



Researching Medical Literature on the Internet¹

by Gloria Miccioli

The proliferation of medical Web sites is good news for the researcher with a small medical book collection. Legal researchers often need to consult medical sources, so it is fortunate that the Internet provides free access to medical literature, either in full text or citation and abstract format. Search capabilities fulfill most information requests. Demand for medical information on the World Wide Web is growing. Many professionally oriented health care sites meet consumer needs, and consumer-oriented sites often include professional literature.²

How does the researcher navigate the maze of medical Web sites?³ It depends on what you are looking for. MEDLINE, one of the crown jewels of medical research, is an electronic database that has provided citations and abstracts to 4,200 American and foreign biomedical journals since 1966. It is a mainstay of medical research, especially for current information, and has long been searchable for a fee. It is now free on the World Wide Web. Produced by the National Library of Medicine, a federal agency, it is accessible not only from the NLM Web site, but also from many others, such as those of medical libraries and medical associations. But remember: *Not all MEDLINE sites are the same.* Some do not cover the entire MEDLINE database; others do not offer all MEDLINE search features. Read the Web site description to determine what is offered.

MEDLINE is available from the National Library of Medicine in different official versions, PubMed [<http://pubmed.gov>] and NLM Gateway [<http://gateway.nlm.nih.gov/gw/Cmd/>].

National Library of Medicine Databases

NLM Gateway [<http://gateway.nlm.nih.gov/gw/Cmd/>]

NLM Gateway is the user-friendly way to search MEDLINE. It requires no knowledge of search command language. Introduced in October 2000, NLM Gateway is a Web-based interface that will search not only MEDLINE, but also several other NLM databases at the same time. Currently, Gateway is somewhat confusing because it is in the process of adding databases to its system. To see the databases currently available, go to <http://gateway.nlm.nih.gov/gw/Cmd?/Overview.x>. For example, TOXLINE, a database on drug toxicity is not yet available through Gateway. It can be accessed at toxnet.nlm.nih.gov.

Despite the confusion during this transition, researchers will find NLM Gateway a good starting point. The system locates precise medical terminology by searching for MeSH headings. The National Library of Medicine has developed an extensive controlled vocabulary called Medical Subject Headings (MeSH) that leads to greater search accuracy and relevancy. By entering a term and then clicking on *Find Terms* on the Gateway search page, you can access NLM's Unified Medical Language System's Metathesaurus [www.nlm.nih.gov/pubs/factsheets/umlsmeta.html]. Browse through a ranked list of terms, MeSH hierarchies, and relevant co-terms, and select terms to be added to your search. You can also designate main headings. Terms will be automati-

cally exploded unless you indicate otherwise; subheadings of a MeSH term will be searched with the main heading. I can't stress enough the importance of using the MeSH function: Your results will be more accurate when you use the terms assigned to the article by the indexer. And the non-medical searcher may not guess the correct terms. How many would know that "mad cow disease" is represented in MEDLINE as "encephalopathy, bovine spongiform"?

There is a simple search box. Results are divided into categories: journal articles; books/serials/AV materials from the NLM collection; meeting abstracts; and other collections. For each category you can get search details, i.e., how the terms fit in MeSH and what databases were searched. Displaying results brings up citations with an option to display abstracts if they exist. You can also request articles related to a particular citation, like the "More" option in Lexis/Nexis. The *Limits* button lets you narrow your search by document type, English language, and publication year. *History* will show your search statements and allow you to modify them. I recommend that you read the *FAQ* (on the left sidebar of the home page) for basic search tips and for printing or downloading information. Gateway also links to the full text of articles available on-line by participating publishers. Retrieval may require a fee or a subscription. It also links to Loansome Doc, the online ordering system of the National Library of Medicine.

NLM Gateway is easy to use and permits simultaneous searching of many databases. It is intended to be a first step for medical researchers. Those who need more detail and more sophisticated searching should use PubMed.

PubMed [<http://pubmed.gov/>]

PubMed is narrower in scope than NLM Gateway, but it offers more powerful searching. PubMed was developed by the National Center for Biotechnology Information (NCBI) at the National Library of Medicine in conjunction with publishers of medical literature. PubMed does not include all the NLM databases found on Gateway, but does link to the full text of articles of participating journals. There are currently links to the full text of about 1,700 of 4,200 journals indexed by MEDLINE. Access to the full text depends on the publisher; some require a fee or subscription. For a list of journals with full-text links, click on *Journal Browser* on the home page, then on the list of journals with links to full text Web sites. PubMed covers MEDLINE, and it links to NCBI's molecular biology databases.

Enter terms in a simple query box on the PubMed home page, or click on *Preview/Index* for more advanced searches. You can also search by author and journal title. To narrow search parameters, click on *Limits* and use pull-down menus to restrict the search by field (such as title, title word, abstract word, MeSH heading, issue, page number and so on) and by language, age, gender, publication type, date range, and more. Read the *FAQ* (the link is on the left sidebar of the home page) for basic information on PubMed, and take the on-line *Tutorial*.

The PubMed search engine automatically tries to match search terms, phrases, author names and journal titles against estab-

lished lists. Putting a phrase in quotes will prompt the system to search a phrase dictionary. If a match is not found, the individual terms are ANDed together. It is also possible to search MeSH headings in PubMed. Click on *MeSH Browser* on the left sidebar. Enter a term and the system will respond with the correct MeSH heading(s), which can be selected. When I entered "norplant", I got the MeSH heading "levonorgestrel", a short definition, and the term hierarchy, from which more terms could be selected and added to the search.

Search results can be displayed in brief citation format or with abstracts, if available. Like Gateway, PubMed allows you to retrieve related articles for most citations, because most records in MEDLINE are linked to other records by a matching algorithm. For the full text of the articles, you can link to a participating journal or order online from NLM through Loansome Doc, your local public library or public law library.

PubMed has several other useful features; links are on the home page sidebar: The *Journal Browser* lets you look up journal names and MEDLINE abbreviations, *Single Citation Matcher* allows you to verify a single citation, and the *Batch Citation Matcher* allows you to verify multiple citations.

Cubby is a search feature that allows users to store and automatically update searches (like Eclipse on Lexis or WestClip on Westlaw). To register for Cubby, click on the button and follow the instructions.

Both Gateway and PubMed are attractive alternatives to fee-based sources of MEDLINE. NLM has made MeSH headings available so that the user can find terms that will constitute an accurate, comprehensive search. Using the correct medical vocabulary is the most important factor when looking for medical information. However, getting the actual articles can be time-consuming. With NLM Web products, the user may sometimes point and click to order articles, some of which may be online in full text, some for a fee. A consultation with your local law librarian will help you find the articles you need. You may ask your librarian for help conducting the research. Some public law libraries offer this service for a reasonable fee.

Practice both systems. Maneuvering among the MeSH browser, pull-down menus, and various fields—i.e., defining and modifying the query—takes time and is difficult to track. However, upgrades have made these systems easier to use.

If MEDLINE is available in not one, but two, formats from NLM, why would a researcher choose to search it on a non-NLM Web site? One reason is convenience, especially if the user is already on another medical site that links to MEDLINE. A more compelling reason is that some sites offer MEDLINE with a little something extra.

Commercial Web Sites

Medscape [www.medscape.com]

Medscape's products are "designed to give healthcare professionals and consumers the healthcare information and digital data

they need regardless of where or when they need it.” This Web site combines information from journals, medical texts, medical news providers, medical education programs and materials created specifically for Medscape. It hosts a collection of 25,000 free, full-text, peer-reviewed clinical medicine articles that are searchable and collected from journals or written for Medscape. Click on *Search Medscape* on the home page to search MEDLINE, AIDSLINE, Medscape’s full-text articles and several databases that include drug information, patient information, medical images and a medical dictionary. The database called “Clinical Content” contains the articles written for Medscape as well as discussion group archives, treatment updates, conference summaries, textbooks and practice guidelines. There is so much in Medscape.com that the home page is a little confusing. A list of links to the resources on this site, found by clicking on *Site Map* on the top of the screen, makes the site easier to navigate. I often use Medscape first when I’m given a medical research question because I can search both MEDLINE and the information produced for and by Medscape. Like many medical Web sites, Medscape requires free registration.

Medscape’s MEDLINE offers two search options: a basic screen that allows for only natural language queries (i.e., fuzzy logic), searching by author and journal. It limits the search to English, abstracts, review articles, date and to the top 269 ranked MEDLINE journals. The advanced screen includes all this and also offers “concept mapping”—the automatic selection of correct medical terms. Search by word variants, and a choice of fuzzy or Boolean logic. Medscape has designed its own search screens, rather than defaulting to Gateway’s or PubMed’s.

MedicineNet.com [www.medicinenet.com]

When I do medical research, I try to find a plain English description of the topic before I start to search MEDLINE.

MedicineNet.com is a good place to go for understandable yet in-depth medical information. Produced by a network of U.S. board certified physicians, this site has hundreds of Web articles on diseases, treatments, procedures, tests and drugs. To access the articles, which are arranged by category (e.g., diseases and conditions, medications, procedures and tests), select a category at the top of the home page and choose from the detailed alphabetical list. To search by keyword, in one category or all, click on *Advanced Search* on the left sidebar.

InteliHealth [www.intelihealth.com]

InteliHealth is a site designed to make health care information accessible. It is a subsidiary of Aetna U.S. Healthcare. It seeks to provide “credible information and useful tools from the most trusted sources, including Harvard Medical School and the University of Pennsylvania School of Dental Medicine.” Health information developed by InteliHealth is reviewed and approved by medical experts. Over 150 health care organizations, including NIH, contribute. There is a simple query box on the home page. The sidebar button *Health A to Z* brings up a detailed alphabetical list of article topics. The sidebar also links to other information. Click on *Drug Search* to access the Drug Resource Center, with drug information, FDA actions, news, reactions and more. *Condition Center* links to articles on diseases, conditions

and procedures. Select from a detailed alphabetical list or a list of broader subjects. *Resources* links to a physician locator, a hospital locator, drug information and articles. TopicDoc (formerly MedCite) is a user-friendly medical literature service that offers a topic-driven approach to MEDLINE. TopicDoc consists of more than 15,000 topics that have been searched by medical research librarians from the Johns Hopkins health science centers. Citations or abstracts to the 50 best articles are immediately accessible for each topic. All TopicDoc searches are updated and document delivery is available.

Libraries and Nonprofit Organizations

Medical Matrix [www.medmatrix.org]

If you need a comprehensive guide to clinical medicine resources on the Internet, consult Medical Matrix. This metasite annotates, evaluates and links to medical sites that are relevant to the clinical practice of medicine. It targets American physicians and healthcare workers. An editorial board reviews and ranks all resources. For example, if you click on *MEDLINE* on the left sidebar, Medical Matrix links to more than 10 MEDLINE sites, including Gateway and PubMed and fee and free sites. It also briefly describes each site and links to a comparison chart (Click on *View MEDLINE entries in a table format*). Sites are ranked by a rating system of stars. PubMed-Advanced has the highest rating, 5 stars. Medical Matrix evaluates an enormous number of sites. Clicking on *Rx Assist* on the left sidebar of the home page brought up a rated list of 48 Web sites on drugs. These sites are grouped by category: searchable databases, patient education, textbooks and educational materials. It is easy to see the focus of each site. Medical Matrix continuously updates its content. For an explanation of the rating system, go to www.medmatrix.org/info/edboard.asp#Star.

To sample the breadth of coverage available on Medical Matrix, I entered “panic disorder” in the home page simple search box. I got 77 sites and 265 links. Each listing was ranked. Users can also select to search the resources within a specialty or category found on the home page, which has eight broad subject groupings, including specialties, diseases, clinical practice, and literature (including hypertextbooks, journals, and MEDLINE). Each grouping has numerous subcategories. For example, when I clicked on “Psychiatry” under “Specialties,” I got a long list of ranked sites that were displayed by type of information: databases, news, abstracts, texts, major sites, conference literature, directories, practice guidelines, online forums, patient education materials and organizational resources. Medical Matrix provides the kind of one-stop shopping and searching available in FindLaw, with an emphasis on quality as well as quantity.

MedWeb [www.medweb.emory.edu]

Librarians have helped to make medical information more available and easier to search. MedWeb, the medical metasite of Emory University’s Health Sciences Library, is impressive for its links to health-related sites located around the world (click on *Institutions* on the home page). Browse and select for relevant links. *Medical libraries* brings up 347 links to medical libraries

around the world. MEDLINE links to sites that offer MEDLINE searching as well as information about searching MEDLINE. Back on the homepage, *Publications* links to numerous e-publications, including journals, texts, practice guidelines, databases, directories and encyclopedias. Some are free and others are fee-based. There is also a search box for keywords.

Medical/Health Sciences Libraries on the Web [www.arcade.uiowa.edu/hardin-www/hslibs.html]

Hospitals, medical libraries and professional associations on the Web link to sites that reproduce or index medical literature. The on-line catalogs of medical libraries are a window to the world of medical publishing. Medical/Health Sciences Libraries on the Web links to academic, hospital and military medical libraries and other medical sites worldwide. The home page also links to a list of free medical journals. In addition, this site, produced by the University of Iowa Hardin Library for the Health Sciences, compiles the Hardin Meta Directory of Internet Health Sources [www.lib.uiowa.edu/hardin/md/index.html].

Medical Society of Virginia [www.msv.org]

The Medical Society of Virginia compiles Web links to regional medical resources. Click on *Links/Resources* on the sidebar to see a page of links to Virginia-based health care sites, including state and local agencies, Virginia medical schools, and nonprofit organizations. One link to the Eastern Virginia Medical School [www.evms.edu], whose Medical Library provides links to electronic resources such as its on-line catalog, PubMed, and a collection of electronic journals, not all of which make full text available.

Journals and Textbooks

FreeMedicalJournals.com [www.freemedicaljournals.com]

For direct access to the current issues of several hundred free, full-text medical journals, go to FreeMedicalJournals.com. Although there is little information about who owns and maintains it, its goal is

continued on the following page

admirable: to promote the free availability of full text medical journals on the Web. The journals are arranged alphabetically and by specialty.

Internet Medical Bookstore [www.fimb.com/FrontPage.html]

Often researchers will need to consult medical texts. First, however, they must be identified and obtained. For information about medical textbooks, CD-Roms, and software that are available for sale, visit the Internet Medical Bookstore. Over 50,000 items can be ordered on-line. Click on *Browse Our Store* and you can browse by subject or search by keyword. For example, the search “anxiety disorders” brought up 36 titles.

Medical Search Engines and Visual Information

MedNets [www.mednets.com]

MedNets uses proprietary search engines to search international medical databases. I could not find an explanation of how it works so I can only tell you what I found by trial and error. The home page allows for searching across the site or by medical specialty by medical professionals or by consumers. It searches the medical literature of a large number of databases, including MEDLINE. Select *Research Engines* on the home page for a list of medical specialties. Clicking one leads to a list of databases with information relating to that specialty; each database can be selected and searched individually. However, note that some of the links are not active. You can also search across the MedNets site or within each category by entering a keyword search in the simple search box on the left sidebar. It is also possible to search MEDLINE via PubMed separately using a search form on the right of the screen. There is also a search box for a general literature search. Unique to my experience is a feature allowing you to get results within one to sixty seconds. Search results include articles and guidelines.

MedNets also functions as a medical metasite. Hit any of the search engine buttons on the home page and the resulting page will have a detailed sidebar of links to health care-related Web sites. These include patient and physician resources, a global list of hospitals and medical associations, medical schools, and a medical bookstore. Although MedNets covers a great deal of medical information, the site is not well designed and needs more explanation.

MedBot [www-med.stanford.edu/medworld/medbot]

MedBot, by Stanford University, collects general search engines, medical indices, news sites, medical education, and medical imaging and multimedia sites. Some of these resources can be combined for a single Super Search, that selects up to four databases to be searched at one time. Or, click on each category and search the listed sites one at a time.

The button marked *Medical Images and Multimedia* underscores that the research of medical sources is often a hunt for visual

information. The fact that the Internet is not restricted to textual medical information makes it an extremely valuable research tool. Clicking on that button on the left sidebar brings up query boxes for:

WebPath [www-medlib.med.utah.edu/WebPath/webpath.html] is an electronic collection of 1900 images of pathology specimens along with text, tutorials, laboratory exercises, and examination items, and

The Digital Anatomist [www9.biostr.washington.edu/da.html] is a collection of computer-generated images based on cryosection studies.

When I tried to find some images, I was more successful in searching the above Web sites directly from their home pages than I was in using MedBot. Entering “stomach” in the MedBot query box for WebPath brought up two hits. Entering stomach in the WebPath search box retrieved 38 items. I could also browse “General Pathology” and “Organ Systems Pathology.”

Medscape [www.medscape.com] also has compiled a file of medical images. Its search box allows the researcher to click on *Medical Images* and search for visual information. I entered “keratosis”, which is a skin lesion, and got a thumbnail image. Clicking on the image brought up a screen-sized version with a caption and the source of the image.

Researchers can search a Findlaw database of more than 10,000 medical images [<http://medpics.findlaw.com/index.cfm>]. The illustrations were developed for legal matters, such as medical malpractice exhibits. Enter a term in the query box or select from an alphabetical list. Selecting “knee caps” brings up one anatomical model, 27 stock illustrations, four medifocus guides, and 18 medical exhibits (Findlaw explains each category). Click on an image to enlarge it. Users must pay a fee to download an image.

Physician Information

Researchers often need information on medical providers as well as on medical conditions. Licensing data and educational background are usually available, but the availability of disciplinary information varies from state to state. The watchdog group Public Citizen conducted a survey of Doctor Disciplinary Information on State Medical Board Web Sites [www.citizen.org/hrg/PUBLICATIONS/1506.htm] to determine which states publish disciplinary information on the Internet. It surveyed 51 boards that regulate medical doctors and found that 41 boards name disciplined doctors on their Web sites. The earliest information is from 1996, so this is a relatively new development. A table at [www.citizen.org/hrg/PUBLICATIONS/1506uptodate.htm] lists the state boards and tells what information is given. It also provides links, if available, to the boards' Web sites, which usually also give licensing data and educational background.

If you are not satisfied with free information related to disciplinary actions against doctors, try the Federal Physician Data Center, [www.docinfo.org], which was launched in early 2001 by the Federation of State Medical Boards, whose membership is comprised of the 69 medical boards of the states, the District of Columbia, Puerto Rico, Guam and the Virgin Islands. The Data

Center lists 117,000 state board charges against 35,000 doctors dating back to the 1960s, although some information goes back to the 1940s. The site covers only U.S. medical licensed physicians, osteopathic physicians and physician assistants. To be included in the database, a disciplinary action must be a matter of public record or be legally releasable; there is no information on malpractice claims or settlements. The database, which is updated monthly and quarterly, costs \$9.95 per search, whether an action is found or not. Users will learn whether action was taken, what type of action (e.g., license revocation) and the date and reason for the action.

Virginia's Board of Medicine Practitioner Information Web site [www.vahealthproviders.com] is an example of the controversy surrounding public access to physician information. In 1998, the state legislature approved the re-design of the Web site as a comprehensive source of information on physicians, osteopaths, and podiatrists. The site debuted in July 2001. The breadth of information that is supposed to be provided is indeed impressive: office and hospital affiliations, education, board certification, practice areas, honors academic appointments, publications, proceedings and actions and paid malpractice claims. Most of this information is available on-line. However, emergency legislation was passed in July to bar the posting of certain disciplinary information on the Web site, although the information is available to those who write, call or e-mail the board. Under the new law, only final disciplinary orders will be on the Web site. Pending cases and those that do not result in disciplinary action will not be posted, at least not as of this writing. Nevertheless, it is clear that people want physician information: A *Washington Post* article reveals that more than 16,000 hits were recorded within the first 36 hours that the Web site was on-line.⁴

The Internet has become an important source of information in medicine and the health sciences. Medical information professionals are at the forefront of the effort to organize this vast, ever-increasing store of knowledge. The sites mentioned in this article reflect this effort and are merely a sampling of the marvelous tools available to the medical researcher. Take some time to explore medical information on the Web; no doubt you'll discover many more. ☺

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Endnotes

- 1 A longer version of this article appears on the Law Library Resource Exchange Web site at www.llrx.com.
- 2 For discussion and review of medical information on the Internet, see articles in *USA Today*, July 14, 1999. Also in *USA Today* of July 19, 2000, see "Some Useful Web Resources."
- 3 I am going to discuss selected Web sites. For an excellent, comprehensive introduction to medical research on the World Wide Web, see "How to Search for Medical Information," by Frank Kellerman, Mary Zammareli, and Robert Balliot at <http://204.17.98.73/midlib/www.htm>.
- 4 See "New Tech, Old Politics: Virginia Doctors Block Web Access to Data Available by Phone, Mail," by Sandra G. Boodman, in *Washington Post*, July 31, 2001, p. F1 for an analysis of the politics behind the ban.