Special Topic

# Web-Based Medicine as a Means to Establish Centers of Surgical Excellence in the Developing World

**Ross I. S. Zbar, M.D., Leo R. Otake, Ph.D., Michael J. Miller, M.D., John A. Persing, M.D., and David L. Dingman, M.D.**

*Mountain View, Calif.; New Haven, Conn.; and Houston, Texas*

The growth of the Internet has provided a unique opportunity for rapid, global communication. Web-based medicine uses this technology to help surgeons in developing regions of the world gain direct access to recognized experts. This serves to empower local surgeons in the developing world through direct skill-transfer and encouraging academic pursuit. Web-based medicine follows the paradigm of a university without borders, therefore requiring exacting patient record keeping, monthly peer review, and continuing medical education of all its participants. All those who participate in Web-based medicine have undergone a credentialing process to guarantee that they possess adequate credentials. Patient confidentiality is strictly maintained. Web-based medicine also provides a follow-up strategy for medical volunteer groups who provide overseas services. Interplast, Inc., has administered a Web-based medicine site at http://www.wiredmd.com since July of 1999. A total of 767 cleft malformation cases performed locally by participating host surgeons in the developing world have been reviewed through the site. Additionally, 16 consultations have been posted and discussed by participating surgeons worldwide. Financing remains the major impediment to the globalization of this technology. (*Plast. Reconstr. Surg.* 108: 460, 2001.)

As applications of the Internet proliferate at unprecedented speed, plastic surgeons in more developed countries have a unique opportunity to teach those in less developed regions throughout the world. Web-based medicine far exceeds prior applications of technology, as it now functions under the paradigm of a university without borders. Unlike prior attempts at initiating international cooperation between university centers, Web-based medicine (as organized by Interplast, Inc.) guarantees that a high standard of care, a true continuing medical education curriculum, and an outstanding quality assurance system are maintained. Web-based medicine also promotes the empowerment of the participating surgeon in the developing world.

## Web-Based Medicine

Web-based medicine differs from teleconferencing in several major ways. Teleconferencing is live, interactive verbal communication in real time, with or without video relay. Teleconferencing may occur over telephone lines, satellite relays, or the Internet. This type of communication becomes quite difficult to manage in sites located throughout the world that may be separated by times zones as much as 12 hours apart. In addition, teleconferencing requires immediate language translation or an understanding of varied accents. Finally, teleconferencing is expensive if using telephone or satellite connections to communicate across the globe in real time. Using the Internet for live verbal or image communication between multiple sites in developing countries is unreliable and involves a significant time delay.[1] The terms telemedicine and teleconsultation have been used synonymously by some physicians to refer to medically oriented teleconferencing.

Web-based medicine with global participants cannot be based in real time because the reality of time zones precludes meaningful interactive conferencing. Therefore, Web-based medicine requires written communication among partic-

From Interplast, Inc, 300-B Pioneer Way, Mountain View, California 94041, www.Interplast.org; the Division of Plastic Surgery, Yale University School of Medicine; and the Department of Plastic Surgery, University of Texas M. D. Anderson Cancer Center. Received for publication August 18, 2000.

ipants. By avoiding live speech, language accents and miscommunication are minimized. English is used as the primary communicating language, but because Web-based medicine is written, there is ample time for translation by those who require it. In addition, there is software available to aid those needing translation.

Web-based medicine has many purposes. It primarily educates physicians in developing regions of the world by providing them with direct and timely access to their colleagues in more developed countries. An offshoot of Web-based medicine is that it brings together a community of surgeons in developing nations who face similar hardships and difficulties, thereby providing a support network. The overall effect is to enable surgeons in developing countries to pursue academic endeavors with the ultimate goal of local empowerment through the creation of a university without borders.

## MATERIALS AND METHODS

Run like a surgical department in any U.S.-based hospital, Web-based medicine has several requirements for its participants, including exacting patient record-keeping in the selected field of interest; monthly peer review of surgical case load; and participation in continuing medical education. Web-based medicine as administered by Interplast, Inc., is located at http://www.wiredmd.com (Fig. 1).

### *Record Keeping*

Each local participating surgeon is required to log all of his or her surgical cases performed in the particular field of interest. These patient records have been standardized for all participating sites.[2] Although the patient record is quite long, it is set up in a regression formula so that no matter what the diagnosis is, an accurate description of the case is obtained. The regression format lists several questions in a yes/no format. There are no open-ended questions. By providing only objective questions, a proper diagnosis can be made, despite global differences in syndrome names or cultural beliefs regarding cause. For example, if a patient has a cleft lip, one physician may call it an incomplete cleft lip, whereas another may call it a complete cleft lip with a Simonart's band. These subtle differences matter in data collection. Therefore, asking objective, closed-end questions with only yes or no answers eliminates any subjective data entry by the hosts. It also decreases the chance for human error. On occasion, the side of the cleft may be missing from the patient record: by following a standard set of questions for each patient, the regression-formula patient record will prevent this type of error. In addition, standard preoperative and postoperative photographs are required in multiple views.[3] Web-based medicine allows for rapid transmission of these patient records with digital pictures as well. The partici-

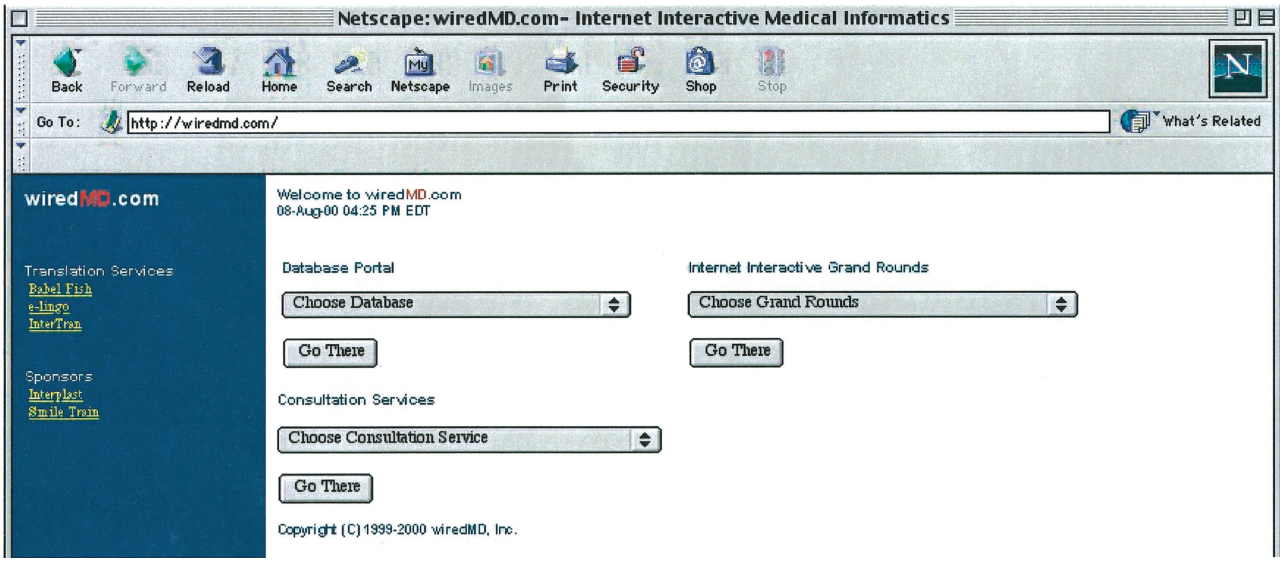


FIG. 1. An image of the Web-based medicine homepage (http://www.wiredmd.com) from the Internet. From this Web page, portals to the various services are available by means of drop-down menus. Requiring user names and passwords protects confidentiality.

pating local surgeon stores hard copies of all records.

*Peer Review*

All cases logged by the local hosts are reviewed by plastic surgeons in developed countries with recognized experience in the selected field. Preoperative and immediate postoperative photographs are indeed required of the local participating surgeons. Long-term, follow-up photographs are encouraged, but the program recognizes that this may be quite difficult for colleagues in underdeveloped regions. Often, patients are migratory or simply live in very remote sites.

Web-based medicine facilitates peer review by allowing the case history and operative photographs to be posted on the Web site for review by selected physicians. Constructive comments are elicited and e-mailed back and forth. Any major morbidities and mortalities are reviewed on a monthly basis by e-mail. This information is also recorded on the patient records. Any sentinel event is reviewed carefully by an appointed quality-assurance committee of surgeons and anesthesiologists based in the developed world who have a great familiarity with the issues confronting a surgeon in a less-developed country.

*Continuing Medical Education*

Web-based medicine allows for virtual conferencing across significant time zones. By posting digital pictures of selected cases, preoperative planning can be discussed through messaging. Participants are automatically notified when a new message appears regarding a specific case of interest. This functions as an indication conference.

Also, complete case presentations can be posted through the use of digital images. Specific comments or questions can then be added by all the participants, thereby creating a dialogue. In essence, this becomes an electronic version of grand rounds. Because the dialogue is not in real time, participants are able to contribute actively from all over the globe, despite their other commitments or time zone differences. Like a journal club, Web-based medicine sites can post manuscripts of interest for review by participants (Fig. 2).

*Issues of Confidentiality*

As in the United States, the confidentiality of the patient is strictly maintained. The host surgeons do indeed collect consent from the participating patients to take photographs. For those patients who are illiterate, the consent is read in the native language. In Nepal, for example, those patients who do not write affix a thumbprint to the consent after it is read to them. If the patient is a minor, parental or guardian involvement is required.

The Internet itself raises issues concerning confidentiality. Because Web-based medicine is similar to any other hospital database, it must remain secure. Access to the database is granted only to those physicians who are actively participating in the program. All the physicians who participate in Web-based medicine, in both the developed and the less-developed world, undergo a process that guarantees adequate credentials. Curious nonparticipating surgeons can only view the home page, because entry beyond this point violates patient confidentiality. Individual passwords to the database are used so the author of any comment can be identified. Internal markers (known as cookies) are left as users go through the database so that activity may be tracked. The database server also has a firewall to decrease the likelihood of hackers. We recognize that hackers can certainly make their way into any database they select, but a standard firewall will prevent the merely curious from casually entering.

*Financing*

The successful maintenance of a Web-based medicine site cannot depend on volunteerism from computer-savvy surgeons because the time commitment required is too great. This endeavor is truly a university without borders and, therefore, it requires salaried staff like any other surgical department. A dedicated programmer/Webmaster and an overseeing surgeon are required. Also, dialogue between participants will occasionally require prodding, just as a department must remind its members to attend conferences. Appropriate topics that participants in developing regions of the world find useful must be selected by the overseeing surgeon. As in resident case presentations, the overseeing surgeon must sometimes resort to posting messages using Socratic methodology to engender discussion among participants.[4]

Other costs include digital cameras, laptop computers, and Internet service provider connections for all participants.

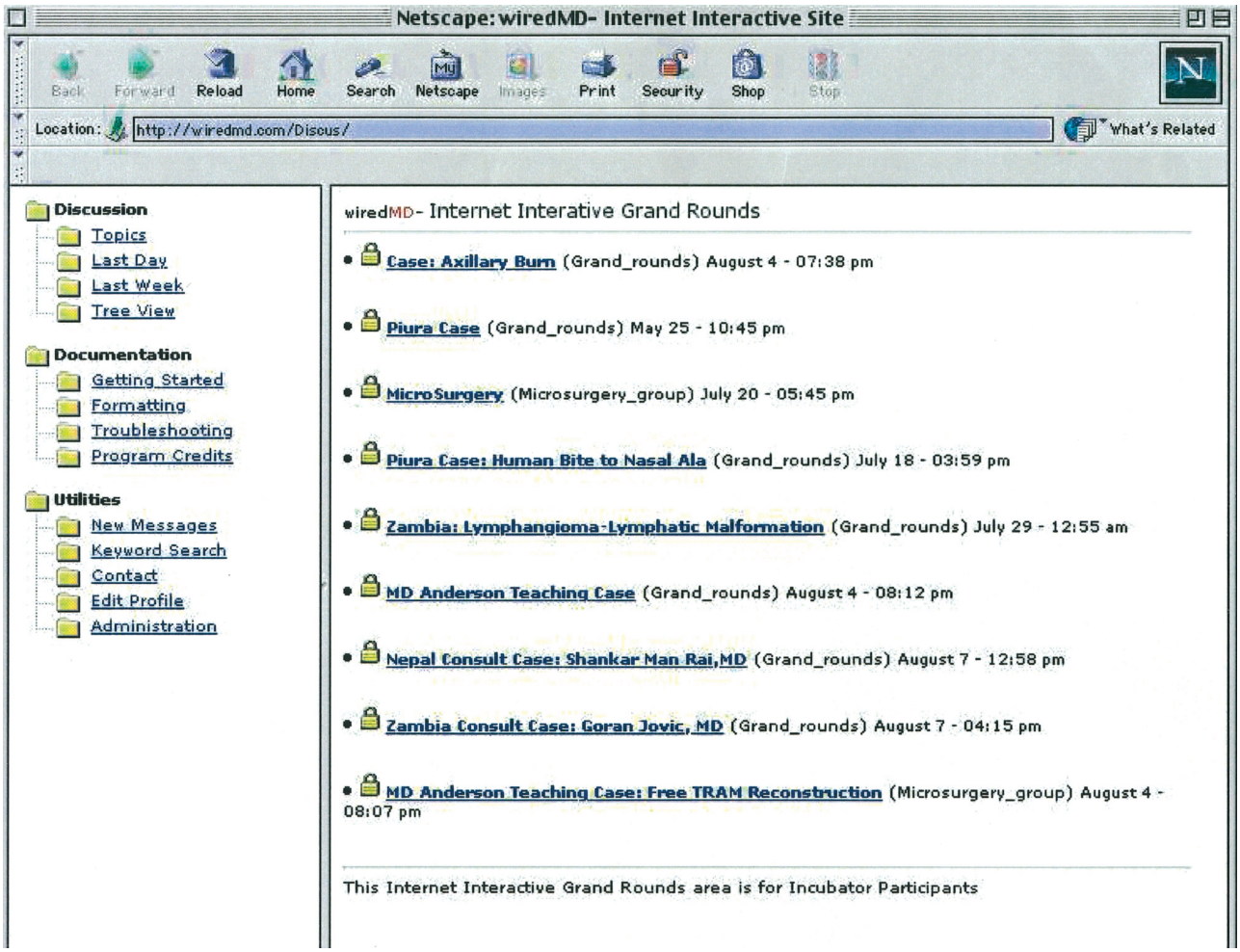


FIG. 2. An image of the discussion page. The portals offer links to various consultations, discussion groups, and continuing medical education activities. Internet traffic beyond this point is password-protected to protect patient confidentiality.

*Equipment*

Participants use a Windows (Microsoft, Inc.)-compatible personal laptop computer with a modem. The Web site (http://www.wiredmd.com) is accessed using a standard browser (Netscape Communications Corp). Photographs are captured with the Sony Mavica (FD-85) digital camera, which stores images up to 1280 × 960 pixels on a 3.5-inch diskette. This equipment has proven versatile and sturdy in the field.

The Web site stores data in a Microsoft Access database via a software interface written in Cold Fusion (Allaire, Inc, Newton, Mass.) language. Digital images are linked to the appropriate records using the database software. Continuing medical education discussions are posted using software licensed by DiscusWare, LLC (http://www.Discusware.com).

## RESULTS

Interplast, Inc., has administered a Web-based medicine site since July 1, 1999. There are currently six participating locations: Dhaka, Bangladesh (Dr. Shafquat Khundkar); Guayaquil, Ecuador (Dr. Jorge Palacios); Kathmandu, Nepal (Dr. Shankar Rai); Piura, Peru (Dr. Jorge De La Cruz); Colombo, Sri Lanka (Drs. Indranee Amerasinghe, Duleep Perera, Naomal Perera, and Nirendra Wijemane); and Lusaka, Zambia (Dr. Goran Jovic). As in any university department, participation is varied, but a minimal level of attendance and interaction is required to maintain membership.

During its first year, the Web site documented a total of 767 cleft lip and palate cases performed by participating plastic surgeons in the developing world. In addition, 16 consultations were posted. Currently, through collaboration with the M. D. Anderson Cancer Cen-

ter, an ongoing dialogue regarding free tissue transfer is underway after a clinical educational visit to the host site. This has resulted in a 25 percent improvement in free flap survival for one participating site involved with cancer care.

## Discussion

Web-based medicine far exceeds previous use of the Internet for medical communication. Although many ventures from different fields of medicine based in the developed world have used the Internet for the rapid communication and transfer of medical data,[5–11] far fewer have specifically used the Internet for interactive communication with overseas colleagues in the developing world.[12–14] Web-based medicine, as opposed to simple teleconferencing, creates a university without borders that fosters academic growth and independence because the local participating surgeons have direct access to experts in the developed world.

The factors associated with active participation by surgeons in both the developed and less developed world include the identification of a healthcare provider who is sincerely interested and academically oriented. He or she must possess a high level of surgical ability and a familiarity with the Internet. As with all teaching, enthusiasm and devotion are key ingredients.[15] The goal of a Web-based medicine site must be straightforward: to improve the surgical foundation of the local host in a developing country while actively pursuing independence.

The participating surgeons in the developing world, of course, must have access to telephone lines with connections to Internet service providers and digital cameras. Economic conditions are difficult enough in developing countries; to burden participants by requiring the purchase of this equipment would doom the project to failure. The hardware requirements for participating surgeons in the developing world have been supplied by funding from the nonprofit organizations Interplast, Inc., and The Smile Train. Unfortunately, as has also been documented in other studies, financing remains the limiting reagent in Web-based medicine.[13]

Web-based medicine also facilitates many other activities that have evolved slowly and were not part of the original paradigm. An offshoot of the Web-based medicine patient record is its applicability to the plethora of overseas volunteer organizations that originate from developed countries and travel to less developed regions of the world. Although well-intentioned, many of these overseas volunteer groups maintain different databases of varying caliber, if any. Although not yet a reality, global standardization of record keeping could provide huge amounts of useable data. In addition, these overseas groups could access unified databases regarding many of the itinerant patients and thereby provide true linear treatment.[16,17]

Web-based medicine also provides an exit strategy for many international volunteer groups. A major criticism of overseas volunteer medicine is that after the volunteer team departs, local infrastructure is not equipped to handle surgical follow-up.[16,17] Web-based medicine provides a means of consultation and follow-up in these situations.

Presumably in the future, Web-based medicine could provide hyperlinks to interactive surgical simulators, such as those developed at the National Biocomputational Center at Stanford.[18,19]

## Summary

Web-based medicine allows direct communication with host surgeons in the developing world, thereby facilitating skill transfer in a timely fashion. It also empowers surgeons in developing regions to keep medical records, participate in peer review, and pursue continuing medical education that was previously unavailable. Web-based medicine also provides an exit strategy for overseas medical volunteer organizations such that continued support is available to the local surgical hosts in the developing world even after the trip is complete. Financing, however, remains a significant hurdle for the total globalization of this technology.

*Ross I. S. Zbar, M.D.*
*200 Highland Avenue*
*Glen Ridge, N.J. 07028*
*risz@ix.netcom.com*

## Acknowledgments

Sincere gratitude must be expressed to all the patients, local participating surgeons, volunteers, and donors who have made this program possible.

## Addendum

As of May 31, 2001, there were seven participating local host sites. The newest addition is Hyderabad, India (Drs. Patricia Bidinger and Mekunda Reddy). A total of 1351 cleft

lip and palate cases have been administered through this Web site. The total number of consultations is currently 41.

## REFERENCES


1. Lemaire, E. D., Boudrias, Y., and Greene, G. Technical evaluation of a low-bandwidth: Internet-based system for teleconsultations. *J. Telemed. Telecare* 6: 163, 2000.
2. Greenwood, D. Personal communication, 2000. More information available at: http://www.smiletrain.org.
3. Plastic Surgery Educational Foundation Clinical Photography Committee. *Photographic Standards in Plastic Surgery.* Arlington Heights, Ill.: Plastic Surgery Educational Foundation, 1991.
4. Rohrich, R. J., and Johns, D. F. The Socratic method in plastic surgery education: A lost art revisited. *Plast. Reconstr. Surg.* 105: 1803, 2000.
5. Gustafson, D. H., McTavish, F., Hawkins, R., et al. Computer support for elderly women with breast cancer. *J.A.M.A.* 280: 1305, 1998.
6. Perednia, D. A., and Allen, A. Telemedicine technology and clinical applications. *J.A.M.A.* 273: 483, 1995.
7. Bergen, M. D. Create a virtual community: Start an Internet discussion list. *J. Sch. Nurs.* 15: 24, 2000.
8. Hellawell, G. O., Turner, K. J., Le Monnier, K. J., and Brewster, S. F. Urology and the Internet: An evaluation of Internet use by urology patients and of information available on urological topics. *B.J.U. Int.* 86: 191, 2000.
9. Austin, E. Interactive medicine: Resources in dermatology and dermatologic surgery. *Cutis* 65: 372, 2000.
10. Fotheringham, M. J., Owies, D., Leslie, E., and Owen, N. Interactive health communication in preventative medicine: Internet-based strategies in teaching and research. *Am. J. Prev. Med.* 19: 113, 2000.
11. Bovbjerg, V. E., Olchanski, V., Zimberg, S. E., Green, J. S., and Rossiter, L. F. Internet-based monitoring and benchmarking in ambulatory surgery centers. *Jt. Comm. J. Qual. Improv.* 26: 450, 2000.
12. Otake, L. R., Thomson, J. G., Persing, J. A., and Merrell, R. C. Telemedicine: Low-bandwidth applications for intermittent health services in remote areas. *J.A.M.A.* 280: 1305, 1998.
13. Darkwa, O. An exploratory survey of the applications of telemedicine in Ghana. *J. Telemed. Telecare* 6: 177, 2000.
14. Dietel, M., Nguyen-Dobinsky, T. N., and Hufnagl, P. The International Union Against Cancer (UICC) Telepathology Consultation Center: A global approach to improving consultation for pathologists in cancer diagnosis. *Cancer* 89: 187, 2000.
15. Oneal, R. M., Dingman, R. O., and Grabb, W. C. The teaching of plastic surgical techniques to medical students. *Plast. Reconstr. Surg.* 40: 494, 1967.
16. Zbar, R. I. S., Rai, S. M., and Dingman, D. L. Establishing cleft malformation surgery in developing nations: A model for the new millennium. *Plast. Reconstr. Surg.* 106: 886, 2000.
17. Ruiz-Razura, A., Cronin, E. D., and Navarro, C. E. Creating long-term benefits in cleft lip and palate volunteer missions. *Plast. Reconstr. Surg.* 105: 195, 2000.
18. Stephanides, M., Montgomery, K., and Schendel, S. The future of microsurgery. Presented at the Annual Meeting of the American Society of Microsurgery, Miami, Fla., January 17, 2000.
19. Schendel, S. Three-dimensional surgical simulation in resident training. *Aesthetic Surg. J.* 20: 260, 2000.