drugs, to where to get them, or even how to make them (Kolata, 1991; Richman, 1989). While many health professionals may be uncomfortable with these new roles of consumers and patients, the established biomedical community will need to acknowledge this new level of assertiveness and participation in the health and health information process and the conditions and frustrations which led to their appearance.

Computer-assisted instruction programs for AIDS have been produced to assist health professionals in managing and caring for those with AIDS. Available from the East Central AIDS Education and Training Center, AIDS: Vignettes for Physicians, AIDS Vignettes for Dental Professionals, AIDS-Vignettes for Nurses, and AIDS and HIV Disease: Psychosocial Interventions for Health Care Workers contain case-based vignettes which present health care professionals with decision-making situations and the opportunity to test their own knowledge (East Central Aids Education and Training Center, 1990). More AIDS resources of this type will likely be developed in
the 1990s as a wider range of health professionals (not just AIDS experts) are required to provide care and treatment to those with HIV and AIDS.

**INTEGRATIVE SERVICES AND SYSTEMS**

The difficulty inherent in providing AIDS information from multiple sources and in varying formats has created the need for integrated services and systems. These services and systems have attempted to bridge the gap between the multitude of different information sources and formats.

The first computerized information system which attempted to bring together the variety of information sources, traditional and nontraditional, in a variety of formats, was the Computerized AIDS Information Network (CAIN) developed by Delphi Inc. in 1986. Administered by the Gay and Lesbian Community Service Center in Hollywood, California, and the San Francisco AIDS Foundation, CAIN attempts to provide a database comprising a broad spectrum of AIDS information. Designed primarily to meet the needs of support organizations, health professionals, people with AIDS, and educators, the database was unique in bringing traditional and nontraditional information into the same system. The menu includes service resources, organization assistance, informational and educational resources, electronic publications, and legal information. A small number of citations from the biomedical literature are also included. CAIN is structured to allow subscribers to contribute information to the database as direct information providers, with technical information reviewed by professional advisory panels local to each information provider, also a new approach (Ginn, 1987).

The state of the art for integrated online computerized AIDS information may be the recently developed Southeast Florida AIDS Information Network (SEFAIN) and Boston’s Service Providers Information Network (SPIN).

SEFAIN (Burrows, 1992) is a community-based AIDS information system prototype developed for the 40,000 health professionals in the high incidence South Florida area, which includes West Palm Beach, Ft. Lauderdale, Miami, and Key West. The system integrates the University of Miami School of Medicine’s online catalog with the AIDS Care and Service Provider database, which provides access to information on over 400 AIDS service and care providers in the region. SEFAIN includes the Research and Clinical Trials database which provides information on research in South Florida, inclusion/exclusion for participation in clinical trials, and the National Library of Medicine’s AIDS databases, AIDSLINE, AIDS DRUGS, and AIDSTRIALS.
Similar to SEFAIN, the Service Providers Information Network (SPIN) (Boston AIDS Consortium, 1992) is based at the Harvard School of Public Health and designed by the Boston AIDS Consortium. The network enables direct care providers and people with HIV to access a range of information from a personal computer equipped with a modem. SPIN services include information services (newsletters, information on clinical trials, statistics, experimental treatments, job opportunities, information on drug reimbursement programs); communication services, including electronic mail, conferencing and forums; and provider referral. The provider referral is an online database of over 1,200 health and social service agencies providing services across the continuum of HIV/AIDS care (Boston AIDS Consortium, 1992; Boston AIDS Consortium, 1993).

TOWARD A COMPREHENSIVE SPECIALIZED INFORMATION COLLECTION AND SERVICE

Providing a truly comprehensive collection and service, even in a specialized biomedical area, is nearly impossible. The proliferation of AIDS information has already been discussed, together with the various formats in which it is produced. Specialized collections and information services will still need to evaluate and select information, even while attempting to be comprehensive. The two most ambitious attempts to collect comprehensively in the area of AIDS have probably been undertaken by the National AIDS Information Clearinghouse (NAIC) and the AIDS Library of Philadelphia.

Established in 1987, the NAIC is an information service provided by the Centers for Disease Control. The clearinghouse collects and distributes information on HIV and AIDS, maintains databases of AIDS organizations and educational materials, and provides telephone reference assistance. The clearinghouse also provides a funding database for HIV and AIDS service or support organization and the AIDS Clinical Trial Information Service.

While most of the specialized AIDS information centers of significant size have been associated with AIDS support organizations, the library at the AIDS Information Network in Philadelphia represents the state of the art in specialized information centers and houses perhaps the most extensive collection on the topic. Established in 1987 as the AIDS Library of Philadelphia, the network’s library now houses an information file of 80,000 articles from 1981 to present, 3,000 monographs, 250 videos, 160 serial titles, 200 pamphlet and brochure titles, as well as CD-ROMs and laserdisks. In FY92, the network answered 35,000 queries. Funded by private donations, some grant funding, and special events, the network is staffed by 2.5 FTE librarians, a paraprofessional, and approximately twenty volunteers.
Other staffing includes an executive director of the AIDS Information Network and an office manager. The AIDS Information Network also publishes a monthly newsletter and provides an AIDS education and prevention program (Schmidt, 1991; J. Hofacket, personal communication, February 12, 1993).

The National AIDS Information Clearinghouse and the AIDS Information Network of Philadelphia provide information and services to the widest range of those needing information on AIDS. These attempts at comprehensive collections and services represent important resources in the spectrum of AIDS information.

CONCLUSION

As an example of specialized biomedical information, AIDS is both representative and unique. AIDS has presented the biomedical and biomedical information community with challenges that are somewhat similar in kind to other diseases or conditions, but which operate in a significantly more intense environment and which present a set of information dynamics previously unseen. New participants in the AIDS information equation have added to this complexity, with consumers assuming roles even more active than those seen in the growing consumer health movement. These new participants have produced or inspired new information sources, formats, and modes of dissemination.

Those in the biomedical information community, such as librarians and information specialists, will need to provide their expertise to assist in the development of effective information sources, services, and systems. But they will also need to recognize that those directly and indirectly involved in the provision, organization, and dissemination of information now constitute a wider sphere. This wider sphere of involvement extends the role of librarian beyond that of either information collector or gatekeeper to that of educator, consultant, and resource.

AIDS has challenged our ability to provide both effective health care and effective health care information sources, services, and systems. Some of the solutions, strategies, and technologies brought to bear on the problem have been effective, but the AIDS information crisis has also exposed some of the flaws and weaknesses in our ability to solve information problems. The development of solutions and strategies for the AIDS information crisis will help solve the challenges of the broader range of medical and health information problems.

REFERENCES


EIR Biological Holocaust Task Force. (1986). The real story of AIDS in Belle Glade, Florida; Interview: Dr. Caroline L. MacLeod and Interview: Dr. Mark Whiteside. In W. J. Hamerman, J. Grauerholz, et al. (Eds.), *EIR special report: An emergency war plan to fight AIDS and other pandemics* (pp. 13-31). Washington, DC: Executive Intelligence Review.


The Health Sciences Librarian as Knowledge Worker

VALERIE FLORANCE AND NINA W. MATHESON

ABSTRACT

Technological development, economic constraints, and changing expectations about ownership of, and compensation for, intellectual property, challenge librarians to demonstrate more forcefully the value of their contributions to their institutions. Knowledge work in the library setting is defined as the development of products and services designed to meet client information needs. In an academic setting, client information needs revolve around the activities of scientific communication. Health sciences libraries have begun to change in fundamental ways to meet this challenge, redefining their missions, re-educating their staff, and re-engineering their programs. Examples are drawn from the Welch Medical Library and other academic health sciences libraries to demonstrate different strategies for achieving a competitive edge in the campus information environment.

INTRODUCTION

This article presents the changing role of health sciences librarians in academic medical centers and their part in the institution's scientific communication activities. Although discussion and examples highlight experiences of academic health sciences libraries, the concepts also apply to other kinds of libraries. Knowledge work in the library setting is the design of products and services to meet information needs. In the environment of scientific communication, those needs revolve around the retrieval, creation,
manipulation, management, and dissemination of new knowledge. The current environment for knowledge generation in the academic medical center is characterized by rapid technological change, turbulent economic conditions, and changing expectations about the value and ownership of inventions and intellectual property. In this highly competitive setting, all partners must add measurable recognizable value to the enterprise if they are to receive continued institutional support. Products that no longer meet critical information needs of the institution's populations are discarded or left under- or unfunded; new products and services arise which support themselves through a mixed funding base dependent upon continued measurable usage.

**Fundamental Assumptions About Libraries**

The library is not simply a service organization but an institution that creates *products* and *services* to meet the information needs of its clients. This is as true for the small hospital information center as it is for the large academic medical library. Management and process models borrowed directly from manufacturing industries often divide the world into "production" and "service." This approach inappropriately limits the library's vision of how it can and should operate. Historically, the term "manufacturing" has been used to describe the development of a material product that is no longer the responsibility of those who designed and built it once it leaves the factory or foundry. An important difference between a library and a manufacturing company is the fact that the library also designs and provides *services* to support its *products*. Knowledge work involves the development of integrated information products and services. Services are tightly coupled to products; products are not developed without a complement of services, and services are not offered independent of products for which they were designed. Many libraries must change in fundamental ways to fit this model, redefining their mission, re-educating their staff, and re-engineering their programs.

Another basic assumption is that, as the scholarly communication system shifts from a paper-based system to a network-based electronic information transfer medium, the traditional roles of libraries will change in the process. Libraries, authors, publishers, and information seekers have shared responsibility for various parts of the existing scientific communication system. In the electronic networked environment, librarians will be required to demonstrate their value to the communication system through their knowledge work activities if they are to continue to be seen as viable participants in scientific communication. As the rewards for intellectual invention are
redistributed to recognize the value added by each contributor in
the process, the value of the library's contribution must be clear.
If the library is viewed as only a storage or service center rather
than as an active participant in the information life cycle, then its
value to the institution will diminish as new less costly storage media
and service options appear on the horizon.

A final assumption is that libraries themselves must seek new
roles in their respective information environments. It would be rare
to find today an academic librarian who has not heard the terms
"transformation," "restructuring," or "re-engineering" used by deans
and other strategic planners on their campuses. The traditional roles
and values of the past, where libraries operated as uncompetitive
cost centers on their campuses, protected by noble values of
"intellectual freedom" and "equal rights to information," are fast
crumbling under the pressures of the new economic order. Health
sciences libraries whose institutional support derives partly from fee-
based health services and research grants—two intensely competitive
domains—are increasingly called upon to prove their value to the
institution through evaluative data and cost/benefit analyses. Such
self-assessment cannot effectively be done within the traditional
service center model of libraries.

Management Perceptions of Libraries

Nolan (1990), Drucker (1991), and Schlesinger and Heskett (1991),
among others, insist that survival in the information economy of
the 1990s and beyond means organizing for innovation, productivity,
and competitiveness. Their point is that many services will experience
in the 1990s the obsolescence and restructuring that has plagued
manufacturing since the 1980s. Large automobile and steel plants
closed, but smaller restructured plants opened in other parts of the
country under different management philosophies. How can libraries
benefit from this knowledge? What can be done to avoid obsolescence?

Academic libraries view themselves as knowledge-based
organizations, and librarians view themselves as knowledge workers.
They, along with their more satisfied scholarly clients, often describe
the library as being "the heart of the university" or the "most valuable
resource on campus." Yet little of the management literature outside
the information science disciplines reflects such views, nor do
management analysts seem to consider libraries to be critical elements
of the academic enterprise. One problem is the perception that
libraries are slow in stimulating and disseminating new technologies.
Straub and Wetherbe (1989) note that: "Computerized libraries, on-
line external database searching, and data extraction and conversion
software" will be "technologies with limited impact during the
1990's" (p. 1337). "Even though computerized libraries, for example, would be 'a valuable increment in our capabilities' their impact will be limited, first affecting researchers and only later management..." (p. 1337). Without a proactive role in introducing and integrating technologies into the scholarly communication process, libraries are thus seen as ineffective.

Another problem is the perception that the library as an enterprise is outdated and/or dysfunctional. Management advisors and commentators call for the transformation or restructuring of academic and service organizations like libraries (Nolan, 1990; Schlesinger & Heskett, 1991; Penrod & Dolence, 1991; Roach, 1991). Bottom line values once were measured in terms of growth, size, number of transactions, and acquisition of new technologies; now they are more often calculated in terms of cost, benefit, quality, speed of response, functionality, and adaptability. Being the first to apply new knowledge, rather than being the first to apply a new technology, is now the measure of success. Technology is not itself a source of competitive advantage but rather a resource and support tool for achieving that advantage.

A more general, and more insidious, problem lies in the lack of well-recognized desirable products and services for which the library is seen as the best source. When librarians do not characterize their work in terms of products and services designed to meet information needs, they fail to clarify the parameters of their knowledge work for themselves or their information-seeking clients. Since the introduction of online MEDLINE searching in the 1970s, health sciences libraries and librarians have explored a number of additional roles and responsibilities in health information management and dissemination, including a range of what might be called "personal shopper services." They have acted as agents for the information seeker by gathering published information, seeking new sources, weighing responses, consulting on the design of personal databases, and packaging results into customized products. They have taken some services beyond the walls of the library, joining teams of clinicians or researchers to provide on-site consultation and delivery of information services or teaching the use of information management techniques and technologies in classrooms, labs, and offices. While doing this, health sciences librarians have been successful in acquiring new computational skills, deeper understanding of the distinctive information needs in subject disciplines, and expertise about the management of knowledge in distributed technology-intensive environments. They have been less successful at using their new knowledge toward innovation, permanent
membership in teaching, clinical service, or research teams, and product development for different markets.

In their search for organizational relevance, librarians have continually asked themselves what change is required. The question, Can we package the data we have differently? translates to actions like automating circulation. The question, Can we make libraries more useful? is answered by attempting to offer existing services in new locations, like the office or the bedside. Information industry analysts such as Collier (1991) say that these are the wrong questions. The proper question is, What information products and services do people in this area actually want and what will they pay for? For administrators as well as researchers, the desirable library of the future gives access to information products, tools, and services which meet immediate needs at an acceptable cost. For administrators, the issue of return on the investment is drawn in terms of financial resources; for researchers, it is drawn in terms of time and cognitive energy.

**Products, Services, and Work in Libraries**

The standard dictionary definition of a product is “something produced”—commodities or goods which receive tangible form through manufacture. Products have no innate qualities or utility; they are simply “available for use.” Products have a known cost for materials; the product’s value to any single user is not known and, hence, is not calculated into the direct cost. Service, on the other hand, is defined as labor that does not produce a tangible commodity. Service involves a transaction; implicit in the definition is an exchange between two parties. The cost of services is negotiable between the server and the served based on direct costs and expected value. Tangibility is a crucial element in both of these definitions. Services can produce satisfied or dissatisfied customers, but they cannot produce products. A third important term is “work.” Work creates products by expending labor, whether the labor is mental or physical. Like service, work involves exertion; unlike service, work results in a product. These definitions clearly draw upon the manufacturing industry for conceptual underpinnings; products are made; service is performed. Work creates tangibles, service creates intangibles.

How well do these definitions of products, work, and services apply to what goes on in libraries? Libraries generally define themselves as purely service institutions. In this context, libraries create no products, and librarians do no work. Rather, they provide services for others, using their own labor and products available to them through the library setting. Clearly, a number of important traditional library activities are services, including question-answering, document delivery, and circulation. In the networked
computer-rich campuses of the 1990s, database searching, network management, and publication support are also important library services.

If the activity of libraries is viewed differently, however, one can easily identify a number of products which result from the knowledge work of librarians. For example, the physical collection of books and journals can be considered a product if assembly is an act of manufacturing (and manufacturing makes products). Tools that facilitate the use of the collection, like the online catalog or a network of CD-ROM players, are also products "engineered" by constructing an assemblage of other tangible goods. Even the library's skilled staff can be considered a product: resources brought to the library in different states, shaped through experience and continued learning. Other products typically developed by librarians include online tools such as tutorials and help screens for problem-solving algorithms, scripts for verifying bibliographic citations, and instructional programs for personal information management.

The importance of identifying the library's products is that it clarifies the fact that libraries produce something, and products can be assigned values and costs. Once the products are identified, the nature and substance of the services which support them are more easily characterized. By defining clearly their products and services, and by assigning properly the costs of production and support, libraries are in a position to evaluate their current programs, to make the case for new programs, or to re-engineer for competitive advantage. Without this background, libraries are not positioned to compete successfully against other suppliers of information products and services now populating the campus.

**Competitive Advantage and Productivity**

An important part of competitive advantage is productivity, a composite measure of the rate, quality, and impact of product development. Once the library is seen as a place where products are created, attention turns naturally to the library's productivity—the fluency and quality and effectiveness of its knowledge work efforts. Health sciences libraries, as all units within the health industry (schools and hospitals alike), must confront the demands for improved productivity. That does not just mean doing more of the same thing faster or at a cheaper rate. Rather, it means increasing quality and quantity of the products without working harder or longer (Drucker, 1991). It means offering enough value that the benefit to the customer exceeds the price, which in turn exceeds the cost to the library for producing or supporting a product (Grenier & Metes, 1992). When the customer asks, Why shouldn't I do this for myself? the answer
has to be that she or he receives more from the library than if the work were done personally. Measures of a library's productivity might include the number and skillfulness of independent information seekers that graduate from its parent institution, the number, kind and usefulness of tools developed by the library, the extent of penetration into different information markets on campus, and so on.

Schlesinger and Heskett (1991) offer an instructive example of productivity and competitive advantage, contrasting the trajectories of two fast-food companies. Up to the mid-1980s, one company was enormously successful with its mass-production approach of creating a product and then marketing it. At the end of the 1980s, it had flat or falling sales, little or no growth in productivity, rising costs, and increasingly disaffected customers. To maintain competitiveness, Company #1 invested in creating and marketing new mass-produced food products with little success. In this same period, Company #2, another fast-food operation, started with service rather than food production as its core structural design. Instead of the manufacturing-derived “what you see is what you get” approach, Company #2 concentrated on customer desires for fresh, healthy, tasty food at low cost served in clean surroundings. As a result, Company #2 experienced phenomenal growth. This company recognized the demand of its customers, designed the product, and put additional energy into product-related services. By recognizing itself as a products and services operation, Company #2 gained competitive advantage over Company #1.

The analogy for libraries may be more obvious with hardware stores rather than fast-food companies. Old-fashioned hardware stores offered a small stock of basic items coupled with staff expertise on how and when to use them. The huge warehouse-style hardware stores with miles of aisles and multiples of very similar products, which replaced the old style stores, are finding themselves no longer competitive. They cannot maintain the inventory, and customers want something else. Customers value the service model where the staff know the products so well that they lead the customer to what is needed to solve a problem; advise on quality, strengths, and weaknesses of the products; help assemble all the parts needed to get the job done; and, in some instances, contract with the customer to do the job. When hardware stores failed to recognize that they were offering both products and services, they reduced the initial competitive advantage gained by “one-stop shopping” and wide-ranging choice.

**Competitive Strategies for Libraries**

In every sphere of traditional operations (e.g., document delivery, bibliographic instruction, reference services), the library now has
competitors. Schlesinger and Heskett's (1991) statement about commercial service operations applies equally to the environment in which libraries now find themselves: "For years, customers had no alternative but to accept the poor performance and limited quality that were designed into almost every service operation. Today they do" (p. 81). Without recognizing and measuring their own productivity, librarians cannot capably defend themselves against charges of inefficiency and dysfunction, or against incursions by other information services vendors into their once-protected turf. One approach to this kind of self-guided transformation has been termed re-engineering (Hammer, 1990). Re-engineering focuses attention on the operational levels of an organization and mandates the re-evaluation, realignment, and redistribution of work tasks in relation to desired outcomes. Re-evaluation means questioning the purpose and value of existing products and services and discarding those that do not capitalize on technological capabilities. Realignment means organizing services around products and organizing work around outcomes. Redistribution means giving decision and control to those who use the output of a process (e.g., the product or the service). Libraries and organizations that have engaged in serious strategic planning over the past decade will find it easier to apply the principles of re-engineering than will those operating in the "business-as-usual" mode.

Strategies for Document Delivery Services

One arena of library operations where the competition is keenly felt is the delivery of published information to clients. Increasingly, publishers and commercial entities offer document delivery services directly to information seekers, bypassing local libraries completely. For example, one document service offers document delivery from tables of contents of 12,000 journal titles at a fee of $10-12 per article.1 Delivery via electronic facsimile can be within 24 hours for an article processed for the first time or within minutes for items previously processed. Primary scientific publishers like Springer-Verlag and Elsevier have been positioning themselves over the past decade to become the sole source for their publications in electronic form, and Williams & Wilkins has begun to offer document delivery for articles in journals it publishes. These services strike at the heart of the traditional view of libraries, where providing access to documents is the library’s raison d’etre.

Some strategies for competitive survival in this arena are beginning to emerge in academic libraries. The library can act as a facilitator, encouraging the relationship between the library’s clients and commercial vendors. This approach has been adopted by the
The APL Library plans to provide its users with direct access to a document delivery service. APL Library clients can treat the service as an index to the library's journal collections. Users can charge document orders directly to their departmental accounts or to personal credit cards. Of course, users can also continue to use journals in the library or request interlibrary loans for articles in journals not owned by the APL Library. However, the APL Library expects over time that users will find the convenience of direct ordering and rapid delivery worth the costs and will use the library less and less as a document source. Employing a product developed outside APL, the library re-engineered its document delivery services by placing the user in charge of identification and ordering.

A second approach libraries can adopt in the document delivery arena is that of direct distributor. At least one health sciences library is negotiating with a publisher to be its electronic document dissemination source on an experimental basis. A few university libraries, such as the University of Southern California and Cornell University, have other collaborative experiments with publishers well underway. In a different scenario, the library might instead opt to act as the user's agent, developing in-house products and services to support fully-electronic transfer of locally-mounted materials. This approach, more in line with traditional views of the library, is to assume the role of a network server. As a server, the library mounts electronic text and data files and provides access routes to them via the campus network. Within the University of California system, mounting full-text files for multicampus access is under investigation.

If electronic books and publisher-controlled on-demand journal articles are commercially viable, academic institutions may re-enter or compete more strongly in the scholarly publishing industry, as they did prior to the 1970s. In this scenario, the library might assume publishing roles such as providing scientific editing services, data management and quality control of electronic text, and "outsourcing" database extracts to typographers and printers. This fourth strategy, adopted by the Welch Library in its work with authors and editors of Online Mendelian Inheritance in Man (OMIM™), the GDB Human Genome Data Base (GDB™), and the Principles of Ambulatory Medicine (PAM), involves the library directly in the processes of scientific communication as a publisher.

Strategies for Library Instruction Programs

Bibliographic instruction is another fertile ground for re-engineering in health sciences libraries. Training individuals to use the bibliographic tools that provide access to biomedical knowledge
has been the mainstay of library education programs. As personal computers became ubiquitous, many libraries broadened their instruction programs to include training on a very broad array of software packages for scholarly information handling from desktop publishing to database development. Likewise, as online bibliographic databases became a significant reference source for scholarship, libraries added database search training to their array of courses. The focus of these educational services has usually been to provide familiarity with products or tools and their features. Introduction to DOS, Using WordPerfect™, Using GRATEFUL MED™ are typical of such courses. Increasingly, however, computer centers, campus continuing education programs, and off-site consultants or software stores offer a vast array of training options for adults seeking to learn to use computers or improve their skills with application programs. Integration of computing in elementary and secondary education are making introductory computing skills courses unnecessary for incoming students.

Rarely have library instruction programs attempted to teach their clients how to apply technologies to solve their domain-specific information needs. The shift in emphasis is subtle but important—such courses must be content-centered rather than process-centered, building technical proficiency in the context of scientific research. Information seekers are not seeking primarily to become expert searchers. Rather, they wish to learn the most effective strategies for finding and managing knowledge. In 1991, the Department of Biological Chemistry at the Johns Hopkins University offered a credit course, organized and taught by the Welch Library, entitled MEDLINE and Beyond: Survival Skills for Information Management. In this course, retrieval and organization of scientific information were taught within the context of the department's disciplinary knowledge, with problems and examples drawing upon chemical/structural or molecular biology/genetics databases for answers.

In shifting emphasis from process to content, library education programs can help improve the institution's knowledge productivity by teaching clients to apply tools to solve their information problems and by educating clients to design better tools to accomplish their work. Such programs are best designed and presented as a curriculum. The Welch Library's curriculum in scientific communication includes ten lectures and workshops on such topics as drafting a research paper, citation management, peer review, developing poster sessions, slide preparation, and abstract writing. Information literacy programs that incorporate increasing levels of complexity and content management are another important example of curriculum design for knowledge work (Ball et al., 1989; Association of American Medical Colleges, 1989).
Strategies for Reference Services

Another indication of the changing perspectives and needs of information seekers is the demand for new and different services. For several years, the Welch Library has managed a small satellite library for the Oncology Department, providing a traditional array of reference services and on-site collections. In the latest renewal negotiation for the management contract, the department proposed to eliminate most of the print collections and all traditional reference desk services such as citation verification and question-answering. In their place, the department funded a full-time "knowledge worker," a librarian whose job is to: (1) teach students, faculty, and staff to find and manage the information they need for their work, (2) assemble computing and communication technologies for use in scientific communication, and (3) provide consultation on tools and techniques for solving specific information problems.

The oncology example is one way a library's reference service can be re-engineered for competitive advantage. When the library's primary mission is the design of products and services to meet information needs, the appropriate response is a radical restructuring of this type, rather than an attempt to convince the department that existing programs are simply misunderstood or misused. Another approach adopted by health sciences libraries is to maintain traditional reference desk functions and complement them with specialist positions that cater to individual and departmental requests for assistance. Often, these specialist positions require a doctorate in a subject discipline relevant to the institution's research or clinical programs. The Personal Information Management Specialist positions at the Welch Library and the University of California, San Francisco Library are examples of this approach.

Re-engineering reference services presages the need for a fundamental redefinition of scope for the library's other programs, so that courses on software application or the design of a workstation environment replace bibliographic instruction programs or a mediated search service. It also results in a need for tools—guides, tutorials, menu interfaces—which help the independent information seeker to work effectively. The shape and function of these tools are defined through the dialogue between the librarian-knowledge workers and their clients.

Building Tools for Scientific Communication

The traditional expertise of librarians lies in several arenas. Perhaps the most fundamental and enduring is the creation and management of a system for organizing and describing information entities. In current terminology, this involves categorization,
knowledge representation, and database design. Periodically, this knowledge is re-invented or, occasionally, rediscovered. For example, those who have enthusiastically embraced document image processing (DIP) have discovered the need for retrieval mechanisms such as indexes, subject headings, and vocabulary control.

These and related library techniques have evolved over untold thousands of worker-years of deep experience in document-collection management. But think for a minute. Did librarians come up with such schemes because they enjoy complication? More likely, these techniques exist because they—or something very much like them—are crucial to doing the job. (Locke, 1991)

A second arena of librarian expertise is facilitating access to information, including the Johnsonian kind of knowledge (i.e., knowing where to find information on a subject) and also assembling the means for getting it. Computer terms for this work include interface design, network engineering, and knowledge acquisition.

As technologies have made it possible, the expertise of librarians has increasingly been expressed through computational tools that are the work of librarians themselves. The lineage in health sciences libraries includes Frank B. Rogers (the National Library of Medicine's MEDLARS system), Estelle Brodman (first automated card catalog and online serials control system named PHILSOM, for Periodical Holdings in Libraries of Schools of Medicine), Irwin Pizer (developer of the SUNY Network, precursor to BRS), and Naomi Broering (MiniMEDLINE™, LIS™, and BioSYNTHESIS) (The National Library... 1961; Pizer et al., 1963; Pizer, 1984; Broering, 1985; Georgetown University, 1988; Broering et al., 1991). Over the past two to three years, some other library management tools have been reported in the literature but, by and large, tools that improve individual or functional productivity have not emerged from libraries (Slach, 1985). This is partially a reflection of the traditional library ethic that emphasizes service over product development.

To build effective tools for scientific communication, libraries need to be deeply involved in the creation and management of new knowledge developed at their institutions. Helping researchers locate published knowledge does not provide sufficient insight into the functional requirements of tools for knowledge work. Call it toolworks or something else, but some group in the library must be charged with the responsibility for finding and/or building tools for managing knowledge. They must be constantly evaluating new products in light of their clients' information needs, making office calls, providing consultation services, offering themselves as contractors, gathering feedback, and measuring product effectiveness. The toolworks group must also create new tools, tools that can be
used by different departments within the institution, tools that can be taken to market by entrepreneurs. The biological sciences environment understands productivity of this kind as professionalism. Broering's development and sales of the LIS™ System was a proof-of-concept as well as a major breakthrough, earning for herself and her library the latitude and freedom to pursue innovative research (Broering et al., 1991).

The roles that health sciences librarians play in the electronic scholarly information systems of the future will be shaped by how scientists and clinicians view the library's importance to managing the knowledge of their disciplines. Understanding the integral nature of service to product is a critical concept in the networked electronic information environment, one that is new for many scientists. In the past, authors were concerned solely with the creation of intellectual products. Their responsibility for these products did not extend to maintenance of the product longitudinally in a real-time fashion. For example, four years could pass before another edition of a textbook had to be prepared. Gathering information for updating the edition could be left until the year before publication. Feedback from users of the product (i.e., readers and colleagues) was expressed in terms of sales and, sometimes, personal glory. Rarely were authors contacted directly to support or explain their claims, nor were they asked to offer support to the users of their products, beyond the informal collegial exchange of data and experience. That model of communication, mandated by the processes of the publishing industry, is not viable in the fast-paced creative environment of networked science. In the networked environment, few information products can stand alone without a support system. In the networked environment, the scientist must build a library rather than a manuscript. That is, the creation of an information product (i.e., a manuscript or text) must be accompanied by appropriate services (e.g., question answering, consultation, quality control).

INTEGRATION AS A COMPETITIVE STRATEGY

In the networked environment of scientific communication, the health sciences library has an opportunity to market its expertise directly to the scientists at its institution. The Welch Library's Applied Research Laboratory has integrated the library into scientific communication at Johns Hopkins through its work in the development and management of the Online Mendelian Inheritance in Man database (OMIM™) and the Human Genome Data Base (GDB™). In each case, librarians worked with scientists and software engineers throughout the various steps in designing, building, testing, and implementing an important source of disciplinary knowledge.
Integration at each step demonstrated the value added by library expertise to the entire project, and clarified the continuing roles appropriate for the library in ongoing management. For example, the interface design and search features for the software used to search OMIM™ were shaped by the online searching experiences of the librarians, who provided a context that the author himself could not. Software tools used by the author and his editorial staff underwent constant modification as the advantages of online searching and editing became more apparent to them. Welch librarians initially provided user support to the author and editorial staff as they learned to use the authoring tools. Later, this support extended to distant users as the database became available across national and international networks. Collaborative roles in managing the OMIM™ online database extend to the production of Mendelian Inheritance in Man, a printed derivative from the online file. Book format design and presentation are determined by the author and publisher. Requirements for the production tape, from which the book is electronically typeset, are determined by the publisher, printer and the library's book production manager. Book production for the tenth printed edition of Mendelian Inheritance in Man was managed by the Welch Library's Assistant Director for Database Development & Access (the equivalent of the Head of Technical Services in other library organizations). The value of the library's work in the publication of the book is recognized through an agreement wherein the publisher, author, and library share royalties on sales.

Staff at the Welch's Applied Research Lab are similarly integrated into the production and management of the GDB™. Because the GDB™ is a scientific data file whose contents are continually reviewed and updated by the scientific community, domain knowledge is required of Welch staff who work with the database content and scientific editors. Training and user support services for the GDB™, a relational database with hundreds of data elements, require staff to understand questions being put to the database, and to understand the data structures and query capabilities of the software as well. The educational and experiential requirements for librarians seeking integration into scientific knowledge work of this kind are being clarified as the database grows and matures. For now, they include library science training, graduate-level biological science, and computer science skills.

*The Integrated Academic Information Management System (IAIMS)*

Participation in the daily work of scientists is not the only integrating strategy employed by health sciences libraries. For a
decade, since the publication of the IAIMS report (Matheson & Cooper, 1988), academic health sciences libraries have explored mechanisms for integrating information within their institutional settings (Lucier, 1990; West & Katz, 1990; Moulik & Lai, 1992; Lorenzi, 1992). In many IAIMS models, the library sits at the center of the campus information network, serving as an integrating force and a central access point for the medical center's disparate scientific, administrative, and scholarly databases. In these settings, coordinated access to the university's information resources is offered through an information system centered at the library. At Columbia University, the Augustus C. Long Library's leadership of IAIMS development led to the Columbia-Presbyterian Medical Center's CPMC/IAIMS network, providing access, through a single "window," to clinical information systems, administrative files, scholarly databases, and electronic mail for its on- and off-campus clients (Guide to the CPMC-IAIMS Network, 1992). The Willow interface, developed at the University of Washington, offers access to a similar range of resources through an innovative interface which integrates information-seeking functions regardless of the type of database being searched (Ketchell, 1992). Similarly, through BioSYNTHESIS, Georgetown University offers an interface that gives clients access to locally mounted full-text resources, medical decision support tools, and bibliographic files, as well as providing a gateway through national networks to remote information resources (Broering et al., 1991).

IAIMS models embed the library into the corporate framework of the institution in new and powerful ways. As Anderson and Fuller (1992) note, IAIMS requires "the participation of librarians in areas outside their traditional purview in order to support the institution's general educational and administrative goals" (p. 200). For example, early IAIMS activities at the University of Utah led to institutional integration beyond the medical center. The Eccles Health Sciences Library's work on networking information resources, and the early introduction of a public computing center at the library, brought campus-wide recognition of the library's leadership role in developing information management systems. The director of the health sciences library now chairs the university's task force on computing, responsible for allocating several million dollars for instructional computing (W. J. Peay, personal communication, August 31, 1992). In these and other IAIMS models, the library's role as an initiator of action places it at the center of a larger institutional landscape. The emphasis on integrated access increases the importance and visibility of knowledge network administration and highlights the need for institution-wide agreements about appropriate databases and access levels.
A Model Integrative Strategy: The WELCH Workstation

A view of the Welch Library's strategic plan is offered as an example of how the library's products and services can be arrayed to accentuate their place in the processes of scientific communication. In this picture, the focus is on creation and dissemination of new knowledge. If a different aspect of the institution's mission were addressed (e.g., the service or education goals), a different view would prevail. The workstation metaphor employed in the example emphasizes the fact that the scientist's knowledge work is the center of attention. The name of the workstation, the Welch Electronic Library and Center for Health Knowledge (WELCH), reflects the presence on the user's desktop of the Welch Library's considerable human and knowledge resources. The menu structure for the workstation groups the library's products and services in terms of the fundamental activities of scientific communication—i.e., retrieval, organization, creation, management, manipulation, and dissemination of new knowledge.

The initial entry menu to the WELCH workstation serves as a directory to library offerings (see Figure 1). A library card is the switch that turns on the WELCH workstation. Each selection on the general menu represents a significant library program; library programs are centered on activities in the information life cycle.

Databases Menu: The Databases selection on the workstation's entry menu supports retrieval of knowledge from existing databases. Databases may be locally developed, commercially developed and locally managed, or remotely located and managed. They may be bibliographic databases or scientific data files.

Databases listed on the WELCH workstation are public databases available to all library card holders, defined as important bibliographic or data sources for the library's community of scientists. Figure 2 illustrates the current set of databases available to the Johns Hopkins Medical Institutions (JHMI) community; they include locally mounted and managed files and links to remote files:

- the JHMI Online Catalog, an integrated file of book, journal and audiovisual holdings in libraries on The Johns Hopkins University's East Baltimore campus;
- MED2000+, offering access to MEDLINE and Health Planning and Administration databases;
- Hopkins Current Contents™; a link to a locally-mounted Current Contents™ database jointly funded by the Welch Library, the University of Maryland's Health Sciences Library, and the APL Library;
Figure 1. The WELCH main menu

- GDB™ and OMIM™, human genome databases hosted at JHU and managed by staff and faculty at the Welch Library’s Applied Research Lab;
- WELCORK, an alcohol resources database developed at Dartmouth;
- JANUS, the online catalog of JHU’s Milton S. Eisenhower Library;
- Gateway to BRS Colleague™ databases, the most popular commercial source of information for departments at JHMI;
- NIH Clinical Alert(s) made available locally online.

Ideally, any database listed on the workstation’s entry menu offers a standard complement of products and services—no database is added to the Databases menu without this minimal set in place. These requirements include:

- Registration: New users can register online for passwords and access.
- Tutorial: Users can choose self-instruction through programmed tutorials. These tutorials may be developed in-house or purchased from database vendors.
Online help: Users can get online assistance when working where in-person consultation is not available.

Directory of consultants: Users can identify librarians and other campus resources with expertise about this database or topic.

Directory of training: Users can find and register for course offerings to obtain in-person instruction for this database.

Search and retrieve: Users interact directly with the database. Ordering items listed in the database is offered within the search & retrieval module.

Direct order: Users who know what they want can order directly without entering the search and retrieval module of a database. Orders may be for items the library owns, or for data to be borrowed or purchased from another source.

Expertise Menu: The Expertise menu (see Figure 3) supports the knowledge organization and management needs of the library's clients. It describes products and services available via individual consultations with library staff. In addition to their work developing the knowledge bases accessed through the Databases selection, Welch librarians offer tailored support for scientific communication activities. Products and services that draw upon library expertise include:
Figure 3. The WELCH expertise menu

- **Database design**: Users can request assistance in designing personal databases for storing scientific or bibliographic information to be used for research and publishing. Guidance on managing reprint files, thesaurus and index design, and recommendations for appropriate technologies are part of this consultation.

- **Curriculum support**: Users who teach can arrange to incorporate information management techniques or products into their courses. Formal instruction within classes, development of new courses and curricula emphasizing information management skills, computer-based instruction, journal clubs, and lab sessions are curriculum options.

- **Information agent**: A consulting service which gathers and packages information on a subject. The result is an information product built or selected based upon specifications from the information seeker.

- **Question answering**: Traditional in-person question answering available at reference desks is also offered.

**Tools Menu**: The information life cycle involves *creating and manipulating new knowledge* before it is disseminated via formal
and informal media. The library provides a set of tools (see Figure 4) for knowledge work whose design draws on librarians' own experience as purveyors of information products and services. A conceptual framework exists for these tools, based on the Welch Library's knowledge work with OMIM™, GDB™, and PAM. The tools are often locally developed shell scripts, templates, and macros. They may also be public domain products gathered and assembled with the community's needs in mind, or commercial products for which site licenses and network accessibility have been arranged.

Figure 4. The WELCH tools menu

- **Acquisition tools:** Authors need tools for reviewing and compiling knowledge from outside sources. Acquisition tools include scanners, import/export tools, "cameras" to capture data snapshots online, and dumping programs which transfer data directly from one database to another.
- **Organization tools:** Authors need tools for structuring and indexing data they create or acquire from other sources. These include automatic thesaurus construction for documents, files, text segments, or data. Database programs are organizing tools, as are outliners and graphic mappers.
• **Engineering tools:** Users will want to reconfigure data to fit different programs or uses. For example, a bibliographic record captured from a remote database can be stripped, restructured, and matched to the library's online catalog or the researcher's personal files to see if the item is locally available.

• **Quality control tools:** Typographical errors, missing fields, and other problems which impede retrieval must be amended. Authority control, spell checking, and dictionary and field matching are other examples of quality control activities.

• **Evaluation tools:** Quality testing of databases via sampling, review of user transactions and characteristics, comment capture, and automatic statistical comparisons and growth projections are examples of evaluation techniques which require tools.

**Publishing Menu:** The Publishing selection on the WELCH workstation's entry menu (see Figure 5) offers scientists tools and services that support *dissemination of knowledge* through formal and informal channels of scientific communication. Although libraries have traditionally remained outside the publishing process, their work in designing and managing knowledge bases created on their campuses positions them to take a leadership role in this area. The selections on the Publishing menu include:

• **Authoring:** Shell scripts, translators, and parsers for introducing Standard Generalized Markup Language (SGML) or other mark-up into standard word processing files allow the author to work with familiar tools to develop a more flexible manuscript file. Presentation graphics and layout tools offer preliminary views of the written text and numeric data.

• **Scientific editing:** Electronic collaborative writing requires tools for exchanging and marking up documents shared among authors. Text analysis programs provide data about the level and nature of the manuscript's contents. Editorial consultants can also be requested.

• **Publication management:** In the networked environment, scientific authors will publish by drawing data from personal and public databases and reformatting it for publication. Generating indexes, extracting data to fit established templates, verifying file sizes, and other production activities require electronic tools. The library may offer publishing services such as scheduling production of manuscripts and extracts, organizing sources to handle printing and distribution, preparing tapes for electronic typesetting, and running data verification programs.

• **Electronic conference:** Informal communication among scientists is supported through conference facilities which make moderating
and reviewing incoming messages possible with familiar tools. Simple extracts from personal files (e.g., unpublished data) are made by the scientist without library assistance.

Figure 5. The WELCH publishing menu

CONCLUSION

Academic institutions devote their resources and energies to research, teaching, and service. The Welch workstation, with its menus of knowledge-centered products and services, exemplifies one future for health sciences libraries, a future where the library is both integral and critical to the university's mission to create and disseminate new knowledge. The library designs and offers products and services that help scientists locate, discover, shape, store, and publish the data which derive from their research. Products are chosen or developed on the basis of explicit demand, and services are tightly bound to products. Some products and services are prepackaged while others are custom-tailored to meet the needs of individual information seekers. Consultation to develop customized products and services generates new ideas for development of new, more general, offerings.

Other futures are possible, employing different integrating strategies or different mixes of products and services. Whatever path
is chosen, positioning the health sciences library for competitive advantage requires immediate action in two arenas: the library must exploit fully the capabilities of computing and communication technologies, and it must redefine its products and services to be (and be perceived as) integral to the work of the institution.

**NOTES**

1 CARL (the Colorado Association of Research Libraries) Uncover™ service provides this service to libraries across the United States. The FAXON Company's FAXON Research Service and OCLC, Inc. plan on providing similar services for at least 10,000 journals, and other firms, including Engineering Information, Inc., Marine Biology Laboratory Library at Woods Hole, and University Microfilms International are also getting into the business.

2 The APL Library uses the CARL Uncover™ document delivery service for this purpose.

**REFERENCES**


About the Contributors

HOLLY SHIPP BUCHANAN is a doctoral candidate in education administration at the University of Louisville and formerly Director of Corporate Information Resources at NKC, Inc. in Louisville, Kentucky. She has served as president of the Medical Library Association and chair of its Hospital Library Section and is a Distinguished Member of the Academy of Health Information Professionals. She has served as symposium editor for the January 1985 issue of the Bulletin of the Medical Library Association on “The Hospital Health Sciences Library: Challenges and Future Directions.” Ms. Buchanan has developed and teaches continuing education courses for the Medical Library Association and Special Libraries Association on total quality management and benchmarking.

KAREN HACKLEMAN DAHLEN is Head of Information Services at the DAHLEN Library of the Health Sciences, University of Illinois at Chicago (UIC). Ms. Dahlen holds joint appointments in both the College of Medicine (Department of Medical Education) and the College of Associated Health Professions (Health Information Management). She has taught the M.L.A. course (Consumer Health Information Resources for the Layman) for the past ten years; she has developed an M.L.A. course (Geriatric and Gerontology Information Resources). She teaches in curriculum courses within the UIC health professional schools and consults with organizations developing aging collections. She edited a symposium for the Bulletin of the Medical Library Association (vol. 78, no. 2, April 1990) on “The Evolving Role of the Health Sciences Library in Continuing Education.” Currently Ms. Dahlen is involved in a study to assess the effectiveness of libraries in responding to consumer health information requests. Research interests also include a better understanding of the knowledge and skills required to support lifelong learning in the health professions. In 1989 she received the Medical Library Association’s research award.
CONTRIBUTORS

Prudence W. Dalrymple is Director, Office of Accreditation, at the American Library Association. She has taught health sciences librarianship at the Graduate School of Library and Information Science at the University of Illinois at Urbana-Champaign, where she was a member of the faculty from 1988 to 1991. She has also held positions both in hospital and academic health sciences libraries. Recently, she has published articles on research in health sciences libraries and currently chairs the Medical Library Association's Research Task Force.

Valerie Florance is the Deputy Director of the William H. Welch Medical Library at Johns Hopkins University where she is responsible for the library's day-to-day operations and long-range planning. Previously, she served as project director for a grant from the Council on Library Resources that examined the knowledge management model implemented at the library’s Applied Research Laboratory. Ms. Florance's most recent research focuses on the design of tools to support information seeking in practice environments.

David S. Ginn is Director of the Alumni Medical Library at Boston University Medical Center. He was previously Associate Director for Information Services at the University of Pittsburgh’s Falk Library and has held other library positions at the University of Miami (Florida) and University of Illinois at Chicago. He is the author of articles on end-user training, integration of information-seeking skills into medical school curricula, and quality filtering of the clinical literature. He has served as information consultant to AIDS support organizations and spoken at numerous professional meetings on the development and dissemination of AIDS information. He is the co-developer of the Medical Library Association CE course, “AIDS: Concepts and Resources” (Chicago: Medical Library Association, 1988) and the author of the article “The AIDS Information Crisis: Confluence of the Roles of Information Seeker, Creator and Provider” (Bulletin of the Medical Library Association, 1987).

Joanne G. Marshall is an Associate Professor at the Faculty of Library and Information Science at the University of Toronto. In addition to her Ph.D. in Community Health, Ms. Marshall holds a Master of Health Sciences degree from McMaster University and a Master of Library Science degree from McGill University. At the University of Toronto, she also holds cross appointments in the Centre for Health Promotion and the Department of Health Administration. Prior to her faculty appointment, Ms. Marshall worked for fifteen years as a librarian in various academic and health sciences libraries,
including a number of years as a clinical librarian. She has received a number of research awards including the Medical Library Association (MLA) doctoral fellowship, the MLA Eliot Prize for the most significant research in medical librarianship for 1982 and 1992, and the Award of Outstanding Achievement from the Canadian Health Libraries Association in 1992. Her current research interests include assessing the impact of library and information services and the information needs of health care providers and consumers.

NINA W. MATHESON is Professor of Medical Information and Director of the William H. Welch Medical Library, Johns Hopkins University. She received her B.A. in English Literature and Master of Librarianship from the University of Washington in Seattle. She has held positions as a health sciences library administrator at the University of Missouri, Missouri Institute of Psychiatry, The George Washington University, and The Johns Hopkins University. She was also a program officer and policy analyst at the National Library of Medicine and at the Association of American Medical Colleges. Ms. Matheson has been President of the Medical Library Association as well as a member of the Association of Academic Health Sciences Library Directors. She has served on the National Library of Medicine Board of Regents, SCAMC Board of Directors, and the NAS Panel on Information Technology. In 1993, she was elected to the Institute of Medicine of the National Academy of Sciences and received the Medical Library Association's Marcia C. Noyes Award. Her areas of expertise encompass library organizational development and management and the use of computer and communications technologies to improve the management and dissemination of knowledge.

M. KENT MAYFIELD is an independent consultant providing interim leadership, management, and training services for human services agencies, professional associations, and educational institutions. Widely represented in the literature of adult and continuing education, Mr. Mayfield was formerly the Associate Executive Director of the Medical Library Association and served as a member of the CLENE Board of Directors.

JOCELYN A. RANKIN is Director of the Library and Learning Resources Center at Mercer University School of Medicine, Macon, Georgia, and is a professor on the faculty of the School of Medicine. Her doctoral research investigated the relationships between problem-based medical education and the use of the library. Dr. Rankin is a Distinguished Member of the Medical Library Association's Academy of Health Information Professionals. She is the author of
several publications in the library and medical literature and is active in professional organizations.

NANCY K. RODERER is the Director of the Harvey Cushing/John Hay Whitney Medical Library of Yale University. At Yale and in previous positions at Columbia University, Ms. Roderer has been heavily involved in IAIMS implementations. She has written extensively on the scientific and technical journal system, on library networking, and on the evaluation of a variety of library and information systems.

FRED W. ROPER is Dean of the College of Library and Information Science at the University of South Carolina in Columbia where he instructs in various aspects of health sciences librarianship. He is the co-author of *Introduction to Reference Sources in the Health Sciences* which serves as a major text for health sciences literature courses. Mr. Roper has written widely in the area of library education with recent emphasis on distance education and the delivery of courses by satellite technology. In May 1993, he will become president-elect of the Medical Library Association.

JEAN WILLIAMS SAYRE is Director and Chief Medical Librarian at the Ocacek Regional Information Center and faculty member of the Northeastern Ohio Universities College of the Academy of Health Professionals and was co-recipient with Dr. Jocelyn Rankin of the 1992 Frank Bradway Rogers Information Advancement Award. Ms. Sayre serves on advisory committees for the development of Ohio's statewide information system, OHIOLINK, and is active in regional and national professional organizations.

STEVEN J. SQUIRES is bibliographic access librarian at the Health Sciences Library of the University of North Carolina (UNC) at Chapel Hill. A graduate, in 1983, of the UNC School of Library and Information Science, Mr. Squires is active in the Medical Library Association, currently serving as its liaison to the ALA Committee on Cataloging-Description and Access.

FREIDA O. WEISE is Assistant Vice President for Information Services and Director of the Health Sciences Library at the University of Maryland at Baltimore. She also serves as Director of the Regional Medical Library for Region Two of the National Network of Libraries of Medicine. Throughout her career in health sciences librarianship, Ms. Weise has been interested in the applications of information technology in libraries. She has authored several articles on the subject and made numerous presentations. She is also active in the Medical Library Association and the Association of Academic Health Sciences Library Directors.
This Page Intentionally Left Blank
"Library Trends has become the premier thematic quarterly journal in the field of American Librarianship."

*Library Science Annual*

Both practicing librarians and educators use Library Trends as an essential tool in professional development and continuing education. They know Library Trends is the place to discover practical applications, thorough analyses, and literature reviews for a wide range of trends. See for yourself the breadth of topics covered in the 41st volume.

**Libraries and Information Services in the Health Sciences**
(Summer 1993) Edited by Prudence W. Dalrymple
Issue addresses major developments in health sciences librarianship related to delivery of information, the educational role of health sciences libraries for staff and administrators, and consumer health information.

**Education for and Information Service Careers in Corporate and Information Industry Environments**
(Fall 1993) Edited by Linda L. Hill
Contributors to this issue are practitioners, educators, and management personnel and leaders of the Special Libraries Association who discuss preparation for careers in corporate special libraries and information industry environments today and in the future.

**Changing Concepts in the Financing of Libraries and the Changing Library Context**
(Winter/Spring 1994) Edited by Murray S. Martín
This double issue addresses the library's role in the community, funding for various libraries, budgeting, online costs, and dealing with budget cuts. The second part addresses resource sharing, service fees, fundraising, the role of vendors, networks and costs, personnel concerns, and library facilities.

Subscription price $60 (plus $7 for overseas subscribers). Single copies are available for $18.50, including postage. Order from the University of Illinois Press, Journals Department, 54 E. Gregory Drive, Champaign, IL 61820.