

The Pervasiveness of Telemedicine: Adoption With or Without a Research Base

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Arguably, telemedicine could claim that it is the oldest of the health information technologies, dating from the first telephone consultation in the 1800s. Modern telemedicine encompasses a variety of technologies and uses, ranging from direct patient care to both patient and provider education. Because of this, the definition of telemedicine remains elusive but its disparate applications belong in this special issue of *Journal of General Internal Medicine* (JGIM).

In 2006, a group of researchers from several countries found 104 definitions of telemedicine in journal articles, books, and conference proceedings published between 1970 and 2006.¹ They developed a consensus definition that takes into account the four major elements of telemedicine: supplying medical care, use of technology, mitigation of issues of distance, and provision of benefits. Specifically, they suggest that telemedicine relies on telecommunication networks for the delivery of healthcare and medical education across a distance to mitigate issues of maldistribution of healthcare resources.

As the characterization implies, the technology of telemedicine is broad, if defined first as use of telecommunication networks. Commonly, it is thought to encompass the transmission of data, voice, images, and video over distances using video conferencing systems. However, telemedicine might use Web applications, mobile computing, or even telephony.

Telecommunications of medical information can be synchronous or asynchronous. Synchronous transmission could involve a provider-to-provider consultation or linking a patient to a provider at a distance. It could also be educationally based, with an instructor teaching students at a different location. More recently, interactive telephone technology has enabled both tailored messages for patient health improvement as well as information exchange to mitigate illness exacerbation in chronic disease management.

Sarkar et al., in this issue, describe the use of such a telephony system with diabetes patients.² In an attempt to foster self-management, they used interactive prompts designed around adverse events and potential adverse events. This surveillance detected events in 11% of the completed calls and of those, 59% were a result of an IT facilitated trigger. This

research shows that use of a relatively inexpensive technology was able to improve patient safety and lessen potential morbidity.

Asynchronous telecommunication in telemedicine is primarily used when direct communication between patients and providers or providers and specialty consultants is not required. The majority of early telemedicine fell into this category. Teledermatology, telepathology, and teleradiology gained widespread acceptance because of the need for specialty consultation in remote areas.

Capture of patient information asynchronously, either prior to an office visit or as part of monitoring of chronic illnesses, is gaining in popularity with the desire to involve patients in their own health care. Remote monitoring of such signs as blood pressure and blood sugar levels has enabled the chronically ill to remain in their homes and has improved quality of life without endangering patient safety.

With the widespread use of computers, mobile computing in the office prior to the visit with the health care provider can allow for the collection of valuable patient information and save time during the actual exam. The article by Hess et al., also published in this special issue of JGIM, evaluated the use of touch-screen tablet computers in the waiting room as a part of routine screening and found that the majority of patients were comfortable using the technology.³ However, in stratifying their results among such variables as age, minority status, and comorbid conditions, they found that vulnerable groups were not as facile with the technology and could need additional support. This is an important finding to consider when developing any telemedicine system that involves patients and could be tied to issues of health information/computer literacy.

Use of the Internet in health care has been growing in popularity and this is another form of asynchronous communication within the broad telemedicine rubric. Patients routinely use e-mail to communicate with their providers for prescription refill requests and general health care advice. A number of consumer health Web sites proliferated in the 1990s and some, such as MedlinePlus and WebMD, provide advice to thousands of health care consumers on a daily basis.

The use of the Web in a secure environment to collect health status information is the next step in remote monitoring of patients. The Web serves as a data collection vehicle, with the information collected being captured in a database. This information can then be analyzed against rules that detect emerging health conditions. The Leveille et al. article in this issue of JGIM describes such a patient portal tool.⁴ Their online screening survey for three chronic conditions—untreated

depression, chronic pain, and mobility difficulty—was completed by volunteer patients prior to a non-urgent office visit. Thirty-three percent of the patients screened positive for one or more of the conditions, alerting their providers to initiate management. These tools hold promise for improving healthcare by identifying conditions that might remain undetected in routine office visits.

The Web has also been used successfully in a number of health education venues. Most relate to the training of undergraduate medical students with the construct of anytime, anywhere education. Learning management systems with a Web front end enable students to view new material or review material given in didactic class sessions. Video capture and video streaming embedded into class content can enhance learning through multimedia presentations. Case-based tools simulate a patient presentation and provide for both formative and summative assessment of the cognitive parts of the clinical encounter.

Patient care in telemedicine has frequently been balanced by the use of the technology for distance learning to offset costs. The same system that is used for a synchronous remote consultation can also be used for in-service training at a distance. However, using the on-demand features of the Web, if synchronicity is not a requirement, reduces costs and addresses time constraints in a health care learning environment.

In their article in this issue of JGIM, Lyman et al. take the concept of Web-based education to another level in their work to combine resident competency education with a profiling tool to support practice-based learning and improvement.⁵ Early research in academic detailing has shown that immediate feedback can change practice behaviors, and in a similar vein, the Web-based tool has been integrated into a practice-based learning and improvement curriculum that provides reports to residents on an aggregation of patient demographics and clinical characteristics, preventive medicine activities, and disease management. These reports can be used by the resident to compare his or her performance against those on the same rotation, in the same year, or all residents and faculty. The majority of the respondents felt that the system was useful and would change practice patterns.

Sometimes telemedicine tools, such as mobile computing devices, can be used to improve patient care indirectly by improving workflow for required data collection. An example of this is found in the article by Dollarhide et al. in this issue of JGIM in which a handheld computer is used for reporting medication events.⁶ Telemedicine focuses on distance and ways to solve problems caused by distance. However, the area does not have to be great to seek to employ telemedicine tools. If a handheld computer such as a PDA facilitates data collection when paper forms are not convenient, then the intervention could prove successful. Such was the case with the Medication Event Reporting Tool, which was found to provide a viable means to augment traditional reporting methods.

Telemedicine is still a relatively new technology to the healthcare field. Its initial purpose was to mitigate healthcare disparities caused by distance and healthcare status. By virtue of its focus on telecommunication, its uses, as well as the specific technology types, are growing. However, there are some questions as to whether or not it is meeting its own goals.

In 2001, a systematic review article was published looking at the outcomes of telemedicine interventions. The authors

found little research that definitively tied telemedicine interventions to improved healthcare, with the greatest of the identified benefits coming in the home healthcare environment in the management of chronic diseases and in emergency situations in which providers with necessary skills were not available onsite.⁷

An update to this systematic review was published in 2006 with much the same findings. It was the lead article in a supplement to the *Journal of Telemedicine and Telecare* that looked at the evidence base of telemedicine.⁸ The problem encountered by the authors and indeed virtually all telemedicine researchers is the difficulty in directly linking the telemedicine intervention to healthcare outcomes.

Telemedicine offers a number of benefits. It can reduce time-to-diagnosis and/or treatment for those where distance to a health care facility is an issue. It can provide equal healthcare for those living in medically underserved areas. It can improve patient quality of life and patient satisfaction. It can reduce costs in the overall health care system. But can it improve outcomes? This has yet to be decided.

In addition, there are also some potential patient safety issues that need consideration. Technology failure, particularly if the system has been integrated into workflow, presents a major risk. The healthcare team will find it difficult if not impossible to change back to protocols that existed prior to the technology implementation. A drop in the quality of the technology that leads to a wrong diagnosis or the inability of the provider to appropriately manage the technology could cause injury. As telemedicine becomes more ubiquitous, there are many areas that beg for substantive research.

Most telemedicine research has focused on the efficacy of the systems. It has determined that image quality in plain films meets the standards requirement of the American College of Radiology. It has found that pathology/dermatology images can be improved through the color enhancement feature of the systems. It has shown that wound care at a distance can be managed through telemedicine. It has discovered that patients and providers not only like telemedicine but learn to rely upon it.

No one argues that the system efficacy studies, the patient and provider satisfaction studies, the return-on-investment studies, and the substantive anecdotal evidence have given a solid rationale for telemedicine as an integral healthcare technology. The articles in this special issue underscore the value of telemedicine in healthcare.

More and more, CMS and even third party payers are supporting use of telemedicine in healthcare provision. As medical students graduate, having been exposed to the usefulness of learning management systems and PDAs that offer decision support on the wards and thinking that e-mail and cell phones have replaced the "Black Bag", they will wonder why telemedicine tools are not available in some of their residencies.

Telemedicine holds a great deal of promise for healthcare improvement. Telemedicine tools that seem new and complex today will be commonplace in the near future. Just as the telephone was not designed for healthcare but added value in the healthcare environment of the 1800s, so too will the Internet and the World Wide Web provide new ways for communicating with patients and mobile technologies such as smart phones will ease the way information is captured at the bedside. Telemedicine, using telecommunications technologies to improve healthcare delivery across distances, is the

telephone of tomorrow, and will only be enhanced by substantive research proving its impact on healthcare outcomes.

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