

THE INTERNET : AN APPROACH TO FINDING ANSWERS TO BIOMEDICAL INFORMATION*

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Basics of Internet services & resources — it's historical development and the applications available therein viz., e-mail, FTP and remote login have been briefly described. Mentioning important biomedical sources, available on Internet, along with the journals and their home page sites and also some of the issues involved for it's connectivity e.g. financial, technical and organisational, the paper offers biomedical reference scenario that illustrates how to search a database and find a document/information on biomedical subjects on the Network.

INTRODUCTION

Information Technology (IT) is transforming the nature of information availability and it's management, thereby altering the traditional responsibilities of librarians. Due to developments in telecommunication and networking technologies, today's world is becoming more and more interconnected. This means that a car phone may be used to dial up a friend halfway around the globe. One of the most exciting manifestations of this interconnectedness is the INTERNET. The Internet is a global collection of interconnected networks—distinct, local, regional and national, people and computers, all linked together, via cables, telephone lines and/or satellite lines, all able to communicate because they share a common language [1, 2, 3, 4].

The Internet is accessible to anyone with a personal computer (PC) and a modem. Internet is quite young and began as a small group of military research institutions and universities in physically separate places, who needed to share their computerised research data timely. To a Internet

user(s), these distinct networks appear as a seamless whole. In the 1980s, the National Science Foundation (USA) created a special network, connecting it's super computing centres, called as NSFNET [5]. The Internet represents a "meta-network" - a network of networks [6]. It provides a way of joining many diverse networks, including those of government, and very recently industry. More recently, universities, biomedical centres, and even patients have become more prominent "publisher" of biomedical information on Internet. Some have chosen to distribute information on specific field of biomedicine intended to physicians and the public, where as others have developed resources exclusively for physicians. A quick research under the health heading on Yahoo, a leading Web directory, shows 194 sites devoted to alternative medicine, 125 to dentistry, 983 to diseases and conditions, 1,633 to medicine, 346 to mental health, 389 to pharmacology and many more.

NEED TO ACCESS THE INTERNET

In addition to the traditional uses of telecommunications for phone conversations and paging, there is an increasing need for remote communication to transfer digital biomedical/health information. Physicians might wish to use computer at home to track the status of patients or receive notification of important laboratory results. There are at least six reasons why the user(s) require to access information centres and libraries (ICLs) from the Internet [7] :

- i) to get help publishing their information;
- ii) to get help locating information (on-line services and catalogues);

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- iii) to get help in determining the quality of various information resources;
- iv) document delivery and distribution is another area of traditional ICL services that the Internet technology is changing; and
- v) full text documents and information are also available via Internet. Users can find path to current information about many organizations, including names, addresses, contact information, lists of reports, and other documents. Users can browse or search these documents by using tools viz., *Gopher*, *Mosaic*, *World Wide Web (WWW)*, etc. [8]. For example, the National Institute of Health (NIH) *Gopher* (*gopher to "Gopher.nih.gov"*) illustrates the breadth of information available for physicians, scientists, clinicians, nurses, researchers, and information professionals.

With E-Mail services, individuals can learn about health issues and correspond with others who share common interests by joining electronic mail lists dedicated to discussions on biomedical conditions. Many health care providers now provide educational materials for patients, consumers and doctors through World Wide Web (WWW) pages, which are collections of pictures, text, sound and video along with links to related information on other computers. The Oncolink multimedia (MM) Cancer Resource Web page at the University of Pennsylvania is an example. From this page, computer users can navigate to many other pages that give them information about cancer terminology, on-going clinical trials, how to prepare for a hospital visit, and many other topics. There is no incremental charges to access such files of other web sites offering biomedical and health information on the Internet.

THE INTERNET : A Professional Challenge to Biomedical ICLs

The future of biomedical organisation and their ICLs is interdependent to digital information. The changing nature of digital information has created new pressure on ICLs, especially in the biomedical organisations. Unless ICLs respond effectively to this change, their role may be minimised and even their existence threatened. Recently, the

concept of resource sharing at local, regional, national and international level to enhance the ICL services has become an essential need for various reasons. The Internet is very dynamic in nature, where resources are being added, changed, updated or removed daily, even hourly. Therefore, librarians have to impose order onto the Internet by using it systematically. The Internet provides access to databases, softwares (including sound and image files) and documents and serves as a gateway to remote computers. There are no manuals, instead these are "frequent asked questions" (FAQs) and "readme" files. The Internet allows access not only to many standard databases, but local databases also, which may be uploaded at any time without permission [9,10,11]. The critical mass of information necessary for effective performance in biomedical discipline continues to grow in size and complexity. The information need is not only based on text, but also, unstructured information i.e., databases viz., the Genome Database, image and sound. Several biomedical organisations, particularly the research community, have generated large amount of information that will be available through the Internet and may not be published, according to the common existing standards [12]. These changes have occurred as the information seeking behaviour of the biomedical professionals have become more complicated and varied, and have broken the traditional link between printed work and information transfer. Thus, the role of ICLs and librarians have increased multifold, for new and richer type of information access including multimedia/hypermedia (MM/HM). Thus, the Internet is going to play a pivotal role in information access for ICLs in the coming years.

The MM experience is radically different from text only option. At least for the immediate future, there is tremendous need for information specialists to help designers of MM based information. For example, a researcher relies more on the usual images to represent his/her findings. He/she will need some mechanism to capture the experience and structure it so that his/her work can be communicated effectively. This is a function that should be of librarians, because of his/her formal training in organizing information as well as long experience in dealing with the information needs of biomedical professionals [13].

HOW DOES THE INTERNET WORKS

Like other computer networks, Internet also requires the address of destination, electronic media to transmit the signals and some safety for data communication. The Internet uses a special computer language (a protocol) - *Transmission Communication Protocol and Internet Protocol (TCP/IP)* [14, 15]. The TCP divides the text to be communicated into little data packets, so that data could not be lost/damaged during transmission, while IP puts a label with addressing information

on this packet. There is a special machine called Router to decide the efficient path of journey. When TCP/IP packets arrive at their destination, the computer removes the IP label, uses the packing list in the packet for the damage, if any, done during transmission and reassembles the packets into the original block of text. When the receiving computer finds any damaged packet, it asks the sending computer to transmit a new copy of bad packet (Fig. 1). It is a gateway, allowing different types of networks on electronic frontier to talk to the Internet using TCP/IP.

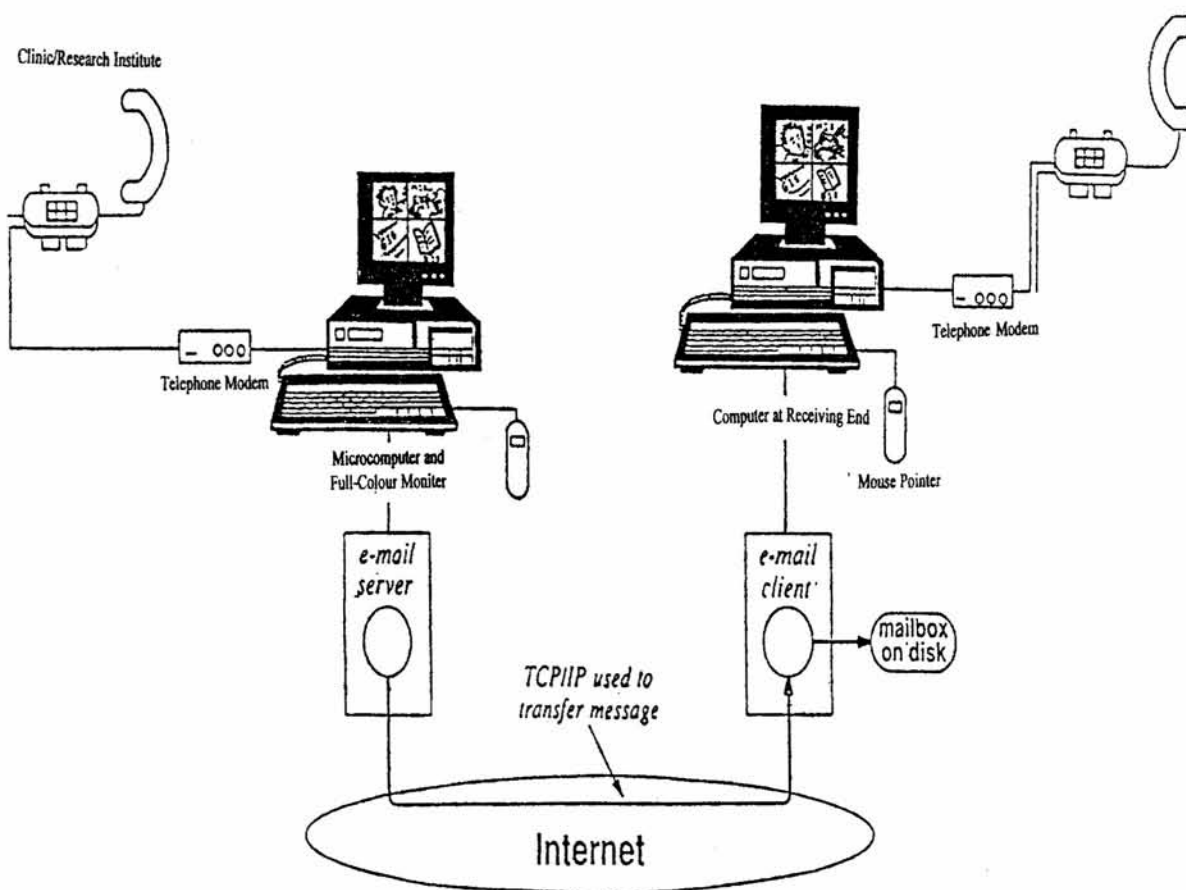


Fig. 1 : E-mail on Internet

HISTORY OF INTERNET

The Internet was born about 27 years ago out of an effort called the Advanced Research Project Agency Network (ARPANET), to connect U.S. Defence departments for supporting military research. Users of any of the internetworks can reach users on any of the networks. The internet started with ARPANET, but now includes such networks, as National Science Foundation Network (NSFNET), New England Academic and Research Network (NEARNET) and others. Many other networks, viz., British Information Technology Network (BITNET) and SPAN are tied to the internet, but are not an integral part of it. The Internet now is a worldwide collection of thousands of computer networks that can intercommunicate. The ARPANET which was made operational in 1969 became an essential tool for remote login, file transfer, E-mail and the sharing of information and resources among researchers, librarians, clinicians and other interested groups.

The Internet first became operational in 1983, when ARPANET was splitted into the separate networks, Military Network (MILNET) and ARPANET which together formed the Internet [16]. Each was given a network number, and gateways were installed to provide packet forwarding be-

tween them. Nine years ago, the Internet had a few thousand users. All the users had either ready access to experts, or were experts themselves, but now, the number of the Internet users has increased a thousand fold and thousands of new users are being added daily. More than one million people are using the Internet daily, comprising chemists, librarians, information scientists, meteorologists, doctors, scientists, surgeons, specialists, media persons, patients, kindergarden teachers, etc.

Since it's creation in 1983, the Internet has grown exponentially in terms of number of networks connected to it. In 1985, the number was approximately one hundred. By 1987, the number has grown to two hundred; in 1989, it exceeded five hundred and in January 1990 it was 2,218 [17, 18, 19, 20]. The Internet is often described as the world's largest network of computer networks. In May 1994, the Internet Society on International Organisation, set up to encourage the network, estimated that there were more than thirty thousand networks making up the Internet. Some of these networks in turn connect thousands of computers, spotted around the world. Each year, more and more countries join the Internet in order to share it's resources (Table 1).

Table 1

The Internet growth

Sr. no.	Year	Users growth
1	1983	20,000,000
2	1993	40,000,000
3	1994	60,000,000
4	1995	80,000,000
5	2000	100,000,000 (estimate)

The number of it's users is growing by 12% a month: about 10 million people in 91 countries now have access to the system. The Internet was initially used for electronic mail and now allows "bulk" mailings with over 2500 electronic newsletters and 4000 discussion groups. Bulletin Boards supply information of public interest, details of relevant meetings, and the like [21, 22, 23].

APPLICATIONS

Although, the Internet has evolved more than twenty seven years ago, but resources useful to biomedical users have become available on Internet only recently. Internet has been geared toward many tasks. Every year people think of new and exciting ways of using the Internet. A

recent development involves transmitting live videos and sound to selected locations [24, 25]. Applications can range from home recipes to research, library to laboratory, technique to technology, training to tutorial, tour to transport, home grown programs to proprietary programs supplied by a vendor. The Internet provides access to an enormous number of databases distributed around the world and to a variety of scientific facilities including digital ICLs, unique databases, super computers and remote scientific sensing instruments. The Internet collectively offers tremendous potential for collaborating and for sharing resources such as, documents, software data and network services [26].

1. Accessing the different databases available in different laboratories/institutions facilitates research in interested areas. Students/researchers and workers of these institutions may use the Internet to exchange E-mail and share information. A variety of sites are devoted to biomedical education e.g., University of California at San Francisco Primary Care Teaching Module. HEALTHLINE and other servers offer multimedia (MM) educational material advice column, etc. Computer based education is rapidly increasing and improving reading materials. Video and audio could be transmitted across distances at low costs, and interaction is possible. Hundreds of schools are already networked together for public health researchers.
2. Pictures on files at the Library of Congress, National Library of Medicine and other member ICLs may be looked up. *The Visible Human Project* documents human anatomy and a series of magnetic resonance, photographic and computerized topography images of cross sections of a human body at one mm. interval. *Visible Embryo Project* is related to images of developmental embryology, while the *GE, Three Dimensional Medical Reconstruction* page includes animated flying thought of the heart arteries, the lung and the brain, and simulation of a baby delivery.
3. Information and tutorials, to help to do more

things, are available on Internet. It is possible to track down lists of Internet groups and even access entire books and journals using Internet. Important journals viz., British Medical journal, CDC AIDS Weekly, Emerging Infectious Diseases, EMBL, MMWR Weekly Report, Nature, New Scientist, Science, etc. are now available on Internet.

4. Public domain programs for DOS, Windows, Macintosh, UNIX or Amiga computer are available free on Internet.
5. An electronic copy of different documents available on the Internet can be made.
6. Similarly, weather satellite photos of different countries at most an hour old may be available. Various types of information services viz., Clinical Information System (CIS), Geographical Information System (GIS) and Meteorological Information System (MIS) are accessible on Internet.
7. Latest global news via Voice of America, British Broadcasting Corporation (BBC) and other news agencies are also possible. Latest developments in outbreaks of various epidemic diseases in any part of the world are being obtained through above agencies on Internet.
8. The Internet lets the people meet around the world with similar interests or hobbies from home, schooling of children to research. Various scientific groups in biomedicine including NIH (USA) are meeting on Internet and are accessible through their home page.
9. The Internet gives access to special job listings and career information at the online career centre. Many universities, professional associations and non profit co-operative companies make their job listings available on Internet.

The Internet is being used for research, government and commercial policy and/or decision making, education, medicine, defence, etc. (Fig. 2).

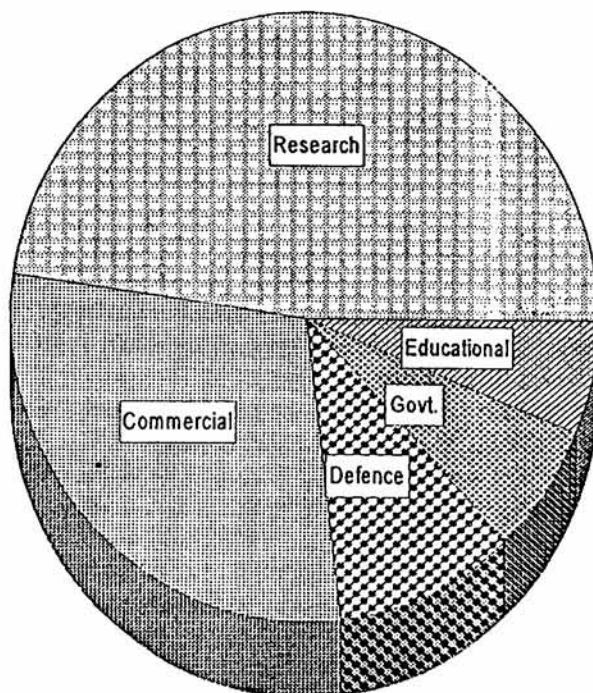


Fig. 2 : How's the Internet used

BIOMEDICAL INFORMATION SOURCES, SITES AND INTERNET

An enormous amount of biomedical information is now available in electronic form. Until recently, most of these resources were accessible through dial-up bulletin board systems or, if the file resided on a computer connected to the Internet, through a number of different means of transferring copies of the files from the source computer to a remote user's computer. Recently, through WWW, it is possible expeditious retrieval, arrange, and display on web pages the content of the files rather than just their name.

Consumer and patient information are also available through Internet. Numerous web pages containing specific biomedical information are available viz., Physician's Guide to the Internet, Interactive Medical Student Lounge, Nightspale, M P Web, for physicians, medical students, nurses. Sites such as, the Emergency Medicine and Primary Care Home Page provide resources and

discussion forum for specialised health disciplines and reference sites. Some of the biomedical sources and sites available on Internet are given in *Appendix*.

BIOMEDICAL JOURNALS AVAILABLE ONLINE THROUGH INTERNET

1840 marked the introduction of the penny post and the first issue of the "Provincial Medical and Surgical Journal". Since then, the journal has dependent especially on the postal services for its distribution. But the arrival of Internet has made some of the important biomedical journals to appear online. It is hoped that the journals' presence on Internet might help to change the one-to-many communications with their readers. The electronic medium allows for much greater interaction than the traditional format of the journals and home pages make it easy for readers to send their comments back to editors. Some of the important biomedical journals and their home page addresses are as follows (Table 2):

Table 2

Important biomedical journals available on Internet

Sl.no.	Name of the journal	Internet home page address
1.	British Medical Journal (BMJ)	http://www.bmj.com.bmj/
2.	CDC AIDS Weekly	http://www.cdc.gov
3.	Emerging Infectious Diseases	http://www.cdc.gov
4.	EMBL	http://www.embl.com
5.	Immunology Today	http://www.elsevier.nl/locate.ito
6.	MMWR (Morbidity and Mortality Weekly Report)	http://www.cdc.gov/
7.	Nature	http://www.nature.com
8.	New Scientist	http://www.newscientist.com
9.	Science	http://science-mag.aaas.org/science/

The number of biomedical sites joining the Internet increases monthly, as does the number of information resources available on it. Biomedical research is also taking advantages of web as journals begin to appear on the web in preference to or in advance of print. For example, the Journal of Medical Imaging is publishing papers on the net. Medical imaging is developing so fast that print media are now seen only as the archival form of knowledge. Most of the journals can be accessed through one or many software viz., WWW, GOPHER, FTP, LISTSERV, etc. There are more than 100 biomedical journals available on Internet and more than 50 can be accessed only on WWW sites.

Homeopathic Potencies on the INTERNET

"Homeopathic Internet Resources List" is available on-line on Internet since January 1995. It contains information on Internet connection, file, list servers and on-line access to homeopathy as a regular medical list and can be obtained by FTP from a distant computer [28].

ACCESS TOOLS (SOFTWARES FOR NAVIGATING THE INTERNET)

The Internet can be accessed in different ways. Software for the Internet access and navigation

permits some conventional searching and browsing. These are Telenet, Archie, File Transfer Protocol(FTP), GRATEFUL MED, World Wide Web (WWW), Wide Area Information Services (WAIS), Gopher, Mosaic, etc. Some of the research, academic and medical institutions in India are connected to Internet [29, 30].

The Telenet

Telenet is the remote protocol of Internet to help connect one computer (key board) to another. This connection may be in the same room, on the same campus, same city, same state, same country or any part of the world. Whatever services the remote machine provides to its local terminals can be accessed. We can look at library catalogues, we can run normal interactive session and/or many special services [31]. Telenet is a program that allows our Internet list computer to become a terminal of another host computer on the Internet. Anonymous telenet sessions are generally not permitted, but occasionally user names are created with restricted privileges for use by the Internet public. With FTP, it is possible only to open connection to transfer a file, whereas Telenet allows to login as a user on a remote machine and run the Internet computer programs that machine provides.

The Telenet provides facilities to access hosts when somebody writes interfaces to help other users and to use their interfaces. Similarly, when someone creates a useful service, Telenet allows to access these valuable information resources. It is extremely simple to use — just type Telenet, followed by the address to be connected with. Once connected with a remote computer, we can interact with the programs, it makes available viz. GOPHER, WWW, WAIS, ARCHIE, e.g. telnet library.uc.w/u.edu.

E-Mail

E-Mail is one of the most popular usages of the

Internet. Of course, it is necessary to learn how to send and/or receive, read, and to reply mail from the Internet account. The Internet allows biomedical professionals to communicate and collaborate more frequently and quickly than was previously possible [32]. There are three organised sources of interested group who can exchange mail with Internet viz., BITNET, LISTSERV and a U.S. based international network (USENET). Developed countries viz., USA, UK, are using above services to keep upto date on current events in the field, ask questions to colleagues and offer duplicate journal issues willing to pay postage. Biomedical agencies with E-Mail numbers and contact persons have been given in Table 3.

Table 3

Health agencies with E-Mail numbers and contact persons

Sl. no.	Name	Designation	E-Mail address
1.	WHO, Geneva HQ Mr Shumichi Akazawa	Network Manager	<manager@who.arcom.CH>
	Mr David Berg	Director Info. Technology Office	<berg@who.arcom.CH>
2.	CDC (Center for Disease Control), Atlanta (USA)	complete list of CDC staff, bitnet address obtainable	HSPNET-@ALBNYDH2 fileserver.
3.	NIH (National Institute of Health) - BLR Joseph Manghton		@User%node @ CU. NIH.GOV JDN @ NIHCU

USENET (News Group)

Usenet is Internet based where end users need to know only how to interact with the particular Usenet program on their computers. Usenet is a U.S. based global network of computers and people who share similar interest to communicate with

another internet. It helps to know what is Usenet news? what is a reader? how to get a particular item of the news required? how to save the news. Thus, Usenet is a system of organised 'news groups' sharing many features with traditional newsletters, mailing lists and focused scientific societies.

There are discussion groups for topics ranging from hobbying to practicals to solve one's problem. Inside each news group, there are, usually, multiple discussions going on under specific subjects. As with the most Internet applications, there are many newsreading programs from which we can choose our interested articles. It is also possible to set up our news reader to view or discard certain items automatically based on the author's name of the article, subject. Reading news, steering a news reader, saving news articles, controlling what we read, catching up, posting articles (adding to an existing discussions and/or starting a new discussion), supplying e-mail are some of the facilities available on news group on the Internet. E-Mail internet allows almost instantly to exchange electronic messages (e-mail) with friends across the hall or around the world. The Internet account also includes an electronic mail box.

MEDLIB-L

MEDLIB-L serves the above purposes, among others, for biomedical librarians. The statistics for MEDLIB-L shows that more librarians are joining the electronic community. Although it is located in U.S., but subscribership is international, with participants from more than thirty five countries.

Listservs

Listservs also have changed the way of library professionals in the method of communication. There are many listservs, in the subject interests of ICL professionals, to keep on their current interest from reference questions to copyright.

File Transfer Protocol (FTP)

One of the primary services of the Internet is file transfer. One major reason to access the Internet is, that it gives access to all kinds of information. Files and data are scattered all around the Internet in large and small archives. These files may contain text, pictures, sound or computer programs. Internet has a standard tool for transferring copies of file to PC's - a program called FTP which allows to transfer a copy of file between two computers. Files from one account can be copied to a distant computer and *vice versa*. (Internet Resources: Internet resource guide, Computing Centres, Data Archives, White pages, Miscellaneous)

Data Archives/Archie

The Internet is a home to a wide variety of data archives. It is simple to use Archie through TELINET, because additional software is not required. Archie allows to search indexes to locate files that are available on public services. Like other services on the Internet, Archie can be accessed in multiple ways i.e., through E-mail, TELINET, etc. Some of the biomedical services available are:

- * Gene server,
- * IUBIO archives for molecular and general biology,
- * LIMB (listing of molecular biology databases),
- * Matrix of biological knowledge archive server, and
- * MBC RR : The molecular biology computer research resources.

Archie is a very popular service and is used around the world. It is not unusual for a server to handle over 40 requests simultaneously. There are several facilities available to avoid collapse due to over use. To protect the responsiveness of the services, some servers have the limits on the number of concurrent requests that can be handled. If a server is tried and hit one of these limits, a message like:

'Due to serious overloading on the archie server, we have been forced to restrict the number of concurrent interactive (telnnet) session to 10. Connection closed by foreign host' [33] is received.

Gopher

Gopher software has emerged rapidly as a powerful tool for providing ICL users with organised access to Internet resources. It is a program that is designed to allow browse the resources of the Internet which displays a set of resources as menus. A database can be accessed by selecting one of these user friendly menus. Gopher is one of the most popular services on the Internet, making the connection can sometimes take a while. The best way to understand Gopher is to use it. If one is a Gopher user on the Internet host, one can use it to connect directly to a specific Gopher server by typing GOPHER followed by the address of server e.g., Fig 3-5 to connect directly to the University of Minnesota Gopher server.

Gopher helps us to browse remote libraries catalogue and automatically sending the material

which is wanted. It does not really matter where the library is located as long as it is a part of the Gopher system.

1	Information About Gopher
2	Computer Information
3	Discussion Group
4	Fun & Games
5	Internet file server (ftp) sites
6	Libraries
7	News
8	Other Gopher and Information Servers
9	Phone Books
10	Search Gopher Titles at the University of Minnesota
11	Search lots of places at the University of Minnesota
12	University of Minnesota Campus Information

Fig.3 : Current Gopher format (main menu) Michigan libraries

1.	Genetic Resources
2.	NIH Information
3.	Electronic Publications
4.	Cancer Net
5.	Biology, FTP Sites
6.	Biomedical Shareware
7.	Search of Biologists funded by NIH DOE, NSF

Fig. 4 : Life science menu

ULibrary Gopher main menu	
University of Michigan Libraries	
1.	About Using the ULibrary Gopher
2.	Contents of the ULibrary Gopher
3.	About Univ. Michigan Libraries & Information Resources
4.	News Services
5.	General Reference Resources
6.	Humanities Resources
7.	Science Resources
8.	Social Science Resources
9.	Library Catalogs
10.	Univ. Michigan Campus Information (Gopher BLUE)
11.	Other Gophers and Veronica
12.	What's New and Featured Resources

Fig.5 : Building and maintaining a Library Gopher

When something interesting is found, this can be read or accessed through Gopher without worrying about domain names, IP addresses, changing programs, etc. For example, to access the online library catalogue at National Library of Medicine (USA) or the University of California, rather than the address and telenetting to it, we find an entry in a Gopher menu and select it. It lets us browse through the Internet resources regardless of their type just as we might browse through our local library, with books, filmstrips and photograph records on the same subject, grouped together. Gopher also helps in inter library loan through the online catalogue if the library permits it. A Gopher server is like hiring a librarian to find out details of what and where of the required document. If the required material is not found at our genital library, we can search elsewhere; when it is found, the same may be received by inter library loan. With libraries, it can take a while; with Gopher, getting material from somewhere else is instantaneous. Building and maintaining Gopher is one way in which librarians' traditional knowledge and skills are being applied in a non-traditional area.

Since the Gopher service is still under development, the features available are changing, hopefully for the better. Gopher services will be somewhat better everytime. Gopher can be used to access other resource finders like Archie, WWW and WAIS. It has versions for various computers and is menu driven software.

World Wide Web (WWW)

The WWW is the newest information service to arrive on the Internet. The feature of WWW is that it allows rapid access to web site elsewhere. The WWW which is based on HM/MM is a graphical navigational tool that works across the Internet giving it a more friendly feature. It allows the users to add text, formatting, picture, sound, video and some virtual reality to the information they wish to share with other users [34]. As with Gopher, the same resource may be available on WWW server but it provides valuable browsing, having combination of text, sound, video, etc., i.e., hypertext (HT), MM, HM based information on the Internet [35, 36, 37, 38].

"LYNX HELP FILES"

The menu on the monitor will display choose a subject

- * Key stroke commands
 - * About lynx
 - * Lynx user's guide version 2.2
 - * Help on version 2.2
 - * Help on HTML
 - * HTML Quick reference guide
 - * Help on URL's
-

LYNX DEFAULT HOME PAGE WELCOME TO LYNX AND THE WORLD OF THE WEB

You are using a WWW product called Lynx. For more information about obtaining and installing Lynx please choose about Lynx.

The correct version of the lynx is 2.2. If you are running an earlier version please update.

Information Sources about and for WWW

- * For a description of WWW choose Web overview,
- * About the WWW information sharing project,
- * WWW information by subject, and
- * WWW information by type

Other INFO sources

- * University of Kansas CWIS,
- * O'Reilly & Res. Global Network Navigator,
- * Nova link : Internet access made easy, and
- * MCSA : Network starting points. Information resource meta index.

For the biologists, medical scientists, all the protein databases that have become so central to the practice of molecular biology are now accessible on WWW. A site at NIH provides direct access to GENBANK and BROOKLAVERN Protein database. The Genome database at the Johns Hopkins University has a HT WWW interface. For access to New Scientist, we have to type help:/WWW.newscientist.com. More than 50 biomedical journals are available on Internet only under WWW interface.

Wide Area Information Server (WAIS)

The WAIS is another service provided by the Internet. It is really a tool for working with collections of data as databases and helpful for searching through indexed material and finding articles based on what they contain. The WAIS goes a few step further than Archie and FTP by indexing the content of text files stored on a network. The WAIS indexes the contents of documents rather than document titles. Using WAIS is more like thumbing through the indexes in the back of books, than like using a card catalogue that lists book titles only. There are two ways of accessing the WAIS servers i.e. Gopher or WAIS client. There are more than 600 libraries on the network now.

REMOTE LOGIN FACILITIES

Biomedical ICLs in developed countries are discovering a multitude of uses for the Internet by mastering and exploiting new skills and terminology through the tools such as, library catalogue or a database, E-Mail, access to remote system (Telenet), Gopher, FTP, WAIS, ARCHIE, WWW, USENETNEWS, etc.,

The Internet provides new link to colleagues, services and information. There are three standard internet applications, E-mail, file transfer and remote login. The Internet also offers a wide range of services, bulletin boards, index programme and so on.

THE ISSUES

As the Internet continues to expand, it has become the home of information and computer tools, necessary for any one on the internet to access that information.

Financial Issues

Cost is a major issue in establishing a direct Internet connection at biomedical ICL in the developing countries like India, where budget crunch is a severe problem. Cost is highly visible to administrators, especially when applied to a new IT, and even more, when the need for that technology is not well understood. Because the issues are complex, any single decision can affect part of the organization. A direct Internet connection

affects the entire organisation and requires the administration to be knowledgeable, committed and supportive. Collaborative relationships among administrators and the information & library staff, are essential. In India, dial up access is advisable as it is low cost, low risk and suitable for an ICL. On the other hand, a direct connection involves the entire organization and requires high level knowledge, commitment and support. Recently Videsh Sanchar Nigam, Ltd. (VSNL), India, has announced special concessional rates to the student researchers and not-for-profit organisation i.e. Rs.15,500 for 500 hours (login time) in dial up mode.

Technical Issues

In India, where the Internet is yet to get momentum, the low level of technical expertise available within biomedical ICLs computing environment, is probably the biggest barrier to overcome in implementing a direct Internet connection. Librarians will have to face a steep learning curve in trying to understand the components of the Internet connection and related issues. At every turn, issues of compatibility with one configuration or another, lead into difficulty.

There is also a possibility of telecommunication related problems with the integral service providers during early phase of Internet services. The lack of technical resources available locally, will often lead the librarians/information scientists to turn to regional medical libraries (RMLs) or national medical libraries (NMLs) for assistance. The RML staff will not always have the answer, but they will like to help and assist. Occasionally, the Internet itself provided the means for acquiring assistance from experts at other location but it cannot take the place of local expertise. To start with the Internet, there is extensive need to have close involvement of knowledgeable and trained system engineers.

Organisational Issues

In India, biomedical librarians/information scientists have to play the central role in introducing the Internet, as the resident expert in managing external information resources. Dial up Internet access does not raise these questions as the organisational risk is low. But, attempts to estab-

lish direct Internet connection often do raise the question about the biomedical information systems, strategy, structure and accountability. Decision making authority should not ignore the librarians, while recommending the Internet access. The responsibility to access Internet should be given to librarians as they are fully focussed on external information resources in order to fulfil the information needs of scientists, clinicians, decision makers and administrators. These professional outlook may lead to the development of an overview of information management that will serve the needs of the organisation.

INTERNET AND BIOMEDICAL ICLs IN INDIA

In India, awareness amongst the scientists, decision makers, clinicians, etc. about the Internet is increasing in an alarming rate. NICNET has now weaved the entire country into one single communication, entirely for reaching out to the world at large without any technical barriers. Finding articles, and other global information can be obtained intently on Internet through Research and Educational Network of NIC (RENNIC). Most of the ICLs accessing through Internet are directly or indirectly connected via NICNET, ERNET, INET, C-WEB (Centre for WWW services over NICNET). C-Wane is the first web server in India, to navigate through Internet for exchanging MM based documents. Most of the Indian Council of Medical Research (ICMR) ICLs are having Internet facility through NICNET. Today, it connects government institutes, universities, research and commercial organisations and is known as Internet globally. In India, only few biomedical ICLs are having the Internet connection with limited access and uses. Some of the users including physicians and scientists who are aware of Internet are using the facility through NICNET or special facility provided by VSNL on a very concessional rate. Efforts are being made to put some Indian popular journals, catalogues of publications - text, audio, visual, slides and databases on Internet viz. Science Today by Vigyan Prasar (DST) - comcom (<http://Vigyanprasar.com>).

PUNENET and INTERNET Access

Under Pune Library and Information Network (PUNENET), users are allowed to access the in-

formation from city ICLs and database currently available on various topics. The users are also allowed to access world wide databases of their interest through the Internet. Every user of PUNENET can now avail the facility of total Internet access through dial up lines, by connecting to the Sun Server. The SUN SPARCS workstation is the main server for the PUNENET project. This server is situated at the Bioinformatics Centre, Pune. The server can be accessed over the telephone cables through two modems. This system is ideal as a database server. The operating system is loaded in *solaris v2.4*. The server as configured for network connectivity with the Poona University Fibre Optics Network can thus avail full Internet facilities having class-C Internet address IP address (202.41.70.1) and act as main node for machines assigned addresses between 202.41.70.2 and 202.41.70.255. The configuration of Sun Server is as follows:

Hardware

SUN SPARCS, 32 Mb RAM, 535 Mb Internal hard disk (HD), 2 Gb external HD, 150 Mb cartridge tape drive, CD-ROM drive, 8 Port serial - parallel controller, high resolution colour monitor.

Software

Solaris v2.4 operating system, SPARC works Pro C v3.0, C++ 4.0.1 & Fortran 3.01, SPARC work Common Tools.

The facilities provided to the PUNENET users through the Internet are :

1. The WWW sites can be accessed through graphical and character based browsers such as
 - * Mosaic Netscape (GUI based)
 - * Gopher, Lynx (Character based)

At present, GUI based browsers will work only on SUN machines. However, effort are on for third party software for SLIP and PPP implementation. This will allow the browsers to work over dial up lines on other machines.

2. Access to databanks available on the Internet such as,
 - * Bioline
 - * MSDN (Microbial Strain Data Network)
 - * MEDLINE
 - * Dialog (charged)
3. Apart from the above, the user can avail other Internet facilities like,
 - * E-Mail
 - * FTP for accessing data from remote computers.
 - * Accessing various newsgroups of the Internet
 - * Searching data across the network with search engines like Archie.

The PUNENET can be accessed through MODEM Lynx (a text based Browser). Also, a graphical browser, Netscape can be used for accessing. The Lynx also supports the Graphics. For accessing PUNENET through Lynx, type: *lynx http://bioinfo.ernet.in/punenet* and press enter, when PUNENET menu driven home page will be visible supported by help.

WHO GOVERNS THE INTERNET

No one person or group runs the Internet. A group of volunteers called Internet Society of ISOC who directs this to promote global information exchange through internet technology. There is a myth that the Internet is free, but it is not so. Some one pays for every connection to the Internet. Similarly, no one pays for it, on the contrary everyone pays for their part. Many times these fees are not passed on to the actual users, which feeds illusion of free access. Some sites are supported by government while others by private grants.

GETTING CONNECTED TO THE INTERNET

To use the Internet, one must have the Internet connection. There are several ways of getting connected to the Internet. To get access to the Internet via a service provider, the basic kit required is:

- i) Communication (Dial up access, ISDN, satellite, leased line, ordinary telephone);
- ii) A computer (PC/AT preferably PC/AT-

- 80386);
- iii) A modem (9600 bits per second);
- iv) Password (Membership) address; and
- v) A software (viz. PROCOM).

To get the complete set of services, a TCP/IP style connection is needed but for limited services, there is no need of a full connection to the Internet i.e., we can, beg, borrow or buy an account on a computer which is connected to the Internet.

DON'Ts (What is not allowed on Internet)

It may be possible to do what we want, but it is also our responsibility to find out what is allowed and what is not on Internet. It is influenced by law, ethics and policies. Following points should be taken care of while using the Internet:

- i) Never forget that the person on the other side is also a human, one should not hurt the feelings of others. Please remember that when you are sending a message (strongly criticising messages on a network) to a bulletin board or mailing list, people all over the world are going to read your words;
- ii) Be careful what you say about others;
- iii) Think twice before you post your personal information about yourself or others;
- iv) Say succinctly, as it will have a greater impact. Remember that longer you make your article, the fewer people will read it;
- v) Avoid abbreviations and acronyms, if possible;
- vi) If your message is very interesting to a limited geographical area (conference, meetings, appointments, etc) restrict the distribution of the message to your local area;
- vii) Avoid posting messages to more than one group unless you are sure, it is appropriate;
- viii) When you request information from the network, it is common courtesy to report your findings that can benefit others as well;

- ix) One of the biggest problems on the Internet is that when someone asks a question, many send identical answers. When this happens, dozens of the identical answers pour in through the net. Mail your answer to the persons and suggest that they summarise to the network. This way the network will only see a single copy of answers, no matter how many people answer the question; and
- x) Be careful about copyright and licences. Posting movie, reviews, songs, lyrics and anything else published under a copyright could cause members of the net community to be held liable for damages.

BIOMEDICAL RESOURCES ON THE INTERNET

There are lots of resources on the Internet but there is no official list. Anyone, who has an Internet connection, can put a new resource online at any moment. The Internet is dynamic, some resources are always parting out of date and they are always missing the latest and greatest things on the net. The major resources are: 1. Friends, 2. Networknews, 3. mailing lists, 4. Gopher, 5. Archie, 6. WAIS, 7. WWW. The special resources are: 1. The InterNIC, 2. Registration service (information about remote networks), 3. Database services (White page equivalent to Yellow page), 4. Information services (like reference service, fax, E-mail questions). Of particular interest to the biomedical community is the large and increasing number of technical, scientific and biomedical resources that can be accessed through the Internet. Most of the bigger biomedical centres have publicly accessible information viz., NIH, NML, etc. having extensive databases and services that can be used by biomedical researchers, clinicians, educationist, decision makers and administrators. In addition, many biomedical organisations and some biomedical journals are advertising their services over the Internet and can be contacted through E-Mail. Different type of information sources available are: consumer and patient information, resources for health professionals, medical images, telemedicine and rural medicine, health policy and government standards, professional organisations and journals.

Many government agencies maintain sites with information for both health care professionals and

health care consumers. The centres for disease control and prevention and the public health services maintain internet sites with information about communicable diseases, epidemics, and population based health care. WHO maintains web sites with information on international health issues. Sites such as, Healthwise at Columbia University, the HEALTHLINE server at the University of Montana, and the Healthinfo Gopher at Rice University offer multimedia (MM) educational materials advice columns, mailing list, and other resources addressing preventive medicine, nutrition, AIDS, sports medicine, drug and alcohol abuse, woman's health, sexuality and other public health information. Bibliographical resources are also available on the internet.

ROLE OF LIBRARIANS/INFORMATION PROFESSIONALS

New IT can vastly improve the storage and retrieval of information on public health. There are many forces coming together to provide a forum for biomedical librarians/information scientists, who are interested/involved in leading information initiative in their institutions. There is an urge to have standards for information management to provide an outstanding opportunity for biomedical librarians/information system staff and biomedical records staff to work together to create a seamless information system for users of biomedical information, viz., physicians, clinicians, nurses, scientists, researchers, decision makers, etc. Communication among these geographically distributed institutions and hospitals is vital. Biomedical librarians/information scientists, can play a vital role in the newly emerging national biomedical information landscape through the wealth of information capabilities of the Internet [39, 40, 41, 42, 43, 44]. We should be prepared for these inevitable changes by becoming more familiar with Internet through formal and informal training course and Internet library should be incorporated into biomedical schools and continuing biomedical curricula.

CONCLUSION

Thus, the Internet is much more than a computer network or an information service. It should be clear by now that the Internet is not only a collection of computers and cables but also a global com-

munity of people who share a wide variety of resources. It allows the researchers to share data and publications, experiences, opinion and knowledge/information and provides a way to create resources and share them instantly with millions of people around the world. The Internet in India is still in initial stage, and its infrastructure is yet to be grown to the desirable extent. Computer networks in general and the Internet in particular are likely to play vital role in many aspects of biomedicine in future. As a health care information providers we must also be the prominent providers of Internet based biomedical information for both our colleagues and the public.

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29. MARINE (April) *et al.* Internet getting started. 1993. Englewood Cliffs: N.J.; Prentice Hall 1993. 360p.
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39. COLERA (Ehtrico). *Op. cit.*
40. FLANNERY (M R). *Op. cit.*
41. KAROL (E D). *Op. cit.*
42. LAPORTE, (R E). Global public health and public superhighway tomorrow the world. *British. Med. Jour.* 1994, June 25; 1651-52.
43. NEESHAM (Claire). *Op. cit.*
44. OBRACZKA (Kalia) *et al.* *Op. cit.*

BIOMEDICAL SOURCES AND SITES AVAILABLE ON INTERNET

1. Netscape Communications Corp., <URL: <http://home.netscape.com/> >. URLs listed in this appendix are accurate as of the date of publication but will change over time. The indices mentioned in the last section of the appendix should be consulted for updated access information.
2. National Center for Supercomputer Applications, <URL: <http://www.ncsa.uiuc.edu> >.
3. W3 Consortium, <URL: <http://www.w3.org/hypertext/WWW/Lynx/Stqtus.html> >.
4. Columbia University Health Service, Health Education and Wellness Program, <URL: <http://www.cc.columbia.edu/cu/healthwise/> >.
5. University of Montana Student Health Services, <URL: <http://healthline.umn.edu:700> >.
6. Rice University Student Health Service, <URL: gopher://riceinfo.rice.edu/11/Safety/HealthInfo >.
7. University of Connecticut Health Center, Lyman Maynard Stowe Library, <URL: gopher://inform.uchc.edu/11gopher-root%3a%5b-data04.-data0401%d >.
8. University of Minnesota, <URL: gopher://lenti.med.umn.edu:71/11/news/citations >.
9. University of Iowa College of Medicine, Department of Radiology, Electric Differential MM Laboratory, <URL: <http://indy.radiology.uiowa.edu/VirtualHospital.html> >.
10. University of Washington, Department of Statistics, <URL: <http://www.stat.washington.edu/TALARIA/TALARIA.html> >.
11. Pharmaceutical Information Associates, Ltd., <URL: <http://pharminfo.com/drugdb/db-mnu.html> >.
12. University of Tennessee at Knoxville, College of Nursing, <URL: <http://nightingale.con.utk.edu:70/0/homepage.html> >.
13. University of New Hampshire, Department of Nursing, <URL: <http://unhinfo.unh.edu/unh/acad/health/nursing/index.html> >.
14. NetRep Explorer, <URL: <http://www.netrep.com/global/biz/pgi.html> >.
15. University of Kansas, <URL: <http://falcon.cc.ukans.edu:80/nsween/> >.
16. Emergency Medicine Bulletin Board System, <URL: <http://www.njnet.com/-embbs/> >.
17. Medical College of Wisconsin, <URL: <http://chorus.rad.mcw.edu/chorus.html> >.
18. National Library of Medicine, <URL: <ftp://nlmpubs.nlm.nih.gov/BIBS/CBM/> >.
19. Stanford University and the University of California at San Francisco, Divisions of General Internal Medicine, <URL: <http://www-med.stanford.edu/MedCentre/MedSchool/DGIM/Teaching/Modules-index.html> >.
20. Marshall University School of Medicine, <URL: <http://medicus.marshall.edu/medicus.htm> >.
21. University of Washington, Department of Radiology, <URL: <http://www.rad.washington.edu/> >.
22. Massachusetts General Hospital, Department of Emergency Medicine, <URL: <http://emergency.mgh.harvard.edu/wice.htm> >.
23. Loyola University (Chicago) Medical Education Network, <URL: <http://www.meddean.luc.edu/lumen/MedEd/Medpage.html> >.
24. MedSearch America, <URL: gopher://gopher.medsearch.com.9001/1 >.
25. National Library Medicine, <URL: <http://www.nlm.nih.gov/extramural-research/dif/visible-human.html> >.
26. National Museum of Health and Medicine, Human Developmental Anatomy Center <URL: <http://bubba.afip.nih.gov> >.
27. General Electric Corporate Research and Development, <URL: <http://www.ge.com/crd/iv/three-dim-medical.html> >.
28. Harvard Medical School, <URL: <http://www.med.harvard.edu/AANLIB/home.html> >.
29. Mednexus, <URL: <http://www.mednexus.com/med-illustrator/index.html> >.
30. National Library of Medicine, <URL: <http://www.nlm.nih.gov/hmd/dir/oli.dir> >.
31. Center for Advanced Studies, Research, and Development in Sardinia, <URL: <http://www.crsr.it/france/MEDICAL/institutions.html> >.
32. Telemedicine Research Center, <URL: <http://tie.telemed.org/> >.
33. University of Washington, Image Computing Systems Laboratory, <URL: <http://icsl.ee.washington.edu/~carbralje/tmresources.html> >.
34. East Carolina University School of Medicine, Center for Health Sciences Communication, <URL: <http://www.telemed.med.ecu.edu/telemenu.htm> >.
35. Marshall University School of Medicine, <URL: <http://ruralnet.mu.wvnet.edu/> >.
36. Health Care Financing Administration, <URL: <http://www.ssa.gov/hcfa/hcfahp2.html> >.
37. Department of Health and Human Services, <URL: <http://www.os.dhhs.gov/> >.
38. U.S. Food and Drug Administration, <URL: <http://www.fda.gov/fdahome-page.html> >.
39. National Institute on Aging, <URL: gopher://gopher.os.dhhs.gov/1/dhhs/aoa/aoa/agepages >.
40. National Library of Medicine, <URL: <http://text.nlm.nih.gov/> >.

41. Centers for Disease Control and Prevention, <URL:<http://www.cdc.gov/>>.
42. Public Health Service, <URL:<http://phs.os.dhhs.gov/phs.html>>.
43. World Health Organization, <URL:[http://www.who.ch/programmes/WHO Programmes.html](http://www.who.ch/programmes/WHO_Programmes.html)>.
44. National Health Information Center, <URL:<http://nhic-nt.health.org/>>.
45. Duke University Medical Center Information Systems, <URL:[http://www. mcis.duke.edu:80/standards/](http://www.mcis.duke.edu:80/standards/)>.
46. United Technologies National Standards System Network, <URL:[http://hsd www.res.utc.com/std/gateway/ orgindex.html](http://hsd www.res.utc.com/std/gateway/orgindex.html)>.
47. American Medical Informatics Association, <URL:<http://amia2.amia.org/>>.
48. American Psychological Society, <URL:<http://psych.hanover.edu/APS/>>.
49. International Society of Nephrology - Renal Pathology Society, <URL: [http://synapse.uah.ualberta.ca/synapse/ 000p0035.htm](http://synapse.uah.ualberta.ca/synapse/000p0035.htm)>.
50. Massachusetts Eye and Ear Infirmary, Department of Ophthalmology, <URL:[http://www.meei.harvard.edu/meei/ DJOhome.html](http://www.meei.harvard.edu/meei/DJOhome.html)>.
51. Johns Hopkins University, School of Medicine, Department of Radiology and the William H. Welch Medical Library, <URL:[http://jmi.gdb.org/JXII/ ejourn.html](http://jmi.gdb.org/JXII_ejournal.html)>.
52. Centers for Disease Control and Prevention, <URL:[http://www.crawford. com/cdc/mmwr/mmwr.html](http://www.crawford.com/cdc/mmwr/mmwr.html)>.
53. Internet Working Group of the American Medical Informatics Association, <URL:[http://kuhttp.cc.ukans.edu/ cwis/units/medcntr/Lee/HOMEPAGE.HTML](http://kuhttp.cc.ukans.edu/cwis/units/medcntr/Lee/HOMEPAGE.HTML)>.
54. International Network for Interfaith Health Practices, <UREL:<http:// www.interaccess.com/ihpnet/health.html>>.
55. Massachusetts General Hospital, Department of Neurology, <URL:[http:// demOnmac.mgh.harvard.edu/ hospitalweb.html](http:// demOnmac.mgh.harvard.edu/hospitalweb.html)>.
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(Source: Bringing Health Care Online: The Role of Information Technologies; Office of Technology Assessment, Congress of the United States, Appendix E, Electronic Health Information Sources, page 207-211.)

The sites listed above are only small fraction of existing sites and new sites are being developed at a very alarming rate [27].