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Neurologists and the Internet

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The development of the electronic Internet catalyzed a communications revolution that may compare with the invention of the printing press. The Internet has greatly expanded our ability to communicate with one another. Currently, about 1 in 5 Americans have used the Internet.[1] Web addresses are becoming ubiquitous, even on television advertisements and highway billboards. We access the Internet for news, weather, factual information, financial investment, and interpersonal communication.

In this article, we discuss the use of widely available Internet resources and applications for a neurologist's professional activities, including clinical care, practice matters, research, and teaching, from the office or home. Many of these resources are also available to neurological patients and their families. Patients and "third parties" increasingly locate physicians of various subspecialties through the Internet rather than the Yellow Pages. Furthermore, there is a demand for the temporal immediacy of electronic communication. As such, patients are asking their neurologists for their Web site or e-mail address almost as frequently as they ask for their business telephone number.

Internet technology allows the performance of old tasks in new ways and new tasks that were previously impossible. Two such categories most useful for neurologists are electronic communication and knowledge bases, which easily fill needs that remain difficult with nonelectronic media.

Electronic mail has revolutionized professional communication. It is nearly free—compared with long-distance telephone costs—available 24 hours per day, and extemporaneous, yet nonetheless allows "conversations" that do not require the 2 parties to be available simultaneously. Professional directories and stationery now commonly include e-mail addresses and Web sites. An e-mailing list of neurologists[2] brings them together from all over the world. Because of the extreme ease in mass mailings, e-mail has become essential to maintaining continuity within professional organizations; board and committee business can proceed, even between national meetings, via e-mail and mailing lists, and members can be alerted about important practice issues via e-mail newsletters.

E-mail is increasingly entering clinical care. Patients can contact physicians, their staff, or even prospective physicians through e-mail. This may increase the involvement of patients in supervising and documenting their own health care, and contribute to improved health, but may also assist in hypochondriacal pursuits. E-mail between physicians and patients poses several challenges, and may have new implications for that relationship; guidelines for the clinical use of such e-mail have been promulgated by the American Medical Informatics Association.[3] The intent of these guidelines is to

> provide guidance concerning computer-based communications between clinicians and patients within a contractual relationship in which the health-care provider has taken on an explicit measure of responsibility for the client's care.

The guidelines also address effective clinician-patient communication and medicolegal matters.

Web forums and chat rooms are Internet versions of more traditional electronic bulletin boards, many of which allow unrestricted, worldwide anony-

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Web Sites of Interest to Neurologists*

Organization	Internet Address
General	
American Academy of Neurology	<http://www.aan.com/>
American Board of Psychiatry and Neurology	<http://www.abpn.com/>
American Neurological Association	<http://www.aneuroa.org/>
American Society of Neuroradiology	<http://www.asnr.org/>
American Speech-Language-Hearing Association	<http://www.asha.org/>
American University Professors of Neurology	<http://www.aupn.org/>
MEDLINE (National Library of Medicine)	<http://www.nlm.nih.gov/>
National Institute on Aging	<http://www.nih.gov/nia/>
National Institute for Neurological Disorders and Stroke (NINDS)	<http://www.ninds.nih.gov/>
Neurosciences on the Internet (compendium)	<http://www.neuroguide.com/>
Society for Neuroscience	<http://www.sfn.org/>
Whole Brain Atlas	<http://www.med.harvard.edu/AANLIB/home.html>
Child neurology and neurogenetics	
Child Neurology Society	<http://www1.umn.edu/cns/>
Child Neurology Web Site	<http://www.waisman.wisc.edu/child-neuro/>
March of Dimes	<http://www.modimes.org/>
Online Mendelian Inheritance in Man	<http://www3.ncbi.nlm.nih.gov/Omim/>
Dementia	
Alzheimer's Association	<http://www.alz.org/>
Alzheimer's Disease Education and Referral Center	<http://www.alzheimers.org/>
Alzheimer Research Forum	<http://www.alzforum.org/>
Alzheimer Web (Melbourne, Australia)	<http://dsmallpc2.path.unimelb.edu.au/ad2.html>
Brain Aging and Dementia (University of California, Irvine)	<http://www.alz.uci.edu/>
Epilepsy and sleep	
American Epilepsy Society	<http://www.aesnet.org/>
Epilepsy Foundation of America	<http://www.efa.org/>
International League Against Epilepsy	<http://www.websciences.org/engel/>
National Sleep Foundation	<http://www.sleepfoundation.org/>
Headache and pain	
American Council for Headache Education	<http://www.achenet.org/>
American Pain Society	<http://www.ampainsoc.org/>
National Headache Foundation	<http://www.headaches.org/>
Movement disorders	
Dystonia Medical Research Foundation	<http://www.dystonia-foundation.org/dmrf.html>
LewyNet (Nottingham Medical School, Nottingham, England)	<http://www.ccc.nottingham.ac.uk/~mpzjlowe/lewy/lewyhome.html>
Huntington's Disease Society of America	<http://www.hsda.org/>
Movement Disorder Society	<http://www.movementdisorders.org/>
National Parkinson Foundation	<http://www.parkinson.org/>
Neuromuscular and multiple sclerosis	
ALS Association†	<http://www.alsa.org/>
American Association of Electrodiagnostic Medicine	<http://www.aaem.net/>
Muscular Dystrophy Association (USA)	<http://www.mdausa.org/>
National Multiple Sclerosis Society (USA)	<http://www.nmss.org/>
Neuromuscular Disease (Washington University, St Louis, Mo)	<http://www.neuro.wustl.edu/neuromuscular/>
Neuro-opthalmology	
American Academy of Ophthalmology	<http://www.eyenet.org/>
North American Neuro-Ophthalmology Society	<http://www.nanosWeb.org/>
Strokes and tumors	
American Brain Tumor Association	<http://www.abta.org/>
National Brain Tumor Foundation	<http://www.braintumor.org/>
National Stroke Association	<http://www.stroke.org/>
Stroke Information (NINDS)	<http://www.ninds.nih.gov/patients/Disorders/STROKE/strokehp.htm/>

**All Web addresses accessed September 20, 1999.*
†*ALS indicates amyotrophic lateral sclerosis.*

mous access by all users. Some sites, such as the American Medical Association[4] and American Academy of Neurology,[5] contain additional areas restricted to members or professionals. Other sites provide real-time, synchronous, text-based electronic communication. Particularly well developed are the Massachusetts General Hospital neurology chat rooms,[6] which are mainly populated by patients, but are also visited on a scheduled basis by physicians. Real-time multimedia electronic communication is increasingly used in neurology. This includes teleconferencing and more technologically advanced forms of telemedicine,[7] which encompasses many techniques of electronic communication between provider and patient or provider and data over a distance. It can be relatively prosaic, such as sharing radiology images between hospitals, or it can involve multimodality remote-

control examination of a patient in a rural area by a physician who is in a university medical center hundreds of miles away.[8]

KNOWLEDGE BASES

The World Wide Web makes knowledge bases freely available and accessible to people worldwide, whether to access a specific resource ("searching via the Web") or to broadly search ("searching the Web") using a variety of search engines, such as AltaVista, Excite, Google, HotBot, Infoseek, Lycos, Netscape, Webcrawler, Yahoo!, and others. Searching involves using a Web-based form to submit a query to a database, most of which might also be accessible via telnet, gopher, or other older, less graphical, and less powerful methods. Clinical searches are commonly accomplished using the freely available National Library of Medicine databases such as MEDLINE and AIDSLINE, which store bibliographic information, including abstracts (in recent years), of articles published in indexed medical journals since 1966; the Web can also access the entire worldwide "electronically published" realm. Search engines, which allow Boolean searches, provide comprehensive lists of all electronic sites containing those keywords and can yield otherwise difficult-to-find information. However, they can also result in a profusion of Web pages with marginal relevance or of extremely low quality; patients and physicians must not assume that information published electronically is as valid as information in textbooks or peer-reviewed journals.

NEUROLOGICAL RESOURCES

Many individuals have extensive "bookmarks" of specific, frequently visited Web sites of interest. The **Table** lists Web resources that neurologists might find useful, including professional organizations and patient information or support organizations. An enormous range of other useful resources is available, such as sites created by neurology or neuroscience departments of universities and medical centers. These can be found by individual searches or by following links contained in some sites (Table). One comprehensive browsable and searchable database of basic and clinical neuroscience resources is Neurosciences on the Internet.[9]

The wide availability of Internet access allows neurologists to network with their peers, and to access resources in ways that, even a few years ago, were unforeseen. The Internet can enhance and facilitate clinical care, research, teaching, and practice issues. While currently available Internet resources already provide valuable tools for practicing neurologists, it is likely that future technological developments will create further advances. For example, making neurological and medical data on the Internet machine-readable and machine-understandable should lead to a new generation of neurological and medical Internet resources and applications of even greater utility.

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3. American Medical Informatics Association. Available at: http://www.amia.org/. Accessed September 20, 1999.
4. American Medical Association. Available at: http://www.ama-assn.org/. Accessed September 20, 1999.
5. American Academy of Neurology. Available at: http://www.aan.com/. Accessed September 20, 1999.
6. Massachusetts General Hospital Neurology Chat Rooms. Available at: http://neuro-www3.mgh.harvard.edu/interaction$/chat/index. Accessed September 20, 1999.
7. National Library of Medicine's NGI & Telemedicine Projects. Available at: http://www.nlm.nih.gov/research/telfront.html. Accessed September 20, 1999.
8. Telemedicine Information Exchange. Available at: http://www.telemed.org/. Accessed September 20, 1999.
9. Neurosciences on the Internet. Available at: http://www.neuroguide.com/. Accessed September 20, 1999.