



The Interplay Between Health Literacy and Digital Health Tools: Implications for Enhancing Patient Engagement and Public Health Outcomes in Diverse Populations

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Abstract

Background: The integration of digital technologies in healthcare has the potential to improve patient engagement and health outcomes. However, disparities in digital literacy can exacerbate existing health inequities. This study aims to explore the intersection of health literacy and digital tools, focusing on the implications for patient engagement and public health.

Methods: A comprehensive scoping review was conducted, utilizing databases such as Medline, Embase, Scopus, and Google Scholar. The search included terms related to digital health literacy, telehealth, vulnerable populations, and health outcomes. The review emphasized recent, well-cited studies published in English.

Results: The findings indicate that digital health literacy, often conflated with eHealth and telehealth literacy, varies significantly across demographic groups, particularly impacting older adults, minorities, and those with lower educational attainment. Many individuals exhibit a lack of confidence in navigating digital health resources, which can hinder their engagement with healthcare services. Despite the proliferation of digital health tools, a substantial portion of the population remains disconnected due to inadequate digital literacy, reinforcing the "digital divide."

Conclusion: Enhancing digital health literacy is essential for mitigating health disparities and improving patient engagement in the digital age. Future research should prioritize the development of targeted interventions to foster digital literacy among underrepresented populations, ensuring equitable access to digital health resources. The need for inclusive strategies that consider patients' perspectives is paramount in bridging the digital gap.

Keywords: Digital Health Literacy, Health Equity, Patient Engagement, Telehealth, Vulnerable Populations

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1. Introduction

Digital technologies are revolutionizing health, healthcare, and public health systems globally, with significant potential to enhance both population and individual health and well-being. Technological advancements have enabled a broader range of contacts between users and medical providers or healthcare systems. Accessing health information and scheduling appointments online, engaging in virtual consultations, using asynchronous digital communication with healthcare providers, employing health-tracking wearables, and using self-monitoring gadgets are all contemporary technologies accessible today [1]. These systems provide several benefits; they enable the scaling of information processing, streamline administrative procedures, and enhance access to healthcare via virtual consultations. Utilizing a video or an online appointment application allows clinicians to assist several individuals concurrently, eliminating the need for travel for in-person consultations that do not need physical examinations or testing [2]. Nonetheless, inadequate governance of digital revolutions may result in disparate global repercussions, exacerbating health inequality. This illustrates the paradox of digital health we currently encounter while digital health innovations possess the potential to revolutionize care delivery for underserved populations (such as those in rural areas, elderly patients, minorities, or individuals with disabilities), these groups are often marginalized from the digital realm due to their sociodemographic attributes [3,4].

The digital change, ostensibly beneficial, may exacerbate existing inequities in healthcare access, creating a "digital divide." The phrase "digital divide" refers to the many societal disparities in access to and use of digital devices and services, particularly personal computers and smartphones, as well as the capability to access the Internet, including both physical connectivity and user-friendliness. As healthcare increasingly depends on technology-driven technologies, the digital gap is likely to intensify current inequities in healthcare access [5-7].

Digital technologies must be acknowledged now as a crucial predictor of health, akin to socioeconomic level, income, education, age, race, ethnicity, and gender [4]. Despite the global population's proximity to mobile broadband and internet services, and the widespread use of mobile phones, barely fifty percent of people globally utilize the internet and possess fundamental information and communications technology skills. The disparity between internet access and use indicates the presence of several obstacles to substantial access that must be resolved, particularly the deficiency in education related to science, technology, engineering, and mathematics, as well as digital skills and digital literacy [8,9].

Digital literacy refers to the diverse capabilities of individuals, including youngsters and adults, to use digital technology and comprehend their associated threats. It encompasses both the technical abilities required to use and access the internet and the ability to critically and comfortably interact with the online world. Digital literacy significantly interacts with other intermediate health indicators and socioeconomic determinants, affecting access to digital health resources and broader health equality effects [10-12]. Health literacy—the capacity to acquire, interpret, comprehend, and use healthcare information to make educated health decisions—is progressively emerging as an essential skill for navigating health-related information on the Internet. Digital health literacy might first be seen as the intersection of digital literacy and health literacy. Nonetheless, the truth is probably more complex, since each area of digital and health literacy may influence one or more domains of digital health literacy [13]. Conversely, other phrases are used interchangeably in the literature to denote digital health literacy.

The National Institutes of Health All of Us Research Program defines digital health literacy as "the ability to seek, find, understand, and appraise health information from electronic sources and apply the knowledge gained to addressing or solving a health problem." [8] Alternative terminology is used based on the sources of health information. mHealth literacy pertains to knowledge acquired via mobile devices, eHealth literacy pertains to information sourced from internet resources, and telehealth literacy especially pertains to telehealth platforms [14-16]. In all these instances, inadequate digital health literacy may result in various repercussions. It may primarily exacerbate health disparities in a more computerized healthcare environment. Patients who lack knowledge of digital health technologies, fail to recognize their significance, or cannot access them in their chosen language will eventually refrain from using them. This puts them at

a disadvantage regarding patient involvement and health enhancement [17-19]. Digital health literacy has recently been recognized as a significant social determinant of health due to its impact on broader social determinants [20-22]. To formulate effective strategies to address this emerging health determinant, it is essential to understand its consequences and the populations it influences. Consequently, we resolved to conduct this scoping review aimed at assessing the impact of inadequate digital literacy on health, specifically focusing on defining poor digital health literacy, identifying at-risk populations, examining affected health outcomes, analyzing consequences, and exploring interventions designed to mitigate the digital health literacy gap.

2. Methods

A thorough literature review was conducted by a skilled medical librarian. Medline, Embase, Scopus, and Google Scholar were searched with both natural language and controlled vocabulary phrases related to telehealth, digital health, digital literacy, computer competence, vulnerable populations, and health outcomes. We concentrated on current and extensively referenced references published in English.

3. Digital health literacy description

Digital health literacy was referred to by a variety of names in various research, including telehealth literacy, mHealth literacy, electronic health knowledge, eHealth literacy, and mobile health competence. Among them, eHealth literacy is the most commonly used in the included research, after digital health literacy. These principles pertain to the capacity to locate and use health information to treat or resolve a health issue using technology. Nonetheless, they are distinguished by the origin(s) of the health information [23–26]. mHealth literacy pertains to knowledge acquired using mobile devices, while eHealth literacy pertains to information obtained from internet resources. Telehealth literacy primarily pertains to telehealth platforms [27].

In the research provided, digital health literacy was often used synonymously with the preceding term eHealth literacy [23]. While eHealth literacy pertains only to information from Web 1.0 platforms accessed passively by users, digital health literacy encompasses information from Web 2.0 platforms including interactive material such as social media, blogs, and video-sharing sites [23–25]. Digital health literacy is a more comprehensive notion than eHealth literacy. A special term associated with digital health literacy identified in one research is digital healthy diet literacy, which is defined as the capacity to acquire and evaluate digital information pertaining to healthy diets in order to enhance eating behaviors and health outcomes [28].

In seven of the included research, the term digital literacy was used instead of digital health literacy. In contrast to digital health literacy and eHealth literacy, digital literacy has a wider scope, referring to the capacity to locate and use digital information. The research used several labels for the same idea, including digital competence, digital capability level, mobile phone digital literacy, new media literacy, and technology literacy [29-32].

The eHealth literacy conceptual framework by Norman and Skinner was used in the majority of research. Four research [33–36] used the e-health literacy framework established by Norgaard et al. [24], while one study [37] applied the transactional model of e-health literacy proposed by Paige et al. [38]. In the framework proposed by Norman and Skinner, eHealth literacy is analogous to the pistil that unites the petals of a lily flower, as it integrates six fundamental skills: conventional literacy, medical literacy, knowledge literacy, scientific understanding, media comprehension, as well as computer literacy [23]. The framework proposed by Norgaard et al. [24] includes domains primarily reliant on the individual, domains predominantly reliant on the system, and domains concerning the interaction between the individual and the system. The transactional model of eHealth literacy emphasizes the transactional aspects fundamental to eHealth literacy and delineates four operational competencies: functional, communicative, critical, and translational [38].

4. Populations impacted by diminished digital literacy

Multiple papers indicate that health digital literacy levels correlate with gender, age, and educational attainment. Abdulai et al. [39] conducted a study including 268 participants to assess the digital literacy of general consumers of online COVID-19-related material in Ghana. The authors indicate that men had a higher propensity for advanced digital literacy about internet-based information compared to females. This poll indicates that digital literacy is likely poorer among older individuals, who are also the demographic most susceptible to issues from COVID-19. Guo et al. [40] investigated socioeconomic differences in the pursuit of online information for COVID-19 and eHealth literacy, as well as their correlations with individual preventative behaviors during the pandemic, in a random sample of people in Hong Kong. This research found substantial negative correlations between eHL and mHL literacy scores and age. The findings indicate that individuals with higher education had a superior degree of mobile eHealth literacy.

Adil et al. [28] elucidated the correlation between educational attainment and digital literacy. Their survey of university students revealed that different categories of educational achievement influence the extent of usage and proficiency in digital health literacy in diverse manners. This research shows that educational attainment is the primary determinant of disparate responses to digital health literacy. The research further revealed that students at the BS/Master, MS/MPhil, and PhD levels exhibit significant differences in their use and skill.

To identify patients' perspectives on the primary causes of the digital divide, Alkureishi et al. [2] conducted 54 semi-structured telephone interviews with adult patients and parents of pediatric patients who participated in virtual visits (phone, video, or both) between March and September 2020 at the University of Chicago Medical Center (UCMC) primary care clinics. The predominant subtheme identified by participants as a factor contributing to the medical gap was advanced age, seen as a significant impediment to their capacity to learn and use technology. Cognitive and physiological impairments, such as memory loss and auditory and visual deficits, also posed hurdles that exacerbated the digital gap among older adults.

The study by Aponte et al. [41], which assessed the Spanish version of the eHEALS among older Hispanic adults in a senior organization within a Spanish neighborhood in New York, revealed that the highest-rated item pertained to the significance attributed to accessing health resources online. Conversely, the lowest-rated item concerned their capacity to utilize the Internet for addressing health inquiries. This suggests that while respondents were adept at locating health-related information online, they lacked confidence in employing that information for health decision-making.

Furthermore, a secondary analysis of the CALSPEAKS survey conducted by Berkowsky et al. [42] revealed that among respondents aged over 65, educational attainment (less than high school, high school, some college, associate's degree, bachelor's degree, or postgraduate degree) and indicators of digital experience and proficiency (e.g., frequency of Internet usage, variety of Internet activities regularly engaged in) exhibited robust and consistent correlations with eHealth literacy.

5. Discussion

Digital determinants of health, such as inadequate access to technology and limited digital literacy, are now acknowledged as Social Determinants of Health (SDOH). Nevertheless, they must not be regarded just as the sixth domain among the determinants of health, since they significantly regulate every social determinant of health and the environment that facilitates their complete accessibility. Digital determinants have to be regarded as "super determinants of health," since they significantly influence the functionality or dysfunctionality of each social determinant of health (SDOH), hence possibly affecting overall health and quality of life.

Decision-makers, healthcare providers, and academics must evaluate and address the impact of digital determinants on public health to formulate and execute enhancement initiatives. Consequently, we undertook this scoping review to consolidate existing knowledge regarding digital literacy and its implications for health, specifically aiming to identify the most frequently affected groups, the health outcomes impacted, and the proposed interventions designed to mitigate the so-called "Digital divide."

The extant literature on the issue is extensive and expanding, particularly in the last two years. Despite the abundance of definitions and authors' proposed tactics for enhancing digital health literacy, there is a paucity of articles detailing particular health outcomes influenced or validated treatments. The overall evidence quality of the examined studies was low; only 4 of the 53 articles in the review possessed evidence levels II and III, indicative of small randomized controlled trials and case-control studies, respectively; the remainder were classified as level V, corresponding to observational studies and case series [43]. The majority of the samples from the amended articles were of limited size.

Most studies indicate that individuals with diminished digital literacy and limited access to technology are predominantly from marginalized groups, such as the elderly, Black and Hispanic populations, and non-English speakers; however, the majority of these studies were conducted in North America, Europe, and China. The chosen papers indicate that Africa, South America, and significant portions of Asia and Oceania are underrepresented, correlating with regions most impacted by the digital health literacy deficit. In these areas, a substantial portion of the population shares socioeconomic and educational characteristics with the groups identified as most affected by this digital health gap.

Establishing and quantifying digital health literacy must be the first step in closing the digital gap. Nonetheless, the definitions used in various investigations are varied, as are the equipment utilized for measurement. Digital literacy serves as an overarching phrase including many technologies (internet, mobile devices, social media, etc.), and influences several facets of human life, including education, business, health, and government, among others. It is described as "the skills necessary for attaining digital competence, characterized by the confident and critical utilization of information and communication technology for professional, recreational, and communicative purposes" [26]. Health literacy is described as "the degree to which individuals can obtain, process, understand, and communicate health-related information necessary for making informed health decisions" [23]. Initially, "Digital Health Literacy" might be seen as the intersection between digital literacy and health literacy. Nevertheless, the situation is more complex.

In the majority of published research, health, and digital literacy are framed using competency-based models. Health literacy is comprehensively articulated through a matrix comprising four dimensions: accessing and obtaining health-related information, understanding health-related information, processing and appraising health-related information, and applying and utilizing health-related information. These dimensions are relevant across three domains: healthcare, disease prevention, and health promotion. The European Commission's framework on digital competencies parallels digital literacy by outlining five dimensions: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving, each comprising four to six sub-dimensions that exemplify a fundamental aspect of digital literacy. The interplay among digital literacy, health literacy, and digital health literacy is complex, with each domain potentially influencing one or more aspects of digital health literacy; however, specific competencies within digital health literacy may not be encompassed by either digital or health literacy. Abdulai indicated that educational level, internet use frequency, and the use of the internet for social media and pleasure were not significant predictors of digital literacy about online COVID-19 material [44].

Despite a high overall literacy level, respondents exhibited a comparatively lower mean score on questions suggesting difficulties in locating appropriate COVID-19 online resources and a limited capacity to differentiate between high-quality information and content based on personal opinions or anecdotal evidence [39]. Similarly, Guo et al. indicate in their study conducted among individuals with diabetes across three Taiwanese hospitals that, despite their confidence in using mobile eHealth and technology, hardly 1.6% engaged with health applications or integrated these tools into their everyday routines [40].

The intricacy and multifaceted nature of health and digital literacy underscore the need to frame digital health literacy within a competency framework. The examination of tools used for digital health assessment revealed that the eHealth Literacy Scale (eHEALS) was the most prevalent across all nations and demographics. The eHEALS has shown significant reliability and validity in research conducted across

many contexts (countries with varying resource profiles) and demographic groupings (college students, undergraduate nurses, and elderly persons). It was translated into many languages and altered by some authors, restricting it to specific resources such as COVID-19 materials rather than the general health resources included in the original instrument or specialized subjects like digital dietary literacy [39,45]. Despite the prevalent usage of eHEALS, it is widely acknowledged that the efficacy of health information systems relies on the alignment between system requirements and the end user's electronic health literacy level [46]. Simultaneously, it is essential to acknowledge that the scales used in the majority of research are not objective metrics. Occasionally, self-assessment may distort the results, since self-reported digital abilities may not necessarily correlate with effective computer use [39]. Given the sometimes-tenuous connection between self-perception and actual conduct, it is essential to solicit not just self-reports about a skill but also demonstrations of that competence as well [41]. Simultaneously, it is essential to acknowledge that several investigations used unvalidated measures, and none of the instruments established a particular cut-off to delineate inadequate digital literacy [20].

The intricate relationship among digital literacy, health literacy, and health outcomes, coupled with the design of the reviewed studies—primarily voluntary surveys or interviews—precluded a robust identification of the effects of digital literacy on outcomes for particular pathologies. Guo et al. [40] sought to illustrate the correlation between eHealth literacy (eHL), mobile health literacy (mHL), and health outcomes, namely HbA1c, in a cohort of Taiwanese patients with type 2 diabetes. The research indicated that mobile eHealth literacy directly influenced self-care behaviors and proficiency in computers, the internet, and mobile technology, while also indirectly affecting health outcomes, such as glycemic control and self-assessed health status. Statistically, an increase in mobile eHL cannot be presumed to lower HbA1c in this research. Consequently, several general repercussions may be seen from the patients' viewpoints, including diminished access to healthcare portals, prolonged wait times for medical appointments, misuse of emergency services, and inadequate coordination of preventive treatment. Poor digital literacy may exacerbate several healthcare effects.

Simultaneously, some writers suggest that elevated digital literacy may be associated with improved quality of life, health enhancement, and mental well-being [2,46-50]. Kim et al. [49] determined that eHealth literacy emerged as the most significant predictor of health behaviors, subsequent to adjustments for sociodemographic and health-related factors. The results suggest that eHealth literacy may significantly influence personal health practices. While the majority of the examined articles suggest various techniques to enhance digital literacy, we identified just seven studies that documented treatments related to the subject. The interventions may be classified into two categories: educational and training supply, and social assistance. Massive open online courses, university training in e-health via tutoring, and online video-based portal training were found to enhance digital health literacy for both children and adults. Conversely, social support from technologically proficient family members, professionals, and peers has been shown to enhance the digital health literacy of adults and seniors.

From the patient's viewpoint, instructions must be straightforward, especially for elderly folks or those with cognitive problems like memory loss. Patients suggested that educational institutions, including universities and healthcare organizations, serve as suitable venues for workshops, continuous classes, and a dedicated technology help desk in clinics. This would enable patients and their families to learn in-person how to navigate online patient portals, conduct video visits, and utilize technology effectively. Furthermore, synchronous (e.g., telephone communication) and asynchronous (e.g., instructional films and textual materials) remote learning tools might assist patients in addressing technological challenges associated with video consultations or the use of patient portals. Numerous patients also anticipated the presence of technology advocates and mentors within their neighborhood. In-person instruction was favored due to its perceived relatability and comprehensibility. Surprisingly, less research exists that assesses therapies from the patient's viewpoint.

To mitigate the effects of the digital gap on health outcomes, it is essential to enhance our understanding of patients' digital health literacy and to develop interventions tailored to their perceived requirements. Ensuring access to technology is only one aspect of the gap; enhanced technology design and training are

essential for advancing patients' digital health literacy. Future research should concentrate on higher-quality studies that evaluate digital literacy using objective skill assessments rather than just relying on patients' self-reported metrics. Strategies to enhance digital literacy must be developed with consideration of patients' views, and their impact should be assessed via high-quality research that evaluates both early improvements and long-term durability.

6. Conclusions

Digital health information resources and interactions with providers provide significant benefits, enhancing the efficiency, quality, and accessibility of healthcare systems while empowering patients. Nonetheless, it is essential that adherence to this policy ensures inclusivity for all individuals. Ethnic minorities, the elderly, and those of low socioeconomic position are at danger of possessing inadequate digital literacy, therefore facing escalating challenges in obtaining healthcare as digital health advances. The heightened interest in this issue, evidenced by publications, serves as a commendable foundation; however, it is imperative to enhance measurement tools, expand the geographic diversity of studies, and advocate for the development, implementation, and validation of interventions designed to mitigate inadequate digital health literacy.

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التفاعل بين الإمام الصحي الرقمي والأدوات الصحية الرقمية: التأثيرات على تعزيز مشاركة المرضى ونتائج الصحة العامة في المجتمعات المتنوعة

الملخص

الخلفية: يتمتع دمج التقنيات الرقمية في الرعاية الصحية بإمكانات كبيرة لتحسين مشاركة المرضى ونتائج الصحة العامة. ومع ذلك، قد تؤدي الفجوات في الإمام الرقمي إلى تفاقم التفاوتات الصحية القائمة. تهدف هذه الدراسة إلى استكشاف التقاطع بين الإمام الصحي والأدوات الرقمية، مع التركيز على تأثيرها على مشاركة المرضى والصحة العامة.

الطرق: تم إجراء مراجعة شاملة للمصادر باستخدام قواعد بيانات مثل **Medline** و**Embase** و**Scopus** و**Google Scholar** تضمنت عملية البحث مصطلحات متعلقة بالإمام الصحي الرقمي، الطب عن بعد، الفئات السكانية الضعيفة، ونتائج الصحة. ركزت المراجعة على الدراسات الحديثة ذات الاستشهادات الجيدة والمنشورة باللغة الإنجليزية.

النتائج: تشير النتائج إلى أن الإمام الصحي الرقمي، الذي يُخلط غالبًا مع الإمام بالصحة الإلكترونية والطب عن بعد، يختلف بشكل كبير بين الفئات الديموغرافية، مما يؤثر بشكل خاص على كبار السن والأقليات والأفراد ذوي التعليم المنخفض. يُظهر العديد من الأفراد نقصًا في الثقة في استخدام الموارد الصحية الرقمية، مما يعيق مشاركتهم في خدمات الرعاية الصحية. وعلى الرغم من انتشار الأدوات الصحية الرقمية، يظل جزء كبير من السكان غير متصل بسبب نقص الإمام الرقمي، مما يعزز "الفجوة الرقمية".

الخلاصة: يعد تعزيز الإمام الصحي الرقمي أمرًا أساسيًا لتقليل الفجوات الصحية وتحسين مشاركة المرضى في العصر الرقمي. ينبغي أن تركز الأبحاث المستقبلية على تطوير تدخلات مستهدفة لتعزيز الإمام الرقمي بين الفئات السكانية غير الممثلة، وضمان وصول عادل إلى الموارد الصحية الرقمية. إن الحاجة إلى استراتيجيات شاملة تأخذ في الاعتبار وجهات نظر المرضى أمر بالغ الأهمية لسد الفجوة الرقمية.

الكلمات المفتاحية: الإمام الصحي الرقمي، العدالة الصحية، مشاركة المرضى، الطب عن بعد، الفئات السكانية الضعيفة.