

Developing Next-Generation Telehealth Tools and Technologies: Patients, Systems, and Data Perspectives

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Abstract

The major goals of telemedicine today are to develop next-generation telehealth tools and technologies to enhance healthcare delivery to medically underserved populations using telecommunication technology, to increase access to medical specialty services while decreasing healthcare costs, and to provide training of healthcare providers, clinical trainees, and students in health-related fields. Key drivers for these tools and technologies are the need and interest to collaborate among telehealth stakeholders, including patients, patient communities, research funders, researchers, healthcare services providers, professional societies, industry, healthcare management/economists, and healthcare policy makers. In the development, marketing, adoption, and implementation of these tools and technologies, communication, training, cultural sensitivity, and end-user custo-

mization are critical pieces to the process. Next-generation tools and technologies are vehicles toward personalized medicine, extending the telemedicine model to include cell phones and Internet-based telecommunications tools for remote and home health management with video assessment, remote bedside monitoring, and patient-specific care tools with event logs, patient electronic profile, and physician note-writing capability. Telehealth is ultimately a system of systems in scale and complexity. To cover the full spectrum of dynamic and evolving needs of end-users, we must appreciate system complexity as telehealth moves toward increasing functionality, integration, interoperability, outreach, and quality of service. Toward that end, our group addressed three overarching questions: (1) What are the high-impact topics? (2) What are the barriers to progress? and (3) What roles can the National Institutes of Health and its various institutes and centers play in fostering the future development of telehealth?

Key words: business administration/economics, telehealth tools, technology, National Institutes of Health

Introduction

A breakout session on the topic of “Developing Next-Generation Telehealth Tools and Technologies: Patients, Systems, and Data Perspectives” was held at the National Center for Research Resources Conference on the Future of Telehealth. The session addressed three overarching questions: (1) What are the high-impact topics? (2) What are the barriers to progress? and (3) What roles can the National Institutes of Health play in fostering the future development of telehealth?

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>.

High-Impact Topics

Potential high-impact topics were discussed from three points of view: the patient, the system, and the data. From the patients' and other end-users' perspective, high-impact topics include the availability of home devices for maintaining wellness and for disease diagnosis and treatment. Examples include systems for medical/surgical consultations which include telesurgical mentoring capabilities; reminder systems for patient behavior changes; and way-finding tools for persons with sensorial disabilities. A major area requiring further exploration is the role of social networking platforms and mobile communication technologies in underserved and remote populations, including the use of cell phones for advanced mobile and home telehealth applications.¹

From the data perspective, the expansion of clinical bioinformatics and data integration into an electronic health record (EHR)/electronic medical record (EMR) using devices to acquire physiologic and other patient data is a high-impact topic. The functional connection and integration of data from multiple sources combines communications research with healthcare delivery.²⁻⁵

From the systems perspective, integrating telehealth systems into healthcare delivery represents a high-impact topic. Increasing system complexity, the interaction of multiple systems, and interaction with the physical world are major challenges. Key considerations when addressing increasing system complexity include function, integration, networking interoperability, security, technology management, assurance, certification, reliance on software, and usability. The telehealth system requires integration of techniques, including interoperability of medical devices, EHR/EMR, personal health records, and other technologies. Trust management is crucial to adoption and sustainability of systems. Secure, dependable, real-time communication networks with quality of service guarantees, and interference-resistant wireless networks are needed to increase telehealth systems adoption.²⁻⁶

Major Barriers to Progress

Overall, end-user adoption is challenged by the need for the integration of new technologies in clinical practice workflow and daily activities. Adoption requires cultural and behavioral changes for use and reliance on telehealth technologies. The lack of standard metrics for quality of service assessment impedes the evaluation and obscures the progress of technology adoption and utility.^{1,5,6}

From the patient's perspective, the usability and ease-of-access to technologies are obstructed by the lack of technology integration, interoperability, and standardization. For example, though telecommunication vendors and vendor resources could provide low-cost solutions as data are transmitted through their ubiquitous

networks, they might also limit expansion of applications and affordability for cell phone text and data transmission for economic reasons.^{4,5}

From the providers' perspective, there is limited time available to respond to the multitude of telecommunications from patients and to enter data into EHR/EMR systems. A pervasive barrier for these end-users to secure new tools and technologies is the limited financing available for implementation, maintenance, and sustainability.²⁻⁶

From the data perspective, limited access and limited data flow impede progress. Data flow into practice and hospital centers is strictly regulated, making the main data repository's (EHR/EMR systems) difficult to access and utilize for their true value with ongoing data mining and automated decision support. Failure to address data integration will limit the proliferation of patient-centric telehealth tools. The lack of data standards coupled with issues of security, privacy, and trust remain barriers to data collection, compilation, and transmission between healthcare providers, thus frustrating efforts to coordinate care. These barriers also hinder access to data for research purposes. Moreover, limited funding resources remain a barrier for data analysis, integration, and automated decision support.²⁻⁶

From the systems perspective, proliferation of stand-alone systems, nonintegrated data, and disparate databases provides an infrastructure poised for collapse and end-user discontent. Lack of interoperability limits data sharing, utilization, and the comparison of data, algorithms, and approaches. EHR systems do not currently facilitate data integration and automated analysis. There are no clinical standards for automated decision support, such as agreement in alarm and trend setting of devices. System developers and administrators are well aware of the time and cost limitations for improved validation and certification within computerized telehealth systems.²⁻⁶

Role of NIH and Other Agencies in Shaping the Future of Telehealth

Breakout session discussions led to a consensus that the National Institutes of Health and other federal research agencies should take a national leadership role to facilitate collaborations among stakeholders. Key recommendations are to:

1. Conduct multistakeholders meetings with focused deliverables and provide funding opportunities to bring multiple stakeholders together.
2. Consider funding more innovative research to develop, assess, and support telehealth-related tools and technologies. In particular, new research and development (R&D) is needed to

develop standardized “translational” platforms that integrate telehealth data into EHR/EMR systems such that the data may be studied in relation to other data for automated decision support. An additional study area is needed for automated decision support systems that view several real-time or near real-time datasets simultaneously for chronic disease states, to assist providers with timely detection of outliers. There is also a need for R&D to develop interoperable telehealth system interfaces and tools for use with independent telehealth systems, as well as for education, training, care management, treatment, and preventive care. In addition to these technology-focused initiatives, there is a need for R&D focusing on issues surrounding data security, patient and provider privacy and trust, and management of telehealth systems.

3. Consider funding “implementation” research to assess and improve delivery, use, and adoption of technologies. There are needs for economical, organizational management, communication and information dissemination systems, change management, and sociological and behavioral studies for effective adoption of telehealth tools and technologies among end users.
4. Create a central information resource managed by a neutral entity to compile an inventory of freeware telehealth software and other telehealth resources, with regular updates and ongoing outreach to both the end-user communities and the research community.

Summary

Next-generation telehealth tools and technologies that utilize the Internet and its robust computational resources hold great promise for improving healthcare for medically underserved populations, increasing access to specialty services at lower cost, enhancing health literacy, and expanding the healthcare workforce through “virtual” education and training. Realizing these benefits will require extensive and ongoing collaboration and coordination among stakeholders across the research and healthcare ecosystem. Communication, training, cultural sensitivity, and end-user customization are critical to success. Extending the “traditional” point-to-point telemedicine model to include newer cell phone and Internet-based telecommunications tools that are increasingly widespread and affordable, even in rural and remote locations, will be key to putting the “person” in

“personalized medicine” and making research advances available to everyone. Furthermore, we must appreciate system complexity to realize the benefits of telehealth as it evolves toward increasing functionality, integration, interoperability, outreach, and quality of service.

Disclosure Statement

No competing financial interests exist.

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