



The Role of Digital Health Literacy in Modern Healthcare: Implications for Nurses, Radiologic Technologists, Pharmacists, Medical Secretaries, and Health Administrators

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Abstract

Digital health literacy (DHL) has emerged as a foundational competency for the contemporary healthcare workforce as health systems worldwide undergo rapid digital transformation. This narrative review synthesizes contemporary evidence on the role of DHL across five key professional groups: nurses, radiologic technologists, pharmacists, medical secretaries, and health administrators. Drawing on literature published between 2016 and 2025, the review examines conceptualizations of DHL, its measured levels across professions, and its implications for clinical practice, patient safety, and organizational performance. Evidence indicates that DHL levels vary considerably across and within professions, with education, professional role, and organizational support serving as consistent predictors. The review identifies significant gaps in profession-specific DHL frameworks, standardized assessment tools, and targeted educational interventions. Interprofessional and organizational approaches to enhancing DHL are discussed, alongside recommendations for policy, education, and future research. The findings underscore that DHL is no longer optional but essential for all healthcare roles in the digital era.

Keywords: digital health literacy, healthcare workforce, nurses, interprofessional education, patient safety.

Introduction

The digital transformation of healthcare has fundamentally altered how health services are delivered, accessed, and experienced. Electronic health records, telehealth platforms, mobile health applications, artificial intelligence-assisted diagnostics, and remote monitoring technologies have become embedded in routine practice across diverse care settings (Brors et al., 2023; Bremer et al., 2021). This technological shift has not only changed clinical workflows but has also created new competency demands for the entire healthcare workforce. Among these demands, digital health literacy (DHL) has emerged as a critical determinant of both professional effectiveness and patient outcomes (Ban et al., 2024; Kasaye et al., 2024).

Digital health literacy refers to the ability to seek, find, understand, evaluate, and apply health information obtained through digital technologies and services to address health problems (Ban et al., 2024; Yoon et al., 2024). While early conceptualizations focused primarily on individual patients' capacity to

navigate online health resources, contemporary frameworks recognize DHL as equally relevant for healthcare providers, who must not only use digital tools competently but also support patients in doing so (Brors et al., 2023; Dijkman et al., 2023). The COVID-19 pandemic accelerated the adoption of digital health solutions and simultaneously exposed significant gaps in workforce readiness, making DHL a pressing priority for health systems globally (Kasaye et al., 2024; Chereka et al., 2024).

The healthcare workforce is diverse, encompassing clinical professionals such as nurses, radiologic technologists, and pharmacists, as well as non-clinical personnel including medical secretaries and health administrators. Each of these groups interacts with digital health technologies in distinct ways and therefore requires tailored DHL competencies (Palese et al., 2022; Vukmirović et al., 2023). However, much of the existing literature on DHL has focused narrowly on physicians or patients, leaving significant knowledge gaps regarding other essential professional groups (Brors et al., 2023; Yoon

et al., 2024). This narrative review addresses these gaps by synthesizing contemporary evidence on DHL across five key professional groups: nurses, radiologic technologists, pharmacists, medical secretaries, and health administrators. It examines conceptual foundations, current levels of DHL, profession-specific implications, and strategies for enhancing DHL through education, organizational policy, and interprofessional collaboration.

Conceptual Foundations of Digital Health Literacy

Understanding DHL requires situating it within the broader evolution of health literacy and digital literacy scholarship. Health literacy, traditionally defined as the individual's capacity to access, understand, appraise, and apply health information to make informed health decisions, has long been recognized as a determinant of health outcomes (Ban et al., 2024). The advent of digital technologies expanded this concept, giving rise to eHealth literacy, which Norman and Skinner (2006, as cited in Brors et al., 2023) defined as the ability to seek, find, understand, and appraise health information from electronic sources and apply that knowledge to solve a health problem. This definition,

grounded in the Lily model, emphasized six core skills: traditional literacy, health literacy, information literacy, scientific literacy, media literacy, and computer literacy (Yoon et al., 2024).

Over time, the concept has evolved further. Ban et al. (2024) conducted a concept analysis identifying four critical attributes of contemporary DHL: goal-driven regulation, information processing, communication, and utilisation. This conceptualization moves beyond functional skills to encompass the dynamic and contextual nature of digital health engagement. Similarly, Yoon et al. (2024) identified three thematic categories in their scoping review: advanced health literacy, digital skills-based and multidimensional literacy, and internal or external factors influencing users' engagement with digital health. These frameworks acknowledge that DHL is not merely a set of technical competencies but also involves critical appraisal, ethical judgment, and the capacity to navigate complex digital ecosystems. Table 1 presents a synthesis of key definitions and dimensions of DHL as articulated in recent literature.

Table 1. Definitions and Dimensions of Digital Health Literacy in Contemporary Literature

Author(s)	Definition	Key Dimensions
Ban et al. (2024)	Ability to convert knowledge into practical actions by processing, communicating, and utilising health information from digital platforms	Goal-driven regulation; information processing; communication; utilisation
Yoon et al. (2024)	Ability to find, understand, evaluate, and apply health information using digital technologies and services	Advanced health literacy; digital skills-based literacy; internal/external engagement factors
Brors et al. (2023)	Individual's ability to seek, find, understand, and appraise health information from electronic sources and apply knowledge to solve health problems	Individual eHealth literacy; interaction with eHealth system; access to system
Dijkman et al. (2023)	Organizational capacity to support individuals in using digital and analogue information and services for health decisions	Personal health literacy; organizational health literacy; digital health integration

An important conceptual development is the recognition that DHL operates at multiple levels. Bremer et al. (2021) proposed an augmented definition of organizational health literacy that explicitly incorporates digital health, arguing that health organizations have a responsibility to create digital environments that are accessible and usable for both patients and staff. This organizational perspective is crucial because it shifts attention from individual deficits to systemic barriers and enablers. As Dijkman et al. (2023) emphasized, "organizational health literacy" encompasses the degree to which organizations equitably enable individuals to find, understand, and use information and services to inform health-related decisions. This framing has direct implications for healthcare professionals, who function simultaneously as individual users of digital systems and as organizational actors responsible for

supporting patients' digital health engagement. Figure 1 illustrates a conceptual model of DHL that integrates individual, interactional, and organizational dimensions as synthesized from recent literature.



Figure 1. Integrated Conceptual Model of Digital Health Literacy in Healthcare

The conceptual evolution of DHL has significant implications for healthcare professionals. It

suggests that DHL is not a static attribute but a dynamic capability that must be continually developed in response to technological change. It also highlights the interdependence of individual and organizational factors: healthcare professionals cannot achieve optimal DHL without organizational support, and organizations cannot achieve digital health transformation without a digitally literate workforce (World Health Organization, 2019; Madsen et al., 2023).

Digital Health Literacy among Nurses

Nurses constitute the largest segment of the healthcare workforce and are at the forefront of digital health implementation. They interact with electronic health records, telehealth platforms, remote monitoring systems, and patient portals on a daily basis, while also serving as key intermediaries between digital health technologies and patients (Palese et al., 2022; Brors et al., 2023). Consequently, nurses' DHL has direct implications for both their own professional effectiveness and the quality of patient care.

Research consistently indicates that nurses' DHL is influenced by education level, professional role, and attitudes toward digital technologies. Palese et al. (2022), in a cross-sectional study of 551 nurses in Italy, found that nurses in managerial or coordinator roles and those with postgraduate degrees used digital resources with greater frequency and demonstrated higher levels of DHL. The study employed the Health Literacy Survey19 Digital (HLS19-DIGI) instrument and identified three distinct clusters of nurses based on education and professional role, with significant differences in DHL scores across clusters. These findings suggest that advanced education and leadership responsibilities are associated with greater digital health engagement, possibly because these roles require more interaction with digital systems and provide more opportunities for skill development.

A scoping review by Wilandika et al. (2023) similarly reported that nurses' DHL levels vary considerably across studies but generally indicate low

to moderate proficiency. The review, which included 21 studies predominantly from high-income and upper-middle-income countries, identified only four general measurement tools for assessing nurses' DHL, none of which were nursing-specific. Influencing factors were categorized at individual, interpersonal, and organizational levels, with higher DHL linked to positive outcomes including improved patient safety culture and better care coordination. The authors concluded that there is an urgent need for a nursing-specific conceptual model and standardized assessment framework responsive to evolving Web 2.0 and Web 3.0 technologies (Wilandika et al., 2023).

The relationship between nurses' DHL and patient safety has received particular attention. A multi-centre study of Jordanian nurses found that DHL was significantly associated with better patient safety culture, with organizational and educational factors exerting greater influence than generational stereotypes (Salameh et al., 2023). This finding challenges assumptions that younger nurses are inherently more digitally literate and underscores the importance of targeted education and organizational support. Similarly, research on patient safety protocols in the context of digital health and telemedicine has identified nurses' DHL as a critical enabler of safe virtual care delivery (Kuek & Hakkennes, 2020; Alotaibi et al., 2024).

Beyond clinical practice, nurses' DHL has implications for their own health behaviors and role modeling. A study of Turkish nurses found a significant positive correlation between eHealth literacy and healthy lifestyle behaviors, including spiritual growth, health responsibility, and interpersonal relationships (Yoğurtcu & Ozturk Haney, 2022). This suggests that DHL may contribute not only to professional competence but also to nurses' personal health and well-being, potentially enhancing their credibility as health promoters. Table 2 summarizes key findings from recent studies on DHL across the five professional groups discussed in this review.

Table 2. Summary of Key Studies on Digital Health Literacy Across Healthcare Professions

Profession	Study	Key Findings
Nurses	Wubante et al. (2023)	DHL strongly influenced by education level, professional role, and digital attitudes; managers/coordinators had highest DHL
Nurses	Wilandika et al. (2023)	DHL generally low to moderate; lack of nursing-specific measurement tools; multilevel influencing factors
Radiologic Technologists	Housawi et al. (2021)	Lack of digital literacy and skills identified as major barrier to digital health integration; need for national competency framework
Radiologic Technologists	Crotty et al. (2024)	AI literacy framework proposed for radiographers; Digital Literacy Global Framework as foundation
Pharmacists	Vukmirović et al. (2023)	Only 15.8% aware of diabetes mHealth apps; 2.4% received relevant training; higher DHTL associated with greater awareness
Pharmacists	Ilkic et al. (2023)	35.9% had low DHTL, 44.5% high; significant differences by years of experience; need for targeted DHTL training

Medical Secretaries	Madsen et al. (2023)	Telehealth transformed administrative roles; new digital literacy demands, patient education responsibilities, and workflow fragmentation
Health Administrators	Naamati-Schneider & Alt (2024)	eHealth literacy skills essential for healthcare managers; competency-oriented learning approaches needed

Digital Health Literacy among Radiologic Technologists

Radiologic technologists occupy a unique position in the digital health ecosystem, as medical imaging has become increasingly digitized and technology-dependent. From picture archiving and communication systems (PACS) to artificial intelligence-assisted image analysis and teleradiology, radiologic technologists must navigate a complex array of digital tools that directly affect diagnostic accuracy and patient safety (Housawi et al., 2021; Malamateniou et al., 2021). Despite this technological intensity, DHL among radiologic technologists has received comparatively less research attention than nursing or pharmacy.

A systematic review examining digital health integration in radiological screening practices in Saudi Arabia identified lack of digital literacy and skills as one of the primary challenges facing radiology technicians (Alzghaibi, 2023). The review, which synthesized 25 studies, found that while digital health technologies such as artificial intelligence, teleradiology, and mobile health applications offer significant opportunities for enhancing screening accessibility, efficiency, and accuracy, their effective implementation is hindered by workforce readiness gaps. The authors recommended the development of a national framework for education, training, and certification of radiology technicians in digital health competencies (Abdulaziz et al., 2023). This recommendation aligns with broader calls for structured digital health education in radiography programs.

The emergence of artificial intelligence in medical imaging has prompted specific attention to AI literacy among radiologic technologists. Crotty et al. (2024) developed an AI literacy framework for radiographers, drawing on the Digital Literacy Global Framework to conceptualize the technical knowledge and understanding required for AI use in clinical practice. The framework addresses foundational concepts such as data quality, algorithm validation, and ethical considerations, as well as practical skills for interacting with AI-assisted diagnostic tools. Similarly, Crotty et al. (2024) proposed a modular framework for integrating AI education into undergraduate radiography curricula, emphasizing the need for educational reform to prepare future professionals for AI-augmented practice.

Beyond technical skills, DHL for radiologic technologists encompasses communication and patient education competencies. Research indicates that clear communication before imaging procedures

can reduce patient anxiety and improve overall health literacy, suggesting that radiologic technologists' DHL has direct implications for patient experience and informed consent (Morimoto et al., 2024). The ability to explain digital imaging processes, address patient concerns about radiation exposure, and guide patients through technology-mediated procedures requires a combination of technical, communicative, and critical appraisal skills that constitute advanced DHL.

The professional landscape for radiologic technologists is also shaped by broader digital transformation initiatives. In Saudi Arabia, Vision 2030 has driven substantial investment in digital health infrastructure, creating both opportunities and pressures for radiology technicians to upskill (Alanazi et al., 2024). Similar trends are observable globally, as health systems increasingly adopt AI-assisted diagnostics, cloud-based imaging platforms, and remote reporting capabilities. These developments underscore the urgency of embedding DHL throughout radiography education and continuing professional development.

Digital Health Literacy among Pharmacists

Pharmacists have undergone a significant role expansion in recent decades, moving from dispensing-focused practice toward comprehensive medication management, chronic disease support, and public health service delivery. Digital health technologies have accelerated this transformation, offering new tools for medication adherence monitoring, telehealth consultation, mobile health application recommendation, and interoperable health information exchange (Paudyal et al., 2021; Jain et al., 2020). However, evidence suggests that pharmacists' DHL may not yet be sufficient to fully capitalize on these opportunities.

A study of community pharmacists in Serbia found that while general digital literacy was relatively high (with 68.8% of respondents scoring at a medium level and 16.0% at a high level), specific digital health technology literacy was more variable, with 35.9% demonstrating low DHTL, 19.6% medium, and 44.5% high (Ilkic et al., 2023). The study, which surveyed 368 pharmacists using a validated DHTL assessment questionnaire, found that DHTL levels were significantly associated with years of working experience but not with other demographic variables. Notably, 41.3% of respondents did not use social media professionally, suggesting untapped potential for digital patient engagement. The authors concluded that targeted DHTL training is needed to support the expansion of pharmacist-led digital health services (Ilkic et al., 2023).

A complementary study focusing on mobile applications for diabetes self-management found even more pronounced gaps. Only 15.8% of community pharmacists were aware of such applications, and just 2.4% reported receiving relevant training (Jain et al., 2020). However, higher digital health technology literacy was associated with greater awareness, confidence, and preference for digital learning. Most participants supported expanding pharmacists' roles in advising patients on digital tools and expressed interest in structured education and official guidance. These findings indicate that while pharmacists recognize the potential of digital health, current awareness and training levels are insufficient to support effective integration into practice (Jain et al., 2020).

The literature suggests several pathways for enhancing pharmacists' DHL. Digital health education is increasingly recognized as essential in both undergraduate pharmacy curricula and continuing professional development (Uzman et al., 2023; Mantel-Teeuwisse et al., 2021). The International Pharmaceutical Federation (FIP) has developed online courses and competency frameworks to support digital health integration in pharmacy education, emphasizing the need for interdisciplinary digital health curricula that address the specific knowledge requirements of pharmacists (Mantel-Teeuwisse et al., 2021; Senbekov et al., 2020). Research on student pharmacists has demonstrated that integrating digital health topics into case conference series can improve familiarity, attitudes, comfort, and knowledge (Kayyali et al., 2021). These educational innovations provide a foundation for building a digitally capable pharmaceutical workforce.

Pharmacists' DHL also has implications for patient education and medication safety. As frontline providers, pharmacists are well positioned to promote digital health literacy among patients, helping them evaluate the credibility of online health information, use medication management apps safely, and navigate patient portals (Vukmirović et al., 2023). This role requires pharmacists to possess not only technical proficiency but also the critical appraisal and communication skills that characterize advanced DHL.

Digital Health Literacy among Medical Secretaries

Medical secretaries and administrative staff represent a critical but often overlooked segment of the healthcare workforce. They serve as the "digital front door" to healthcare, managing patient scheduling, electronic health record documentation, telehealth coordination, and patient communication (Madsen et al., 2023). The digital transformation of healthcare has significantly reshaped their roles, creating new competency demands and expanding their responsibilities beyond traditional clerical functions.

A systematic review examining the impact of telehealth on administrative and secretarial roles found

that the integration of telehealth technologies introduced new digital literacy demands, fragmented workflows, and new responsibilities for patient technology education (Muir et al., 2020). The review, which analyzed qualitative, quantitative, and mixed-methods studies published between 2013 and 2025, described how the transformed administrative role now encompasses complex digital care coordination, virtual clinic management, and patient technology support. Importantly, the "digital front door" positioning of administrative staff places them at a critical juncture in facilitating equitable access to digital health services while simultaneously exposing them to new stressors and workflow interruptions (Muir et al., 2020).

Medical secretaries in the telemedicine era require a diverse skill set that includes platform mastery, basic troubleshooting, digital communication, and digital empathy (Madsen et al., 2023). They must be able to guide patients through technology setup, explain digital processes clearly, and convey care and concern through technology-mediated interactions. These competencies go beyond basic computer literacy and align with the multidimensional conceptualization of DHL discussed earlier. Research from Saudi Arabia has emphasized the importance of adaptability, technology proficiency, and effective communication skills for medical secretaries working in telemedicine, highlighting their critical role in managing digital documentation and ensuring data accuracy and security (Al-Anazi et al., 2024).

The literature also indicates that medical secretaries often receive inadequate training for these expanded digital responsibilities. The systematic review by Muir et al. (2020) concluded that strategic investments in training, workflow redesign, and supportive technologies are required to harness the full potential of administrative professionals in the digital health era. Similarly, research on healthcare data management tasks performed by medical secretaries has identified enablers and barriers to effective performance, emphasizing the need for organizational support and targeted competency development (Howsawi et al., 2021, as cited in Longhini et al., 2022).

The implications of medical secretaries' DHL extend beyond individual job performance to organizational outcomes. As the first point of contact for many patients, medical secretaries shape patient perceptions of digital health services and influence access and equity. Their ability to troubleshoot technology issues, provide clear guidance, and maintain data security directly affects patient experience and organizational efficiency. Consequently, investing in medical secretaries' DHL is not merely a human resources concern but a strategic imperative for health organizations pursuing digital transformation.

Digital Health Literacy among Health Administrators

Health administrators occupy a distinctive position in the DHL landscape. Unlike clinical professionals who use digital health tools primarily for patient care, administrators are responsible for strategic planning, resource allocation, policy development, and organizational change management related to digital health initiatives (Naamati-Schneider & Alt, 2024; Palumbo et al., 2022). Their DHL therefore encompasses not only personal digital competence but also the ability to lead and support digital transformation across the organization.

Research on eHealth literacy among healthcare managers has emphasized the importance of competency-oriented learning approaches. Naamati-Schneider and Alt (2024) examined the development of eHealth literacy skills among healthcare management students, finding that future administrators require educational experiences that integrate digital health knowledge with practical management skills. Their work highlighted the need for health management curricula to address digital health literacy as a core competency, preparing graduates to navigate the complex intersection of technology, policy, and patient care. The authors argued that eHealth literacy for administrators is not simply about using digital tools but about understanding the strategic, ethical, and organizational implications of digital health technologies (Naamati-Schneider & Alt, 2024).

The organizational dimension of DHL is particularly relevant for health administrators. Palumbo et al. (2022) proposed an augmented definition of organizational health literacy that explicitly incorporates digital health, arguing that organizations have a responsibility to create digital environments that are accessible and usable for both patients and staff. This responsibility includes ensuring that digital health technologies are implemented in ways that support rather than hinder health literacy, and that organizational policies and training programs are aligned with digital health goals. Health administrators play a central role in operationalizing this organizational commitment, making their own DHL a prerequisite for effective leadership.

Research on digital citizenship among early-career healthcare leaders has further emphasized the need for administrators to understand digital governance, policy, and responsible participation in digital health ecosystems (Ndejjo et al., 2022). This extends beyond technical competence to encompass ethical reasoning, data stewardship, and advocacy for equitable digital health access. As health systems increasingly rely on data analytics, artificial intelligence, and digital platforms for decision-making, administrators must be able to critically evaluate these technologies and their implications for patients and communities.

The literature also suggests that health administrators' DHL influences organizational readiness for digital transformation. A study of health management students found that eHealth literacy levels were generally good but varied across dimensions, with students demonstrating stronger skills in information seeking than in critical evaluation or content creation (Naamati-Schneider & Alt, 2024). This pattern suggests that educational programs may need to emphasize higher-order DHL competencies such as critical appraisal and digital content development. Similar findings have been reported for health service provider candidates, indicating that eHealth literacy is recognized as important but may not yet be fully developed in pre-service education (Dergipark, 2023).

Interprofessional and Organizational Implications

The profession-specific analyses presented above reveal both commonalities and differences in DHL requirements across healthcare roles. While all five professional groups require foundational digital competencies, the specific applications and emphases differ considerably. Nurses need DHL for patient monitoring, documentation, and telehealth facilitation; radiologic technologists require advanced technical and AI literacy for imaging technologies; pharmacists need DHL for medication management and patient education about digital tools; medical secretaries need DHL for care coordination and patient technology support; and health administrators need DHL for strategic leadership and organizational change management (Wubante et al., 2023; Vukmirović et al., 2023; Longhini et al., 2022; Naamati-Schneider & Alt, 2024).

These differences have important implications for education and training. Generic DHL training programs are unlikely to meet the needs of all professional groups. Instead, profession-specific content should be embedded within broader interprofessional digital health curricula that foster shared understanding and collaborative practice (Obarcanin et al., 2024). Interprofessional education in digital health has been identified as a promising approach for developing the teamwork and communication skills necessary for effective digital health collaboration (Machleid et al., 2020). By learning together, students from different professions can develop appreciation for each other's digital health roles and competencies, facilitating more integrated care delivery in practice. Figure 2 presents a multilevel framework illustrating the individual, interpersonal, and organizational factors that influence DHL across healthcare professions.

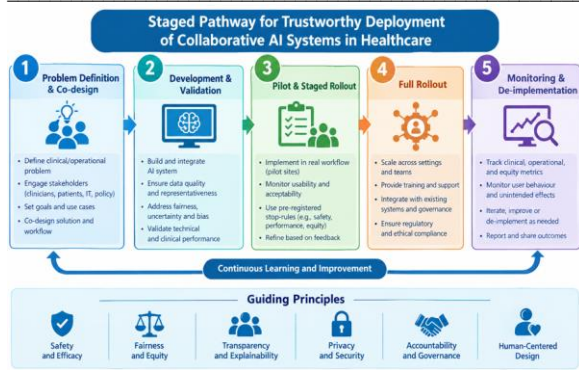


Figure 2. Multilevel Influences on Digital Health Literacy Across Healthcare Professions

The organizational dimension of DHL is particularly important because individual-level interventions alone are insufficient to achieve systemic change. Organizations must create environments that support DHL development through accessible technology, protected time for training, supportive policies, and leadership commitment (World Health Organization, 2019). The concept of organizational health literacy, extended to include digital health, provides a framework for understanding how health organizations can systematically support both workforce and patient DHL (Palumbo et al., 2022). This includes ensuring that digital health technologies are designed and implemented with usability in mind, that training programs are adequately resourced, and that organizational culture values continuous learning and digital innovation.

The COVID-19 pandemic provided a natural experiment in organizational DHL, as health systems worldwide rapidly deployed digital health solutions under crisis conditions. Research from Ethiopia found that the pooled level of high digital health literacy among health professionals during the pandemic was 56.0%, with significant variation associated with internet access, perceived ease of use, favorable attitudes, perceived usefulness, and prior information-communication-technology training (Kasaye et al., 2024). These findings highlight the importance of organizational provision of training and infrastructure, as well as the role of individual attitudes and perceptions in shaping DHL outcomes. The authors recommended comprehensive information-communication-technology training programs to equip healthcare professionals with the skills needed to respond effectively to future health crises (Kasaye et al., 2024).

Challenges and Barriers to Digital Health Literacy

Despite growing recognition of DHL's importance, significant challenges and barriers persist across all healthcare professions. These can be categorized as individual, educational, technological, and organizational factors. At the individual level, variation in DHL is associated with education level, age, prior experience with technology, and attitudes toward digital health (Ahmed et al., 2022; Kasaye et al., 2024). While assumptions about generational

differences are common, research suggests that organizational and educational factors exert greater influence than age stereotypes (Kuek & Hakkennes, 2020). Healthcare professionals with postgraduate degrees and leadership roles tend to demonstrate higher DHL, suggesting that advanced education provides both skills and opportunities for digital engagement (Ahmed et al., 2022). Conversely, professionals in direct patient care roles with limited digital interaction may have fewer opportunities to develop DHL, creating a gap between job requirements and actual competencies.

Educational barriers include the slow integration of digital health content into professional curricula and the lack of standardized competency frameworks for DHL across professions. A scoping review of digital literacy in undergraduate pharmacy education found that while digital health education is increasingly recognized as essential, curricula remain inconsistent and often lack explicit DHL outcomes (Uzman et al., 2023). Similar gaps have been identified in radiography education, where AI literacy frameworks are only beginning to emerge (Malamateniou et al., 2021; Crotty et al., 2024). For nursing, the lack of a nursing-specific DHL conceptual model and measurement tool has been identified as a significant limitation (Wilandika et al., 2023). These educational gaps mean that many healthcare professionals enter practice without adequate preparation for digital health roles.

Technological barriers include limited access to digital infrastructure, interoperability challenges, and usability issues with digital health systems. Research from resource-constrained settings has highlighted how lack of internet access and inadequate technological infrastructure impede DHL development (Kasaye et al., 2024). Even in well-resourced settings, fragmented systems and poor usability can undermine professionals' willingness and ability to engage with digital health tools (Das et al., 2023). The rapid pace of technological change also creates ongoing challenges, as skills acquired today may become obsolete as new technologies emerge.

Organizational barriers include insufficient training provision, lack of protected time for learning, and organizational cultures that do not prioritize digital health competency development. The systematic review of telehealth's impact on administrative roles found that new digital literacy demands were often imposed without corresponding investments in training or workflow redesign (Wosny et al., 2023). Similarly, research on pharmacists' DHTL found that only a small minority had received relevant training, despite growing expectations for digital health engagement (Vukmirović et al., 2023). These findings suggest that organizational support is a critical enabler of DHL and that without it, individual-level interventions are unlikely to succeed.

Strategies for Enhancing Digital Health Literacy

Addressing the DHL challenge requires multifaceted strategies targeting education, training, organizational policy, and interprofessional collaboration. In education, the integration of DHL into pre-service curricula for all health professions is essential. This includes not only technical skills but also critical appraisal, ethical reasoning, and communication competencies. For nursing, the development of a nursing-specific DHL conceptual model and measurement tool would support more targeted educational interventions (Wilandika et al., 2023). For radiologic technologists, the adoption of AI literacy frameworks and modular AI education represents a promising direction (Crotty et al., 2024; Crotty et al., 2024). For pharmacists, the expansion of digital health content in PharmD curricula and continuing professional development is needed (Mantel-Teeuwisse et al., 2021; Kayyali et al., 2021). For medical secretaries and administrators, competency frameworks should explicitly include digital health literacy domains (Wosny et al., 2023; Naamati-Schneider & Alt, 2024).

Continuing professional development (CPD) is equally important for the existing workforce. Given the rapid pace of technological change, initial education alone cannot prepare professionals for lifelong digital health practice. CPD programs should offer modular, flexible learning opportunities that address profession-specific DHL needs while also fostering interprofessional collaboration. Online courses, simulation-based training, and case-based learning have all been identified as effective approaches for developing DHL in practicing professionals (Mantel-Teeuwisse et al., 2021; Darnell et al., 2023). Organizations should provide protected time and resources for CPD and recognize DHL development as a legitimate professional responsibility.

At the organizational level, health systems must create supportive environments for DHL development. This includes investing in digital infrastructure, ensuring usability of digital health technologies, providing training and technical support, and fostering a culture of continuous learning (World Health Organization, 2019). The concept of organizational health literacy, extended to digital health, provides a framework for systematic organizational action (Palumbo et al., 2022). Organizations should conduct DHL needs assessments, develop targeted training programs, and evaluate the impact of DHL interventions on patient outcomes and organizational performance.

Interprofessional collaboration is a cross-cutting strategy that can enhance DHL across all professional groups. By learning together and working together, healthcare professionals can share knowledge, develop mutual understanding of digital health roles, and create more integrated digital care pathways (Machleid et al., 2020; Obarcanin et al., 2024). Interprofessional digital health education

should be embedded throughout the curriculum and reinforced in clinical practice. Simulation-based interprofessional training, where professionals from different disciplines collaborate on digital health scenarios, can be particularly effective for developing teamwork and communication skills.

Policy-level interventions are also necessary to support DHL development at scale. National competency frameworks, accreditation standards, and funding for digital health education can drive systemic change. The recommendation for a national framework for digital health competencies among radiology technicians in Saudi Arabia (Alanazi et al., 2024) exemplifies the kind of policy action needed. Similarly, the integration of DHL into professional licensure and certification requirements would signal its importance and ensure accountability. Governments and professional bodies should collaborate to develop and implement such policies.

Future Research Directions

This review has identified several priorities for future research. First, profession-specific DHL frameworks and measurement tools are needed for radiologic technologists, medical secretaries, and health administrators, building on the work already underway for nurses and pharmacists. Second, longitudinal studies are needed to track DHL development over time and its relationship to patient outcomes, organizational performance, and workforce well-being. Third, intervention studies are needed to evaluate the effectiveness of different educational and organizational strategies for enhancing DHL. Fourth, research should examine the intersection of DHL with health equity, investigating how disparities in digital access and literacy affect both healthcare professionals and the patients they serve. Fifth, interprofessional DHL research is needed to understand how different professional groups can collaborate effectively in digital health environments.

The rapid evolution of digital health technologies, including artificial intelligence, virtual reality, and remote monitoring, creates an ongoing need for research that keeps pace with technological change. As new technologies emerge, their implications for DHL must be systematically investigated. This includes not only technical competencies but also ethical, legal, and social implications. Research on AI literacy for radiologic technologists (Crotty et al., 2024) provides a model for how profession-specific DHL research can respond to technological innovation.

Conclusion

Digital health literacy has become an indispensable competency for the modern healthcare workforce. This review has demonstrated that DHL is relevant to all professional groups—nurses, radiologic technologists, pharmacists, medical secretaries, and health administrators—though the specific requirements and applications differ across roles. Evidence indicates that DHL levels are generally

suboptimal, with significant variation associated with education, professional role, and organizational support. The lack of profession-specific frameworks and measurement tools, inadequate educational integration, and insufficient organizational investment in training represent significant barriers to DHL development.

Addressing these challenges requires coordinated action across education, practice, policy, and research. Pre-service curricula must integrate DHL as a core competency, continuing professional development must provide ongoing opportunities for skill development, organizations must create supportive environments for digital health practice, and policymakers must develop standards and incentives that prioritize DHL. Interprofessional collaboration is a cross-cutting strategy that can enhance DHL across all professional groups and promote more integrated digital care delivery.

The digital transformation of healthcare is not a future possibility but a present reality. The COVID-19 pandemic demonstrated both the potential and the fragility of digital health systems, and it exposed the consequences of inadequate workforce DHL. As health systems continue to evolve, the need for a digitally literate healthcare workforce will only intensify. Investing in DHL is not merely a matter of professional competence—it is a fundamental requirement for safe, effective, equitable, and patient-centered care in the digital age. Health systems that prioritize DHL will be better positioned to harness the benefits of digital health technologies while mitigating risks and ensuring that no patient or professional is left behind in the digital transition.

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