

## Telemedicine and Patient Safety

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### Perspective

A paradigm shift is ongoing in the health care sector. The traditional model of episodic and hospital-based care is being replaced by a patient-centric approach, in which patients are constantly connected to their health care providers. This shift is driven by the need to optimize the performance of the health care system and enabled by advances in technology.

Advanced communications and monitoring technologies facilitate the exchange of a patient's information between two or more sites. These technologies are now commonly applied in virtually every medical specialty to educate, monitor, offer self-management support for patients, and provide clinicians with clinical decision support for diagnosis and ongoing care. A variety of terms—telemedicine, telehealth, connected health, eHealth, mHealth—are used to describe this model of care delivery. The more general term, telemedicine, will be used in this article.

The evidence supporting the role of telemedicine is strong. Studies have shown that telemedicine promotes continuity of care, decreases the cost of care, and improves patient self-management and overall clinical outcomes. For example, a synthesis of evidence from 15 systematic reviews published between 2003 and 2013 demonstrated that heart failure telemonitoring reduced all-cause mortality by 15%-40% and heart failure-related hospitalizations by 14%-36%.<sup>(1)</sup> Another systematic review found that, compared with usual care, telemonitoring for patients with heart failure was associated with significant cost reductions, ranging from 1.6%-68.3%.<sup>(2)</sup> This body of evidence is driving the increased adoption of telemedicine services. For instance, the heart failure telemonitoring program (Connected Cardiac Care Program) at Partners Healthcare, which has consistently achieved significant reductions in 30-day readmissions, started as a small pilot project in 2007.<sup>(3)</sup> Since then, the program has been deployed as a population health management tool across Partners' network of hospitals.

Telemedicine can also help in identifying and preventing treatment-related errors between clinic visits. As one example, a number of studies have shown that medication errors can be significantly reduced by telemedicine. One study utilized real-time videoconferencing consultations between physicians in rural

emergency departments (EDs) and pediatric critical care physicians in a large academic medical center to manage treatment of children with serious illness or injury in eight rural EDs in California. They found that the frequency of physician-related medication errors was at least three times higher in patients who didn't receive telemedicine consultation than in those who did.(4) Similar reductions in medication errors have been reported in telepharmacy programs.(5,6)

Furthermore, telemedicine surveillance applications can detect preventable treatment-related adverse events that may otherwise go unnoticed by care providers. For instance, a study of ambulatory patients with diabetes found that a weekly interactive, automated telephone application that provided patient education and self-management support with targeted nurse follow-up detected more (59%) treatment-related adverse events than either nurse elicitation (30%) or patient detection (11%) alone.(7) Another similar application is used for monitoring patients with implantable cardioverter defibrillators to prevent inappropriate defibrillator shock.(8)

These studies create a body of evidence that supports a positive impact of telemedicine on patient outcomes, particularly in the management of discrete disease states like heart failure or for specific situations such as the use of defibrillators. However, the overall impact of telemedicine on safety is less well studied, and some have raised concerns.(9) Like any innovation that affects care delivery, telemedicine must face the same standards and thoughtful evaluation as traditional care. Some argue that telemedicine should be subject to even closer scrutiny because the absence of the traditional face-to-face encounter could increase the risk of medical errors. Moreover, in an effort to improve clinical efficiency, telemedicine could be employed in situations that are inappropriate. For example, even telemedicine advocates would not argue that patients with chest pain should be managed via email or over the telephone. One key component of the telemedicine research agenda is to determine these boundaries. One concerning study reviewed 32 cases that ended in catastrophic outcomes, including deaths and malpractice settlements amounting to more than \$12 million.(10) Telephone communication was implicated as a significant root cause, raising issues regarding the importance of face-to-face visits in some circumstances.

The exponential growth of mobile medical applications raises new safety concerns. Telemedicine has evolved from simple telephone communications to more complex algorithmic-driven smartphone-based applications. Many developers lack medical training, and some fail to involve clinicians in the mobile application development or implementation process. On top of that, many of these applications are marketed directly to consumers without any formal safety or efficacy testing.(11) For example, one study investigated the accuracy of a top-selling mobile application that promised personal assistance with management and diagnosis of skin cancer. In the study, the authors tested the application's ability to detect melanoma by using it to evaluate 93 photos of biopsy-proven melanoma.(12) Disconcertingly, it correctly classified only 10.8% of the lesions. Other examples include applications that, based on inputting the diet of patient with diabetes, calculate that patient's insulin dose. The Food and Drug Administration and the Federal Trade Commission are fast at work trying to evaluate medical mobile applications to determine if they are safe and effective. However, with the tally of mobile health applications now exceeding 100,000, the task is a mammoth one.(13)

Given these concerns, should we suspend telemedicine implementations until we can address these issues? In the spirit of "not throwing the baby out with the bathwater," we argue that the answer is "no." New technologies and care models come with attendant risks. Telemedicine has demonstrated many positive effects on care. Rather than stop the forward progress, we argue for a more thoughtful, continuous safety improvement process that could start from the moment of project conception. Suggestions to increase patient safety in telemedicine include: (i) patient safety awareness should permeate all phases of the telemedicine project life cycle; (ii) integrate safety testing as part of usability and efficacy trials, such evaluations should not be limited to academic medical settings; (iii) use the latest data security and encryption systems to protect patient privacy; (iv) increase regulatory, professional, and health care organizations' involvement in creating consensus-driven guidelines, operational protocols, and standards, all of which should be updated regularly; (v) full disclosure of possible risks prior to patient enrollment in telemedicine interventions; (vi) create systems for clinicians to document telemedicine services and integrate them as part of regular workflow; and (vii) increase efforts to lessen social risks by creating more solutions for patients with low health literacy, along with solutions for non-English speakers.

On the whole, telemedicine is improving the health of patients and has the promise to revolutionize health care delivery. The current rise in adoption and integration into clinical workflows will no doubt continue. The constant advances in technological innovations present new opportunities for care delivery innovation as well as new challenges. Although some telemedicine programs can prevent medical errors, known and emerging threats to patient safety are real. Therefore, there is a need to increase research efforts evaluating the impact of telemedicine on patient safety. Ultimately, we need to balance our commitment to the ethical principle of nonmaleficence (do no harm) with the need to adopt technology-driven innovations in health care to enhance quality and efficiency. Doing so should allow us to use these technologies to improve patient safety.

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