

Accessing the Scientific Literature

The Reality of Virtual Scholarship

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The age-honored practice of plowing through the *Index Medicus* in a good medical library to meander through citations for treasured finds is an anachronism. Today, clinicians have the astonishing capacity to bring to bear existing knowledge almost effortlessly. Virtual scholarship makes available up-to-date medical citations and their abstracts. There can be access around the clock on any topic in the office, at the bedside, or from home. Computerized searches of the medical literature promote directed continuing education and may enhance clinical care of patients.

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The information explosion has profoundly affected the amount and dissemination of medical knowledge. Physicians are expected to digest and synthesize ever-increasing amounts of scientific literature. In the past, physicians went to the literature to look it up. A good medical library, a recent text, the *Index Medicus*, a pencil and paper, and plenty of time were essential ingredients for the tedious but rewarding process of reviewing citations. Today, the demands of practice often conflict with the time requirements for continued scholarship. Even without special computer knowledge, a busy physician can work smarter rather than harder by accessing the biomedical literature through several easily available technologies.

BASIC OPTIONS

In their efforts to keep abreast of the medical literature, many physicians have become familiar with MEDLINE. This database, or collection of material in electronic form, is produced by the National Library of Medicine (NLM).¹ It is a computerized version of the *Index Medicus*, the *International Nursing Index*, and the *Index to Dental*

Literature and includes abstracts when available. MEDLINE is more current than the printed *Index Medicus* because it is updated on a regular basis from weekly to monthly depending on the system. More than 3600 journals are indexed from 1966 to the present.

When access to MEDLINE became available in 1971, most searching was done through intermediaries, usually a librarian. In addition to convenience, librarians can usually run a more comprehensive search because of knowledge of database availability and the complexities of medical subject classification (ie, indexing). However, physicians who are office based or otherwise without direct access to search services (ie, a library or searching intermediary) have alternatives.²⁻⁴ The elimination of time constraints as a barrier to scholarship allows citations to be found 24 hours a day in the office or hospital, at the bedside, or from home without the delays of a mediated search. With the use of a personal computer and a *modem* (a device that encodes data for transmission over a particular medium such as telephone lines) to make the telephone connection to the vendor's computer, MEDLINE and other databases can be readily accessed from any convenient location. A librarian can serve as a consultant and often offer valuable advice if the physician does not obtain the desirable search results.

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THE SEARCHING PROCESS

Before examining the offerings of the various vendors, the following is a general description of searching and why it is done:

1. To obtain up-to-date citations on a topic.
2. To narrow a topic by crossing 2 or more terms together (eg, diabetes and patient education). Citations to articles discussing both of these topics would be obtained.
3. To receive regular updates from the literature on a specific topic.

Certain questions need to be asked when considering a search:

- What is the purpose of the search? Do I need a detailed bibliography or the classic "few good articles"?
- What are the variables that I would like to assign to my search to focus it (eg, English language, human or animal studies, year of publication, or particular age group [such as adolescents or the elderly])?
- Do I want my search terms to be a major focus of the article?

Medical subject headings (MeSHs) include the official indexing terms that are used by the NLM. Appropriate terms are assigned to each article by indexers who choose between 10 and 20 terms. Understanding this terminology is essential in information retrieval and will likely result in the most complete search.⁵ Lack of knowledge of MeSHs is often the greatest single technical barrier to an efficient, successful search. However, the physician may want to search a subject that does not have an official MeSH term. This can be done with the use of free text terms. The result is often a more comprehensive search. It is always important to remember that searching is an interactive process that demands flexibility as the results appear. Ideally both techniques should be used for the most complete searching result.

EQUIPMENT

A personal computer (486/33 with color graphics is desirable—the faster, the better) or a McIntosh computer (Cupertino, Calif) with a modem (14.4 bits per second minimum, 28.8 bits per second is even better), a telephone line, and communication software are needed. To use CD-ROM, the personal computer should be a multimedia personal computer—a specification that describes the minimum hardware requirements necessary to run multimedia software using the operating system (Windows, Microsoft Corporation, Redmond, Wash) for IBM-compatible computers.

SYSTEM CHOICE

Because the family practitioner is faced with various information alternatives, several issues should be considered before choosing a system:

- Information needs. Do I need specialized databases or will MEDLINE be sufficient? How quickly do I need access to articles? What time of day and how often do I anticipate searching?
- Cost. This would include the start-up costs of equipment and the cost of the vendor's contract, software, or CD-ROM.

- Ease of use. This includes the readability of manual, on-line tutorials and the availability of mapping to MeSHs on the screen so that indexing terms may be used.
- Frequency of updating. The number of years of the literature compiled in the system should be considered.
- Assistance. What is the availability and reliability of vendor assistance if problems arise?

AVAILABLE SYSTEMS

The systems currently available allow searching by author, subject, and often journal title. They are user friendly and menu driven, meaning that the search procedure is explained step by step, allowing easy navigation for novice computer users or those who search infrequently and do not recall the commands. An expert mode is also usually available for those who have memorized the commands. These systems also offer a choice between using the MeSHs or text words in cases in which the user supplies the term.

For a comprehensive search it is always preferable to use the MeSHs because these will search the term as a concept. *Index Medicus* indexers are required to use these terms. In choosing a system, the capability to map to the MeSH term or to choose from the screen can be an important feature.⁶ For example, the user typing in "AIDS" will be mapped to the official heading "Acquired Immunodeficiency Syndrome." This is convenient if a copy of the MeSHs is not at hand. All major vendors offer an 800 assistance number and a newsletter with update information. Many systems also offer automatic monthly updates on requested topics, called "selective dissemination of information," as well as the ability to order full-text articles not available directly from the computer.

The following briefly describes several common methods for the office-based physician to access MEDLINE and other useful databases:

1. A cost-effective automatic front end way to search the literature is offered by GRATEFUL MED.^{2,7} This is a software system available from the NLM. Fully automated installation and a thorough, understandable manual make it user friendly. It provides access via a home computer and modem to the NLM's Medical Literature Analysis and Retrieval System. MEDLINE, AIDSLINE, TOXLINE (toxicology literature online), BIOETHICSLINE, and CANCERLINE are among the more than 30 NLM databases available. The search for optimum terms is formulated off-line, saving money. The average search takes only a few minutes and costs a few dollars. The user is charged according to time and number of citations downloaded, and the software is updated approximately once a year at no cost to registered users. The MEDLINE file is updated weekly. For the experienced user who wants to interact with the main search computer directly, the expert mode can be used with type commands.

An important new feature of GRATEFUL MED that has been introduced is called "Loansome Doc." This service allows the user who does not have easy access to a medical library to obtain the full-text document within 24 hours. Health professionals register with a medical library and arrange to order documents on a fee-paying basis through their GRATEFUL MED software. Costs to users to register and to obtain articles are set by the li-

brary where the user has an agreement. Physicians lacking an institutional library should contact the regional National Network of Libraries of Medicine, formerly the Regional Medical Library, to learn about resource libraries. An important recent development is the fact that the NLM has begun offering AIDS and DIRLINE (Directory of information resources on-line) databases at no charge. AIDSLINE, AIDSTRIALS, and AIDS DRUGS are examples of the AIDS databases.

2. OVID Technologies (formerly CDPLUS) recently purchased BRS Information Services. This service offers access to MEDLINE as well as many other biomedical databases (~200), such as PSYCHOLOGICAL ABSTRACTS, AGELINE, EXCERPTA MEDICA, and BIOLOGICAL ABSTRACTS, not available through GRATEFUL MED but of possible interest to the practitioner.⁸ EXCERPTA MEDICA indexes approximately 3500 international journals with extensive coverage of pharmacological data, particularly from Europe. A unique feature of the OVID Technologies' system is the Comprehensive Core Medical Library offering full-text articles from more than 80 journals.

3. DIALOG Information Services Inc (referred to as DIALOG). This vendor also offers access to varied databases in business, science, and the humanities. The DIALOG menu offers menu-driven, user-friendly access to more than 200 of DIALOG's databases. DIALOG menus have recently been enhanced with a new selection of databases; the Target database allows searching by relevance ranking, whereas the Statistical Analysis database identifies relevant records.

DIALOG's biomedical databases include MEDLINE, EXCERPTA MEDICA, AGELINE (covers gerontology), and the SCIENCE CITATION INDEX (a database that indicates how often and where an article has been cited). Complete articles can be ordered through a personal computer and delivered by mail. As an alternative, DataStar, purchased by DIALOG in 1993, uses commands similar to those used by OVID Technologies and offers heavily discounted searching during afternoons because the mainframe is in Switzerland and includes many drug information databases.

4. PaperChase. This service offers access to MEDLINE, AIDS LINE, CANCERLIT, and HEALTH PLANNING AND ADMINISTRATION either through PaperChase software or CompuServe, an intermediary service. It offers fax service to obtain full-text articles quickly.

5. MEDIS. This service is provided from Mead Data Central and is a front end to MEDLINE and other databases (eg, Lexis-Nexis) that are aimed at the legal professions. It concentrates on full-text format, also available through GenMed, but the cost is much higher than MEDLINE accessed directly through GRATEFUL MED.

6. Physicians On-line. This is a commercially sponsored service offering free access to MEDLINE to physicians only. The toll free number is 800-332-0009.

7. CD-ROM. Through the use of a disk player, physicians with access to libraries have begun to be familiar with CD-ROM.^{9,10} Each disk can store up to 680 megabytes of audio, video, animation, graphics, text, and photographic images. These laser disks offer access to MEDLINE, PSYCHOLOGICAL ABSTRACTS, and many other databases. Improved search, printing, cross-referencing, and

retrieval capabilities are distinct advantages. Purchasing CD-ROMs may be more cost-effective than online searching for high-volume institutional searches, although clinical departments and individuals are also entering this market. CD-ROM offers the advantage of fixed yearly rates with no charge for access time or printing citations. Updates are monthly or sometimes less, whereas the online MEDLINE database is updated weekly. Silver Platter (including Compact Cambridge, which was absorbed by Silver Platter) and OVID Technologies offer these compact disks.

An example of a CD-ROM is MEDLINE Professional from Silver Platter (800-343-0064). It is a subset of MEDLINE that focuses on clinical medicine and includes 320 journals in the *Abridged Index Medicus*, the *Library of Internists* lists, and the *Brandon Hill* list. It is updated bimonthly and includes the current plus 3 preceding years. Many hospital and academic medical libraries have networked CD-ROMs with remote access from a network or dial-in access for practitioners who are unable to come to the library or who search off hours.

Examples of other journals available on CD-ROM include *American Family Physician* (1985 to the present) and the *New England Journal of Medicine* in full-text format. Textbooks and collections of texts are also available on CD-ROM, such as the *Physician's Desk Reference*, *Scientific American Medicine* (212-754-0550), *MAXX: The Electronic Library of Medicine* (the Little Brown spiral series) (800-343-9204), and *Stat!-Ref Plus Library* (800-755-7828). Additionally, there are a growing number of medical applications (eg, *Family Doctor*, *Mayo Clinic Family*, *Health Book*, and *Vital Signs: The Good Health Resource*) and general interest applications (eg, atlases and encyclopedias) for the general public.

OTHER ONLINE APPLICATIONS

In addition to searching the literature online or via CD-ROM, online service providers¹¹⁻¹³ can provide other information useful to practicing physicians (note: online services are those that can be accessed by modem).

1. America Online is a full-spectrum service providing reference sources, *e-mail* (an online messaging service between computer users), public bulletin boards (ie, forums), games and entertainment, computer file transfers, several Internet access tools, various retail areas, and online versions of news magazines and newspapers. Its creative services, pocket computer support, and ease of use has produced a loyal and rapidly growing customer base. Time On-line provides information on health care reform and medicine; Lifestyle and Interests includes bulletin boards such as DisAbilities, SeniorNet, and Better Health and Medical Forum; Learning and Reference provides a Medical Seminar folder that includes a patient education forum and discussions on office and medical information files; and Computing and Software contains file areas for office practice, patient information, and clinical care.

2. CompuServe is the largest, most complex, most costly, and most comprehensive of all online services. It includes Knowledge Index through a relationship with DIALOG, DataStar, and PaperChase. One hundred twenty databases are included, of which 49 are medical databases that may be accessed at lower rates at night and on weekends.

3. Genie is an older, smaller service. Its online encyclopedia is a cost-effective alternative to CD-ROM or paper versions. The cost is on par with America Online and its high-speed, toll-free access is recommended for rural users.

4. Electronic bulletin board services. Inexpensive and fun, bulletin board services are an easy and growing way to explore online communications. Such services are usually established by a computer hobbyist, business, government, or educational or other organization for communication purposes. Access typically requires registration with the system operators. Many bulletin board services have a special focus (eg, the Food and Drug Administration and GRATEFUL MED), and many subscribe to international discussion activities. Connections to the Internet may not be as reliable as through a major online service.

5. E-mail. Rivaling mail, fax, and telephone services, this simple tool grows daily in value and effect. MCI-Mail (800-444-6245), a communication-only service, allows subscribers to communicate online with practically anyone, anywhere, anytime via fax, telex, and same-day delivery paper mail to be sent directly from your personal computer. Rural as well as urban users and travelers are well served via its 800 number. AT&T Everylink (800-242-6005) is a competing service oriented primarily to corporations.

6. The Internet is an online service in which computers are connected worldwide by wire and radio.^{12,14} Because it is still in the public domain, cost is nonexistent or small, although commercial enterprise is a growing interest. Telnet is the internet protocol-providing connection ("remote login") to a remote computer. It is also considered the general program implementing the protocol. Home and office connections via e-mail are often challenging (eg, BITNET, AppleLink, ATT-Mail, and MCI Mail), and while electronic guides are being developed, paper guides remain critical for most users.^{15,16} Major and minor commercial online services (ie, Prodigy [800-PRODIGY] and America Online [800-827-3338]) provide the easiest and most widely available form of access. Toll-free, direct access is available through Community News Services and Colorado SuperNet. For those who have a university medical center, library, or computer department close to home, access is often free or inexpensive. There are more than 250 medical discussion groups and mailing lists, including behavioral aspects of family medicine (Family-L) and computers in family medicine (Fam-Med). Many of the clinical and research resources of the NLM (including GRATEFUL MED software) and the National Institutes of Health are available on the Internet. Familiarity with the Internet will facilitate colleague consultation, job hunting, patient discussion and education, and access to clinical information.

Gopher expedites access and navigation within the Internet by creating a menu-driven, point-and-click interface to public computer files. There are approximately 6000 known Gopher services. The World Wide Web allows navigation of the net by highlighting words in the text of one or more documents that may include graphics. The World Wide Web also permits searching by the Universal Resource Locator address. A listserv is a system that distributes E-mail messages between a group

of members or subscribers. It is available through the Internet and BITNET software. Detailed discussions of the Internet and the World Wide Web are beyond the scope of this article.

CONCLUSIONS

Busy practitioners can choose the information system that best meets their needs and best facilitates patient care whatever the time of day or geographic location. The information highway is rapidly evolving into a well-defined superhighway with multiple primary and secondary access roads. The challenge for today's physician is to begin travelling on these new technological routes by using appropriate software and services so that tomorrow's entry into the information superstructure will be familiar and optimum.

Up-to-date journal citations can be easily accessed through computerized searches for continuing education as well as patient care needs. CD-ROM and various online applications like the Internet are additional options for accessing a range of electronic information that may also be helpful in the management of patients, scholarly reviews, and research projects.

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