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Telehealth Innovations in Health Education and Training

José G. Conde, M.D., M.P.H.[1], **Suvranu De, Ph.D.**[2], **Richard W. Hall, M.D.**[3], **Edward Johansen, M.S., J.D.**[4], **Dwight Meglan, Ph.D.**[5], and **Grace C.Y. Peng, Ph.D.**[6]

[1]School of Medicine and Research Centers in Minority Institutions, Program, University of Puerto Rico Medical Sciences Campus, San Juan, Puerto Rico [2]Department of Mechanical, Aerospace, and Nuclear Engineering, Rensselaer Polytechnic Institute, Troy, New York [3]College of Medicine, University of Arkansas for Medical Sciences, Little Rock, Arkansas [4]California Orthopedic Research Network, Santa Monica, California [5]SimQuest, Westwood, Massachusetts [6]National Institute of Biomedical Imaging and Bioengineering, National Institutes of Health, Bethesda, Maryland

Abstract

Telehealth applications are increasingly important in many areas of health education and training. In addition, they will play a vital role in biomedical research and research training by facilitating remote collaborations and providing access to expensive/remote instrumentation. In order to fulfill their true potential to leverage education, training, and research activities, innovations in telehealth applications should be fostered across a range of technology fronts, including online, on-demand computational models for simulation; simplified interfaces for software and hardware; software frameworks for simulations; portable telepresence systems; artificial intelligence applications to be applied when simulated human patients are not options; and the development of more simulator applications. This article presents the results of discussion on potential areas of future development, barries to overcome, and suggestions to translate the promise of telehealth applications into a transformed environment of training, education, and research in the health sciences.

Keywords

technology; telecommunications; innovations; teleresearch

Introduction

Teleheath applications are increasingly important for graduate and postgraduate education in the health professions, professional certification and recertification, continuing medical education, and health education for consumers and patients. Realizing telehealth's broad potential, for example, in telelearning, telementoring, telesurgical planning environments, telerobotic surgery, and teleconsultation, will allow forward-looking institutions to teach anything, anytime, anywhere with the same quality of curriculum and mentorship as delivered in traditional classroom settings, focusing on competence mastery rather than information

Address correspondence to: José G. Conde, M.D., M.P.H., RCMI Program, University of Puerto Rico Medical Sciences Campus, Office B621-A, GPO Box 365067, San Juan, Puerto Rico 00936-5067, jose.conde1@upr.edu.

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This paper is part of a series that summarizes the NIH conference, Future of Telehealth: Essential Tools and Technologies for Clinical Research and Care. The agenda and presentations from this conference are available online at http://www.internet2.edu/health/library/NIH2009/. A videocast of the June 25 plenary session is available online at http://videocast.nih.gov/summary.asp?live=7466.

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mastery. In addition, telehealth applications will play a vital role in the conduct of biomedical research and research training by facilitating remote collaborations and providing remote access to expensive instrumentation that is not widely available otherwise.

Key innovations will be necessary in order to turn this vision into a reality. These include scalable, online, on-demand computational models for simulation that can be accessed from low-end computers; simplified interfaces for software and hardware (including video-conference systems); software frameworks for simulations; portable telepresence systems, [1-5] artificial intelligence applications (e.g., Second Life® [Linden Research, Inc., San Francisco, CA]) when simulated human patients are not options, and the development of more simulator applications, focusing initially on minimally invasive surgical and medical procedures. Remote 3-D visualization techniques may also provide innovations in training, education, and research.

Although many of these innovations may emerge from telehealth- and simulation-oriented research, innovations will also emerge from the application and/or integration of technologies already available but used in other fields.[1-6] Translation of these technologies into the telehealth arena may provide opportunities for innovation in the short term.

Innovation

Besides technology development, other activities will contribute to innovations in telehealth for training, education, and research. Patterns of healthcare delivery need to change in order to incorporate the benefits of telehealth applications. For example, teletraining programs such as Antenatal and Neonatal Guidelines, Education, and Learning System and PedsPLACE, a combined obstetrical and pediatric telemedicine outreach program that connects hospitals throughout the state of Arkansas with each other and the single academic medical center through weekly telemedicine conferences and 24/7 consultation, can reduce unnecessary costs while improving community health outcomes.[7,8] Developers need to listen to healthcare and research professionals and organizations in order to understand their needs for teletraining and teleresearch. Strategic partnerships with industry are key to development of novel applications.

Research at the intersection of computational mechanics, real-time computing, computer graphics, and computer haptics is key to the development of novel computational technology for real-time surgical simulation with visual and touch feedback. Technically, there is a need for network architectures that support multiple simulation users through direct interfaces with computer clouds. Examples linked to telehealth include the development of the Software Framework for Multimodal Interactive Simulations,[9] a research resource that allows rapid development of networked interactive environments with realtime graphics and haptics; a hybrid network architecture that allows client-server as well as peer-to-peer communications for better synchronization;[10] an environment where surgical students, geographically separated, can collaboratively learn and interact with specialists; telementoring environments where trainees may be “hand held” by geographically separated experts; and telesurgical planning environments where experts who are geographically separated may collaborate to plan a surgery. In addition, implementation and access to dynamic circuit networks technology should improve both network utilization and user experience.

Barriers

Several barriers may hinder the widespread use of teleheath innovations. There is a lack of qualified instructors to guide trainees during remote simulations. This need may be fulfilled through mechanisms such as the creation of communities of collaboration and automated guidance systems based on learner feedback. Network time delay is also an issue, especially for remote simulations.

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Social barriers include resistance to adopt new technologies and models for collaboration; inadequate access to quality cyber-infrastructure from underserved/remote areas; professional credentialing standards that center on information mastery rather than competence mastery, thus denying remote simulation to play a role in skills assessment; and Health Insurance Portability and Accountability Act issues and liability.

There is wide agreement that formal evaluation of telehealth technologies is necessary to assess their effectiveness in real-world conditions. However, outcomes research studies are complex activities that require time, effort, and attention to detail. In order to finally bring the benefits of telehealth to the user in a timely fashion, outcomes research studies should be designed, implemented, and analyzed with utmost care so that they can readily provide the evidence required by users and policy makers.

Recommendations

1. *Increase support for research in key areas.* These include scalable, online, on-demand computational models for simulation that can be accessed from low-end computers; simplified software and hardware interfaces (including videoconference systems); software frameworks for simulations; portable telepresence systems; artificial intelligence applications when simulated human patients are not options, and the development of more simulator applications and procedures, focusing initially on minimally invasive surgical and medical procedures. Remote 3-D visualization techniques may also provide innovations in training, education, and research.
2. *Support collaboratory demonstration centers to disseminate the use of telehealth technologies in training, education, and research.* These centers will provide environments where telehealth applications will be demonstrated to healthcare professionals, faculty, students, and researchers. They will also play a role in identifying telehealth solutions for specific scenarios in these communities. These centers may also serve as technology translators and integrators by identifying technologies already developed for other areas and putting them to work in the telehealth arena.
3. *Create the Palpable Human Project.* Taking the Visible Human Project[11] to the next step, this initiative will focus on obtaining haptics data of organs that can be translated into realistic simulations of surgical and medical procedures. The project should include data for both genders and for patients of different age groups. This project can be complemented with Virtual Human Wikis where a community of researchers can contribute their haptics data and computational models to a collective effort.
4. *Establish national resource centers on virtual surgical trainers.* These centers will focus on development and testing of surgical simulations for training and education of our healthcare workforce.
5. *Facilitate bandwidth access to underserved areas and institutions through high-speed networks such as Internet2.* Networks may facilitate or hinder access to training, education, and research resources.
6. *Implement and provide access to dynamic circuit networks technology.* This technology provides a way to open up specific amounts of dedicated bandwidth as needed. Thus, it will improve both network efficiency and user experience.
7. *Collaborate with professional societies in setting standard guidelines for simulation of medical procedures.* Development of realistic, effective simulations requires constant interactions between developers and healthcare professionals. In addition,

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simulation applications should comply with professional guidelines to assure that trainees will improve their performance in the real world through their virtual training.

8. *Accelerate development of telehealth tools for biomedical, translational, and clinical researchers.* Telehealth applications can provide remote access to expensive or remote research instrumentation, thus increasing its availability and use. In addition, telehealth applications (beyond videoconferencing) can improve the research and research training environments of institutions across the nation by fostering interactions between geographically separated research teams. The National Institutes of Health NIH already supports a number of research programs that can drive innovation in telehealth technology, such as the P41 Biomedical Technology Research Centers funded by the National Center for Research Resources (NCRR) and the National Institute of Biomedical Imaging and Bioengineering (NIBIB),[12,13] and NIBIB's Telehealth Program Area.14 In addition, the NCRR's Shared Instrumentation Grant program15 and the trans-NIH Small Business Research Funding Opportunities programs[16] are potential sources of funding for major shared equipment items (e.g., imaging systems) and new technology development, respectively. The NIH should partner with the American Telemedicine Association and other stakeholder groups to raise awareness about these ongoing grant programs and provide technical assistance to potential applicants.

Conclusions

Telehealth applications have the potential of greatly improving training, education, and research. Key innovations will emerge from research and development in specific areas, and by the integration of technologies already in use for other purposes. NIH may play a lead role in facilitating telehealth innovation by establishing specific research initiatives, setting up collaboration/demonstration centers, collaborating with professional societies, and facilitating access to adequate cyber-infrastructure. These efforts will enhance training, education, and research activities across the nation.

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