Health Literacy and Internet- and Mobile App-based Health Services: A Systematic Review of the Literature

**Henna Kim**  
School of Information  
University of Texas at Austin  
Austin, TX 78701-1213  
henna@utexas.edu

**Bo Xie**  
School of Nursing & School of Information  
University of Texas at Austin  
Austin, TX 78701-1213  
boxie@utexas.edu

**ABSTRACT**
As information and communication technologies (ICTs) are increasingly used to support and deliver health care, access to Internet-based health services is enabling consumers to play an active role in their own health care. Today, this requires consumers to have a certain degree of health literacy within the context of e-health. To understand the extent to which existing studies have addressed health literacy within the context of Internet-based services, we conducted a systematic review of the literature. We performed four rounds of selection to identify relevant publications: database selection, keyword search, screening titles and abstracts, and screening the full text. This process produced a final sample of 42 publications. The findings from our review provide insights into how health literacy has been, and should be, addressed in the e-health era.

**Keywords**
Health literacy, e-health, health apps, health information seeking behavior.

**INTRODUCTION**
Information and communication technologies (ICTs) are now widely used to support and deliver health care for patients and the general public. Individuals are expected to interact with health systems to engage in appropriate self-care (Fagnano, Halterman, Conn, & Shone, 2012). Nevertheless, evidence suggests that individuals with low health literacy have difficulties in effectively utilizing and interacting with technologies in health care settings (Jensen, King, Davis, & Guntzviller, 2010).

Health literacy can be defined as “the degree to which individuals have the capability to obtain, process, and understand basic health information and services needed to make appropriate health decisions” (Ratzan & Parker, 2000). Low health literacy is related to delayed diagnoses, poor adherence to treatment regimens, increased morbidity and mortality (Paasche-Orlow & Wolf, 2007), and increased rates of hospitalization and poor health outcomes (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011).

While ICTs provide new opportunities for accessing health information and self-management of health conditions, few studies have systematically reviewed the relationship between health literacy and use of Internet-based health services. To address this gap in the literature, we conducted a systematic review to examine whether existing studies have addressed health literacy within the context of Internet-based services, and if so, how they have done so, including both web-based and mobile applications (apps). This review is intended to provide insights into how health literacy for health care should be addressed in technology environments.

**LITERATURE REVIEW**

**Health Information Technology and Health Literacy**
The term *e-health* refers to health services and information delivered or enhanced through a spectrum of ICTs such as computers and the Internet (Eysenbach, 2001). Thus, e-health includes a wide range of IT services—Internet-based, mobile app-based, and telehealth (Demiris et al., 2008). Health care can be improved by effective use of e-health tools that have the potential to help people manage their own health care, communicate with their health care providers and support networks, obtain health information, make health decisions, and develop and sustain healthy lifestyles (Demiris et al., 2008). However, with the increasing adoption of health IT services, individuals with limited health literacy—and particularly with limited e-health literacy—experience disparities in health and access to health care resources (Sudore et al., 2006). Compared with individuals who have high health literacy, those with low health literacy tend to use fewer preventive services and less health information technology, contributing to their poor health outcomes (Herndon, Chaney, & Carden, 2011).
Online Health Information Seeking and Health Literacy
The Internet has become an important source for health information. Evidence suggests that socio-demographic characteristics are associated with health literacy as well as access to and use of the Internet for health information (Xiao, Sharman, Rao, & Upadhyaya, 2014). For example, individuals age 65 years or older, men, African Americans or Hispanics, non-English speakers, and people who have low incomes, as well as those with less than high school education, are more likely to have lower health literacy than their respective counterparts (Cutilli & Bennett, 2009). Moreover, individuals with low health literacy are less likely to use the Internet to access health information than those with high health literacy (Jensen et al., 2010). Individuals’ low health literacy is a significant barrier that constrains their Internet use and prevents adequate access to health information.

METHOD
To examine whether existing studies have explored the relationship between health literacy and Internet-based services, and if so, how, we conducted a systematic review of the literature published since 2010. We performed multiple rounds of data selection in February–March 2014.

Round 1: Database Selection
Electronic databases available through the libraries of the University of Texas at Austin were used to perform the search queries. We selected 13 subjects most relevant to our topic: Communication, Communication Sciences and Disorders, Communication Studies, Computer Sciences, Consumer Health, Education, Educational Psychology, Library and Information Science, Medicine, Nursing, Psychology, Social Work, and Sociology. From the databases listed under the 13 subjects, we selected 25 databases relevant to our investigation: ACM Digital Library; Annual Reviews Online; CINAHL; Cochrane Library; Communication & Mass Media Complete; EdITLib; Emerald Insight; ERIC; Health Source: Consumer Edition; Health Source: Nursing/Academic Edition; IEEE Xplore; Information Science & Technology Abstracts; Internet & Personal Computing Abstracts; INSPEC; Library Literature & Information Science Full Text; Library, Information Science & Technology Abstracts; MEDLINE; Psychology & Behavioral Sciences Collection; PsycINFO; PubMed; SAGE Premier; Sociological Abstracts; Social Services Abstracts; Web of Science; and Wiley Online Library.

Round 2: Keyword Search
Search keywords consisted of two sets focusing on health literacy and ICTs. The following shows the combination of search keywords used in the selected databases:

(“health literacy” OR “ehealth literacy” OR “e-health literacy” OR “health disparity” OR “health disparities”) AND (technology OR technologies OR computer* OR internet OR web OR “mobile app*” OR “mobile application*” OR “mobile device*” OR smartphone* OR “social media” OR “social computing” OR “social networking” OR facebook OR twitter OR youtube OR myspace OR patientslikeme OR webmd).

Titles and abstracts of academic publications in English, including peer-reviewed journal articles and conference proceedings papers, were searched in the 25 databases. This yielded 1,106 publications. After duplicates were removed, 654 remained.

Round 3: Screening the Titles and Abstracts
The titles and abstracts of the 654 publications were screened based on the following criteria: (1) Studies addressing digital services through the Internet and/or mobile apps for health-related purposes were included; those not focusing on the Internet or mobile apps or for health-related purposes were excluded. (2) Studies targeting patients or the general public were included; those targeting health care providers or medical students were excluded. (3) Studies conducted in the U.S. were included; those conducted in other national contexts were excluded. After titles and abstracts were screened, 58 publications remained for further analysis.

Round 4: Screening the Full Text
The full text of each of the 58 publications was further examined to determine whether the article met the final criterion of reporting original, empirical research data. Sixteen articles were thus excluded, leaving a total of 42 publications in the final sample. The search steps and results from each round of the searches are illustrated in Figure 1.

RESULTS
Table 1 presents the characteristics of the final 42 empirical studies addressing ICT use in relation to health literacy.

With regard to target populations, 20 studies (48%) investigated a variety of groups with varying demographics (age, race, and economic status) and health literacy level. Sixteen studies investigated patient groups such as individuals with chronic or acute health conditions, as well as caregivers.
Development and Evaluation of Digital Services

Websites
Three studies focused on the development and evaluation of websites targeting a specific health condition. These studies suggested strategies to improve interface design and functions for low-literate users. They include: simplicity in design (e.g., limited use of colors, one font type and size), display of understandable textual information (e.g., avoid lengthy text and medical jargon), and technical features (e.g., limited use of pop-ups). Using concrete and realistic images with clear captions was considered a more effective way to improve the understanding of educational materials than using text alone. It was also recommended that web design address usability issues associated with navigation and learnability as well as functions to facilitate patient-provider communication.

Web-based apps
Three studies developed web-based apps for adults with limited health literacy and evaluated the effectiveness of the apps in usability tests and in a controlled trial. Apps in two of the studies were developed to help users comprehend textual medical and scientific content; usability tests showed that certain functions, including a dictionary and links to more information on the apps, helped users understand medical, English, and scientific terms, decreasing reading time and increasing comprehension. Another app for text-to-speech engines highlighted natural sentence constructions in the real world, instead of having to touch the screen responding to listening a few words.

Mobile apps
Five studies focused on the development and evaluation of touchscreen-based apps on Kiosks and tablets. One study assessed an app for an asthma screening questionnaire among caregivers with limited health literacy and English proficiency; the other four studies evaluated the effect of mobile apps on patient education in clinical trials, interventions, and user participation in community or clinical settings. All five studies demonstrated that touchscreen apps could serve individuals with limited health literacy. Apps programmed with computer-animated characters, text, and graphics were acceptable and easy to use, providing health communication and education to populations with low health literacy. A kiosk developed for interactive MedlinePlus tutorials increased patients’ health literacy by providing reliable information.

Development and Evaluation of Health Literacy Measurement Tools
Two studies evaluated a new health literacy measurement tool on tablets, the Talking Touchscreen. These studies suggest that such self-administered tools have the potential to reduce staff burden and costs, interview bias, and feelings of embarrassment among individuals with low health literacy.
Interventions to Improve Health Literacy
Six intervention studies investigated implications for improving health literacy via the use of websites or online apps. All six educational interventions served low-literacy adults and older adults, increasing their knowledge about their health conditions, their use of computers and the Web, search skills, confidence in finding and using Internet health information resources, and use of health information in their own health care.

Online Health Information Seeking Behaviors
Eleven studies explored online information-seeking behaviors related to health literacy. Key findings across these studies were identified in terms of the use of Internet/computer and multiple sources (e.g., Internet and health professionals) for health information, self-efficacy, and the adoption of online services in online health information seeking related to health literacy. Several studies showed that individuals with low health literacy were less likely to use computers and Internet technology (e.g., email, search engines, and online patient portals). Individuals with low health literacy were less likely to obtain information from multiple sources and less likely to use the Internet as their primary information source. Self-efficacy was important: people might not be confident about their own abilities to find health information on the Internet or were unsure about the quality of information on the Internet even if they had high levels of health literacy. Patients who had a high level of health literacy were more likely to adopt personal health record technologies than those who had a low level of health literacy.

DISCUSSION
Our systematic review has important implications for addressing the challenges in using digital health services for individuals with varying degrees of health literacy. Our findings support the promotion of features such as simple interface design, visual information, animations, text-to-speech engines, dictionaries, and links to more online resources in order to serve people with low health literacy across different types of service platforms. Health-related organizations should make efforts to provide health information at recommended reading levels. Such features of digital services should be able to help individuals with low health literacy utilize health information technologies.

If interventions offer online health services tailored to individuals’ health literacy levels, they must first assess those individuals’ health and technology literacy. Educational strategies can be effective in teaching patients how to use ICTs and Internet-based health services. Using mobile apps for not only tablets but also smartphones can be an appropriate approach to deliver health information and services tailored to individuals with limited health literacy.

REFERENCES


