

Computer-Assisted Search of Medical Literature

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Computers now offer physicians a wide range of time-saving and cost-effective means of user-friendly access to medical literature. This article describes different methods of using the computer to find information on a subject, focusing on end-user services that provide access to MEDLINE. The different systems available and their respective advantages and disadvantages are described. Use of electronic bulletin boards, Internet and online publishing in medicine also are addressed.

Physicians today have an ever-increasing array of methods available for access to medical literature. They can search libraries' on-line catalogs to see what books are available on a particular topic or they can search bibliographic data bases to retrieve references and abstracts from journal articles on a desired subject or by a particular author. Searching the journal literature can be done through the services of a librarian or by physicians themselves through a variety of direct dial and CD-ROM services. In the last few years physicians have even been able to search full-text data bases that contain the entire text of selected journals and books.

What is Computer-Assisted Search?

Computer-assisted searching is simply using the computer to find articles or information. Until the early 1970s, searching of the literature was done manually, using card catalogs and the printed indices to journal literature, such as *Index Medicus* or *Biological Abstracts*. With the advent of electronic publishing and the development of MEDLARS (Medical Literature Analysis and Retrieval System) by the National Library of Medicine, the ability to search the electronic information being used to print the indices was developed and enhanced. The electronic version of a print index that can be stored and retrieved on a computer is known as a bibliographic data base because of the bibliographic nature of the material retrieved. Sometimes these data bases have information available that the print index doesn't, such as authors' abstracts or summaries of the articles. Other data bases, known as full-text data bases, contain the actual information printed in textbooks and journals. Depending on the software developed to search the data base, the searcher uses a variety of techniques and commands to look for the desired information.

Why Do It?

There are many advantages to searching the literature with a computer. One major advantage is that the data bases are much more current than the comparable print index. The print *Index Medicus* lags several months behind its on-line counterpart, MEDLINE. Another major advantage is the ability to search for a combination of words or topics that can be looked up only one at a time in *Index Medicus*. For example, if the researcher is interested in how exercise affects adolescent asthmatics, the on-line retrieval can be restricted to articles that discuss the 3 subjects of exercise, asthma and adolescence and can

restrict the references to certain years or publication types.

Computerized searching of the literature also allows the searcher to use the advantages of an on-line subject thesaurus better. The National Library of Medicine assigns each article 5 to 20 Medical Subject Headings, known as MeSH headings, to describe the subject content and article design. These headings group articles on similar topics under one heading. For example, all articles on heart attacks or MIs will have the subject heading Myocardial Infarction assigned to them. All MeSH headings are arranged in a hierarchy that indicates broader and narrower terms of a topic known as a tree. Under antibiotics the searcher would find a list of various antibiotics including penicillin and streptomycin as well as a multitude of others. Using the print index, each type of antibiotic needs to be searched separately to do a comprehensive search. The on-line version allows for the search of the main subject and all the narrower subheadings under that subject all at the same time. It is critical for a searcher to use subject headings to achieve the best results. MeSH is also used for the subject headings assigned to books in a medical library collection.

Computer searchers also can search for articles containing certain words or combinations of words, which is called keyword searching. Keywords should not be too general; words such as "disease" are too broad to have much meaning. It is more helpful to search for words that uniquely describe the topic. Keyword searching is especially useful to search for articles on topics too narrow or too new to have a specific assigned subject heading.

Computer searching has several other advantages, including being able to search many years of the data base simultaneously. Searchers can stay abreast of the latest information by saving a literature search on a specific topic and thereafter running it at regular intervals to retrieve the most recent information on that subject. They can also search and print the abstracts of the articles that are available for a large portion of the data bases.

MEDLINE

MEDLARS is the computerized system of data bases and data banks offered by the National Library of Medicine (NLM). The entire system contains more than 13 million bibliographic and factual references in about 30 on-line data bases, including TOXLINE, CANCERLINE, PDQ, HEALTH, and MEDLINE. A comprehensive list and description of available data bases is available from NLM.¹

Of the data bases produced by the NLM, MEDLINE is the world's leading bibliographic data base for medical information. It contains the information found in the print publications *Index Medicus*, *International Nursing Index*, and *Index to Dental Literature* and provides access to the information on medicine, nursing, pharmacology, dentistry, allied health sciences and health care delivery; MEDLINE contains more than 6 million journal references, indexing over 3,500 journals from 1966 to the present.³ Abstracts have been available since 1975 for approximately 65% of the references. MEDLINE uses the medical subject headings known as MeSH. To search accurately for a specific topic, the searcher must know the MeSH term for that topic. Most of the end-user systems have the MeSH headings on-line. Because MEDLINE is the primary data base used to provide access to the medical literature, this article will focus on services that use MEDLINE. Most of the services offering MEDLINE offer access to other data bases as well.

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Develop A Computerized Medical Library

Today, all academic medical libraries and most hospital libraries provide computerized literature searches for their clientele. A physician should contact the medical library at the institution with which he or she is affiliated for details about the type and cost of services provided, whether they will accept requests for searches by telephone, and whether they will pull and photocopy articles retrieved. Most medical libraries will have many other computerized data bases available for searching in addition to MEDLINE. Before requesting a search, the requester should identify the purpose of the search, the key concepts or key words within the topic, and the synonyms for each concept, as well as consider any limitations such as the years covered, type of publication, language, or species. After obtaining the necessary information the librarian will then execute the search by dialing into the MEDLINE data base.

The advantage of having a librarian do the literature search is that the searcher utilizes a professional who is familiar with the data base, who understands the structure of the data base and can search it for maximum relevant retrieval. Physicians with limited time or inclination to learn to do their own searching find this a valuable service. Physicians who search infrequently also will find a librarian's services more cost-effective and satisfactory.

If You Do Your Own

An increasing number of physicians are discovering the advantages and the rewards of doing their own searching. The MEDLINE data base, and many others, is available for searching from many private companies and vendors that sell on-line access for end-users. There is a wide variation from company to company of the costs, data bases available, hours of availability, user-friendliness and the requisite hardware and software. At minimum, a researcher needs a microcomputer, a modem to allow the computer to communicate over phone lines, a communications software program, and an information vendor who will provide access to the data base and the search software necessary to search the data base. Several companies provide their own communications software when a user subscribes to their service. Expenses generally include communications costs, the data base-connect charge, a fee for every article displayed or printed, as well as an initial signup fee, annual fee and/or minimum monthly fee. Table 1 compares some of the features of the various services that provide access to MEDLINE and other health-related data bases, including their costs and the telephone number of the company to contact directly for further information. Most companies distribute demonstration diskettes that enable a user to compare and review the systems before subscribing to them. Some considerations before selecting a company should be the equipment required, hours of access, charges, ease of searching, availability of a manual or training, availability of a MeSH thesaurus, number or type of data bases offered, availability of a document delivery service, and any other special features of the data base.

The 2 services most appropriate for the novice or infrequent searcher are Grateful Med and PaperChase.³ Grateful Med is the on-line service offered by the NLM, providing software designed to simplify the process of searching the MEDLARS data bases. The user who formulates the search first, connects to the computer at NLM, runs the

search, disconnects, then prints or displays the results. It is relatively inexpensive and easy to learn and use.

An alternative search method is available for more experienced users. Grateful Med has an on-line document-ordering feature, LOANSOME DOC, to enable users to order copies from a medical library of articles for citations retrieved. PaperChase, developed by Beth Israel Hospital and designed by physicians, was the first user-friendly vendor for searching MEDLINE. PaperChase is available through CompuServe or directly from Beth Israel Hospital. This service also requires no special training.

More experienced searchers, or those desiring a more sophisticated service, might find BRS, NEXIS, or DIALOG more appropriate. BRS has the advantage of cost as well as providing access to the greatest number of medically oriented data bases, including many full-text book and journal data bases. Its Comprehensive Core Medical Library data base contains full-text articles from 80 major medical journals.

Direct on-line searching also is available to individuals affiliated with a university or other institution that has purchased and mounted the MEDLINE tape data for the use of their students, staff, or employees. The cost to do this is prohibitive for most institutions.

There are many advantages of doing your own on-line searching. One of the major advantages of personally searching the literature is that it can be searched from home or work, day or night. Another advantage is that the physician is able to incorporate his or her own medical knowledge into the search, sometimes resulting in more pertinent retrieval. Also, he or she can modify the search strategy immediately if the results are not satisfactory. Another advantage is that the searcher can download the results, transferring the references or information to his or her own computer's data base or word processor.

Although personally searching the literature is advantageous when only a few references or review articles are needed, for com-

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Where can **YOU GO** this weekend?

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- ... **ocean kayak,**
- ... **visit ancient temples,**
- ... **shoot a round of golf**
- ... and still be back
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plex or comprehensive searches it is best to consult a librarian. Some disadvantages to direct on-line searching is that it is not always easy or cheap. The user needs to be familiar with the communications software, the search software and the command language. When a user pays according to time on-line or number of articles retrieved, he or she is less likely to experiment and try alternative search strategies.¹⁰

Searching MEDLINE on CD-ROM or Compact Disk

In 1986 the NLM released the magnetic tape of its MEDLINE data base to several companies to develop CD-ROM (compact disk read-only memory) counterparts of the data base. A compact disk is a 4.72-inch laser disk, the same shape and size as the CDs used for music. It is able to store the equivalent of 330,000 type-written pages or 900 double-sided floppy diskettes on one disk.⁴ The result was that several variations of MEDLINE now are available on CD-ROM from 11 different companies, each using different search software. The NLM publishes a list of licensees who use its data bases to produce CD-ROM products.⁵ The hardware requirements are a relatively fast microcomputer, and a CD-ROM player with interface card and cable. Users wanting to search multiple years in one search will need a multiple CD-ROM player. Subscribers pay a fixed, annual subscription fee that entitles them to unlimited use.

CD-ROMS are very popular in medical libraries, largely due to the fixed cost, which promotes use, but also due to the ease of access, ease of use, and value as an instructional device. The fixed cost makes CD-ROM particularly cost-effective in institutional settings where there is a heavy demand for searching the literature. The data base also can be networked for an additional fee, making it available at multiple workstations. Many of the advantages of direct on-line searching also apply to CD-ROM searching; physicians are able to incorporate their own medical knowledge into the search, modify results immediately, and can download results for later transfer of the information to their computers.

There are several disadvantages to searching MEDLINE on CD-ROM. One disadvantage is that the relatively high annual subscription fee is prohibitive for most individuals. The CD-ROM data base also is not as current as the on-line version, largely due to time required to master the CD-ROMS and distribute them to subscribers. Another disadvantage is that MEDLINE requires a multiple CD-ROM player in order to search several years at once. The alternative is to load the disk manually for each year. A further drawback is that a subscription to MEDLINE on CD-ROM gives access only to that one data base.

The Future

There have been recent trends in other ways to gain access to the medical literature. One of most dramatic changes in the past 5 years has been the increasing use of electronic mail and bulletin boards to query colleagues on their opinions. Bulletin boards are on-line forums that allow participants to ask and answer questions. To have access to them users need a microcomputer, modem and specialized software. Some services, such as CompuServe, have access to a physician's bulletin board as well as bibliographic data bases such as MEDLINE. If a user is affiliated with a university access to it through its Internet or Bitnet networks might be available, which is usually less expensive than subscribing to a commercial service. Physicians might be interested in Black Bag Bulletin Board, to CompuServe's AMIA Medical Forum, to Fam-Med.⁶ Through the Internet a user also can have access to a variety of library catalogs and factual data bases. Just a few of the many interesting library catalogs a user can peruse are that of the Memorial Sloan-Kettering Cancer

Center, the Cornell University Medical College, the National Library of Medicine Online Catalog (the world's largest biomedical library), the National Institute of Health, New York University's Ehrman Medical and Waldmann Dental Libraries, and our own Hawaii Medical Library. Other sources of medical information on the Internet of interest to physicians include a variety of NLM publications, a collection of disability-related files, National Institute of Health articles and pamphlets and newsletters such as the *ALS (Amyotrophic Lateral Sclerosis) Digest* and the *Chronic Fatigue Syndrome Newsletter*. If you want to know more about the Internet and how to access the resources that are available, the book *The Whole Internet: User's Guide and Catalog* by Krol⁷ is valuable.

Another trend in medical literature is on-line publishing. OCLC published the first on-line medical journal, *Journal of Current Clinical Trials*⁸ which has received mixed reviews. Full-text journal sources generally delete graphs and charts that are available in their print version. *The Journal of Current Clinical Trials*, which has no print counterpart, includes charts, tables, and graphics as well as text. Included with the subscription fee is special software necessary to develop access to this journal. A few other full-text electronic sources on the Internet include the *Morbidity and Mortality Weekly Report (MMWR)*, *The Scientist*, the *AIDS Information Newsletter*, the *Family Medicine Digest*, and *Springer Journals Table of Contents Service*. Most of the services described in Table 1 offer a variety of full-text data bases where the complete text of articles is available for the searching. *The New England Journal of Medicine* and *JAMA* are 2 of the many journals available on-line for full-text searching. Access to the world's drug literature also is easily searched on-line.¹³

Although there are obvious benefits in using electronic sources to search the Internet and full-text data bases for medical information, there are important factors to consider. These sources generally require more computer literacy and a greater investment of time and money. Copyright issues are also still under consideration as to their being accessible.

Conclusion

There are a growing number of ways physicians can obtain access to the medical literature. A physician should be able to find a system that matches his or her needs and inclinations. Although personally searching with the computer can give a physician immediate, inexpensive and flexible access to the literature, it is not for everyone. The physician must select the computer and the information company that is most appropriate to his or her needs; the physician also must be willing to invest the time to learn the system if it is to be used to its maximum potential. We have attempted to present some of the different systems available with their advantages and disadvantages. More information on many of these systems is available from your medical librarian.¹⁴

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