# Personal Computer Access to MEDLINE: An Introduction

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Physicians can personally search MEDLINE to answer clinical questions or to update their knowledge base. The components required, each of which is discussed in the text, are a personal computer, a communications software program, a modem, the literature database, and an information vendor. Physicians can assemble and use these components with a minimum of expense and computer knowledge.

For the novice searcher who does not want to make a large initial investment, obtaining a low-cost personal computer and using an information vendor such as GRATEFUL MED or PaperChase may be the most suitable alternative. For searchers without access to a medical library or for more experienced searchers, an information vendor such as BRS, MEDIS, or DIALOG may be more appropriate.

*Key words.* MEDLARS–MEDLINE Information System; decision making, computer-assisted; diagnosis, computer-assisted. *J Fam Pract 1991; 32:414-419.*

Recent publications state the value of personal computer access to the medical literature and recommend this system as an effective way to answer clinical questions and to further medical education.[1–4] Personal computers give physicians rapid and easy access to more than 700,000 journal citations in the National Library of Medicine as well as much other useful medical information. Physicians who use personal computers but are unfamiliar with computer literature searching can access valuable information after only 1 to 2 hours of reviewing the operating instructions. Several articles explaining the methods involved and the different systems available were written in the mid-1980s, but major changes have occurred since that time. There is a paucity of recent articles that evaluate and compare all of the current systems. This article (1) explains the advantages of personal computer access to the medical literature, (2) gives information on different available components, (3) discusses information vendors in detail and reviews available comparison studies, and (4) gives suggestions as to which components may be most appropriate for different individuals.

*Submitted, revised, November 6, 1990.*

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ISSN 0094-3509

## Why Search?

Physicians use personal computers and communications technology in two main ways. First, specific information is generated with literature searches. In 3 to 4 minutes and for $2 to $5, a personal computer can scan the entire literature base of the National Library of Medicine and produce a list of relevant journal citations and their abstracts. A search may be designed to look for a specific author, article title, or medical subject. The number of citations generated for a medical subject may be limited by using qualifiers. For example, if one were looking for information on orthostatic hypotension, one could easily limit the search to retrieve only review articles about drug therapy for adults that were written in the last 2 years.

Second, a technique known as Selective Dissemination of Information (SDI) helps physicians with the never-ending task of staying abreast of the latest medical literature. The SDI technique entails designing a literature search on a specific topic and running it regularly to retrieve the most recent information on that subject.[5] For example, if a large portion of a practice were devoted to treating diabetes, one could design a search to produce relevant articles on the management of diabetes. Performing this search regularly (every month, quarter, or year, depending on one's reading habits) would generate a list with abstracts of the most current literature on that topic. This search could be restricted further to produce only articles that appear in preselected accessible journals.

Medical librarians perform both literature and SDI searches for physicians. There are, however, several advantages to searching the medical literature personally. First, personal searching may be more precise because it is often difficult for a physician to communicate to a librarian the exact nature of the information he or she is seeking. In performing a search individually, a physician incorporates his or her specific questions and medical knowledge into the search. This process often results in more pertinent data.[6] Second, personal searching is more timely and convenient. Results are obtained when and where they are needed: in the office, in the hospital, or at home. If they do not produce the desired results, searches can be modified immediately rather than having to wait 24 hours to discover from the librarian that the search must be repeated. Physicians' ability to search the medical literature, however, does not supplant the need for trained medical librarians. Librarians provide invaluable assistance in designing complex literature searches, and are expert consultants when personal searches do not produce the desired results.

## The Components

The components necessary to perform personal literature searches are a personal computer, a modem, a communications software program, a medical database, and an information vendor.

### *Personal Computers*

The heart of a literature search system is the personal computer (PC). PCs come in a variety of models, from relatively simple to quite complex and powerful.[7] Prices range accordingly, from several hundred to many thousands of dollars. Most PCs are tabletop models. If a more portable unit is desired, there are many laptop models available that fit easily into a briefcase.[8,9] Almost any type of currently manufactured personal computer is adequate to access the information available from medical vendors.

### *Modems*

The modem is a device that connects the PC to a telephone line.[10] Modems are classified according to their *baud rate*. Basically, the baud rate indicates how rapidly a modem can receive or transmit data. The higher the baud rate, the less time one is online. The term *online* indicates the time that a PC is actually connected to a distant vendor's computer by telephone lines. Since the computer user is billed by the vendor for each minute of online time, faster modems result in less expensive searches. Currently, modems for PCs come in three baud rates. A basic 2400-baud modem costs approximately $150, only slightly more than the cost of the substantially slower 1200-baud modem. Modems with a baud rate of 9600 have recently become available but are not yet fully standardized.

Internal and external modems are available. Internal modems are designed to fit inside a PC and use its power supply (a feature especially useful in laptop computers). Modems are produced by many different manufacturers and in many models, but almost any basic modem will fulfill the needs of most physicians.

### *Printers*

Although not essential for reviewing journal citations, a printer is needed to produce hard copies of the data. Like PCs and modems, printers come in a wide variety of models and prices.[11] An inexpensive dot matrix model costing approximately $200 is adequate to record the results of searches.

### *Communications Software*

The communications software is the set of instructions that tells the PC and the modem the proper telephone numbers to dial and the messages to send to an information vendor many miles away. These messages typically consist of passwords and other information that allow the PC and the vendor's larger computer to communicate.[12] Some vendors supply the necessary software, and many modems come with their own software. Most of these software programs work equally well.

### *Databases*

The database is a collection of information stored in electronic form. A full-text database stores the entire text of a journal or book. A bibliographic database contains a collection of journal citations. The National Library of Medicine produces MEDLINE, the largest and best-known medical bibliographic database. Many other medical bibliographic databases exist, including EMBASE (a European database), TOXLINE (toxicology references), and PDQ (current cancer treatments).

MEDLINE is essentially the *Index Medicus* in electronic form. In addition to the basic citation, it contains abstracts for approximately 60% of the articles referenced.[13] MEDLINE classifies journal articles by a controlled vocabulary of medical subject headings (MeSH). MeSH terms are published in large directories entitled *Medical Subject Headings Annotated Alphabetic List* and

*MeSH Tree Structures*. When an article is published, it is reviewed by the National Library of Medicine and assigned from 5 to 20 MeSH terms related to its study design and subject content. To search accurately for a specific topic, one must know the MeSH term for that topic. For example, an article on acute myocardial infarction will be listed only under "myocardial infarction," not under "heart attack" or "MI" or "acute infarction." If a search is attempted using any of these other terms, it will not generate as much useful information.[14]

## *Information Vendors: The Crucial Component*

Information vendors are companies that purchase data from medical databases such as the National Library of Medicine. They install these data on their large computers and arrange the information so that it is easier to access by individuals who are not trained searchers. Vendors differ from one another in a number of ways (Table 1). All vendors charge their customers per minute of online time; in addition, some charge a registration fee, a monthly minimum, or a yearly subscription fee, or charge per citation generated.

One important feature the vendor should provide is a MeSH thesaurus. This service allows the computer to convert clinical terms to medical subject headings without forcing the user to search the large directories manually. Another essential feature to look for in a vendor is the capacity to run and store SDI searches.

The number and type of databases offered by the vendor may also be important to certain users. All medical information vendors feature MEDLINE. Some make available other medical databases such as EMBASE, AIDS databases, or TOXLINE. Even business and entertainment databases are provided by some vendors. Vendors such as Bibliographic Retrieval Services (BRS) and Mead Data Central (MEDIS) provide full-text services. These services not only offer full-text printouts of articles or books, but also allow searches for a specific word or combination of words in every sentence of a journal or book.

### INDIVIDUAL VENDORS

BRS has been involved in medical information retrieval for years and is familiar to most medical librarians. BRS offers two vendor options of interest to individual medical searchers, COLLEAGUE and BRS AFTER DARK. COLLEAGUE is a full-service option that provides MEDLINE, EMBASE, and over 20 full-text medical textbooks and 70 full-text journals. COLLEAGUE offers many medically oriented features including medical news services and *Journal Watch*. In addition, over 100 other nonmedical databases are available.

BRS AFTER DARK is a budget option that has many of the same features of COLLEAGUE but is available only during non-prime-time hours.

Dialog Information Services, also a well-known source, offers two prime-time services: a full-service general option called DIALOG and a more restricted option called MEDICAL CONNECTION. DIALOG contains all the services available in the MEDICAL CONNECTION and many other databases, mostly nonmedical. DIALOG, however, does not have many full-text medical services. KNOWLEDGE INDEX, a budget service with many of the features of DIALOG, is available only during non-prime-time hours. Mead Data Central, the creator of LEXIS, the famous legal online system, has produced MEDIS for physicians. MEDIS offers bibliographic searches with MEDLINE, but it concentrates on full-text materials. For example, instead of providing information on cancer through the CANCERLIT database, MEDIS provides a full-text library on cancer. It has been described as the best system for handling full-text information.[15] Monthly fees and service charges for MEDIS are relatively quite high.

GRATEFUL MED was created by the National Library of Medicine, the producer of MEDLINE, to provide easier access to their system. The GRATEFUL MED software enables one to formulate a search offline, in a user-friendly fashion; then it automatically dials MEDLINE and performs the search. This strategy is cost-effective (especially for slow typists), because there is no charge for preparing a search offline. Searches on GRATEFUL MED may take longer, however, since a searcher cannot interact with the program while it is connected to MEDLINE. For example, if a search produces too many citations, one must disconnect from MEDLINE, reformulate the search, and then wait while GRATEFUL MED redials MEDLINE. With other vendors the search can be reformulated while online. GRATEFUL MED requires IBM-compatible or Macintosh computers. PaperChase, developed by Beth Israel Hospital, was the first user-friendly vendor for searching MEDLINE. PaperChase was designed by physicians and, therefore, is easy for clinicians to use. PaperChase will automatically convert clinical terms into MeSH terms, thereby producing more thorough searches. If not handled correctly, however, this can also result in searches that produce too many citations.[14] A disadvantage of PaperChase is that MEDLINE is the only database available through this service.

### SELECTING A VENDOR

In the selection process, the most important issue to consider is vendor accuracy. A study by Haynes et al[16] found no differences between the vendors in their ability

Table 1. MEDLINE Information Sources (Information current as of January 1991)

| Vendor | Service | Initial Fee | MEDLINE Online Costs (per hour) | Other Costs* | Times Available† | MeSH Thesaurus | SDI | Databases | Full Text |
|---|---|---|---|---|---|---|---|---|---|
| BRS Information Technologies<br>800 West Park Dr<br>McLean, VA 22102<br>(800-955-0406) | COLLEAGUE | $95 | $32 PT<br>$22 NPT | $20.00/month (minimum)<br>$0.09/citation (varies) | 22 h/day | No | Yes | Approximately 150, including EMBASE, AIDS, and CANCERLIT | Some |
| | AFTER DARK | $75 | $27 | $12.00/month minimum<br>$0.03/citation (varies) | 6 PM–4 AM, Monday–Friday<br>6 AM–2 AM, Saturday<br>9 AM–4AM, Sunday | No | No | Approximately 110, including AIDS and TOXLINE | Some |
| Dialog Information Services<br>3460 Hillview Ave<br>Palo Alto, CA 94304<br>(800-334-2564) | DIALOG | $45 | $46 | $35.00/year<br>$0.05/citation | 24 h/day | No | Yes | Approximately 400, including CANCERLIT, AIDS, and EMBASE | Some |
| | KNOWLEDGE INDEX | $35 | $24 | None | 6 PM– 5AM, Monday–Friday<br>All hours, Saturday and Sunday | No | No | Approximately 75, including CANCERLIT | Some |
| National Technical Information Services<br>5285 Port Royal Rd<br>Springfield, VA 22161<br>(800-638-8480) | GRATEFUL MED | $33 (software) | $32 PT<br>$17 NPT (varies) | None | 24 h/day | Yes | Yes | Approximately 20, including CANCERLIT, AIDS, and TOXLINE | Some |
| Mead Data Central<br>9393 Springboro Pike-DM<br>Dayton, OH 45401<br>(800-227-4908) | MEDIS | None | $39 | $50/month<br>$6–$15/file search | 24 h/day | Yes | Yes | Has full text on most medical subjects | Yes |
| PaperChase<br>Longwood Galleria<br>350 Longwood Ave<br>Boston, MA 02115<br>(800-722-2075) | PaperChase | None | $23 | $0.10/reference displayed or printed | 24 h/day | Yes | Yes | MEDLINE | No (can be ordered) |

**Cost computation method varies. Contact vendor for exact charges.*
*†Vendors have varying amounts of downtime each day or week during which their services are not available.*
*PT—prime time, NPT—non-prime time.*
*SDI—Selective Dissemination of Information.*

to produce the most relevant articles on certain clinical topics. This study was done in 1985, however, and there have been many changes in the information vendors since that time. Despite these changes, it is reasonable to conclude that, if used correctly, any of the vendors will produce accurate and thorough searches within the inherent limitations of the databases searched.

A second issue to consider in choosing a vendor is ease of learning. Several studies have examined this important but difficult-to-measure quality. The most comprehensive comparison study, conducted by Haynes et al[16] found PaperChase to be the easiest to use. GRATEFUL MED was not available when the study was done. PaperChase and BRS COLLEAGUE were compared in two studies. Simon[17] found no significant differences between the two. In a prospective controlled trial, Porter and colleagues[18] found PaperChase easier to learn and easier to use effectively. In a comparison of an early version of GRATEFUL MED and PaperChase, Bonham and Nelson[19] found both to be equally easy to use. GRATEFUL MED was chosen as the favorite because the user's ability to formulate the search offline led to less expensive searches.

A definitive comparison study of current vendors has not been done. An ideal study would use practicing clinicians as subjects and would test all available vendors in clinical situations, both while the subjects are first learning and after they have become experienced. At the present time, using any of the available vendor services appears to produce an accurate search if it is done correctly.

*Recommendations*

A novice to the world of accessing computer information should start with a vendor service that is easy to learn and to use, relatively inexpensive, encourages the use of MeSH headings,[20] and has access to MEDLINE, which is the most commonly used database.[21] PaperChase and GRATEFUL MED are the two services that most nearly approach this ideal. Neither of these requires a large initial financial expenditure, so one could move to a more advanced service later without losing too much of one's initial investment.

For more experienced searchers, for physicians who need full-text articles, or for those who want to start with a more sophisticated service, BRS, MEDIS, or DIALOG may be appropriate. BRS has the most medically oriented features and has many full-text books and journals, making it attractive to those who do not have ready access to a medical library. MEDIS also offers full-text services but is quite expensive. DIALOG, with its large number of nonmedical databases, may be attractive to those searchers with special interests.

## The Future

Recently, several companies have begun to offer the contents of MEDLINE on compact disk. These disks are searched in a manner similar to searching online databases. A modem is not used, but a special computer player is required. Many medical libraries are now using these systems. Currently, these disks cost more than $900 for 12 monthly updates, but they may become cheaper and more appropriate for individuals as demand grows.[22]

## Search Guidelines

The following guidelines will make creating and using a personal medical literature search system easier and more productive.

Before purchasing a medical information service from a vendor, send for further information. All vendors have toll-free numbers for ordering material and answering questions. (This information is given in Table 1.)

Consult additional resources, such as the book by Ronald Albright, MD, *A Basic Guide to Online Information Systems for Health Care Professionals*,[15] for more information.

When beginning to search, follow these guidelines from Bickers[23], Menke and McClead,[24] and DeNeef.[20]

1. Ask five questions about the topic. Is it a (1) part of the body? (2) plant, animal, or microbe? (3) condition or disorder? (4) drug or chemical? (5) diagnostic or therapeutic procedure? These are the five major groups of terms in MEDLINE's MeSH. Always try to use MeSH when searching.
2. Do not hesitate to switch between searching and displaying results. If an initial search produces 100 articles, print the first 10 to 20 and find the one that is closest to the type of article you are seeking. Then display the article's MeSH terms and use these to narrow the original search.
3. Design the search strategy as much as possible before going online.
4. Obtain *The Basics of Searching MEDLINE: A Guide for the Health Professional* from the National Library of Medicine.

Finally, discuss assembling and using a personal medical literature search system with your medical librarian.

## Conclusions

In summary, personal computer searching gives a clinician immediate, inexpensive, and flexible access to the

medical literature. The physician creates a search system by selecting the computer and information vendor most appropriate to his or her needs. Only a very limited knowledge of computers is required to assemble such a system. The physician with the ability to personally search the medical literature using a PC will find it much easier to make informed decisions about clinical problems in this era of burgeoning medical knowledge.

## Acknowledgments

Allen Shaughnessy, PharmD, and Ted Schaffer, MD, of St Margaret Memorial Family Practice Residency Faculty, and Caroline Arms and David Ginn, Director and Associate Director of The University of Pittsburgh Microcomputer Center, contributed valuable reviews of this manuscript.

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