



## Moving Ahead on Webbed Feet

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# Editorial Comments

# JAMIA

## Moving Ahead on Webbed Feet

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The World Wide Web (WWW) has been called the first "killer app" of the global Internet. Built on the principles of hypertext documents whose links can potentially reference information sources anywhere on the planet, the client-server architecture of the Web provides technical solutions to several problems of information systems design and deployment that have previously been nearly intractable: the apparent linkage of geographically dispersed hosts; the creation of a common, universally recognized graphic user interface that hides the arcane computerese of the Internet behind on-screen "clickable" labels; the simple, run-time creation of session-specific on-screen data-entry forms that include graphic "widgets" such as pick lists, radio buttons, and check boxes; and the ability to communicate elegant electronic multimedia pages that may contain mixtures of text, color graphics, sound, and motion pictures. With the development of encryption methods between WWW servers and clients, there is a reasonable prospect of using the Internet as a "virtual private network," enabling the routing of secure computer-to-computer communications, while providing simultaneous access to the exponentially growing array of public information resources.

The paper by Cimino et al.<sup>1</sup> in this issue describes a landmark accomplishment in the field of medical informatics: the use of the WWW technology to provide access to patient-specific clinical data. Cimino et al., by creating a secure Web server that functions as an interface to a legacy mainframe hospital information system and other information resources, demonstrate the feasibility of retrofitting a simple, forms-based searching method combined with instant universal accessibility by clients located anywhere on the Internet. Indeed, one of the most compelling and provocative aspects of the prototype is not so much its clinical information content as its ability to be in-

stantly accessed, exercised, and understood by systems developers around the world. When in the history of medical informatics has one been able to read in a journal a description of a new clinical information system, and then to turn to one's local desktop workstation and immediately access and explore the functionality of that system, despite its being located perhaps thousands of miles away? The catalytic effect of such instantly demonstrable functionality transmitted by high-speed wide area networks will do much to speed the communication and adoption of new ideas in our discipline.

In its current form, the WWW client-server method has significant limitations, some of which are discussed by Cimino et al. A common problem is that of maintaining state information about a user's progress through an application, because the WWW communication method is "stateless" and "connectionless." The undesirable trait of the hypertext history function in allowing a user to "jump over" security login procedures (in itself a predictable complication of a stateless interaction) is described, and points to the larger issue of the current lack of widely accepted methods for secure communications on the Internet. Commonly available WWW client software caches retrieved pages of information, and preferentially retrieves the cached copy of a page rather than retrieving it again from the network source; this adaptation for communication efficiency may cause the redisplay of outdated and inaccurate information when elements of a display contain clinical data that vary over short time periods (such as EKG data or vital signs).

These limitations of the WWW technology are amenable to extensions of the Hypertext Markup Language (HTML) and Hypertext Transport Protocol, which underpin the client-server interaction, and the operators and functions of the HTML and similar

interpreted control languages may be expected to evolve rapidly in coming years. The prospect of apparently seamless integration of information from multiple hosts, local and distant, and the attractiveness of a platform-independent graphic user interface portend that as health care proceeds along the Information Superhighway, some of its most creative future steps will be taken on Webbed feet.

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#### Reference ■

1. Cimino JJ, Socratous SA, Clayton PD. Internet as clinical information system: application development using the world Wide Web. JAMIA. 1995;2:273-84.

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## Leveraging a Fellowship in Medical Informatics: Focus on Software

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How can physicians derive the most benefit from a limited amount of training in medical informatics? In other words, how can physicians use their years of medical training to best advantage when bringing computers into their professional lives? I believe the answer lies in designing and implementing useful software, as I'll explain. In part, but only part, this is just a restatement of the conventional wisdom that software is a bigger barrier to successful applications than is hardware.

Training in medical informatics is undertaken for many reasons. Often, a person is combining high school interests in programming with a newfound appreciation of the central role of information in medicine. Learning more about computers as information processors thus facilitates invention of procedures and devices that deliver medically relevant information to those who need it.

All aspects of computing may enhance information delivery and management. Computer hardware and telecommunication devices, for example, are essential, as are operating systems, programming languages, and mathematical algorithms. Occasionally, a physician already has advanced training in computer science, electrical engineering, physics, or mathematics. Training in medical informatics for these dual-specialty individuals allows them to explore areas

of computing that are ordinarily accessible only with years of nonmedical training, for example, designing integrated circuits for fast, informative interpretation of medical images. So there is more to medical informatics than applications programs. Moreover, anyone who has advanced mathematical, engineering, or scientific training can make substantial contributions to medical informatics and to medicine using this training.

Software is one aspect of computing, however, that can be mastered by clear thinkers with relatively small investments of time. The principles of software design include knowing how to select data structures, analyze worst cases, determine time complexity, manage uncertainty, design "friendly" interfaces, validate complex programs, and avoid well-known blunders. Advanced computer science courses teach these analytic skills with fewer prerequisites than do courses addressing circuit design or other skills, and with less dependence on volumes of background material.

Inventing good applications is not trivial, and I do not want to give the impression that it is. It is much more than programming: the principles of software design provide a sound foundation for programs that are efficient, usable, maintainable, and extensible. High school experience writing BASIC programs may