



National Library of Medicine
Long Range Plan



The NLM Track Record

August 6, 1999

For clickable hyperlinks in this document,
access it from <http://www.nlm.nih.gov/od/nlmplan.html>

National Library of Medicine Long Range Plan

The NLM Track Record

Introduction.....	1
Goals and Objectives.....	2
Goal 1. Organize Health-Related Information and Provide Access to It.....	2
Objective 1.1. Acquire, Organize, and Preserve Biomedical Information.....	2
Objective 1.2. Provide Access to Biomedical Information.....	5
Goal 2. Outreach to the Professional and Lay Publics.....	7
Objective 2.1. Improve the Usefulness of NLM Products and Services and Increase Awareness of Them among Health Professionals.....	7
Objective 2.2. Strengthen the National Network of Libraries of Medicine (NN/LM).....	9
Objective 2.3. Outreach to the General Public.....	10
Objective 2.4. Enhance Global Health Activities.....	12
Goal 3. Promote the Use of Advanced Computer and Communications Technologies in Research, Practice, and Education.....	14
Objective 3.1. Build Health Applications for Current and Future Internet Environments.	14
Objective 3.2. Further Medical Informatics Research and Training.....	17
Objective 3.3. Foster the Education and Training of Health Sciences Librarians	20
Goal 4. Develop New Forms of Knowledge	22
Objective 4.1. Advance Scientific Knowledge in Molecular Biology	22
Objective 4.2. Build Electronic Biomedical Image Libraries and other Digital Libraries.....	25
Objective 4.3. Enhance and Expand the Unified Medical Language System	27
Index.....	28

Cover: Jackie Joyner-Kersey, world record holder and Olympic gold medalist in several track and field events, including the heptathlon (a seven-event track and field competition), the long jump and the hurdles.

Photo from the current NLM exhibit "Breath of Life"
Courtesy, Jackie Joyner-Kersey

National Library of Medicine Long Range Plan

The NLM Track Record

Introduction

The nation's investment in scientific research has created a revolution in the biological, medical, and material sciences unique in human history. Information and computer technology holds the promise of bringing new knowledge to billions of people across our globe in ways undreamed of even a short time ago. The National Library of Medicine now has the opportunity to provide timely and reliable access to health information resources that meet the highest standards of quality. This has always been NLM's underlying goal. Careful planning and visionary thinking are needed to assure that we can fulfill these promises.

In January 1985, NLM's Board of Regents undertook to develop a Long Range Plan to guide the Library in using its human, physical, and financial resources to fulfill its mission. A broadly based process, involving the participation of librarians, health professionals, biomedical scientists, medical informaticians, computer scientists, and others whose interests were intertwined with the Library's, culminated in the adoption of a report by the Board of Regents published in 1987.

Planning reports prepared since then as supplements to the original Plan (also based on the work of broadly based panels of outside experts) contain recommendations on outreach to health professionals, electronic imaging, information services for toxicology and environmental health, the education and training of health science librarians, and, most recently, a plan for NLM's international programs. As a result of this ongoing planning effort, NLM has taken major strides forward. For example, the concept of a National Center for Biotechnology Information was born during a planning panel meeting.

The NLM Track Record has been prepared as a synthesis and summary of past planning efforts and a statement of where we are today, preparatory to updating the Long Range Plan for the next three to five years. We invite public input into the Library's next phase of planning.

For more information about the Long Range Plan, and an opportunity to provide input to the next Long Range Plan, see <http://www.nlm.nih.gov/od/nlmplan.html>.

Goals and Objectives

Goal 1. Organize Health-Related Information and Provide Access to It

The advanced information products and services of the National Library of Medicine are built on the foundation stone of its unparalleled collections. They are broad (encompassing all the health sciences) and deep (from the 11th century to the present). The Library today is looked to as a principal source of biomedical information and the NLM's many high-technology programs are infused with the confidence and competence resulting from a century and a half of experience in supplying the information needs of health professionals. The Library continues to place primary emphasis on its role as acquirer, processor, and disseminator of information.

Objective 1.1. Acquire, Organize, and Preserve Biomedical Information

1985-1998 Long Range Plan Recommendations:

The Plan¹ recommended that NLM continue in its major role as the library of record for biomedicine. Areas to be expanded included acquisition of appropriate electronic media, historically significant records of modern biomedical research and practice, and information included in book cataloging and journal indexing such as table of contents information, signs, symptoms, procedures, research populations, clinical values, and quality indicators. The Plan also encouraged NLM to improve the process by which NLM selects journals for indexing, and to make better use of technology in the cataloging and indexing processes. The Plan recommended that NLM continue in its efforts to preserve books and journals in the collection, play a leadership role in the establishment of bibliographic and long-term preservation requirements and standards for electronic publications in medicine, and work with other interested institutions to define the special technical and policy problems created by electronic publishing. Finally, the panels recommended that NLM pay attention to collection development and basic library services to complement its toxicology databases.

Accomplishments

The NLM continues to accord the highest priority on maintaining the integrity of its collections and serving as the "court of last resource" for the worldwide biomedical literature. Emphasis has been placed on new forms of information (for example, electronic journals and computer software) and evolving areas (for example, medical genetics and computational biology). The content of NLM databases has been enriched with such forms as conference proceedings, clinical practice guidelines, consensus development reports, newsletters, and book sections. New forms of information have been instituted, such as the "Profiles in Science" (see also objective 4.2, p. 25). Under NLM's system reinvention effort, a sophisticated integrated library system has replaced an assortment of custom-built, mainframe-based processes that control acquisitions, serials, cataloging, collection management, circulation, preservation, and binding.

¹ Where this document refers to "the Plan," it means the collective group of NLM Long Range Plan reports, including: NLM Long Range Plan, 1987; Improving Health Professionals' Access to Information, 1989; Electronic Imaging, 1990; Improving Toxicology and Environmental Health Information Services, 1993; The Education and Training of Health Science Librarians, 1995; A Global Vision for the National Library of Medicine, 1998.

A continually evolving online indexing system streamlines the handling of the biomedical literature for MEDLINE, from the time a journal issue arrives at the Library until it is entered into the database. Fully 60% of MEDLINE citation and abstract data is now either received in electronic format directly from publishers or rapidly scanned into the database. In the area of preservation, the NLM led a successful campaign to increase radically the amount of medical journal publishing done on “permanent” (non-acid) paper, the NLM has greatly increased the rate of microfilming brittle monographs and serials, and a modern disaster prevention and recovery program has been adopted. NLM experts have codified standards for the bibliographic control of medical publications (including electronic forms). The Library has also established standard data formats to be used by publishers submitting citation data to NLM for processing into MEDLINE. The long-term preservation requirements for electronic publications, however, is a subject of wide concern within academia, government, industry, and others with an interest in seeing that valuable digital information does not disappear. NLM preservation experts closely monitor this field and cooperate with archivists and experts in preservation techniques.

Current Program Plans

In the immediate future, NLM will work to:

- Develop and implement plans for long-term storage of the NLM collection.
- Continue digitization of NLM’s retrospective indexes and catalogs.
- Continue to expand the use of publisher-supplied electronic data and to experiment with automated indexing techniques as a means for improving access to selected information (e.g., gene names, methodologies, research populations) and for reducing the level of human effort involved in indexing and cataloging.
- Identify important and unique retrospective biomedical collections held by other institutions and develop a strategy for their preservation.
- Work with national libraries and other appropriate organizations to develop, test, and implement strategies for long-term preservation of electronic information.
- Work with other institutions to develop technical standards, public policy, and alternative publication routes that promote more efficient electronic dissemination of the results of research.
- Modify technical processing, indexing, and document delivery systems and procedures so that NLM can handle documents born digitally as efficiently as it handles print documents.
- Organize selected authoritative electronic information written for the general public that is available at low or no cost, with an emphasis on science-based, nationally applicable information.
- Develop a national strategy for organization of the high-quality electronic health-related information useful to all NLM user groups and work with the NN/LM and other appropriate partners to implement it.
- Work with libraries to identify strong collections in toxicology and environmental health.
- Improve access to unique, historically significant records of modern biomedical and health services research.

For more information about the above programs, see:

Systems Reinvention	http://www.nlm.nih.gov/pubs/factsheets/sysreinvent.html
Acquisitions, collection development, cataloging	http://www.nlm.nih.gov/pubs/libprog.html http://www.nlm.nih.gov/pubs/factsheets/tsd.html
Acid-free paper	http://www.nlm.nih.gov/pubs/factsheets/acidfree.html
Journal Selection	http://www.nlm.nih.gov/pubs/factsheets/jssel.html
Integrated Library System	http://www.nlm.nih.gov/services/lpils.html
Medical Subject Headings	http://www.nlm.nih.gov/mesh/
Online Indexing	http://www.nlm.nih.gov/pubs/factsheets/online_indexing_system.html
Lister Hill Center Indexing Research	http://www.cgsb.nlm.nih.gov/research/research/ind
MARS	http://archive.nlm.nih.gov
Print and Electronic Journals in MEDLINE	http://www.nlm.nih.gov/pubs/factsheets/printelecjournals.html
Profiles in Science	http://www.profiles.nlm.nih.gov
Data Format Standards	http://www.ncbi.nlm.nih.gov/PubMed/spec.html
NLM Internet-Available Resources	http://www.nlm.nih.gov/pubs/factsheets/netresources.html
NLM Electronic Publications on the Web	http://www.nlm.nih.gov/pubs/libprog.html
Preservation	http://www.nlm.nih.gov/pubs/factsheets/preservation.html
Preserving Electronic Publications	http://www.nlm.nih.gov/pubs/factsheets/preservation.html
History of Medicine	http://www.nlm.nih.gov/hmd/
Images from the History of Medicine:	http://www.ihm.nlm.nih.gov/

Objective 1.2. Provide Access to Biomedical Information

1985-1998 Long Range Plan Recommendations

The Plan recommended that NLM expand its existing document delivery system to provide more comprehensive resources and to make effective use of newer technologies. The planning panels encouraged NLM to create linkages and gateways among various databases and information sources, at NLM and elsewhere, and to provide more systematic ways to refer requests for scientific information from individuals and organizations to the sources of relevant information. The Plan also recommended that NLM continue to maintain and enhance various databases in toxicology and environmental health. It asked NLM to reassess the contents and organization of its toxicology and environmental health databases. A national coordinating role for Federal and State activities in building and maintaining factual databases on the biological and environmental effects of hazardous chemicals was seen as highly important, as was the development of gateway systems and database integration in this arena. NLM was asked to continue research into improving information support in managing emergencies such as chemical spills.

The Plan also recommended that NLM continue and increase its efforts to ensure the quality of its factual databases (including practice-linked databases and knowledge-based systems), and to develop specialized pseudo-English or menu-driven interfaces for certain factual databases. It asked NLM to signify its willingness to store and make available appendiceal data files of selected published research.

Accomplishments

This is an area in which the Library has made good use of evolving communications technology to improve how health professionals and others have access to biomedical information. Grateful Med (and later Internet Grateful Med) introduced health professionals and other end-users to easy searching of MEDLINE and other NLM databases. In the area of toxicology and environmental health, the NLM collaborates with other Federal and non-Federal agencies to maintain a suite of specialized data resources on the Web that are widely used by health professionals, scientists, and community leaders around the country. To provide access to original or full-text materials, the Library inaugurated DOCLINE (journal holdings in NN/LM libraries) in the mid eighties to electronically route interlibrary loan requests. Since the early nineties “Loansome Doc” has allowed individual MEDLINE users to participate in the interlibrary loan system by entering requests for articles at their terminals. There are now links between PubMed/MEDLINE and 400 journal publisher Web sites thus permitting users to get the text of many articles referenced in the database. Clinical practice guidelines are available in the HealthSTAR database. Medical Subject Headings, the controlled vocabulary for indexing and cataloging, now has a Web-based “MeSH Browser” for quickly locating descriptors. Relais is a new document delivery system that uses scanning and electronic communications technology to more quickly process interlibrary loan requests. Finally, a Web link to evaluated health information for the consumer is provided by NLM’s MEDLINE*plus*, introduced late in 1998 (see also objective 2.3, p. 10).

Current Program Plans

In the immediate future, NLM will work to:

- Continue to improve NLM's retrieval interfaces to serve the needs of the general public, health professionals, biomedical, clinical, and health services researchers, and librarians and other information professionals:
 - Develop an NLM Gateway that provides simple integrated access to all of NLM's databases and Web-based information for the unsophisticated searcher.
 - Improve advanced search and subsetting capabilities so that different categories of users can easily retrieve appropriate information from NLM's large and comprehensive databases.
 - Develop easy-to-use access and delivery mechanisms that promote the public's understanding of health information resources, drawing on UMLS research and development, graphical and multimedia presentation, etc. (see also objective 2.3, p. 10).
- Add improved and expanded drug information to the Hazardous Substances Data Bank.
- Enhance the TOXNET web interface.
- Continue to analyze use and seek out customer comments and feedback and use these to improve NLM products and services.
- Identify, develop, and utilize state-of-the-art methods, techniques, policies and procedures to safeguard NLM's systems, services, and information from threats such as unauthorized use of facilities and computer systems.
- Develop new measurement strategies and metrics to evaluate NLM's computer-based services and their accessibility to users via the Internet and the World Wide Web. This includes, for example, end-to-end performance testing of NLM applications on the current Internet and the Next Generation Internet, and valid means for assessing frequency of use of MEDLINEplus.

For more information about the above programs, see:

NLM databases	http://www.nlm.nih.gov/databases/databases.html
Toxicology Databases	http://www.nlm.nih.gov/pubs/factsheets/tehipfs.html http://sis.nlm.nih.gov/ http://sis.nlm.nih.gov/toxsearch.htm
Internet Grateful Med	http://igm.nlm.nih.gov
PubMed	http://www.nlm.nih.gov/pubs/factsheets/pubmed.html
DOCLINE	http://www.nlm.nih.gov/pubs/factsheets/docline.html
Loansome Doc	http://www.nlm.nih.gov/pubs/factsheets/loansome_doc.html
Health Services Research databases	http://www.nlm.nih.gov/nichsr/nichsr.html
HealthSTAR	http://www.nlm.nih.gov/pubs/factsheets/healthstar.html
Relais	http://www.nlm.nih.gov/psd/cas/relais.html
MEDLINEplus	http://www.nlm.nih.gov/pubs/factsheets/medlineplus.html

Goal 2. Outreach to the Professional and Lay Publics

NLM has a broad mandate not only to collect and organize the literature of the health sciences and to provide information services, but also to "develop an outreach program aimed at... [the] transfer of the latest scientific findings to all health professionals.... [and to] publicize the availability of [its] products and services...." The following objectives encompass these activities—understanding more about the health information needs of professionals and the lay public, improving NLM products and services to meet these needs, publicizing the Library's products and services, strengthening the national network, and special initiatives directed at the general public and the global community.

Objective 2.1. Improve the Usefulness of NLM Products and Services and Increase Awareness of Them among Health Professionals

1985-1998 Long Range Plan Recommendations

The Plan recommended that NLM learn more about the information requirements of U.S. health professionals, and expand and enhance intramural research and development programs for the improvement of current information products and services and the creation of new ones, in accordance with user needs. It was also recommended that NLM mount a national campaign to increase awareness of its information products and services, and put in place permanent feedback mechanisms.

The Plan emphasized examining the information needs of user groups and extending outreach efforts to those working in toxicology and the environmental health sciences, with a special emphasis on those working with underserved populations, including minority health education institutions and the communities they serve. It asked the Library to evaluate and exploit new computer and information science technologies such as intelligent electronic gateway systems and artificial intelligence to make these databases easier to use. Finally, the Library was asked to expand the National Academy of Sciences Toxicology Information Program Committee (TIPCOM) to assume a more vigorous role in advising NLM.

Accomplishments

NLM carries out a diverse set of projects directed at building awareness and use of its products and services by health professionals in general and by particular communities of interest. Considerable emphasis has been placed on targeting health professionals that serve rural and inner city areas. An extensive training program has been developed for Historically Black Colleges and Universities (HBCUs) to train medical and other health professionals in the use of toxicology, environmental, and occupational health and hazardous waste information resources developed at NLM. Connecting American Indian/Alaska Native communities to health resources on the Internet has been a recent project. Other projects have addressed the needs of health professionals in particular subject areas, such as AIDS and health services research. A five year review of NLM's outreach activities was conducted in 1994 that documented the specific accomplishments of nearly 300 outreach projects carried out at more than 500 institutions. Among the findings was the need for NLM and the RMLs to work together to develop further expertise in evaluation methodology, and to incorporate an evaluation component in all NLM-sponsored outreach. Development of an outreach evaluation guidebook for use throughout the Network is nearing completion at the Pacific Northwest Regional Medical Library. NLM has carried out in-house studies and awarded

research grants over the years to determine the information needs and uses of health professionals. A landmark study of this kind employed the Critical Incident Technique to identify the impact of MEDLINE-derived information on a wide range of professional activities, including medical decision-making and patient care outcomes. Other studies surveyed NLM users to determine satisfaction with specific products and services, including beta testing of new offerings such as Grateful Med. Still others queried hospital libraries, and other organizations and individuals, with respect to their readiness to adopt Internet technology. NLM and AHCPR conducted a large scale vocabulary test to look at the vocabulary needs of users. Extramurally, NLM has awarded grants that looked at information needs, usage and value, including the value of providing information at the point of care.

Current Program Plans

In the immediate future, NLM will work to:

- Encourage basic and applied research to identify health care professionals' and researchers' need for, access to, evaluation of and use of biomedical and health information. Where feasible, examine the relationship between access to information and changes in behavior and outcomes.
- Continue special efforts to increase awareness and use of NLM services among health services researchers, health policy makers, public health professionals, and historians of medicine and science.
- Work with advisory groups to address issues concerning the usefulness of toxicology and environmental health databases.
- Review new technological developments for potential implementation in gateways to toxicology information.
- Continue to promote use of toxicology databases and access to technology at HBCUs.
- Produce historical exhibitions and related programs that promote understanding of science, medicine, and health and highlight NLM's collections and services.

For more information about the above programs, see:

Outreach	http://www.nlm.nih.gov/pubs/factsheets/outreach.html
Outreach Long range Plan Report	http://www.nlm.nih.gov/pubs/plan/ih/contents.html
Toxicology Outreach	http://sis.nlm.nih.gov/envjust1.htm
AIDS Outreach	http://www.nlm.nih.gov/pubs/factsheets/aidsinfs.html
NLM/AHCPR Large Scale Vocabulary Test	http://www.cgscb.nlm.nih.gov/research/research/u/mls/lsvt/
Outreach to Public Health Professionals	http://www.nlm.nih.gov/partners/
Critical Incident Technique Study	http://www.nlm.nih.gov/od/opecit.html
Tribal Connections in the Pacific Northwest	http://www.tribalconnections.org/
Planning and Evaluating Health Information Outreach Programs	http://www.nlm.nih.gov/pnr/eval/

Objective 2.2. Strengthen the National Network of Libraries of Medicine (NN/LM)

1985-1998 Long Range Plan Recommendations

The Plan recommended that NLM build a more active partnership with the libraries of the NN/LM, emphasizing bringing biomedical information resources within easy reach of all health professionals, and enhance the NN/LM to assure that it is able to use emerging technologies and to serve successfully as a test bed for new communications systems.

Accomplishments

Over the last 30 years one of the most important factors in the widespread acceptance and use of NLM's information services is the role played by the National Network of Libraries of Medicine. The NN/LM, with its 4500 members, is organized through eight regions, each with a Regional Medical Library designated and supported by the NLM. Those institutions, together with 140 large academic health science libraries and the many hospital and other libraries in the network, provide interlibrary loan and other crucial information services to scientists, health professionals, and, increasingly, the public. The members of the NN/LM have trained health professionals and others in the use of electronic information resources, and they support workshops, exhibiting, and other outreach efforts on behalf of NLM. The RMLs not only are using the Internet to develop new and innovative services, they are helping other Network member institutions, particularly small hospital libraries, to connect to the Internet. NN/LM members perform an invaluable service in helping to develop new communications systems, such as beta testing of successive versions of Grateful Med.

Current Program Plans

In the immediate future, NLM will work to:

- Continue to rely on the NN/LM as the NLM "field force" for outreach to health professionals and the general public. NN/LM priorities should include:
 - Expanding partnerships with state library organizations, public libraries, community-based organizations, state and local health professional associations, and public health agencies to inform health professionals, patients, and the public about NLM services and provide the training needed to use these services effectively.
 - Enhancing RML staff expertise in the full-range of NLM databases and services, including those in environmental health and toxicology, molecular biology and genetics, health services research, public health, and the history of medicine and science
 - Ensuring that NN/LM members, public health agencies, and community-based organizations that provide health information to the public have effective Internet connections.
- Promote the clinical trials database to the general public through the NN/LM.

For more information about the above programs, see:

National Network of Libraries of Medicine	http://www.nlm.nih.gov/pubs/factsheets/nnlm.html http://www.nnlm.nlm.nih.gov/
---	--

Objective 2.3. Outreach to the General Public

1985-1998 Long Range Plan Recommendations

The Plan recommended that NLM study the current sources of health information for the public and the potential role for NLM in this area. It was also recommended to augment DIRLINE (NLM's online directory) to provide a more complete directory of sources of health information for the lay public.

Accomplishments

Starting in 1988, NLM has undertaken a series of projects specifically devoted to addressing the health information needs of this community. These projects build on long experience with addressing the needs of health professionals and on targeted efforts aimed at making consumers aware of medical resources. This has been true particularly in the HIV/AIDS area, where NLM has in the past supported the use of electronic information resources by community-based organizations working directly with HIV affected individuals. A survey early in 1998 showed that about one-third of all PubMed/MEDLINE searches are done by the public. One response by the NLM was to launch, in October 1998, the MEDLINE*plus* web site, which provides access to a rich array of consumer health information on major diseases and conditions. MEDLINE*plus* is the centerpiece of a new pilot project in which NLM is working through the NN/LM with 37 public library systems of various sizes (more than 200 libraries in all) to train public librarians to use the Internet to find reliable health information for their patrons. NLM is also working to create an easy-to-use database containing information about clinical trials (both Federal and non-Federal) for experimental treatments for serious diseases and conditions.

Current Program Plans

In the immediate future, NLM will work to:

- Expand outreach to the patients and the public as recently approved by the NLM Board of Regents:
 - Publicize relevant and reliable electronic health information services, including those available from NLM and other sources.
 - Assist those providing health information to the public to make effective use of electronic services through Internet connections, training, and other means, with an emphasis on those serving minority groups, low income populations, seniors.
 - Promote integration of NLM services with other electronic services covering regional, state, or local health information.
 - Refer members of the public to regional, state, and local libraries and continue to serve as the national backup.
- Encourage basic and applied research to identify the general public's need for, access to, evaluation of and use of biomedical and health information.
- Continue to develop and enhance the clinical trials database.
 - Include clinical trials supported by other Federal agencies and the private sector in the clinical studies database.

- Explore collaborations with international groups that may lead to additional content for the clinical studies database through linking or other strategies.
- Initiate outreach activities to promote the clinical studies database as a resource for patients, physicians, community health groups, researchers, and others.
- Develop training and other educational materials to place clinical trials information in context for patients, families and other members of the public.
- Develop easier to use methods for submission of new information to DIRLINE.
- Produce historical exhibits and related programs that promote understanding of science, medicine, and health and highlight NLM's collections and services.

For more information about the above programs, see:

MEDLINEPlus	http://www.nlm.nih.gov/pubs/factsheets/medlineplus.html http://www.nlm.nih.gov/medlineplus/
AIDS information resources	http://www.nlm.nih.gov/pubs/factsheets/aidsinfs.html http://sis.nlm.nih.gov/hiv.htm
Clinical Trials Database	http://http://www.lhncbc.nlm.nih.gov/clin/
DIRLINE	http://www.nlm.nih.gov/pubs/factsheets/dirlinfs.html
NLM Exhibits	http://www.nlm.nih.gov/exhibition/exhibition.html

Objective 2.4. Enhance Global Health Activities

1985-1998 Long Range Plan Recommendations

The Plan recommended that NLM both assist other countries in identifying and gaining access to biomedical information in the U.S., and help U.S. health-care professionals in accessing information developed outside this country, including toxicology and environmental health information. In addition, the Plan advised NLM to (1) strengthen and expand efforts in global health information networking; (2) expand international partnerships with additional countries and regions; (3) foster collaborative development of molecular biology information resources; (4) pursue targets of opportunity to support the generation of new knowledge in infectious diseases and to aid in its utilization by scientists and workers in the field; (5) offer its expertise in informatics as a partner in research enterprises; (7) develop and offer training opportunities to U.S. and foreign students; and (8) speak out on issues vital to the international exchange of scientific and medical information.

Accomplishments

The Library places a high priority on maintaining the international character of its collections and databases. A network of International MEDLARS Centers has grown over the years to 20 members. In 1998 the Library published *A Global Vision for the NLM*, a supplement to the Long Range Plan that charted an international course for the institution in the coming years. In December 1998, an invitational International Partner meeting was convened at NLM to discuss programs in areas of high priority, such as document delivery, connectivity and infrastructure, and a crosscut that focused on the special needs of developing countries. A follow-up meeting was convened in Taiwan in May 1999 with representatives of the Asian International Centers to discuss new opportunities for collaboration with a focus on the special needs of that region. NLM is participating in the multi-agency Multilateral Initiative on Malaria and has begun to enhance communications and Internet connectivity at malaria research sites in Africa. This project has become a model for capacity building in electronic communications in support of research collaborators in developing regions of the world. NLM is collaborating with the NIH Fogarty International Center (FIC) in a new grants program to support the training of African scientists in medical informatics, both at in-country locations and in the U.S. The program has been expanded to include trainees from Latin America.

Current Program Plans

In the immediate future, NLM will work to:

- Expand and enhance its efforts to improve Internet connectivity and communications in sub-Saharan Africa.
- Assist the development of effective document delivery mechanisms for international MEDLINE users:
 - Promote regional document delivery networks in areas that currently lack effective document delivery mechanisms. Conceptually, these arrangements also address the Plan's notion of encouraging the development of a "loosely arrayed network of international centers for medical information."
 - Add additional international libraries to DOCLINE and increase international participation in Loansome Doc service.

- Expand high bandwidth connectivity testing internationally and include protocols for vBNS (very High Speed Backbone Network Service) connections in addition to the current Internet.
- Explore ways NLM can encourage institutional twinning arrangements, in which U.S. institutions assist foreign counterparts by means of resource sharing and staff training.
- Improve international informatics training, including the possibility of a variant of the Woods Hole informatics training program, structured as a shortened off-shore training experience tailored to the theoretical and practical informatics skills needs of malaria research scientists, their graduate students, and library staff.
- Provide technical assistance to Central American countries in toxicology and environmental health information

For more information about the above programs, see:

“Global Vision” Long Range Plan Report	http://www.nlm.nih.gov/pubs/plan/index.html
International Partners	http://www.nlm.nih.gov/pubs/factsheets/intlmedlars.html
Malaria Initiative	http://www.nlm.nih.gov/pubs/nlmnews/janmar98.html#Multilateral
FIC/NLM Training	http://www.nih.gov/fic/opportunities/itmi.html

Goal 3. Promote the Use of Advanced Computer and Communications Technologies in Research, Practice, and Education

Advances in communications and networking technologies help facilitate NLM's achievement of its mission. The rapid development of Internet and World Wide Web technologies make possible the quick, cost-effective distribution and exchange of biomedical information. Progress in telemedicine offers the promise of the cost-effective practice of medicine at a distance. NLM has always been a leader in researching and applying new technologies—typically years ahead of their widespread adoption. Today, the Internet offers new opportunities for NLM to leverage its limited resources for strengthening the U.S. and global biomedical information infrastructure.

Objective 3.1. Build Health Applications for Current and Future Internet Environments

1985-1998 Long Range Plan Recommendations

Through all its iterations, the Plan has embraced the use of computer and communications technologies to work towards the goal of improved health for all. As the Internet has unfolded over the years since the original Plan was developed, its use has been enthusiastically underscored. In order to permit academic and other health care institutions to access the growing number of networked information resources, the Plan recommended that NLM continue to support IAIMS planning, model development, and implementation effort, and strengthen and facilitate local institutions' access to national biomedical information sources. Although the Plan did not include telemedicine specifically in any of its formal recommendations, various reports, including the 1998 *A Global Vision for the National Library of Medicine* (see also objective 2.4, p. 12), acknowledge the potential of the field and NLM's contributions to it. Confidentiality and security of health data is another concern that, although not specifically stated in the Plan's formal recommendations, is clearly a concern reflected in *A Global Vision* and elsewhere in the Plan.

The Plan also recommended that NLM support the development of promising, innovative forms of information technology applications for health professional education and promote awareness of and access to computer-based educational resources. It asked NLM to investigate the technical requirements for and feasibility of a registry or database of computer-based health education materials, and also encouraged NLM to support the testing of computer-based learning materials.

Accomplishments

The Internet and the World Wide Web have increased enormously the potential for health applications in research, education, and practice. NLM's role was given a significant boost when NLM Director Lindberg was appointed by the White House as the founding director of the new multi-agency High Performance Computing and Communications (HPCC) Initiative, thus ensuring that biomedicine would be represented in this area. Because NLM depends to a great extent on the ability of the Internet to deliver health care information, the Library is an active participant in the Next Generation Internet initiative, a cooperative effort among industry, academia, and government agencies that seeks to provide affordable, secure information delivery at rates thousands of times faster than today. NLM has in recent years supported a variety of efforts in telemedicine and related areas: \$4.1 million for a large-scale

telemedicine project in rural West Virginia; \$26 million for 12 “advanced technology” projects, including telemedicine, under the HPCC rubric; \$42 million for 19 telemedicine projects announced jointly with the HHS Secretary; and 24 Next Generation Internet awards totaling \$2.3 million. In addition, NLM has sponsored a conference on telehealth for minority communities, supported the Telemedicine Information Exchange, and funded several Institute of Medicine studies about protecting electronic health information and how to evaluate telemedicine projects. The Library has a number of assistance programs designed to help medical institutions take maximum advantage of new communications modalities: the Integrated Advanced Information Management System (IAIMS) initiative to help major biomedical institutions create innovative approaches to linking a variety of sources of medical information, internal and external, into a “one-stop shopping” system; several grant programs to encourage institutions and consortia of various size to use of national electronic information resources; and a “connections” grant program to help small institutions hook up to the Internet. A new “Partners in Information Access” program is helping public health professionals across the country by awarding contracts to help them become aware of electronic information resources, connecting them to the Internet, and training them in their use. The Library emphasizes training health professionals in accessing electronic information through workshops in the NN/LM, at the NLM-supported National Online Training Center, and through the HBCU collaboration to provide training in the use of NLM’s chemical and toxicology files (see also objective 3.2, p. 17). The Learning Center for Interactive Technology (TLC) is a “hands-on” laboratory at NLM for educating health professionals about applications of information and educational technology in such areas as distributed learning, telemedicine, Internet/Web-based multimedia, CD-ROM, and virtual reality. Finally, one Library high-technology undertaking that is having a profound impact on health professional education is the Visible Human Project (see also objective 4.2, p. 25).

Current Program Plans

In the immediate future, NLM will work to:

- Promote the development and testing of public policy, national standards, institutional procedures, and technical mechanisms for ensuring the confidentiality and security of identifiable health data.
- Support the evaluation of the impact of information technology, systems, and services on patient care, health professional education, public health, and the behavior of the public.
- Examine the use of clinical data sources in health services research and public health surveillance.
- Work with other Federal agencies and outside organizations to support the establishment, ongoing maintenance, testing, and use of health data standards to enhance the quality of care and improve the data available for research. Use the UMLS Knowledge Sources and programs to facilitate the maintenance and distribution of vocabulary standards.
- Increase the number of investigators capable of doing work in these areas.

For more information about the above programs, see:

NGI and Telemedicine Projects	http://www.nlm.nih.gov/research/telfront.html
Privacy and confidentiality	http://www.nlm.nih.gov/nichsr/rd.html
Information Access and Systems grants	http://www.nlm.nih.gov/pubs/factsheets/resource_grants.html
Connection Grants	http://www.nlm.nih.gov/ep/connect.html
Partners in Information Access Program	http://www.nlm.nih.gov/partners
IAIMS	http://www.nlm.nih.gov/pubs/factsheets/iaims.html
IOM Report on Assessing Telemedicine	http://www.nap.edu/catalog/5296.html
NRC Report on Protecting Electronic Health Data	http://www.nap.edu/catalog/5595.html
Telemedicine Information Exchange	http://tie.telemed.org/
“Global Vision” Long Range Plan Report	http://www.nlm.nih.gov/pubs/plan/index.html

Objective 3.2. Further Medical Informatics Research and Training

1985-1998 Long Range Plan Recommendations

The Plan recommended that NLM increase intramural informatics research as well as support of extramural research in medical informatics, and encourage research that addresses issues and methodologies of fundamental importance to medical information facilitate development and evaluation of expert systems. It suggested that NLM test a prototype national communications system for research in medical informatics, sponsor conferences, workshops, and symposia, strengthen institutional development of medical informatics within universities, and develop an extramural program for research, development, demonstration, and assessment of knowledge management systems for use by health science professionals.

The Plan recommended that NLM substantially increase the number of medical informatics training centers, individual awards for research training and career development, support for young investigators, and demonstration grants. It also recommended strengthening collaboration and scholarship at NLM, and actively partnering with governmental and academic institutions to develop and offer international informatics training opportunities to U.S. and foreign students.

Accomplishments

Intramural: Research in medical informatics is conducted within NLM by scientists at the Lister Hill National Center for Biomedical Communications. Among the specific areas of research: Unified Medical Language System (UMLS—see also objective 4.3, p. 27), Natural Language Systems Program (see also objective 4.3, p. 27), the Visible Human Project (see also objective 4.2, p. 25), Digital Library Research (see also objective 4.2, p. 25), DXPNET (archiving and accessing x-ray images), the Expert Systems Program, DocView, SAIL (System for Automated Interlibrary Loan), the continuing Machine-Readable Archives in Biomedicine Program (MRAB), and the various programs within the Center's High Performance Computing and Communications Office. The Lister Hill Center also sponsors a medical informatics training program for visiting scientists and students. Research focused on bioinformatics and computational biology is conducted by scientists at the National Center for Biotechnology Information (see also objective 4.1, p. 22). Special projects there fall in the areas of structure/function, genome analysis, software and database design, and text retrieval and document analysis. The last category reflects the NCBI in its role as the progenitor of the PubMed/MEDLINE system.

Extramural: The Library has a number of extramural (grant and contract) programs for the support of medical informatics research, including special training tracks for informatics of dentistry, radiation oncology, and librarianship. There are three categories of investigator-initiated grants: medical informatics, biotechnology information, and health sciences library and information science. In addition, there are a number of special programs, for example the collaboration with NIH to fund 14 projects to apply medical informatics and telemedicine techniques to speed critical life-saving information to heart attack victims. The Library conducts and sponsors a variety of medical informatics training for health professionals, ranging from individual fellowships, to formal academic medical informatics programs at major universities (recently increased from 10 to 12), to semiannual intensive 1-week courses in medical informatics at the Marine Biology Laboratory in Woods Hole, Mass. NLM's

National Center for Biotechnology Information (NCBI) supports a postdoctoral bioinformatics training program through grants and also accepts postdoctoral fellows for work and training at the NCBI.

Current Program Plans

In the immediate future, NLM will work to:

- Conduct and support research in health care applications for the Next Generation Internet, including technical capabilities for quality of service, medical data privacy and security, nomadic computing, and infrastructure technology (see also objective 3.1, p. 14).
- Investigate effective searching across federated databases, including the necessary standardization efforts that will make this possible.
- Conduct and support research in smart card technology as an enabling technology for identification, authentication, and small-scale data storage.
- Promote and support research on health data mining as a method for discovering new clinical, public health, and health services information, making use of UMLS tools as appropriate.
- Conduct digital library research addressing issues in building, maintaining, preserving and disseminating diverse multi-media digital collections (see also objective 4.2, p. 25).
- Further develop document management technologies and applications, including scanning, optical character recognition, and document structure analysis.
- Further investigate automated concept-based indexing techniques for the biomedical literature (see also objective 1.1, p. 2)
- Initiate a consumer health research program, focusing on the special needs of members of the general public as they search for and use health care information on the Internet (see also objective 2.3, p. 10).
- Investigate the feasibility of providing multi-language interfaces to systems designed for health care consumers (see also objective 2.3, p. 10).
- Use the clinical studies database as a test-bed for research on health information seeking behavior by consumers (see also objective 2.3, p. 10).
- Develop a consumer health terminology server to provide assistance to the increasing members of the general public who are users of NLM's Web-based systems (see also objective 2.3, p. 10).
- Explore speech recognition and synthesis technology for use in searching biomedical repositories (see also objective 4.2, p. 25).
- Initiate a research program that will bring image-based library systems to the clinical community (see also objective 4.2, p. 25).
- Conduct basic research in algorithms for automated image segmentation, recognition, and decomposition (see also objective 4.2, p. 25).
- Extend basic research in automated image indexing and retrieval, using the salient features of the images themselves (see also objective 4.2, p. 25).

- Broaden the spectrum of health professionals who receive medical informatics training (e.g. nurses, dentists, and other health professions).
- Support and encourage minority institutions in medical informatics training.

For more information about the above programs, see:

Medical Informatics Research	http://www.nlm.nih.gov/resprog.html
Lister Hill Center Research	http://www.lhncbc.nlm.nih.gov/
HPCC	http://www.lhncbc.nlm.nih.gov/ohpcc
NCBI Intramural Research	http://www.ncbi.nlm.nih.gov/Web/Research/proj.html
Extramural Support	http://www.nlm.nih.gov/pubs/factsheets/assistinvestigators.html
Heart Attack Alert Program	http://www.nlm.nih.gov/news/press_releases/haalert.html
Training Opportunities	http://www.nlm.nih.gov/about/training/training.html
Medical Informatics Training	http://www.nlm.nih.gov/pubs/factsheets/trainedu.html
Medical Informatics Institutional Grantees	http://www.nlm.nih.gov/ep/curr_inst_grantees.html
NLM Fellowships in Applied Informatics	http://www.nlm.nih.gov/ep/appfellow.html
The Learning Center for Interactive Technology	http://tlc.nlm.nih.gov/
National Online Training Center	http://www.nlm.nih.gov/mar/online/index.html
Toxicology Database Training	http://sis.nlm.nih.gov/99train.htm
Woods Hole Medical Informatics Course	http://medicine.ucsd.edu/mbl_info
Lister Hill Center Sponsored Training	http://www.lhncbc.nlm.nih.gov/mitp/training.html
NCBI Training	http://www.ncbi.nlm.nih.gov/Web/NCBI/progsfs.html

Objective 3.3. Foster the Education and Training of Health Sciences Librarians

1985-1998 Long Range Plan Recommendations

The Plan recommended that for their own professional development, health sciences librarians should foster partnerships with other information professionals in their institutions, expand their roles in health services research and patient-related information, and take responsibility for their own professional development. The Plan recommended that professional organizations such as the Medical Library Association should make sure that employers know the worth of the services health sciences librarians provide, strengthen their continuing education programs, make a special commitment to minority recruitment, and publicize excellent curricula. The Plan recommended that library schools should ensure a positive academic environment for minority students, review curricula and institute new programs, develop interdisciplinary educational programs, and promote leadership, sponsor continuing education programs, mount aggressive recruitment campaigns, and, with professional associations, focus on the special needs of adult learners.

Accomplishments

In 1992, NLM and the Marine Biological Laboratory, Woods Hole, MA, initiated a one-week course in medical informatics, with trainees selected from applicants in health professions, research, and librarianship. After the publication of the Long Range Plan report on the Education and Training of Health Science Librarians, a new challenge grants program asked for plans to address and implement the recommendations in the report. Among other recent accomplishments in this area are the establishment of additional slots for any librarians recruited for a special librarian track by any of the 12 NLM Informatics Research training programs, and a new fellowship in applied medical informatics for those in other fields (see also objective 3.2, p. 17). The highly successful Library Associate Fellowship Program, which has for decades brought recent library school graduates to NLM for a 1-year training program, has recently doubled the number of trainee slots and expanded to an optional second year of mentored experience.

Current Program Plans

In the immediate future, NLM will work to:

- Review and assess the impact on health sciences librarianship of the NLM Associate Fellowship program, the number of informatics fellowships available to librarians, and the Woods Hole Medical Informatics course.
- Work with MLA and other appropriate organizations to recruit more people from minority groups into health sciences librarianship.
- Expand use of distance learning technology as one mechanism for providing continuing education in the use of information and NLM information services.

- Explore the development of a mid-career training program for health sciences librarians, which would involve nomination by top administrators, onsite experience at institutions which have integrated the library into clinical, research, and/or educational activities, and mentoring.

For more information about the above programs, see:

Long Range Plan Report on Library Training	http://www.nlm.nih.gov/pubs/plan/et/contents.html
Library Associate Program	http://www.nlm.nih.gov/about/training/nlmassoc.html
Training Opportunities	http://www.nlm.nih.gov/about/training/training.html
Woods Hole Medical Informatics Course	http://medicine.ucsd.edu/mbl_info

Goal 4. Develop New Forms of Knowledge

From research laboratories to the patient bedside, biomedical knowledge is being generated at a staggering rate. This new knowledge must be captured and disseminated in order for it to be useful and to make a difference to patient well being. In addition to the traditional forms of knowledge, the use of the computer has enabled scientist to take even greater leaps into the production of knowledge, most notably through molecular biology and new imaging techniques. The challenge is in finding new approaches to deal with the volume and complexity of data and in providing researchers with better access to analysis and computing tools in order to advance understanding of our genetic legacy and its role in health and disease.

Objective 4.1. Advance Scientific Knowledge in Molecular Biology

1985-1998 Long Range Plan Recommendations

The Plan recommended that NLM establish an intramural and extramural program for biotechnology information. It asked the Library to foster collaborative development of molecular biology information resources, such as GenBank, and champion the open and unfettered exchange of this kind of information as essential to the health of this vital science. NLM was encouraged to support national and international modeling and analytical activities particularly as they pertain to relating biological activities to chemical structures, conduct research in the areas of molecular biology data base representation, retrieval-linkages, and modeling systems while examining analytical interfaces based on algorithms, graphics, and expert systems, and provide repository, directory, and distribution services. Additionally, it was recommended that NLM develop and implement training workshops, information clearinghouse activities, and documentation programs, sponsor meetings, investigate possible new information structures and representations, and expand its existing medical and biotechnology informatics research grants program.

Accomplishments

The National Center for Biotechnology Information (NCBI) was established at NLM in 1988 and quickly became the focal point for bioinformatics at NIH. The Center serves as an international resource for databases and software in molecular biology, including the Human Genome project; for research in computational biology; and for the dissemination of biomedical information. NCBI has helped create new databases that combine or enhance existing molecular biology databases and develop links among them. It assumed responsibility for the GenBank DNA sequence database in 1992 and also supports and distributes OMIM, MMDB, UniGene, a Gene Map of the Human Genome, the Taxonomy Browser, and the Cancer Genome Anatomy Project (CGAP). NCBI has developed an extensive suite of software tools, including the BLAST program for sequence similarity searching. A recent accomplishment of significant note is the production of a new "gene map," developed in collaboration with laboratories around the world, which pinpoints the chromosomal locations of almost half of all genes. Entrez is NCBI's search and retrieval system that provides users with integrated access to sequence, mapping, taxonomy, and structural data with the ability to retrieve related sequences, structures, and references. NCBI also developed and continues to enhance PubMed, a Web search interface providing access to MEDLINE and with links to full-text articles at participating publishers' Web sites. NCBI's research activities center on the areas of molecular biology databases, development of search and analysis algorithms, genome analysis, and

molecular structure and function. Extramural grants for regional biology resources, biotechnology databases, genome-related informatics research, and other computational molecular biology research are supported.

Current Program Plans

In the immediate future, NLM will work to:

- Develop a strategic plan for the NCBI with input from NCBI's outside advisors and users.

Human Genome

- Assume responsibility for collecting, managing, and analyzing the growing body of human genomics data generated from the sequencing and genome mapping initiatives of the Human Genome Project. This represents a major buildup due the dissolution of the Genome Data Bank, which previously had responsibilities in this area.
- Expand GenBank, the central DNA sequence resource, to support the Human Genome Project's goal of completing a "working draft" of 90% of the genome by Spring 2000 and the complete sequence by 2003.
- Develop a database of single nucleotide polymorphisms (SNPs) to support a major initiative of NIH and an international pharmaceutical consortium to study genetic variations in the human population. A large, well-characterized collection of SNPs is important for associating sequence variations with heritable phenotypes, a key aspect of genetics research.
- Establish methodologies to automatically assemble and annotate the "working draft" of the human genome sequence, which will contain gaps, overlaps, and inaccuracies. Developing tools to identify potentially overlapping sequences, assemble them into single contiguous units, and compute all possible protein sequence translations is essential to making effective use of the high-volume sequence data generated by commercial and public sequencing centers.
- Develop approaches to apply standard gene nomenclature across multiple data resources, supporting and working in conjunction with the Human Genome Organization (HUGO) Nomenclature Committee and the OMIM database. Because genes are the common currency of genomic analysis, careful cataloging and naming of genes is important.
- Develop methods of integrating and presenting composite views of multiple genome maps produced by various physical and genetic and sequence-based mapping techniques. Consolidating disparate types of mapping data is important for guiding the research effort to pinpoint the location of the approximately 80,000 human genes scattered throughout the genome.
- Expand UniGene, a database that groups multiple DNA sequences into clusters that represent unique genes and is used extensively to guide gene hunting and genome mapping efforts, to include vertebrate models in addition to the current coverage of human, mouse, and rat.

Protein Sequence and Structure Analysis

- Expand accessibility of 3D structure information to a wider range of biologists by achieving greater integration of protein structure and sequence information and developing more intuitive approaches to predicting protein structure.

- Create a system of classifying proteins into families that share common function, based on research that compares complete genomes across different organisms.
- Develop a standard reference set of sequences to represent major genes and gene families. The exponential growth of GenBank requires the production of a summary database of representative gene sequences.

Computational Algorithms and Methods

- Develop new algorithms, mathematical models and graphical tools for supporting computational analysis of sequences and other genome data.
- Emphasize basic research in the areas of sequence analysis, protein structure and function relationships, gene identification and functional genomics, and molecular evolution.

User Education and Training

- Conduct training workshops in the use of NCBI databases and analysis tools, targeted to scientists as well as information specialists.
- Develop online tutorials and additional user documentation to improve user understanding and facilitate effective use of the resources.

Scientific Literature

- Expand scope, linking capabilities, functionality, and customization features of PubMed and Entrez.
 - LinkOut, a service that provides user-customized links to outside resources)
 - PubRef, a service that provides full-text links to journals not covered in PubMed
 - The Cubby, a service which allows users to set up custom profiles of stored queries, filters, and preferences
- Enhance PubMed and Entrez through links to supporting material in electronic textbooks.
- Develop and support innovative Web-based methods of scientific communication and publication (E-Biomed/E-Biosci).

For more information about the above programs, see:

NCBI	http://www.ncbi.nlm.nih.gov http://www.nlm.nih.gov/pubs/factsheets/ncbi.html
NCBI Bibliographic Resources	http://www.ncbi.nlm.nih.gov/PubMed/bibres.html

Objective 4.2. Build Electronic Biomedical Image Libraries and other Digital Libraries

1985-1998 Long Range Plan Recommendations

The Plan recommended that NLM thoroughly and systematically investigate the technical requirements for and feasibility of instituting a biomedical images library. It asked NLM to undertake a first project, building a digital image library of volumetric data representing a complete normal adult human male and female, and to support a follow-on research effort to develop methods, tools and standards for classification of anatomic image data from the Visible Human Project. The next step recommended was to expand upon initial image libraries composed of normal structure to encompass specialized image collections which represent related structural information, such as embryological development, normal and abnormal variations, and disease-related images. The Plan also encouraged NLM to support investigator-initiated research in this area, and to develop and enhance its wide area computer network connections to provide an efficient electronic distribution mechanism for large digital files such as those encoding biomedical images.

Accomplishments

The Visible Human male and female data sets, consisting of MRI, CT and cryosection images, were released as national resources in 1995 and 1996 respectively. Users in over 40 countries are applying them to a wide range of educational, diagnostic, treatment planning, virtual reality, artistic, mathematical and industrial uses. Work has also begun on the next phase of development of the Visible Human, that is, on the segmentation, classification, and three-dimensional rendering of the data sets. The digital library research program at the Lister Hill National Center for Biomedical Communications investigates all aspects of creating and disseminating digital collections, including proposed and adopted standards, emerging technologies and formats, effects on previously established processes, and protection of original materials. In addition, NLM participates in a multi-agency Digital Libraries Initiative. A new Profiles in Science Web site focuses on major scientific achievements of the twentieth century by presenting the papers, letters, and photographs of such leaders as Oswald Theodore Avery and Nobelist Joshua Lederberg. DXPNet, a collaborative project among NLM, NCHS, and NIAIMS, brings together a collection of radiographs and related material from the NHANES Surveys.

Current Program Plans

In the immediate future, NLM will work to:

- Participate with other agencies in the Digital Libraries Initiative - Phase 2 (DLI-2) to explore innovative digital libraries research and applications..
- Using the Visible Human data set, conduct and support research in the development of generalizable image processing tools
- Conduct and support research in the development of a Visible Human Project Atlas for use in educational applications, beginning with the head and neck body regions
- Using the Visible Human data set, undertake and support standardization efforts for classifying, storing, retrieving, and displaying anatomic images

- Develop 3D anatomic image sets from the Visible Human data and conduct research on effective retrieval and transmission of such images over the emerging Next Generation Internet
- Digitize additional collections of prominent biomedical scientists for the Profiles in Science system
- Extend the role of metadata for managing, displaying, and retrieving data in digital archival systems

For more information about the above programs, see:

Electronic Imaging Long Range Plan Report	http://www.nlm.nih.gov/pubs/plan/ei/contents.html
Visible Human	http://www.nlm.nih.gov/research/visible/visible_human.html
Digital Libraries	http://www.lhncbc.nlm.nih.gov/dlb/ http://dli2.nlm.nih.gov/
Profiles in Science	http://www.profiles.nlm.nih.gov/
DXPNet	http://archive.nlm.nih.gov/proj/dxpnet/dxpnet.html
Regional Medical Program Digital Library	http://rmp.nlm.nih.gov/

Objective 4.3. Enhance and Expand the Unified Medical Language System

1985-1998 Long Range Plan Recommendations

The Plan recommended that NLM continue development of the Unified Medical Language System, and undertake further development of the Information Sources Map as a possible mechanism for implementing the directory for toxicology and environmental health information resources.

Accomplishments

The Unified Medical Language System (UMLS) project develops and distributes multi-purpose, electronic "Knowledge Sources" and associated lexical programs. The Metathesaurus, which contains information about biomedical concepts and terms from many controlled vocabularies and classifications, has become an operational product which is continuously updated and enhanced. It is used in several NLM applications, including Internet Grateful Med and PubMed, as well as to enhance a large number of other research and commercial information systems of various sorts. Other components of the UMLS include the Semantic Network, which identifies the semantic types and relationships of Metathesaurus concepts, and the SPECIALIST lexicon, an English language lexicon with many biomedical terms. There are 1008 licensed UMLS users. The variety of uses it is put to include: indexing of bibliographic and clinical material (print, electronic, and multi-media), retrieving information from such diverse sources as the world wide web, diagnostic prompting systems, and electronic medical records, and formalizing language used in medical records and messages. Natural language research at NLM is currently focussed on the development of SPECIALIST, an experimental natural language processing system for the biomedical domain. Modules based on the major components of natural language lexicon, morphology, syntax and semantics have been built and are used in research, particularly in the area of information retrieval effectiveness.

Current Program Plans

In the immediate future, NLM will work to:

- Make the UMLS Knowledge Sources better able to reflect the different perspectives and level of understanding of medical concepts exhibited by the general public, health care practitioners, and researchers so that UMLS technology can be used more effectively in information systems designed for different populations.
- Develop efficient methods for more frequent update and dissemination of the UMLS Knowledge Sources to support the need for immediate access to new vocabulary in areas such as drugs and devices.
- Enhance the capabilities of the Internet-based UMLS Knowledge Source Server to support the needs of sophisticated health information systems.
- Develop algorithms for spelling correction and make these available with the continually developing suite of SPECIALIST lexical processing tools.
- Develop tools to manage, manipulate, and reconcile large numbers of complex biomedical terminologies.

For more information about the above programs, see:

UMLS	http://www.nlm.nih.gov/research/umls/
Natural Language Systems	http://wwwcgsb.nlm.nih.gov/research/research/nls/

Index

A

Acid-free paper · 4
 Acquisitions · 4
 AIDS information resources · 11
 AIDS Outreach · 8

B

Biotechnology · 1, 17, 18, 22
 Board of Regents · 1, 10

C

Cataloging · 2, 3, 4, 5
 Clinical Trials Database · 11
 Collection development · 2, 4
 Confidentiality · 14, 16
 Connection Grants · 16
 Critical Incident Technique · 8
 Cubby · 24

D

Data Format Standards · 4
 Digital Libraries · 25, 26
 DOCLINE · 5, 6, 12
 DXPNet · 25, 26

E

Electronic Journals · 4
 Evaluation · 8, 10, 15, 17
 Expert Systems · 17
 Extramural Support · 19

F

Fellowships in Applied Informatics · 19

G

GenBank · 22, 23, 24
 Gene Map · 22
 Genome · 22, 23
 Global Vision · 2, 12, 13, 14, 16
 Grants · 16
 Grateful Med · 5, 6, 8, 9, 27

H

HBCUs · 7, 8
 Health Services Research · 6
 HealthSTAR · 5, 6
 Heart Attack Alert Program · 19
 History of Medicine · 4
 HPCC · 14, 19
 Human Genome · 22, 23

I

IAIMS · 14, 15, 16
 Images from the History of Medicine · 4
 Indexing Research · 4
 Information Access and Systems grants · 16
 Integrated Library System · 4
 International · 12, 13
 Internet Connectivity · 12, 13
 Internet Grateful Med · 5, 6, 27
 IOM Report on Assessing Telemedicine · 16

J

Journal Selection · 4

L

Large Scale Vocabulary Test · 8
 Learning Center · 15, 19
 Library Associate Program · 20, 21
 LinkOut · 24
 Lister Hill Center · 4, 17, 19
 Loansome Doc · 5, 6, 12
 Long Range Plan · 1, 2, 5, 7, 9, 10, 12, 13, 14, 16, 17, 20, 21, 22, 25, 26, 27

M

Malaria · 12, 13, 15
 MARS · 4
 Medical Informatics Research · 17, 19
 Medical Informatics Training · 19
 Medical Library Association · 20
 Medical Subject Headings · 4, 5
 MEDLINE · 3, 4, 5, 10, 12, 17, 22
 MEDLINEplus · 5, 6, 10
 MLA · 20

N

National Network of Libraries of Medicine · 9
Natural Language Systems · 17, 27
NCBI · 17, 18, 19, 22, 23, 24
NGI · 16
NLM databases · 2, 5, 6, 9
NRC Report on Protecting Electronic Health Data · 16

O

Online Indexing · 4
Online Training · 15, 19
Outreach · 7, 8, 10

P

Preservation · 4
Preserving Electronic Publications · 4
Privacy · 16
Profiles in Science · 2, 4, 25, 26
Public Health · 8
PubMed · 4, 5, 6, 10, 17, 22, 24, 27
PubMed · 4, 5, 6, 10, 17, 22, 24, 27
PubMed · 4, 5, 6, 10, 17, 22, 24, 27
PubRef · 24

R

Regional Medical Program · 26

Relais · 5, 6

S

SAIL · 17
Systems Reinvention · 4

T

Telemedicine · 15, 16
Toxicology Databases · 6
Toxicology Outreach · 8
Training · 2, 13, 15, 17, 19, 20, 21, 24
Tribal Connections · 8

U

UMLS · 6, 15, 17, 18, 27

V

Visible Human · 15, 17, 25, 26

W

Woods Hole · 13, 17, 19, 20, 21