SYMPOSUM: A CLINICIAN'S GUIDE TO THE INTERNET

Development of an Academic Internet Resource

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(Received March 26, 1996; returned for revision May 31, 1996; accepted August 1, 1996)

Networked electronic publication is a relatively new development that has already begun to change the way in which medical information is exchanged. Electronic publications can present ideas that would be impossible in printed text, using multimedia components such as sound and movies. Physicians who use the World Wide Web (WWW) on a regular basis may recognize the value of electronic publication and decide to become information providers. Nearly anyone with a computer and modem can create a WWW resource on a Web server at a hospital or on a commercial hosting service.

Medical publication on the Internet demands a high level of quality control because the information will be available to anyone who cares to look. Creating a peer-review system for electronic information may, therefore, help to enhance academic recognition of Internet medical resources. Resources containing medical information must be continually available and protected from system failures and unauthorized access. As Internet technology matures and these problems are solved, electronic publication may become the predominant method of communication between medical professionals.

INTRODUCTION

Networked electronic publication is a relatively new development that has already begun to change the way in which medical information is exchanged. Electronic publications can present ideas in ways that would be impossible in printed text, using multimedia components such as sound and movies. In addition, computer-based educational materials are easy to search, and context-sensitive help functions can help to find information that may be located in one of thousands of documents. Publication on the Internet offers the added advantages that information can be distributed worldwide and can be easily and rapidly updated to reflect the state of the art. Physicians and institutions who use the World-Wide Web (WWW) d on a regular basis will become aware of the potential of publishing on the WWW, and may decide to become information providers as well as consumers.

Information that the typical physician or academic department may provide on the WWW can be broken down into two broad categories: An institutional page that offers information predominantly about its department or institution (e.g., telephone numbers, services provided, and other information), or information directed at medical professionals,

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 d Abbreviations: WWW, world-wide web; ISP, internet service provider; kbps, kilobits per second; HTML, hypertext markup language.
such as clinical information or research data. Both types of information are important, and can be used to provide a public service. This article briefly describes what is needed to become an Internet resource, and offers recommendations about what type of information to provide.

GASNet (http://gasnet.med.yale.edu) is an educational resource for anesthesiologists that uses the Internet to provide easy access to continuously updated educational material. Nearly all GASNet resources are distributed on the WWW. Material currently includes original material such as Educational Synopses in Anesthesiology and Critical Care, the first on-line journal of anesthesiology. Abstracts of printed articles appearing in Journal of Clinical Monitoring, Journal of Neurosurgical Anesthesia, American Journal of Anesthesiology, and Survey of Anesthesiology are also distributed. Other GASNet resources include the Global Textbook of Anesthesiology, an on-line, hypermedia textbook of anesthesia, and an electronic foreign-language phrasebook for medical practitioners.

CREATING A SERVER

After deciding what information should be provided, one must decide whether to maintain one's own WWW server or distribute the information through an Internet service provider (ISP). Most ISPs provide space on their server, the cost for which is included in monthly maintenance fees or for a small additional charge. For an additional fee, some of these companies will even design a WWW page. The chief advantage of this approach is its simplicity: One does not have to set up and maintain a server. The ISP is responsible for maintaining the hardware and software, and will frequently provide statistical information about the WWW page. The provider also takes care of such housekeeping chores as backups. Most ISPs have a reliable, high-bandwidth, network connection, although this does not guarantee rapid access to the page. The major disadvantage of this approach is that it can be expensive (some sites meter usage). In addition, there may be little flexibility in what can be offered. It can sometimes be difficult to add new documents or to include a script to process a form, for example.

Maintaining a WWW server need not be difficult and doing so provides the maximum amount of flexibility. Information can be added or changed whenever necessary. Software and hardware can be updated as traffic demands, and new features can be added as needed. Until recently, maintaining a WWW site required an intimate knowledge of the UNIX operating system and internetworking and a dedicated server. Server software is now available for a wide variety of desktop computer platforms, including the Apple Macintosh; Microsoft Windows 3.1, Windows 95 and Windows NT; and IBM OS/2. A product that operates on a Novell file server has also recently become available. This approach has disadvantages, however: It is necessary to install and configure the server software. Most importantly, a fast, reliable connection is essential. While a dialup connection at 28.8 kbps is sufficient for individual Internet access, resource providers must handle much higher traffic loads (the GASNet server handles approximately 3,000 connections daily) and must be ready to accept requests 24 hours per day. Such access can be expensive if it is not provided on an institutional level: one ISP quoted a monthly rate of $495.00 for a 56 kbps connection.

Server software is available as freeware, shareware, and commercial products priced at under $300. WWW servers for the Macintosh and Microsoft Windows are relatively easy to install and configure, frequently make use of forms and dialog boxes, and use a familiar operating system. Most commercial products come with online help, and many users and Management Information Systems (MIS) personnel are familiar with configuring network stacks for Windows or the Macintosh. The networking software has frequently already been installed, which simplifies troubleshooting.
There are two major disadvantages of setting up a WWW server on a desktop computer: lack of stability and lack of flexibility. Desktop Macintoshes or PCs running under the MS-DOS or Windows operating systems frequently need to be rebooted during operation. While this may be acceptable for an individual user, WWW servers can be subjected to heavy, continuous use, and will be unreachable if they hang up at night or on a weekend. Microsoft Windows NT is designed as a multitasking operating system, and is somewhat more reliable. In addition, some primitive WWW servers designed for Windows lack the ability to process forms or execute scripts. The NCSA httpd that was written for UNIX has been modified to run under the IBM OS/2 operating system, and is capable of processing forms and scripts using the Rexx language. Microsoft includes a WWW server with Windows NT. It processes scripts and forms with Microsoft Visual Basic.

Despite the plethora of products available for desktop computers, many Web servers still use a UNIX workstation, which need not be expensive: The GASNet server, for instance, runs on a Sun SPARCStation 5 which cost under $6,000. While setting up a UNIX server probably requires the greatest initial effort, there will be far fewer problems in the long run. Although many individuals fear working with UNIX, the operating system is relatively straightforward, and is not much more difficult to learn than MS-DOS. Many books are available on setting up and maintaining a UNIX server. It is also the most robust solution: The GASNet server runs for months at a time with very little maintenance other than regular backups. UNIX servers also provide somewhat greater security against break-in attempts.

Two additional problems facing electronic publication are those of security and reliability. If a resource is to be used by practicing physicians, it must be secure from break-ins, and it must be continuously accessible. Although no computer on the Internet is completely safe, taking well-documented security precautions can significantly reduce the possibility of tampering. Comprehensive backups are essential for recovery after a break-in or hardware malfunction. "Mirroring" a server (regular duplication of its contents on another server, preferably at a remote location) helps to ensure relatively consistent accessibility in the event of a local network outage or computer malfunction.

CREATING CONTENT

At the present time, some of the most challenging questions are those of quality assurance, computer security issues, and academic recognition of electronic publications. Further, many physicians regard information obtained on the Internet with distrust, and are reluctant to publish electronically. A recent editorial in the New England Journal of Medicine stated these reasons as that journal's rationale for not producing a version of the journal for the Internet, although it is now available on the World-Wide Web, where individual articles can be downloaded for a fee.

As physicians begin to use the Internet, they should remember that there is no such thing as an obscure journal; each Internet resource has an equal voice. Patients and other nonphysicians may also distribute information that is not subject to the rigors of peer review. Patients are beginning to shop for information on the Internet prior to consulting a physician, and may demand a specific treatment. While a physician may be able to sort through some of these data, patients may not be able to. This places a special responsibility on the medical professional planning a WWW site: although the information may be addressed to professional colleagues, online publishers must remember that, unless they make their site password-protected, all of their information is available to the general public.

GASNet's editorial board was relatively easy to assemble. As the electronic journal was being formed, a letter was distributed to the Anesthesiology Discussion Group. This
resulted in a large number of volunteers, who were selected based upon their curricula vitae and their contributions to the discussion group. All of these initial editors are still part of the GASNet staff. In addition, a number of highly qualified individuals have volunteered, and there are now individual editors for several different sections, and editors specializing in alternate formats. Communicating with the editorial board has been relatively easy. Articles are usually distributed by electronic mail. If a picture or sound has been included, a pointer to it is made available in a public area of the site. The editorial board has turned the review process into a collaborative venture; the author usually receives a number of helpful suggestions. All material, with the exception of posts to the Anesthesiology Discussion Group, undergo peer review by an editorial board. The board can reject the submission, recommend changes, or accept it without changes.

Another significant issue is the amount of time available to maintain the server. In order to provide high-quality information on a continuous basis, it is necessary to develop some form of support for the resource. Money is required to purchase equipment (servers, scanners, and other items) and to hire editorial and support staff. Possible solutions include providing value-added services (i.e., better searching) for a charge, selling continuing medical education credit, and soliciting advertising. Maintaining a comprehensive information resource such as GASNet currently requires approximately 40 h per week. If a site is to be used on a regular basis, its information must be constantly updated. This involves reviewing all material for accuracy and timeliness, and making sure that links work. In addition, one must decide where the material will come from. The majority of articles on the GASNet server are contributed by members of other institutions. These documents have been either written expressly for GASNet or are adapted from handouts or other printed material. Each method has advantages and disadvantages: many physicians have a supply of topical reviews, such as lecture and course outlines, rotation manuals, etc., that can easily be converted to documents for publication on the Internet. The major problem with this is that they were originally written to be printed. Thus, the information is organized differently, and was designed around having little or no graphic material — a few pictures at most.

Yet another obstacle to publication on the Internet is that relatively few academic institutions regard electronic publications as equivalent to paper publications.

Academicians are therefore reluctant to publish original research or review articles that may be published in printed media. In addition, many printed journals consider electronic distribution to be equivalent to prior publication when determining whether an article will be accepted for publication. These two factors discourage academicians, who might otherwise consider contributing to online publications. This problem will be resolved as electronic publication is better understood and becomes more widespread.

Images and sound should be used sparingly; and only to make a specific point. The best pages use graphics and sounds to highlight important points or present an idea that would not be presentable otherwise. Many users have dialup Internet connections, and do not wish to wait while a large sound file or video file downloads. If video or large image files are included, a "thumbnail" should be added to the page, and the size of the actual file provided. Once the equipment is in place, creation of new documents is relatively simple and inexpensive. The actual location of the document is relatively unimportant to the end user, who simply clicks on the hyperlink.

Writing documents explicitly for the WWW offers the advantage that it can be optimized for electronic publication — hypertext references, planned inclusion of pictures and sounds, etc. The major disadvantages is that writing documents de novo is work-intensive. They are submitted for publication on a floppy disk or placed on a server at the author's institution, if one is available.
Documents being prepared for the WWW are formatted (tagged) with the Hypertext Markup Language (HTML), a set of commands understood by all WWW browsers. Graphics and sounds are incorporated into the document by adding links to the appropriate files. HTML is relatively easy to learn; it consists of commands enclosed in angle brackets. Generally, <command> starts a specific format, and </command> turns it off, for example:

| Command      | Meaning          |
|--------------|------------------|
| <i> ... </i> | Italics          |
| <p>          | New Paragraph    |
| <b> ... </b> | Bold Text        |
| <hr>         | Horizontal Rule (line) |
| <center> ... </center> | Center text |

Documents can be marked manually, or using an HTML editor. Extensions are available for Microsoft Word and WordPerfect that allow them to produce HTML files. Several high-quality HTML editors are available either commercially or as shareware or freeware.

Images can be captured using an Apple QuickTake 150 digital camera and uploaded to the computer. Kodak and Cannon also manufacture electronic cameras which sell for under five hundred dollars. Photographs taken with these cameras can be uploaded directly to the computer. Other options include scanning images, or taking pictures with a conventional camera and asking the film processor to store the images on a Kodak PhotoCD, which typically costs $0.75 to $1.50 per image. Another possibility is a Snappy interface, a device that plugs into the parallel port of an IBM PC compatible computer, and allows single frames to be "grabbed" from a video input.

Video images can be captured using a Sony 8 mm video camcorder and a video digitizing card in an IBM PC compatible or Macintosh computer. These cards vary widely in price, depending upon specific features and image quality, and range in price between $299 and thousands of dollars. An inexpensive black-and-white video camera that plugs into the printer port of an IBM PC compatible computer can now be purchased for under $100. Most audio cards for IBM PC compatibles (and nearly all Macintosh computers) have a microphone input for capturing and recording sound.

**CONCLUSIONS**

Electronic publication has begun to change the ways in which medical information is distributed. Decreasing cost of Internet access, computer equipment, and sound- and video-editing software and hardware are making it easier to become an information resource. While it is relatively simple to set up a computer and configure software for an Internet resource, publication of medical information is made more difficult by the need for high-quality information, the fact that the information will be available to anyone who cares to look, and the global nature of the Internet. Creating a peer-review system for electronic information may help to advance Internet medical resources.

*Acknowledgments:* The authors thank Sorin Brull, M.D. for his comments and direction, and Darryl Kuperstock for her expert editorial assistance. GASNet is funded in part by a grant from the Anesthesia Patient Safety Foundation and by a gift of equipment by The Hewlett-Packard Company.
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