# Telehealth: A Case Study in Disruptive Innovation

This technology uses remote monitoring, videoconferencing, and much more to extend the reach of nurses and improve care.

**OVERVIEW:** Technologic advances in health care have often outpaced our ability to integrate the technology efficiently, establish best practices for its use, and develop policies to regulate and evaluate its effectiveness. However, these may be insufficient reasons to put the brakes on innovation—particularly those "disruptive innovations" that challenge the status quo and have the potential to produce better outcomes in a number of important areas. This article discusses the concept of disruptive innovation and highlights data supporting its necessity within health care in general and nursing in particular. Focusing on telehealth as a case study in disruptive innovation, the author provides examples of its application and reviews literature that examines its effectiveness in both nursing practice and education.

**Keywords:** disruptive innovation, e-health, mHealth, mobile health, remote monitoring, telecare, telehealth, telehealth nursing, telemedicine, telenursing, virtual nursing

As far back as the 1930s, Joseph Schumpeter described "creative destruction" as the process by which businesses entering the market with new ideas and technologies can take advantage of opportunities that traditional, established firms may ignore.[1] Economist Clayton Christensen later expanded on this notion with his theory of "disruptive innovation," in which groundbreaking products or services that are convenient, simple, and easy to use do not, initially, have the appeal of their established counterparts.[2] At first, these products or services may be considered to be inferior to the status quo, but their lower cost, simpler design, and ease of use appeal to specific market segments. Over time, they undergo improvement and demonstrate their value, while an increasing number of consumers adopt their use. Soon these products and services, once disdained, are viewed as the norm and may even shape best practices in a given field.

Such products and services are sometimes described as "disruptive innovations." In health care, examples are plentiful: balloon angioplasty, which eliminated the need for many cardiac bypass surgeries; the delivery by NPs of primary care services that were previously provided exclusively by physicians; and the formation of health care clinics within retail establishments. Each of these innovations initially met the needs of only a subset of consumers but was soon more widely accepted and adopted.

Like these advances, telehealth is a classic disruptive innovation that, having faced its share of detractors, is now being used in increasingly varied ways


A patient uses telehealth equipment to communicate with his nurse. Photo courtesy of Janet Grady.

across health care. This article discusses telehealth's many applications, reviews literature that examines its effectiveness in both nursing practice and nursing education, and explores the trajectory of telehealth as a case history in disruptive innovation.

## WHAT IS TELEHEALTH?

The Health Resources and Services Administration defines telehealth as "the use of electronic information and telecommunications technologies to support long-distance clinical health care, patient and professional health-related education, public health, and health administration."[3] Also called "telehealth nursing" and "telenursing," telehealth is a component of telemedicine, which includes such specialties as teledermatology, teleradiology, and telepsychiatry. Telehealth is not a specialty area of nursing, but rather a means of delivering care that is likely to be part of every nurse's skill set in the not-too-distant future.

Within telehealth, there are a variety of products, processes, and services whose characteristics are consistent with disruptive innovation (see *The Many Uses of Telehealth Technology*[4,5]). Many such innovations were originally rejected by traditional health care consumers and providers, who felt that telehealth did not meet the gold standard of in-person care. But mounting evidence suggests that telehealth can extend the reach of nursing and existing health care resources.

Telehealth nurses may practice in community clinics, schools, prisons, or any setting in which on-site access to health care providers is limited. In a hospital, they may provide direct care at a distance, using a digital stethoscope to auscultate lung sounds or a digital camera to assess and document the progression of wound healing. Telehealth nurses may act as telepresenters, communicating with physicians or other providers through videoconferencing from a patient's bedside. A home care telehealth nurse has the ability to "see" many more patients through virtual visits. Using a wide range of digital and distance technologies, telehealth nurses enable patients in remote locations to connect with specialized care and resources typically available only near major academic medical centers.

According to the American Telemedicine Association, there are currently over 200 telehealth networks and 3,500 service sites in the United States.[6] The Veterans Health Administration (VHA), long a leader in telehealth care delivery, provided 300,000

long-distance consultations for patients in 2011.[6] With increased broadband network capabilities, it is now feasible for the use of telehealth to expand, particularly in areas in which providers are few and access to care is less than optimal.

## POTENTIAL USES IN CHRONIC ILLNESS AND ACUTE CARE

By 2021, it's projected that health care will account for 20% of the U.S. gross domestic product, up from 18% in 2011.[7] Treatment for chronic disease accounts for 75% of the more than $2 trillion our country spends each year on health care.[8] By 2030, the Census Bureau estimates that 19% of the U.S. population will be over 65 years of age,[9] and many older adults will have multiple chronic conditions. Yet, despite these unsettling statistics, telehealth technologies with the potential to lower costs and ease the burden of caring for growing numbers of older patients have not yet been widely adopted.

**In the home.** Medicare and other insurers do not yet reimburse for home telehealth,[10] despite that telehealth technology has been found in a number of studies to improve outcomes and lower costs. For example, when home care nurses "augmented usual care with a web-based resource . . . that provided patients with self-management information, self-monitoring tools, and messaging services," the technology increased quality of life and self-management of chronic heart disease in the early postdischarge period.[11] Patients with heart failure who were enrolled in a yearlong telehealth program on hospital discharge had lower 30-day readmission rates than patients with heart failure who were discharged with routine or no follow-up care.[12] Patients with end-stage renal failure improved self-management and achieved better quality of life through home telehealth monitoring with remote care nurse support.[13] Telemonitoring of vital signs reduced acute care hospitalizations and ED visits for home health care patients, and telemonitoring that collected information on vital signs along with yes/no patient responses regarding perceived health status increased satisfaction for both rural home health care patients and their providers.[14, 15] A review of 14 home telehealth monitoring studies conducted internationally found that home monitoring had a positive effect on patients' blood pressure control, possibly as a result of better medication adherence and health-promoting lifestyle modifications.[16] A Cochrane review of 30 randomized controlled trials involving more than 8,000 patients, published on behalf of the European Society of Cardiology, concluded that both telehealth monitoring and structured

### The Many Uses of Telehealth Technology

Today, a wide variety of telehealth technologies extend the reach of nursing far beyond the examination room and bedside. The following tools are becoming increasingly commonplace.

- **Remote-monitoring devices** allow patients to connect with telehealth nurses from their homes or from a community setting, such as a senior center. Some systems allow real-time communication, using videoconferencing, while others require the patient to use a touch screen to answer questions such as, "How is your breathing this morning?" Answers are recorded and transmitted to the nurse, whose early intervention can prevent complications or unnecessary hospitalizations.
- **Remote physical assessment peripherals,** such as pulse oximeters, weight scales, sphygmomanometers, blood glucose monitors, medication-tracking equipment, and even "intelligent toilets" (that collect data on weight, blood pressure, and urine glucose), are commonly part of telehealth systems. These permit patients who are unable or unlikely to seek specialized health services to transmit data from their own homes to a variety of practitioners. Data are transmitted either in real time (by standing on a scale and pressing a "send" button on a monitoring device, for example) or by using a "store and forward" option, which transmits and stores patient data for later review by the nurse. Most system peripherals allow nurses to track and show trends in patient data. Many also allow nurses to set alerts, so they are automatically notified if there is an increase or decrease in a variable beyond preset parameters (a weight gain of more than two pounds, for example).
- **Mobile health (mHealth) devices,** consisting of wearable sensors that can track and transmit to providers in real time patient parameters ranging from biochemical measurements to movement and balance, are becoming less obtrusive and gaining patient acceptance.[4] Although the use of these technologies is not yet widespread, companies have continued to develop next-generation equipment, such as biosensors embedded in the skin that can collect and transmit blood glucose readings to a mobile device for real-time communication with a health care provider.[5]
- **Personal health record apps** for mobile devices not only hold patient-entered information, such as health history and medication reminders, but they can also collect environmental information on asthma triggers, such as smog or allergens, and monitor respirations, sending alerts of impending asthma symptoms.

telephone support were effective in improving outcomes in patients with chronic heart failure.[17]

**In acute care.** There have been numerous studies in which telehealth used outside the home has also produced better or equal outcomes at reduced costs. For example, a systematic review of telehealth ICU studies published from January 1, 1950, through September 30, 2010, concluded that telehealth ICU programs, which typically allow on-site ICU staff to collaborate with off-site intensivists and critical care nurses through the use of videoconferencing, telemetry, and electronic medical records, can reduce ICU mortality and length of stay in hospitals that lack the resources to keep dedicated intensivists on staff.[18] In contrast, a study conducted in two community hospitals in which patients' primary physicians maintained responsibility for care, though intensivist consultation was available on an as-needed basis, found no reduction in mortality, length of stay, or costs associated with the use of an electronic ICU (one that provides continuous, real-time supplemental monitoring of patients by intensivists and critical care nurses in a centralized, off-site facility).[19] Owing to the tremendous shortage of intensivists, however, only about one-quarter of ICUs are equipped to have "treatment decisions cohesively managed under the guidance of an intensivist."[20] For this reason, supplemental intensivist oversight provided through technology may be welcomed by patients.

One 904-bed tertiary hospital used a robotic telepresence to reduce noise and traffic in the surgical ICU.[21] To eliminate the need for a team of up to 20 people—including an intensivist, surgical residents, NPs, a pharmacist, a nutritionist, and members of other hospital services—gathering at each patient's bedside, this unit initiated a practice in which surgical residents and NPs would examine patients in the early morning, after which the entire multidisciplinary surgical ICU team convened in a conference room and communicated with patients and family members in the ICU through a robot. Of patients surveyed, 92% responded that they didn't believe the robotic telepresence meant "the doctor cared less about them," and 84% believed their care was better because a robot was used.

**In other settings with diverse populations.** Children with type 1 diabetes whose schools contained "a telemedicine unit" in the office of the school nurse—permitting monthly videoconferencing between the school nurse, child, and diabetes team in addition to usual care—experienced a significant reduction in both glycated hemoglobin levels and the need for urgent encounters, with a 91% satisfaction rate among participants.[22] Telehealth systems have also been used successfully in schools to help children manage asthma[23,24] and behavioral health issues.[25] For patients with hearing, speech, and language disorders, a review of studies from 1995 to 2011 "generally validated" telehealth as a means of delivering services such as hearing aid fitting; programming cochlear implants; and conducting speech and language studies to diagnose neurogenic communication disorders, voice disorders, dysphagia, and fluency.[26]

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Elderly patients at elevated risk for stroke who received preventive patient education through telehealth videoconferencing with a researcher were found to be as satisfied, as knowledgeable, and as likely to make behavioral changes to reduce vascular risk factors as those who received the same information through in-person sessions.[27] Patients with mental health disorders achieved improved outcomes and better access to care through a variety of telehealth models that use phone, e-mail, and video consultation between primary care providers and specialists to create "virtual collaborative care teams."[28] When supported by telehealth systems that included video monitoring, sensors, and emergency alert pendants, patients with intellectual disabilities demonstrated greater independence in task completion than patients with similar disabilities who received standard care provided by on-site support staff.[29] Patients with clinically significant levels of mental illness who received evidence-based cognitive behavioral and motivational interviewing therapy delivered via a telehealth nursing program had reduced ED utilization and improved medication adherence.[30] More than 98,000 patients with mental health problems enrolled in telehealth programs sponsored by the Department of Veterans Affairs reduced psychiatric admissions by more than 24% and hospitalization days by more than 26%.[31] Telehealth has also been effective and accepted as a means of delivering diagnostic and therapeutic care for mental health issues and infectious diseases to a prison population in Louisiana, with a large majority of providers expressing satisfaction and the belief that it improved patient prognosis and satisfaction.[32]

At a time when health care providers and policymakers are challenged to provide high-quality care in an accessible manner and at an effective cost, various uses of telehealth are demonstrating the capacity to improve quality, increase access, and lower costs for consumers.

**For telehealth to move from marginal to broad acceptance, its use must be incorporated in nursing education.**

## DISRUPTING NURSING EDUCATION

Many nurse educators would readily agree that it may be time to disrupt how nurses are educated, replacing pedagogic methods in which students are passive learners, subject to much repetition, memorization, and recitation of content, with opportunities to apply and synthesize what they've learned. Such an approach would seem to be more consistent with both the dynamic landscape of health care and today's tech-savvy, highly interactive nursing students, the majority of whom are what Prensky called "digital natives," raised in the age of technology and thus more accepting of it than their "digital immigrant" instructors and mentors.[33] Such nursing students are more likely to understand that they may not always be in the same physical space as their patients and may therefore require skills in both long-distance and traditional assessment. Young nurses, whose practice will extend far into the future, need to be familiar with telehealth tools and methods. This requires that current nursing curricula stretch and grow, and incorporate various forms of telehealth technology to enhance the educational experience of nursing students and provide learning opportunities that would otherwise not be possible. For example, a team of nurses partnered with a software developer to create a virtual nursing care unit with an interactive database of electronic medical records, familiarizing students with the type of technology they will use later in practice.[34] Educators have also used videoconferencing technology to deliver virtual clinical experiences of complex patient cases to nursing students in a rural area without easy access to these types of cases.[35] The nursing students found that the nurse–patient interaction was

### An Author's Call to Action

I would encourage nurses to be the "innovators" or "early adopters" that Rogers described in his classic "diffusion of innovations" theory.[46] According to Rogers, early adopters are those "opinion leaders" who encourage innovative thinking and help to sway the majority. The "early majority" is the group at the "tipping point," meaning that once they are on board with telehealth, many others will follow. Most nurses know and work with colleagues who would be in Rogers's "late majority" group, those who are skeptical and risk averse. These are the nurses who feel we do not have enough evidence that incorporating telehealth into nursing practice would improve the status quo. The last group identified in Rogers's theory is the "laggards," who are suspicious of anything new and will only be dragged into the future kicking and screaming.

The connected world in which we live no longer holds on to the time and space barriers of the past. An online survey of 3,000 adults found that 75% would be interested in telehealth devices that could help prevent trips to a physician's office or otherwise make their daily lives more convenient.[47] Even on a federal level, "patient-centered care" is now recognized as an essential characteristic of a "high-performing, high-quality health care system," and the Office of the National Coordinator for Health Information Technology in the Department of Health and Human Services supports consumer e-health tools.[48] Growing federal support may soon fuel the consumer demand for telehealth, a necessity if this innovation is to become integrated into our health care system.

At this critical juncture in the evolution of health care, it may be time for nurses to declare that the time to think of telehealth as a disruptive innovation is over. Given the current crises we face in health care and nursing education, we can either allow the shortage of resources to further weaken our ability to deliver high-quality care to all who need it at a cost they can afford, or we can view this crisis as a catalyst for change, insisting on the use of telehealth and affirming its acceptance as a basic tool of high-quality, responsive, and responsible nursing care.

"very up close and personal and very emotionally involved despite the distance." In the future, virtual clinical experiences that employ telehealth technology and clinical simulation may be commonplace in nursing education, allowing students to experience a more diverse patient population and a wider range of health care issues while gaining confidence in using the digital assessment equipment they will be using in practice.

In a survey completed by 719 telehealth nurses from 36 countries, more than 89% felt that telehealth technology tools should be included in the basic curricula of nursing programs.[36] Respondents also expressed a need for both clinical experiences in telehealth and instruction in the use of the technology and in telehealth principles. The majority of survey respondents—who worked in settings including hospitals, colleges, call centers, clinics, and the military and in such specialty areas as medical–surgical practice, chronic care, pediatric care, psychiatric care, and obstetric care—reported receiving their telehealth training from equipment vendors or through trial and error, as necessitated by their practice. Besides the questionable reliability of this type of preparation, such on-the-fly training may be influenced more by the value vendors place on the equipment's technical capabilities than by the needs and considerations of the patient and nurse.

For telehealth to move from marginal to broad acceptance, its use must be incorporated in nursing education. To practice effectively in the 21st century,

## Telehealth Resources

To learn more about telehealth nursing and the wide range of telehealth practices, the following is a selection of books and Web sites.

**BOOKS**

**Designing Telehealth for an Aging Population: A Human Factors Perspective**

*By Neil Charness, George Demiris, and Elizabeth Krupinski, Boca Raton, FL: CRC Press; 2011.* A nontechnical discussion of telehealth interventions, including home telehealth, for older adults; includes best practices, guidelines, and clinical examples, and focuses on the characteristics and abilities of the patient in relation to the design of the telehealth system.

**Telenursing**

*Sajeesh Kumar and Helen Snooks, eds, London: Springer-Verlag; 2011.* Provides an overview of the telenursing field; chapters, written by international experts, describe telehealth nursing practice in a variety of settings; includes suggested readings and references.

**Telemental Health: Clinical, Technical, and Administrative Foundations for Evidence-Based Practice**

*Kathleen Myers and Carolyn Turvey, eds, Waltham, MA, and London: Elsevier; 2012.* Leaders in the field review the background of telemental health and the concept of a "therapeutic space"—an environment in which a therapeutic relationship is established. Chapters focus on ethical, legal, regulatory, and business issues, and introduce telemental health applications used in specific populations.

**WEB SITES**

**American Telemedicine Association**

www.americantelemed.org

An international, multidisciplinary nonprofit organization that advocates "the use of advanced remote medical technologies . . . to improve quality, equity, and affordability" of health care systems throughout the world; provides information on telehealth equipment, standards, and guidelines, as well as case studies, videos, and information about accredited training programs.

**National Council of State Boards of Nursing**

www.ncsbn.org/nlc.htm

Provides information on the Nurse Licensure Compact (NLC), whose goal is to enable multistate licensure for nurses. Since 2000, 24 states have joined the NLC, enabling nurses living within these states to incorporate telehealth into their practices more easily. This site lists all NLC states, answers questions about licensure and mobility, and contains links to helpful resources.

**National Telehealth Policy Resource Center**

http://telehealthpolicy.us

Funded by the U.S. Department of Health and Human Services Office for the Advancement of Telehealth, the center provides comprehensive and up-to-date information on federal and state reimbursement policies, credentialing and prescribing information, and laws governing telehealth within each of the 50 states.

nursing students must understand telehealth's various uses and obtain clinical experience in telehealth settings.

## FORCES THAT DRIVE AND OBSTRUCT DISRUPTIVE INNOVATION

The fact that telehealth hasn't been quickly and effortlessly assimilated into the daily practice of nursing is not surprising. The general awareness of telehealth's effectiveness and positive impact on patient outcomes may not have kept pace with the rapidity of its development and sophistication. And translating research into practice is never easy. It may take decades for practitioners to begin using interventions that have been shown through research to be effective.[37] Like other disruptive innovations, telehealth may be subject to more rigorous scrutiny than traditional practice because it defies what we "know" and challenges our comfort level. As with all disruptive innovations, there are stakeholders who support it and those who resist it.

Factors currently driving the adoption of telehealth include rising health care costs, the public's desire to "age in place," patients' increasing comfort with technology, the new generation of nurses who expect to incorporate technology into their practices, and the profit motive of device manufacturers. Factors slowing more widespread adoption of telehealth include concerns about privacy, the fear of diminishing human contact in health care, and limited reimbursement.

Although privacy concerns may hinder acceptance, the same standards of confidentiality and protection of health information that govern traditional practice are applicable to telehealth practice. Even before personal health information was digitized, patients risked having paper records misplaced or misused. Within telehealth applications, such data actually benefit from additional oversight by federal agencies such as the Food and Drug Administration, the Federal Trade Commission, the Federal Communications Commission, and the Department of Health and Human Services.[38] While establishing human contact with patients is always a primary nursing concern, telehealth proponents are not looking to replace traditional care with telehealth, but rather to supplement it as a means of providing quality care in situations in which traditional approaches are not plausible. And numerous studies involving the use of telehealth technology to deliver home care to a variety of patient populations—including premature infants, mental health care patients, veterans enrolled in a tobacco cessation program, and patients with heart failure or chronic obstructive pulmonary disease—have shown patients to be satisfied with the relationships established and the care provided.[39-42] In fact, some patients and nurses report that the technology can make the nurse–patient relationship seem more, rather than less, intensive.[43] More difficult to overcome may be current reimbursement policies. Despite telehealth's extensive and effective use within the VHA, federal reimbursement policies have limited telehealth practice to designated sites (hospitals in remote areas, for example) or purposes (radiology, pathology, or cardiology readings, for example).[6] Barriers include varying state policies governing services reimbursed within public health programs; licensure and credentialing issues (when the patient and provider are in different states, for example); and the fact that most telehealth research has been based on patient and provider surveys, rather than on the gold standard of randomized controlled trials, often focusing on outcomes and satisfaction at the expense of potential cost savings.

## NURSE ACCEPTANCE OF TELEHEALTH

It may be useful for nurses to examine their own technology readiness as a means of assessing their likelihood to incorporate telehealth and other disruptive innovations. Parasuraman has described an index, consisting of both contributors to and inhibitors of technology readiness.[44] Contributors include optimism and innovativeness; inhibitors include discomfort and technologic insecurity. On the readiness scale, "thought leaders" and nurses who have a positive view of technology tend to rank higher than those who feel overwhelmed, not in control, or skeptical about technology.

A recent article examining telemedicine's uneven path to widespread acceptance proposed that successful integration of new health care technologies requires they be recognized as beneficial both to society (for example, in terms of cost-effectiveness or improved patient outcomes) and to the practitioners using them.[45] In the case of telehealth and its evolving assimilation, nurses and other health care professionals will need to believe that, when applied appropriately, telehealth can improve their practice and the lives of their patients (see *An Author's Call to Action*[46-48]). Its value depends a great deal on its acceptance, perception of usefulness, and ease of use by both patients and practitioners. ▼

For four additional continuing nursing education activities on the topic of telehealth, go to www.nursingcenter.com/ce.

*Janet Grady is vice president of academic affairs and chair of the Nursing and Health Sciences Division at the University of Pittsburgh in Johnstown, PA. Contact author: jgrady@pitt.edu.*
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## REFERENCES

1. Burns LR, et al. Strategic response by providers to specialty hospitals, ambulatory surgery centers, and retail clinics. *Popul Health Manag* 2011;14(2):69-77.

2. Christensen CM. *The innovator's dilemma: when new technologies cause great firms to fail*. Boston: Harvard Business Review Press; 1997.
3. Health Resources and Services Administration. *Telehealth*. n.d. http://www.hrsa.gov/ruralhealth/about/telehealth.
4. Dobkin BH, Dorsch A. The promise of mHealth: daily activity monitoring and outcome assessments by wearable sensors. *Neurorehabil Neural Repair* 2011;25(9):788-98.
5. Keckley PH, et al. *The mobile personal health record: technology-enabled self-care*. Washington, DC: Deloitte Center for Health Solutions; 2010. Issue brief; http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/Health%20Reform%20Issues%20Briefs/US_CHS_2010mPHR_091310.pdf.
6. American Telemedicine Association. *Telemedicine frequently asked questions (FAQs)*. 2012. http://www.americantelemed.org/learn/what-is-telemedicine/faqs.
7. Centers for Medicare and Medicaid Services. *National Health Expenditure (NHE) Data fact sheet* 2011. http://cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/NHE-Fact-Sheet.html.
8. Centers for Disease Control and Prevention. *Healthy communities: preventing chronic disease by activating grassroots change at a glance 2011*. 2011. http://www.cdc.gov/chronicdisease/resources/publications/aag/healthy_communities.htm.
9. Vincent GK, Velkoff VA. *The next four decades: the older population in the United States: 2010 to 2050. Population estimates and projections*. 2010 May. P25-1138. Current population reports; http://www.census.gov/prod/2010pubs/p25-1138.pdf.
10. Health Resources and Services Administration. *What are the reimbursement issues for telehealth?* n.d. http://www.hrsa.gov/healthit/toolbox/RuralHealthITtoolbox/Telehealth/whatarethereimbursement.html.
11. Brennan PF, et al. Technology-enhanced practice for patients with chronic cardiac disease: home implementation and evaluation. *Heart Lung* 2010;39(6 Suppl):S34-S46.
12. Woodside PA, et al. Use of telehealth to reduce heart failure readmissions in a rural community. *Heart Lung* 2011;40(4):371-2.
13. Minatodani DE, et al. Home telehealth: facilitators, barriers, and impact of nurse support among high-risk dialysis patients. *Telemed J E Health* 2013;19(8):573-8.
14. Woods LW, Snow SW. The impact of telehealth monitoring on acute care hospitalization rates and emergency department visit rates for patients using home health skilled nursing care. *Home Healthc Nurse* 2013;31(1):39-45.
15. Hicks LL, et al. The application of remote monitoring to improve health outcomes to a rural area. *Telemed J E Health* 2009;15(7):664-71.
16. Janna M, et al. Hypertension home telemonitoring: current evidence and recommendations for future studies. *Disease Management and Health Outcomes* 2007;15(1):19-31.
17. Inglis SC, et al. Which components of heart failure programmes are effective? A systematic review and meta-analysis of the outcomes of structured telephone support or telemonitoring as the primary component of chronic heart failure management in 8323 patients: abridged Cochrane Review. *Eur J Heart Fail* 2011;13(9):1028-40.
18. Young LB, et al. Impact of telemedicine intensive care unit coverage on patient outcomes: a systematic review and meta-analysis. *Arch Intern Med* 2011;171(6):498-506.
19. Morrison JL, et al. Clinical and economic outcomes of the electronic intensive care unit: results from two community hospitals. *Crit Care Med* 2010;38(1):2-8.
20. Popovich MJ, et al. A new ICU paradigm: intensivists as primary critical care physicians. *Cleve Clin J Med* 2011;78(10):697-700.
21. Sucher JF, et al. Robotic telepresence: a helpful adjunct that is viewed favorably by critically ill surgical patients. *Am J Surg* 2011;202(6):843-7.
22. Izquierdo R, et al. School-centered telemedicine for children with type 1 diabetes mellitus. *J Pediatr* 2009;155(3):374-9.
23. Bergman DA, et al. The use of telemedicine access to schools to facilitate expert assessment of children with asthma. *Int J Telemed Appl* 2008:159276.
24. Chan DS, et al. Internet-based home monitoring and education of children with asthma is comparable to ideal office-based care: results of a 1-year asthma in-home monitoring trial. *Pediatrics* 2007;119(3):569-78.
25. Nelson EL, Bui T. Rural telepsychology services for children and adolescents. *J Clin Psychol* 2010;66(5):490-501.
26. Edwards M, et al. Expanding use of telepractice in speech-language pathology and audiology. *Volta Rev* 2012;112(3):227-42.
27. Schweickert PA, et al. Telehealth stroke education for rural elderly Virginians. *Telemed J E Health* 2011;17(10):784-8.
28. Hilty DM, et al. The effectiveness of telemental health: a 2013 review. *Telemed J E Health* 2013;19(6):444-54.
29. Taber-Doughty T, et al. Standard care and telecare services: comparing the effectiveness of two service systems with consumers with intellectual disabilities. *J Intellect Disabil Res* 2010;54(9):843-59.
30. Cook PF, et al. Effects of telephone counseling on antipsychotic adherence and emergency department utilization. *Am J Manag Care* 2008;14(12):841-6.
31. Godleski L, et al. Outcomes of 98,609 U.S. Department of Veterans Affairs patients enrolled in telemental health services, 2006-2010. *Psychiatr Serv* 2012;63(4):383-5.
32. Glaser M, et al. Provider satisfaction and patient outcomes associated with a statewide prison telemedicine program in Louisiana. *Telemed J E Health* 2010;16(4):472-9.
33. Prensky M. Digital natives, digital immigrants. *On the Horizon* 2001;9(5). http://www.marcprensky.com/writing/Prensky%20-%20Digital%20Natives,%20Digital%20Immigrants%20-%20Part1.pdf.
34. Connors H, et al. HIT plants SEEDS in healthcare education. *Nurs Adm Q* 2007;31(2):129-33.
35. Grady JL. The Virtual Clinical Practicum: an innovative telehealth model for clinical nursing education. *Nurs Educ Perspect* 2011;32(3):189-94.
36. Grady JL, Schlachta-Fairchild L. Report of the 2004-2005 International Telenursing Survey. *Comput Inform Nurs* 2007;25(5):266-72.
37. Agency for Healthcare Research and Quality (AHRQ). *Translating research into practice (TRIP)-II*. Rockville, MD; 2001 Mar. No. 01-P017. http://www.ahrq.gov/research/findings/factsheets/translating/tripfac/index.html#.
38. National Telehealth Policy Resource Center. *mHealth laws and regulations*. Center for Connected Health Policy. 2013. http://telehealthpolicy.us/mhealth-laws-and-regulations.
39. Battaglia C, et al. Building a tobacco cessation telehealth care management program for veterans with posttraumatic stress disorder. *J Am Psychiatr Nurses Assoc* 2013;19(2):78-91.
40. Gellis ZD, et al. Outcomes of a telehealth intervention for homebound older adults with heart or chronic respiratory failure: a randomized controlled trial. *Gerontologist* 2012;52(4):541-52.
41. Gund A, et al. A randomized controlled study about the use of eHealth in the home health care of premature infants. *BMC Med Inform Decis Mak* 2013;13:22.
42. Lingley-Pottie P, et al. Barriers to mental health care: perceived delivery system differences. *ANS Adv Nurs Sci* 2013;36(1):51-61.
43. Pols J. The heart of the matter. About good nursing and telecare. *Health Care Anal* 2010;18(4):374-88.
44. Parasuraman A. Technology readiness index (TRI): a multiple-item scale to measure readiness to embrace new technologies. *Journal of Service Research: JSR* 2000;2(4):307-20.
45. Zanaboni P, Wootton R. Adoption of telemedicine: from pilot stage to routine delivery. *BMC Med Inform Decis Mak* 2012;12:1.
46. Rogers EM. *Diffusion of innovations*. 5th ed. New York City: Free Press; 2003.
47. Deloitte Center for Health Solutions. *2008 survey of health care consumers. Executive summary*. Washington, DC; 2008. http://www.deloitte.com/view/en_US/us/Industries/health-care-providers/center-for-health-solutions/cf04da85078ab310VgnVCM2000003356f70aRCRD.htm#.
48. Ricciardi L, et al. A national action plan to support consumer engagement via e-health. *Health Aff (Millwood)* 2013;32(2):376-84.