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Authors
Tuot, Delphine S
Boulware, L Ebony

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Telehealth Applications to Enhance Chronic Kidney Disease Knowledge and Awareness among Patients and Providers

Delphine S. Tuot, MDCM, MAS[1,2] and **L. Ebony Boulware, MD, MPH**[3]

[1]Division of Nephrology, Zuckerberg San Francisco General Hospital, University of California, San Francisco, San Francisco, CA

[2]Center for Innovation in Access and Quality, University of California, San Francisco, San Francisco, CA

[3]Division of General Internal Medicine, Duke University School of Medicine, Durham, NC

Abstract

Chronic kidney disease (CKD) affects 13% of the U.S. adult population, causes excess mortality, and is associated with significant socio-demographic disparities. Optimal CKD management slows progression of disease and reduces cardiovascular-related outcomes. Resources for patients and primary care providers, major stakeholders in preventive CKD care, are critically needed to enhance understanding of the disease and to optimize CKD health, particularly because of the asymptomatic nature of kidney disease. Telehealth is defined as the use of electronic communication and telecommunications technology to support long-distance clinical health care, patient and professional health-related education, public health and health administration. It provides new opportunities to enhance awareness and understanding among these important stakeholders. This review will examine the role of telehealth within existing educational theories, identify telehealth applications that can enhance CKD knowledge and behavior change among patients and primary care providers, and examine the advantages and disadvantages of telehealth versus usual modalities for education.

Keywords

telehealth; CKD; education; chronic kidney disease

Telehealth is defined by US Department of Health and Human Services as the use of electronic communication and telecommunications technology to support long-distance clinical health care, patient and professional health-related education, public health and health administration.[1] The goal of telehealth is to optimize the delivery of health care,

Correspondence: Delphine Tuot, MDCM, MAS, SFGH Renal Center, 1001 Potrero Ave. Bldg 100, Room 342. San Francisco, CA. 94110, Delphine.tuot@ucsf.edu, Tel: 415.206.3784, Fax: 415.282.8182.

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particularly in underserved areas, while achieving the quadruple aim,[2] with enhanced health outcomes at the individual and population level, improved provider and patient experience of care at reduced cost. Telehealth applications include: digital media, short messaging service (text messaging), mobile applications, interactive voice response, video conferencing, asynchronous store-and-forward communication, and wireless communication using peripheral objects such as scales, BP cuffs, glucometers.

Chronic kidney disease (CKD) is a major public health concern, affecting an estimated 13% of the U.S. population.[3] Better management of CKD can slow progression of renal dysfunction, prevent metabolic complications, and reduce cardiovascular-related outcomes.[4] Patient awareness of CKD and engagement with treatment and management plans is crucial to achieving better health outcomes for this population. Provider identification of CKD and its complications, understanding of treatment options, and knowledge about when to refer to nephrologists are also critical.[5,6] Resources for patients and primary care providers, major stakeholders in CKD care, are critically needed to optimize CKD health. Awareness of CKD and its risk factors among patients has been persistently low.[7] Recent estimates of individual CKD awareness among diverse populations range from 6-12%, with higher levels of awareness among individuals with more severe kidney disease and other cardiovascular comorbidities.[3,8,9] Primary care provider recognition of CKD is also persistently suboptimal. Estimates of primary care provider recognition of kidney disease range from 6-50%, influenced by severity of CKD, primary care specialty, and experience. Studies have shown low awareness is associated with poor guideline concordant CKD care delivery,[10] especially among minorities.[11]

Telehealth applications afford new opportunities to enhance awareness among these important stakeholders. This review will examine the role of telehealth within existing educational theories, identify telehealth applications that can enhance CKD knowledge and behavior change among patients and primary care providers, and examine the advantages and disadvantages of telehealth versus usual modalities for education.

How telehealth fits within educational theory

It is well understood that successful health educational interventions incorporate content as well as a strategy to facilitate the process of change.[12] This is consistent with Kolb's theory of experiential learning, which posits that most adult learning is gained through experience and engagement.[13] Kolb's theory describes a 'cycle' of learning divided into two parts: knowing and understanding. Knowledge may come from abstract conceptualization (i.e., reading, lectures/classes) as well as concrete experience (i.e., simulations or real patient encounters). Understanding is the ability to apply such knowledge, and is reached through reflective observation or active experimentation. It is this "learning by doing" that enables adult learners, including patients and providers, to incorporate new knowledge into actions and enact behavioral change to achieve desired outcomes. Because they provide flexible and adaptable platforms for education, telehealth applications can be uniquely leveraged to provide knowledge via diverse modalities to reach individuals with differing learning styles and preferences, and provide understanding, encouraging subsequent behavior change through engagement with others, iterative self-reflection, and trial and error.

Telehealth applications for patient education and self-management

Web-based applications

The internet has become one of the most important sources of health information for patients and their families. Recent studies suggest that most adults seek health information online.[14] Many digital educational materials have been available on-line for patients with CKD by professional societies and patient advocacy groups, satisfying the knowledge component of Kolb's learning cycle. Systematic reviews of these educational materials suggest that most are adequate for use as determined by validated instruments, though relatively few are outstanding and many are written at a literacy level too high to be appreciated by most patients with CKD.[15,16] A well-established repository of educational materials for patients with kidney disease is the National Kidney Disease Education Program (NKDEP), which sponsors an initiative to promote kidney disease education via digital media. The NKDEP website contains several links to kidney disease educational topics (www.nkdep.nih.gov), including pamphlets available for download. Importantly, the website content is directed at an elementary school level reading capability, and has been modified based on an iterative process of review.[17] This same iterative process was used in the development of the Safe Kidney Care Cohort study website (www.safekidneycare.org) which provides information to patients, family members and providers, on topics relevant to patient safety in CKD.[18] Health education videos may also be found on these websites as adjuncts to the written educational materials, or they may stand on their own on websites such as YouTube.

Virtual support groups

The Internet has also become a resource for the development of social support systems for those affected by chronic diseases, including kidney disease.[19] Internet support groups with videoconferencing and virtual group education classes, facilitated by health educators or peer leaders, deliver chronic disease education and promote collaborative problem solving, self-reflection and conceptualization. While these types of classes have not yet been tried for patients with CKD, a trial comparing virtual diabetes classes to in-person classes demonstrated equal improvements in glycemic control among participants in both groups (decrease in glycosylated hemoglobin of 0.4-0.5% groups).[20] Importantly, these classes facilitate both the knowledge and understanding components of Kolb's learning cycle, and they have been well received by older individuals with chronic illnesses, who report appreciating the benefits of group learning without enduring the burden of travel.[21]

Text Messaging

Short message service (SMS) text messaging has been the most extensively studied telehealth application in chronic diseases, though it is still a burgeoning area for research for individuals with CKD. Text messages can deliver succinct educational reminders to patients, prompting them to review previously learned material, as well as web links with access to more in-depth educational content.[22] Standard educational messages satisfy the knowledge component of the Kolb learning cycle, and may be sent in bulk via one-way interactions to many patients simultaneously. More tailored two-way text message communications can also be sent to individual patients by health workers or health educators, allowing to not only self-reflect but also apply their knowledge, completing the Kolb learning cycle..[23] One challenge of text message mediated education lies in the need to transmit substantial education with few words or written characters. Nonetheless, studies of text-based interventions have been associated with improved medication adherence,[24] greater tobacco cessation,[25] increased weight loss among obese adults,[26] and enhanced diabetic control.[27] Still, there is a paucity of information about the best way to tailor text-based educational programs for different subgroups of individuals, based on age, gender, socioeconomic status, or type of chronic disease. In particular, more research is needed to determine the utility of text-based services in improving disease outcomes among CKD populations, and to understand their acceptability to patients with CKD. A recent study examining patient preferences for technologies to impart education about the safety of medications in pre-dialysis CKD found that the SMS texting-based platform was the least preferred by participants, compared with web-based or personal digital assistant-based applications.[28]

Interactive voice response (IVR)

IVR-based applications have great potential for delivery of CKD education, as they rely on simple-to-use telephone technology, are multilingual, and require minimal literacy or numeracy skills. Phone calls often contain educational messages about 1-2 topics, followed by vignettes that highlight self-management behaviors that encourage patients to overcome barriers to engage in their own health and decrease risk of morbidity. Patients use a telephone keypad to respond to queries, encouraging some self-reflection and engagement with the educational material. They may also be used to generate reports for health care teams or health educators to follow-up with patients to ensure understanding. IVR has been shown to enhance self-efficacy, improve quality of life, and increase activity among low-income patients with diabetes[29] and it is currently being tested among low-income patients with CKD.[30]

Mobile Health Applications

Chronic disease education programs are increasingly adopting mobile health applications to support self-management practices, reinforcing both the knowledge and understanding components of Kolb’s educational cycle. Many of these programs rely on wireless communication among peripheral objects (i.e., scales, blood pressure cuffs, glucometers) and smartphones, allowing patients to view their home-recorded data (i.e., blood pressure, weight, eating habits) and potentially submit them to a health care provider for clinical care. In the TASMIN-SR trial,, patients with hypertension and early CKD randomly assigned to receive blood pressure self-monitoring and self-titration of their blood pressure medications experienced an 8.4 mmHg (95%CI 1.1-15.8 mmHg) decrease in systolic blood pressure compared to those who received usual care.[31] Little is known whether patients with more advanced CKD will experience additional kidney health benefits if mobile health applications are incorporated into usual CKD care. In one recent pilot study, ,researchers examined the integration of a smart-phone self-management support program that supported 4 behavioral elements (monitoring blood pressure, managing medications, assessing symptoms, and tracking selected laboratory test results) into usual CKD care among 47 study participants. User adherence and satisfaction with the program were high, with >80% of users performing routine assessments with the application, with notable engagement around medication reconciliation. In addition to experiencing a mean reduction in home systolic blood pressure of −3.4mmHg (−5.0 to −1.8 mmHg), patients indicated that they felt more in-control of their CKD after using the application. [32]

Benefits and drawbacks of patient telehealth education

The biggest benefit associated with telehealth for patient education lies in the incredible reach of mobile phone technology, which can be used for all of the aforementioned telehealth platforms. Recent U.S. estimates suggest that 90% adults own a mobile device,[33] and that nearly 60% of them go online with their phones.[34] Additionally, studies suggest that African American and English-speaking Latinos are the most active users of the Mobile Web in the U.S.[35] This has direct relevance to CKD education, since racial/ethnic minorities are disproportionately affected by kidney disease and suffer worse outcomes than their white counterparts.[36,37] Compared to paper-based or in-person health education with a provider or health educator, telehealth educational applications are also more flexible and adaptable to learner preferences. They can include both visual and auditory modalities of content delivery. Additionally, many applications (virtual support groups, IVR, mobile health applications) offer more opportunity for engagement with the material and reinforcement of knowledge, for example, with knowledge assessment tests and games that emphasize educational concepts.[38] Lastly, all of these modalities occur outside the traditional health care encounter, allowing healthcare professionals the opportunity to reinforce key ideas in context during a medical visit, but not necessarily require the time to fully explain concepts. This paradigm underlies the recent trend of ”flipped classrooms” in higher education, which rely on the delivery of instructional content outside of the classroom (i.e., on-line lecture, textbook reading) and participation in engagement and assimilation activities during class (i.e., quizzes, homework, discussion) with peer support and instructor guidance.[39]

One drawback of education delivered via telehealth may be that it occurs outside the healthcare encounter, potentially leading patients to infer that educational content is not important enough to be prioritized by providers. Additionally, compared to in-person educational delivery, telehealth programs lack the opportunity for patients to immediately ask questions of their providers or educators. While most applications encourage patients to write down their questions/concerns to bring to their next provider visit, only the most motivated patients will do so. Nonetheless, evidence has shown that clinic-based provider education about CKD is often poorly prioritized,[40] particularly in primary care, where providers lack time and resources to deliver education in a comprehensive fashion.[41] Hence, telehealth education may represent a highly promising adjunct to provider-delivered CKD education. In particular, many barriers could be overcome if patients used a secure messaging application to write down their questions when participating in telehealth education. Not only would this increase patient engagement with the learning process, but it could also encourage providers to discuss particular educational topics at the patient’s next clinic visit.

Additional drawbacks of telehealth education include potential challenges associated with data privacy/security and governance, provider mistrust in clinical content delivered via telehealth applications, and the continued existence of a “digital divide” between persons with different age, education levels, and baseline self-efficacy.[42] The “divide” is particularly striking among older individuals who demonstrate a lower predilection for using telehealth applications to learn about their chronic diseases. This is of particular relevance for kidney education, as CKD disproportionately affects older individuals. Notwithstanding this limitation, the young and middle-aged populations of today are the CKD patients of tomorrow, and the demographics of those who will be willing to use telehealth educational modalities for CKD care in the future, may soon change. It is possible, a digital divide may still persist, however, especially among individuals who are less technology savvy or computer literate.[43]

Telehealth applications for primary care provider (PCP) education

Store and Forward communication

Electronic Consultations (eConsults) are asynchronous electronic communications between health care providers that occur within the context of a shared electronic health record or a secure web-based platform, With an eConsult, a provider, most often a PCP, can query a consultant for guidance about patient care with the expectation that the consultant will respond in a timely fashion. The consultant can provide pre-consultative recommendations regarding further diagnostic evaluation,, advice on longitudinal management, or suggest patients attend a face-to-face specialty care visit. Through streamlined and iterative communication, eConsult systems have enhanced patients' experiences with specialty care delivery through decreased wait times for in-person specialty visits,[44] avoided travel for unnecessary specialist visits,[45] and improved care coordination at the primary care specialty care interface.[46]

While perhaps not its original intent, eConsults have also been praised for their educational value, in particular their ability to enrich practice based learning among primary care providers.[47] Surveys of PCPs who use eConsults across diverse heathcare delivery systems have illustrated that PCPs perceive gaining valuable knowledge in new medical disciplines, discovering new diagnoses they were previously unfamiliar with, and refreshing their knowledge of areas in which they had not worked for some time.[48,49] This held true among 49 PCPs who participated in one nephrology-specific pilot eConsult program, where consult questions were most often related to management of stage 3 CKD, medication-dosing among patients with low estimated glomerular filtration rates, abnormal imaging findings of the GU tract, and workup of electrolyte disorders.[50] Less recognized, but equally important using the lens of educational theory, are eConsult programs' abilities to promote self-reflection of PCPs as they craft clinical questions and digest specialist responses.

The educational benefits of eConsults to PCPs are highly variable, potentially influenced by PCP's comfort level with technology or computer-literacy, as well as the quality of specialist communication. Further, providing non-visit consultative communication has potential implications for both medical liability and training. At the present time, very little information exists on the extent of liability in this area. However, many legal jurisdictions have deemed eConsults to be within the specialists' usual scope of practice, precluding additional liability concerns. Additionally, while some specialists are likely better suited to respond to eConsults than others, most specialists receive no formal training or guidance in how to provide non-visit-based consultations.[51] Data from interviews with eConsult stakeholders and end-users suggest that highly rated eConsultants are experienced clinicians who can aptly respond to potentially unclear referral requests, enjoy educating colleagues, and have respect for PCPs.[46] Even these specialists could benefit from feedback and ongoing training to ensure sustained educational benefit for PCPs.

Videoconferencing

The Extension for Community Healthcare Outcomes (Project ECHO) telehealth application uses video teleconferencing, case-based learning, and other didactics to educate PCPs in rural areas. The project initially focused on improving primary care management of hepatitis C and then expanded to other chronic conditions.[52] In this model, primary care teams are linked to a multidisciplinary specialist team via videoconferencing. Cases are presented by the PCPs to the specialist team, enabling them to participate in co-management. The case discussions reach all PCPs who have connected to promote peer learning and allow any provider to ask questions of the specialist team, promoting engagement with the material. A randomized controlled trial of this application found similar clinical outcomes for patients with hepatitis C seen by hepatologists versus those treated at ECHO sites by PCPs with high levels of PCP satisfaction.[53] While not studied as extensively, similar teleconferences have been used to discuss nephrology cases and impart renal education to nurses and case managers caring for patients within some locations of the Indian Health Service.[54]

It is important to note that interactive teleconferencing does have challenges. First and foremost, it requires that all participating health care professionals be available at the same time. This is sometimes daunting and inefficient for health care professionals whose schedules are not always predictable due to clinical care. It also poses a challenge to technical coordinators, who must ensure that adequate broadband channels are available on the telecommunications circuit at the same time at all participating facilities.[55]

Web-based applications for Health Professionals

The internet is an important source of specialty health information for providers, with websites that disseminate content knowledge (i.e., Uptodate.com), as well as websites that promote case-based nephrology learning (i.e. Renal Fellow's Network, http://renalfellow.blogspot.com). Use of Twitter and other social media outlets to promote provider education is relatively new in the field of nephrology, but they have been used by professional societies to increase engagement with nephrology among PCPs and nephrology trainees. NephMadness (http://www.tourneytopia.com/ajkd/nephmadness), for example, is a social media and educational campaign directed at trainees that highlights important topics in nephrology in a tournament bracket format, encouraging engagement and experimental with the educational material. By encouraging providers to tweet, blog and promote their nephrology topics of greatest interest over a month-long period, NephMadness aims to reinforce uptake and durability of content knowledge and to highlight the dynamic nature of the field. The success of these strategies to impart knowledge among nephrology professionals and their potential to expand awareness and knowledge among primary care providers suggest that this remains an important area to study.[56]

Conclusion

Telehealth is largely nascent in the field of nephrology but early examples illustrate great promise to increase general awareness and understanding of kidney disease among patients and to enhance renal knowledge and optimal CKD management among primary care providers. With suboptimal levels of CKD awareness among both of these important stakeholder groups, the use of telehealth applications and other health information technology tools for education rightfully engender great excitement. Care will be needed to ensure that these tools are widely accessible, designed for individuals with all levels of e-literacy. Further, rigorous evaluation will be critical to determine benefits relative to traditional educational modalities, and to identify and mitigate unanticipated consequences. Nephrology education is gearing up for the future—fasten your seatbelts!

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Clinical Summary

- Telehealth applications provide flexible and adaptable platforms that can be uniquely leveraged to enhance knowledge via diverse modalities to reach individuals with differing learning styles and preferences, and to encourage behavior change through engagement, iterative self-reflection, and trial and error.
- Telehealth is largely nascent in the field of nephrology but early examples leveraging digital media, videoconferencing, mobile applications and store-and-forward technology, illustrate great promise to increase general awareness and understanding of kidney disease among patients and to enhance renal knowledge and optimal CKD management among primary care providers.
- Efforts to ensure that telehealth applications are widely accessible and designed for individuals with all levels of e-literacy will be needed. Rigorous evaluation will be critical to determine benefits relative to traditional educational modalities, and to identify and mitigate unanticipated consequences.

Table

. Types of Telehealth applications, definitions and relationship to Kolb's learning theory, current and potential future use among nephrology patients and providers.

Telehealth Application	Definition	Kolb's learning theory	Current uses	Potential Future Uses
Web-based applications	Internet website with educational text or links to educational materials	Knowledge	Patient: education about CKD	Patient: inclusion in self-management training and risk factor education for CKD prevention
			Provider: education about CKD diagnosis and management	Provider: nephrology clinical support tools (protocols, treatment algorithms)
Video-conferencing	Synchronous discussion among peers that are physically distant, broadcast over video	Knowledge and Understanding	Patient: awareness of CKD and empowerment with virtual support groups	Patient: eHealth communities for psychosocial support, including those around kidney donation
			Provider: self-efficacy for CKD management	Provider: intra-professional nephrology education during training
Text messaging	Mobile phone based text messages delivered over telephone cables or broadband	Knowledge	Patient: CKD self-management (medication adherence, appointment reminders) with one-way communication	Patient: engagement with health team with two-way communication
Interactive Voice Response	Telephone based automated voice recognition system that delivers/captures personalized data	Knowledge; limited Understanding	Patient: education about CKD and healthy lifestyles	Patient: self-management (medication titration)
Mobile Applications	Wireless communication among objects that provide individualized data	Knowledge and Understanding	Patient: self-management with personal data	Patient: education about community resources
Store and forward communication	Asynchronous communication using text and/or pictures	Knowledge and Understanding	Provider: asynchronous eConsultation	Provider: proactive preventive consultation