

Digital Competency and Its Correlates Among Healthcare Professionals in Northern Ghana

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Abstract

Across sectors globally, technological adoption is critical for maintaining competitiveness and enhancing productivity. Within healthcare specifically, digital health tools hold significant potential to improve services and strengthen health systems. However, the integration of such technologies frequently faces delays, particularly within middle- and low-income settings. This study investigated digital competency and its associated factors among healthcare professionals in Northern Ghana, grounded in the European Digital Competence Framework (DigComp). A quantitative cross-sectional design was employed among 428 healthcare workers from selected facilities using convenience sampling. Data were collected via a semi-structured questionnaire and analyzed using descriptive statistics and binary logistic regression. The mean age of participants was 37.4±9.4 years. The majority (85.5%) reported high digital competency, while 14.5% exhibited low competency. Additionally, 79.7% held positive perceptions of digital health, compared to 20.3% with poor perceptions. Multivariable analysis revealed that female health professionals were significantly less likely to demonstrate high digital competency than males (AOR=0.45, CI=0.23-0.88, p=0.019). Professionals with 15 or more years of experience had lower odds of high competency compared to those with less than five years, and poor perception of digital health was inversely associated with competency levels. The findings indicate generally high digital competency and positive perceptions among health workers, yet reveal critical disparities requiring intervention. It is recommended that health authorities implement gender-sensitive digital training programs and targeted upskilling initiatives for experienced professionals, alongside strategies to foster positive attitudes toward digital health tools. Addressing these gaps is essential for successful digital health transformation in resource-limited settings.

Keywords: Digital literacy, Northern Ghana, European Digital Competence Framework.

Introduction

Globally, both private and public sectors are increasingly utilizing technological tools to maintain competitiveness and enhance productivity (Daniotti et al., 2020). Within healthcare, cutting-edge technologies hold significant potential to improve service delivery and strengthen health systems (Bulson et al., 2017; Piscotty et al., 2015). However, technology adoption in healthcare is often characterized by delays (Farahat et al., 2018), particularly in low- and middle-income countries (LMICs) where progress is slower (Liu et al., 2020). Despite these challenges, healthcare professionals across clinical settings are gradually relying on information and communication technologies to fulfill their professional responsibilities (Barker and Donnelly, 2017; Koster and van Houwelingen, 2017).

Effective technology use requires healthcare professionals to possess adequate digital competency (MacLure and Stewart, 2018). The implementation of electronic medical records, clinical decision support tools, and digitally interfaced medical equipment depends substantially on practitioners' digital skills. The European Commission defines digital competence as the confident, critical, and responsible use of digital technologies for work, learning, and participation in society, encompassing information literacy, communication, content creation, safety, and problem-solving (Ferrari, 2012). This proficiency enables individuals to utilize digital tools efficiently, critically, creatively, and ethically across various life domains.

Healthcare is experiencing rapid digitalization, with technologies such as telehealth, mobile health, wearable devices, and health information technology transforming service delivery (Sensmeier, 2011; Nohl-Deryk et al., 2018). Digitalization offers potential benefits including reduced costs, enhanced cost-effectiveness, and personalized patient care (Gastaldi and Corso, 2012; Tresp et al., 2016). However, realizing these benefits requires a digitally competent workforce, particularly in low-income settings where skill gaps are most pronounced. Digital literacy is not static but a transient, context-specific capability requiring continuous updating alongside technological advancement (Martin, 2006; Salahuddin and Ismail, 2015).

Problem Statement

Despite rapid digital transformation in healthcare globally, the successful integration of technologies depends critically on health professionals' digital competency (MacLure and Stewart, 2018). Evidence indicates that digital adoption in healthcare is often delayed in LMICs due to infrastructural and human resource constraints (Farahat et al., 2018; Liu et al., 2020). While prior research acknowledges digital skill gaps among health workers (Tresp et al., 2016; Nohl-Deryk et al., 2018), few studies have systematically assessed digital competency using validated theoretical frameworks in sub-Saharan African contexts. In Ghana, the northern region presents diverse healthcare facilities serving urban and rural populations, yet no empirical study has examined health professionals' digital competency

or identified associated sociodemographic and perceptual factors. Without such evidence, digital health interventions risk failure due to unaddressed competency gaps.

Theoretical Framework

This study is grounded in the European Digital Competence Framework (DigComp), developed by the European Commission to define and assess digital competency across populations (Ferrari, 2012; Vuorikari et al., 2022). DigComp conceptualizes digital competence across five domains: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. For this study, the framework was adapted to the healthcare context through a three-dimensional operational model:

1. **Cognitive Dimension:** The ability to locate, evaluate, and manage digital health information critically, including searching for clinical evidence and assessing online health resource credibility.
2. **Practical Dimension:** The capacity to use digital technologies for communication, collaboration, and clinical tasks, encompassing electronic medical records, telehealth platforms, and mobile health applications.
3. **Critical-Ethical Dimension:** The capacity to apply digital technologies safely and ethically, including maintaining patient data confidentiality and recognizing digital tool limitations.

This framework aligns with conceptualizations of digital literacy as a situated capability requiring continuous evolution (Martin, 2006; Salahuddin and Ismail, 2015).

Study Objectives

The study was guided by four objectives: (1) to assess digital competency levels among healthcare professionals in Northern Ghana; (2) to examine perceptions toward digital health; (3) to identify sociodemographic and professional factors associated with digital competency; and (4) to determine the relationship between perceptions and competency levels.

Research Hypotheses

Three main hypotheses were tested: (H₁) significant association exists between gender and digital competency; (H₂) years of professional experience is significantly associated with digital competency; and (H₃) perception of digital health is significantly associated with digital competency.

Literature Review

Digital competency in healthcare extends beyond basic technical proficiency to encompass cognitive, practical, and ethical capacities necessary for effective technology use. The DigComp framework provides comprehensive conceptualization across five domains (Ferrari, 2012; Vuorikari et al., 2022). In healthcare contexts, this enables effective

utilization of electronic medical records, telehealth platforms, and clinical decision support systems (MacLure and Stewart, 2018). eHealth literacy is specifically defined as the ability to seek, find, understand, and appraise health information from electronic sources and apply knowledge to health problems (Kasaye et al., 2024).

Global evidence reveals considerable variation in digital competency levels. In LMICs, competency remains suboptimal. An umbrella review synthesizing Ethiopian evidence found pooled good eHealth literacy of 55% (95% CI: 50–60%) among health professionals (Kasaye et al., 2024). A meta-analysis reported pooled digital literacy prevalence of 49.85% (95% CI: 37.22–62.47%) (Chereka et al., 2023). These figures contrast with training intervention outcomes in Sierra Leone, where foundational digital literacy training—adapted from DigComp—increased high computer literacy understanding from 7.1% to 72.2% (Woods et al., 2023).

Multiple systematic reviews identify consistent factors associated with digital competency. Kasaye et al. (2024) found good eHealth literacy positively associated with perceived usefulness, educational status, favorable attitudes, internet access, and perceived ease of use (pooled effect: 2.29, 95% CI: 1.82–2.76). Chereka et al. (2023) identified six significant predictors: monthly income (AOR=3.89), computer literacy (AOR=2.93), perceived usefulness (AOR=1.68), educational status (AOR=2.56), attitude (AOR=2.23), and perceived ease of use (AOR=2.22).

The BETTEReHEALTH project identified systemic barriers across sub-Saharan Africa including insufficient funds, inadequate infrastructure, poor leadership, and limited training opportunities, emphasizing need for continuous in-service training and supportive policies (BETTEReHEALTH Consortium, 2021). Attom (2024) highlighted challenges including uneven managerial digital skills, resistance to change, system fragmentation, and digital exclusion across African health systems.

While Ghana has advanced digital health policy through initiatives like the BETTEReHEALTH project, empirical evidence on health professionals' digital competency remains limited. The BETTEReHEALTH project established regional hubs but focused on systemic barriers rather than individual competency assessment (BETTEReHEALTH Consortium, 2021). This gap is significant because understanding baseline competency is essential for designing effective interventions (Woods et al., 2023). Khoza-Shangase (2024) identified themes relevant to West Africa: digital healthcare enhances accessibility; AI-driven diagnostics improve efficiency; barriers include infrastructure deficits and digital literacy challenges; and professional training is critical.

Several frameworks inform understanding of digital competency and technology adoption. The Technology Acceptance Model emphasizes perceived usefulness and ease of use as adoption determinants (Davis, 1989), validated in Ethiopian healthcare settings (Chereka et al., 2023). Diffusion of Innovations Theory describes technology integration stages among populations (Rogers, 2003). Human Capital Theory highlights workforce training investment returns (Becker, 1964). The DigComp framework, however, provides the most

comprehensive foundation for competency assessment, successfully applied in Sierra Leone through contextualized training modules (Woods et al., 2023).

Despite growing recognition of digital competency's importance, significant gaps persist. Most sub-Saharan African evidence concentrates on East Africa, particularly Ethiopia, with limited West African representation. Existing studies employ variable definitions and measurement approaches, complicating cross-contextual comparisons. Individual-level competency assessment using validated theoretical frameworks remains scarce. This study addresses these gaps by providing systematic digital competency assessment among healthcare professionals in Northern Ghana, grounded in the DigComp framework and operationalized through theoretically derived cognitive, practical, and critical-ethical dimensions.

Methods

Study Design, Setting, and Population

A quantitative, cross-sectional study was conducted among healthcare professionals employed in selected hospitals within the Northern Region of Ghana. The region is characterized by diverse healthcare settings, including tertiary, secondary, and primary facilities serving both urban and rural populations. The study population included physicians, nurses, midwives, allied health professionals, and relevant administrative staff actively involved in patient care or health service management.

Sample Size and Sampling Techniques

The minimum sample size was calculated using Cochran's formula for a finite population, assuming a 95% confidence level ($Z=1.96$), a conservative outcome proportion (p) of 0.5 to maximize sample size, and a margin of error (ME) of 0.05. The initial calculation yielded a minimum of 384 participants. To account for potential non-response or incomplete data, a 5% contingency was added, resulting in a target sample size of 403.

A multi-stage sampling technique was employed. First, hospitals were purposively selected to ensure representation across different levels of care (tertiary, secondary, primary) and geographical locations (urban/rural). Subsequently, within each selected hospital, healthcare professionals were recruited using a convenience sampling approach. A total of 450 healthcare professionals were approached to participate in the study. Of these, 428 completed and returned the questionnaire, yielding a response rate of 95.1%.

Data Collection Instrument and Pilot Testing

Data were collected using a structured, self-administered questionnaire developed based on the study's theoretical framework and a review of relevant literature. The instrument comprised three sections:

1. Socio-demographic and professional characteristics: Age, gender, profession, years of work experience, and socio-economic indicators.

2. Digital competency assessment: This section was adapted from the European Digital Competence Framework (DigComp 2.1), which conceptualizes digital competency across five domains: information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving. Items were contextualized for the healthcare setting through consultation with local experts and a review of relevant health informatics literature. The adapted scale consisted of 25 items rated on a five-point Likert scale (1 = not at all competent to 5 = highly competent).
3. Perception of digital health: A 12-item module assessed attitudes toward the utility, ease of use, and impact of digital health tools, using a five-point Likert scale (1 = strongly disagree to 5 = strongly agree).

The questionnaire was pilot tested with 35 healthcare professionals from a non-participating facility to assess clarity, comprehensibility, and cultural appropriateness. Feedback from the pilot resulted in minor wording modifications to enhance clarity. Internal consistency reliability was assessed using Cronbach's alpha, yielding coefficients of 0.89 for the digital competency scale and 0.84 for the perception scale, indicating good reliability.

The final questionnaire was administered electronically via secure online platforms or in-person using paper forms, based on participant preference and facility logistics. Data collection occurred over an eight-week period.

Variable Measurement and Cutoff Scores

The primary outcome variable, digital competency, was dichotomized into 'high' and 'low' levels. The total score from the 25-item scale was calculated (range: 25–125). Following established practice in competency research and based on the distribution of pilot data, a cutoff score of ≥ 100 was used to define high digital competency, representing an average item score of ≥ 4.0 (competent to highly competent). Participants scoring below 100 were classified as having low digital competency. This threshold was selected to reflect meaningful competency in practical application rather than mere familiarity.

Similarly, perception of digital health was dichotomized into 'good' and 'poor' categories. The total score from the 12-item perception scale (range: 12–60) was calculated. Based on the theoretical midpoint of the scale (36) and reinforced by the distribution observed in the pilot study, a cutoff score of ≥ 48 (average item score ≥ 4.0 , indicating agreement/positive attitude) was used to define good perception. Scores below 48 were classified as poor perception.

Data Analysis

Data analysis was performed using IBM SPSS Statistics (Version 25.0). Descriptive statistics (frequencies, percentages, means, and standard deviations) were used to summarize participant characteristics and key study variables.

To identify factors associated with digital competency, a two-stage regression analysis was conducted with the dichotomized digital competency variable as the outcome.

1. Bivariate Analysis: Initially, binary logistic regression was performed to examine the unadjusted association between each independent variable (socio-demographic and professional factors, perception of digital health) and the outcome.
2. Multivariate Analysis: Variables with a p-value < 0.2 in the bivariate analysis were entered into a multivariable binary logistic regression model using the backward stepwise (likelihood ratio) method. This model assessed the independent effect of each variable while controlling for potential confounders. Results are presented as Adjusted Odds Ratios (AORs) with 95% Confidence Intervals (CIs). Model fit was assessed using the Hosmer-Lemeshow test, and multicollinearity was checked via variance inflation factors (VIF). Statistical significance for the final model was set at $p < 0.05$.

Results

Participant Characteristics

Table 1: Socio-demographic and Economic Characteristics of Healthcare Providers (N=428)

Characteristic	Frequency (n)	Percentage (%)
Age (years) Mean = 37.4 ±9.4		
20-24	25	5.8
25-29	68	15.9
30-34	82	19.2
35-39	104	24.3
>40	149	34.8
Gender		
Male	244	57.0
Female	184	43.0
Religion		
Islam	259	60.5
Christianity	144	33.6
African Traditional Religion	25	5.8
Marital status		
Married	239	55.8
Unmarried	189	44.2
Ethnicity		
Akan	63	14.7
Dagomba	209	48.8
Frafra	47	11.0
Gonja	80	18.7
Others	29	6.8
Education level		

Characteristic	Frequency (n)	Percentage (%)
Diploma	176	41.1
Bachelor's degree	21	50.2
Master's degree	37	8.6
Profession		
Medical laboratory	21	4.9
Medical officer	44	10.3
Midwife	86	20.1
Nurse	224	52.3
Pharmacist	43	10.1
Others	10	2.3
Years of experience		
<5 years	114	26.6
5-9 years	243	56.8
10-14 years	46	10.8
>15 years	25	5.8
Residence		
Urban	286	66.8
Peri-urban	42	9.8
Rural	100	23.8
Healthcare settings		
Public institution	23	5.4
Primary healthcare	241	56.3
Private healthcare	70	16.4
Specialized healthcare	94	22.0
Monthly income (Ghana cedis)		
1500-3500	237	55.4
3501-5500	171	40.0
>5501	20	4.7

Others (ethnicity): Bissa, Dagaare, Ewe, Kasina, Kokomba, Kusasi, Mamprusi, Moshi, Tampulma, Wala

Others (profession): Accountant, Health Educator, Nutritionist

A total of 428 healthcare professionals participated in the study, yielding a response rate of 95.1% (428/450). Table 1 presents the socio-demographic and professional characteristics of the sample. The mean age of participants was 37.4 ± 9.4 years (range: 20-60 years), with the largest age group being those aged ≥ 40 years (34.8%). The sample comprised 57.0% males and 43.0% females. The majority were married (55.8%), of Dagomba ethnicity (48.8%), and held a bachelor's degree (50.2%). Nurses constituted the largest professional group (52.3%), followed by midwives (20.1%) and medical officers (10.3%). Most participants had 5-9 years of professional experience (56.8%), resided in urban areas (66.8%), and worked in primary healthcare settings (56.3%). Monthly income for the majority (55.4%) ranged between 1500-3500 Ghana cedis.

Level of Digital Competency Among Healthcare Professionals (Objective 1)

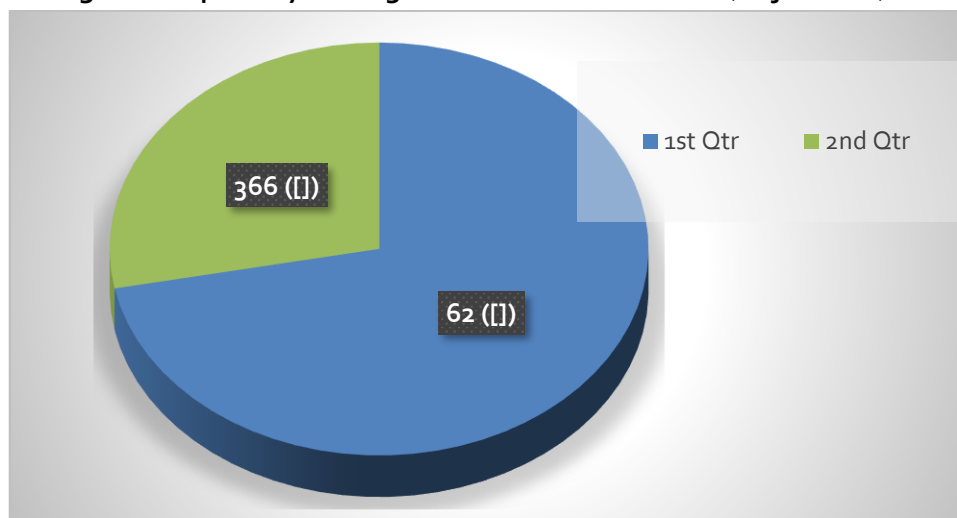


Figure 1: Level of Digital Competency Among Healthcare Providers (N=428)

Figure 1 presents the distribution of digital competency levels among participants. Of the 428 respondents, 366 (85.5%) were classified as having high digital competency, while 62 (14.5%) exhibited low digital competency. High digital competency was defined as a total score of ≥ 100 on the 25-item DigComp-adapted scale (average item score ≥ 4.0), indicating self-reported competence in core digital domains including information literacy, communication and collaboration, digital content creation, safety, and problem-solving.

Healthcare Professionals' Perceptions of Digital Health (Objective 2)

Table 2: Perceptions of Healthcare Providers on Digital Health (N=428)

Variable	Frequency (n)	Percentage (%)
Overall Perception Level		
Good Perception (score >48)	341	79.7
Poor Perception (score <48)	87	20.3
Item-Level Agreement		
Professionals need to provide patient-centric care through digital channels	367	85.8
Professionals need competence in using information technology and digital health systems	340	79.4
Professionals need competence in interacting with patients through digital means	353	82.5
Professionals need competence to evaluate what digital health is	339	79.2
Professionals need competence to combine digital means and traditional methods	346	80.8
Professionals need ability to evaluate their own digital health competence	364	85.1

Table 2 summarizes participants' perceptions of digital health. Overall, 341 respondents (79.7%) demonstrated good perceptions of digital health (total score ≥ 48 on the 12-item scale, average item score ≥ 4.0), while 87 (20.3%) reported poor perceptions. Item-level analysis revealed that the majority of participants agreed with key competency-related statements: 85.8% affirmed that professionals should provide patient-centered care through digital channels; 82.5% agreed on the importance of digital communication with patients; 85.1% recognized the need for self-evaluation of digital competencies; and 80.8% supported integrating digital tools with traditional methods.

Bivariate Analysis of Factors Associated with Digital Competency (Objective 3)

Table 3: Bivariate Analysis of Factors Associated with Digital Competency (N=428)

Characteristic	Total (N)	Low Competency n (%)	High Competency n (%)	χ^2	p-value
Gender				9.9065	0.002
Male	244	24 (9.8)	220 (90.2)		
Female	184	38 (20.7)	146 (79.4)		
Ethnicity				10.2636	0.036
Akan	63	10 (15.9)	53 (84.1)		
Dagomba	209	22 (10.5)	187 (89.5)		
Frafra	47	13 (27.7)	34 (72.3)		
Gonja	80	11 (13.8)	69 (86.3)		
Others	29	6 (20.7)	23 (79.3)		
Years of Professional Experience				35.5929	<0.001
<5 years	114	10 (8.8)	104 (91.2)		
5–9 years	243	26 (10.7)	217 (89.3)		
10–14 years	46	15 (32.6)	31 (67.4)		
≥ 15 years	25	11 (44.0)	14 (56.0)		
Perception of Digital Health				107.6098	<0.001
Good	341	19 (5.6)	322 (94.4)		
Poor	87	43 (49.4)	44 (50.6)		

Note: Only variables with significant associations are displayed in this table.

Bivariate analysis using chi-square and Fisher's exact tests was conducted to examine associations between digital competency levels and participant characteristics (Table 3). Four variables demonstrated statistically significant associations with digital competency at $p < 0.05$:

- Gender ($p = 0.002$): A higher proportion of males (90.2%) reported high digital competency compared to females (79.4%).

- Ethnicity ($p = 0.036$): Digital competency varied across ethnic groups, with Dagomba (89.5%) and Gonja (86.3%) showing higher proportions of high competency compared to Frafra (72.3%).
- Years of Professional Experience ($p < 0.001$): High digital competency decreased progressively with increasing experience: <5 years (91.2%), 5–9 years (89.3%), 10–14 years (67.4%), and ≥ 15 years (56.0%).
- Perception of Digital Health ($p < 0.001$): Among those with good perceptions, 94.4% demonstrated high digital competency, compared to only 50.6% among those with poor perceptions.

Variables not significantly associated with digital competency included age, marital status, education level, profession, residence type, healthcare setting, and monthly income.

Multivariable Analysis of Factors Independently Associated with Digital Competency (Objective 4)

Table 4: Multivariable Logistic Regression Analysis of Factors Associated with Digital Competency (N=428)

Variable	AOR	95% CI	p-value
Gender			
Male	1.00	Reference	
Female	0.45	0.23–0.88	0.019
Years of Professional Experience			
<5 years	1.00	Reference	
5–9 years	0.70	0.29–1.66	0.415
10–14 years	0.37	0.12–1.08	0.069
≥ 15 years	0.19	0.06–0.64	0.007
Perception of Digital Health			
Good	1.00	Reference	
Poor	0.07	0.03–0.13	<0.001
Ethnicity			
Dagomba	1.00	Reference	
Akan	1.57	0.57–4.28	0.381
Frafra	0.39	0.14–1.04	0.059
Gonja	1.35	0.53–3.43	0.527
Others	0.61	0.18–1.98	0.407

AOR = Adjusted Odds Ratio; CI = Confidence Interval Model adjusted for religion and profession (not significant, excluded from final table)

Multivariable binary logistic regression was conducted to identify independent predictors of high digital competency, adjusting for potential confounders. Variables with $p < 0.20$ in bivariate analysis (gender, ethnicity, years of experience, perception, religion, and

profession) were entered into the model. The final model demonstrated good fit (Hosmer-Lemeshow $p = 0.612$) and explained 48.3% of the variance in digital competency (Nagelkerke R^2).

Table 4 presents the adjusted odds ratios (AOR) with 95% confidence intervals (CI). Three factors emerged as significant independent predictors of high digital competency:

1. Gender: Female health professionals were significantly less likely to report high digital competency compared to their male counterparts (AOR = 0.45, 95% CI: 0.23–0.88 $p = 0.019$). This finding supports Hypothesis 1 (H_1) that gender is significantly associated with digital competency.
2. Years of Professional Experience: Compared to professionals with <5 years of experience, those with ≥ 15 years of experience had significantly lower odds of high digital competency (AOR = 0.19, 95% CI: 0.06–0.64, $p = 0.007$). Professionals with 10–14 years of experience showed a trend toward lower competency that approached but did not reach statistical significance (AOR = 0.37, 95% CI: 0.12–1.08, $p = 0.069$). These findings support Hypothesis 2 (H_2) that years of experience is significantly associated with digital competency.
3. Perception of Digital Health: Participants with poor perceptions of digital health were significantly less likely to demonstrate high digital competency compared to those with good perceptions (AOR = 0.07, 95% CI: 0.03–0.13, $p < 0.001$). This finding strongly supports Hypothesis 3 (H_3) that perception is significantly associated with digital competency.

Ethnicity, which was significant in bivariate analysis, did not retain statistical significance in the multivariable model, indicating that its effect was confounded by other variables. Consistent with Hypothesis 4 (H_4), socio-economic characteristics (income, education level) were not significantly associated with digital competency in either bivariate or multivariable analyses.

Discussion

In recent years, integration of digital technology into healthcare systems has gained global prominence, and has potentially revolutionize patient care, advanced healthcare delivery, and increased efficiency (Greenhalgh et al., 2020). However, healthcare providers in Low-Middle-Income Countries (LMICs) who work in public health centers lack basic digital competency (Shiferaw et al., 2020).

This study revealed that 85.5% of healthcare professionals in Northern Ghana reported high levels of digital competency, with 79.7% holding positive perceptions of digital health. These findings suggest a foundation of digital readiness that could support health system digitalization efforts. However, the identification of significant disparities, particularly related to gender, professional experience, and perception, warrants careful examination within the broader context of digital health adoption in low- and middle-income countries (LMICs).

The high prevalence of self-reported digital competency aligns with emerging evidence from similar contexts where mobile technology penetration has accelerated digital familiarity among health workers. However, this finding contrasts with a recent Ghanaian study, which found that only 25% of nurses reported confidence in using technology, despite 35% having received formal nursing informatics training (Bachiere and Shariff, 2026), furthermore, studies by Shiferaw et al. (2020) on digital competence among 193 Ethiopian healthcare professionals found that less than half (49.7%) of healthcare professionals reported a high level of digital competency. It is however consistent with the findings of Kuek and Hakkennes (2020) who reported that more than half (70%-80%) out of 407 health practitioners in Victoria possess high levels of digital literacy. Furthermore, findings from the Committee on Digital Skills for Health Professionals of the European Health Parliament indicate a large majority of health professionals do not receive training, or sufficient training in digital health technology (European Health Parliament, 2016).

This discrepancy may reflect differences in measurement approaches, as the present study assessed self-reported competency across multiple DigComp domains, whereas the comparative study focused specifically on nursing informatics competencies. Alternatively, the higher competency levels observed in Northern Ghana may reflect regional variations in digital exposure or the broader professional mix included in this sample, which encompassed physicians, allied health professionals, and administrative staff alongside nurses.

The positive perception of digital health (79.7%) is consistent with qualitative findings from Southern Africa, which found that health workers generally recognize the potential of digital tools despite significant implementation barriers (Arendse et al., 2022). Their study identified a spectrum of attitudes ranging from enthusiasm to resistance, but noted that even skeptical workers expressed willingness to adapt when tools were appropriately designed and integrated into workflows. This aligns with the current finding that perception is strongly associated with competency, suggesting that attitudes and skills are mutually reinforcing. Furthermore, evidence from Jarva et al. (2024) and Miltuze (2022) identified work experience, self-confidence, attitudes, family support, leader or specialist position, among few others as associated factors of digital competency among health professionals. Female health professionals were significantly less likely than their male counterparts to report high digital competency. This finding reflects persistent gender digital divides documented across Sub-Saharan Africa and other LMIC settings. A recent umbrella review, synthesized evidence from multiple systematic reviews and found that women in LMICs face compounded barriers to digital health engagement, including limited phone ownership, financial dependence, and socio-cultural norms restricting access to health information and technology (Means et al., 2025). The review noted that women in Sub-Saharan Africa are up to 37% less likely than men to use mobile internet, a gap that directly limits opportunities for informal digital skill development.

These structural barriers are further reinforced by institutional factors. Means et al. (2025) found that gender-responsive interventions accounting for these challenges is rare, and

that 57% of countries do not include gender considerations in their digital health strategies or only do so on an ad-hoc basis. The current findings underscore the urgency of integrating gender equity into digital health planning in Ghana, as failure to do so risks perpetuating existing disparities. Similar patterns have been observed in Nigerian healthcare settings, where Fashoto et al., (2023) identified gender as a significant predictor of digital technology engagement among health workers, with women reporting lower access to training opportunities and digital devices.

Health professionals with 15 or more years of work experience demonstrated significantly lower odds of high digital competency compared to those with fewer than five years of experience. These findings contrast evidence from Erfani et al., (2023), which examined digital health competence among 252 healthcare professionals and found that more professional experience was associated with higher digital health competence, particularly in the domain of ethical competence when using digital solutions. The divergence between these findings may reflect contextual differences: The study was conducted in settings with more mature digital health infrastructure, where experienced professionals have had sustained opportunities to develop digital skills through workplace exposure. In contrast, Ghana's digital health transformation is more recent, meaning that experienced professionals entered the workforce before digital tools were integrated into routine practice and may have had fewer structured opportunities for upskilling.

This interpretation is supported by Boadu et al., (2023), who assessed health information competency among 877 healthcare professionals across eight Ghanaian health facilities. Their study found that years of experience was a significant predictive factor for competency, but with important nuances: while experience conferred advantages in domains such as health information law and ethics, it was not consistently associated with higher technical skills. Notably, only health information officers and doctors met the competency threshold in their study, suggesting that professional role and training exposure may moderate the relationship between experience and digital competency.

The strong association between poor perception of digital health and lower digital competency underscores the interconnected nature of affective and cognitive dimensions of technology adoption. Applying the DigComp framework, this finding suggests that individuals who lack confidence across specific competency domains, particularly information literacy, problem-solving, and digital content creation, may develop negative attitudes that further inhibit skill development. Conversely, positive perceptions may enhance motivation to engage with digital tools, creating opportunities for experiential learning that reinforces competency.

The observed gender and experience disparities likely manifest differently across DigComp domains. The gender gap may be most pronounced in domains requiring deeper engagement beyond basic communication, such as digital content creation and problem-solving, where sustained access and practice opportunities are essential. Similarly, experienced professionals may demonstrate adequate competency in communication and collaboration (e.g., using mobile messaging for coordination) while struggling with

information literacy tasks such as retrieving data from electronic medical records or critically evaluating online health information. These domain-specific patterns warrant investigation in future research using validated DigComp-based assessments.

The findings both align with and diverge from international evidence. A German study by Stasielowicz (2024) applied the DigComp framework to assess digital competence among executives in residential care facilities and found that while basic digital skills were widespread, higher-order competencies such as content creation and safety were less developed. This pattern may parallel the current findings, where self-reported high competency may reflect confidence in basic tasks rather than mastery across all DigComp domains.

In contrast to Erfani et al., (2023) finding that higher education and hospital-based practice were associated with greater digital competence, the present study did not identify educational level as a significant predictor in multivariable analysis. This may reflect the relatively homogeneous educational background of the sample or the possibility that in Ghanaian settings, experiential factors such as gender and years of experience exert stronger influences than formal qualifications. The finding that socio-economic characteristics were not associated with competency further suggests that in this context, digital divides are shaped more by gender norms and generational training exposure than by economic factors alone.

Several limitations should be considered when interpreting these findings. First, the cross-sectional design precludes causal inference; associations between factors and digital competency cannot establish directionality. Second, digital competency was self-reported rather than objectively assessed, introducing potential social desirability bias and overestimation of skills. The discrepancy between this study's findings and those of Bachie and Shariff (2023) highlights the need for performance-based assessments in future research. Third, the use of convenience sampling within purposively selected hospitals limits generalizability to all healthcare facilities in Northern Ghana or other LMIC contexts, although the multi-stage approach enhanced representativeness within selected facilities. Fourth, the dichotomization of continuous competency scores, while pragmatically useful for regression analysis, may result in loss of nuanced information about gradations in competency levels across DigComp domains. Finally, the study did not assess organizational factors such as digital infrastructure availability, technical support, or prior training, variables that likely influence both competency and perception.

Conclusions

This study achieved its objective of assessing digital competency and its associated factors among healthcare professionals in Northern Ghana. The findings demonstrate that 85.5% of health workers report high levels of digital competency, and 79.7% hold positive perceptions of digital health, indicating foundational readiness for health system digitalization.

Multivariable analysis identified three significant predictors of digital competency. Female health professionals were significantly less likely to report high competency than males, reflecting persistent gender digital divides documented across Sub-Saharan Africa. Health professionals with 15 or more years of work experience demonstrated significantly lower competency than those with fewer than five years of experience, suggesting a generational gap in digital exposure and training. Additionally, poor perception of digital health was strongly and inversely associated with competency, indicating that attitudes and skills are mutually reinforcing. These findings have practical implications for health system strengthening. Digital health strategies must explicitly address gender equity through accessible training programs and equitable device access. Bridging the generational competency gap requires tailored, mentorship-based upskilling that respects experienced professionals' clinical expertise. Interventions must simultaneously address skill development and attitudinal barriers by demonstrating tangible benefits to clinical practice. Future research should employ objective, performance-based assessments of digital competency and disaggregate findings by DigComp domain to identify precise intervention targets. Longitudinal studies are needed to track competency changes over time as digital health systems mature. In conclusion, while healthcare professionals in Northern Ghana demonstrate foundational digital readiness, significant gender and experiential disparities demand proactive policy attention. Without targeted interventions, digital health transformation risks reinforcing existing inequities rather than ameliorating them.

Recommendations

Based on the study findings, the following actionable recommendations are directed toward key stakeholders responsible for health workforce development and digital health implementation in Ghana. The Ghana health service and the ministry of health should develop a national gender-sensitive digital health strategy that addresses barriers faced by female health workers, including equitable access to devices, connectivity, and training opportunities. Establish national digital competency standards aligned with the European Digital Competence Framework (DigComp) and mandate their integration into continuing professional development programs with regular gender-disaggregated monitoring. Furthermore, hospital administrators should conduct baseline competency assessments to identify gaps, particularly among female staff and those with 15+ years of experience. Implement mentorship-based training that pairs experienced professionals with digitally competent younger colleagues. Demonstrate tangible benefits of digital tools to clinical practice, such as reduced documentation time and improved information access, to foster positive perceptions that motivate skill development. Ensure equitable access to devices and technical support. Health training institutions should integrate digital health competencies across all pre-service curricula, addressing all five DigComp domains within clinical contexts. Develop bridging programs for practicing clinicians to address the generational competency gap. Ensure female students have equitable access to digital

resources and targeted support to build confidence and skills from entry into the workforce. Coordinated action across all levels of the health system, policy leadership, facility-level implementation, educational reform, and user-centered design, is essential to ensure that digital health transformation in Ghana is equitable, inclusive, and effective.

List of Abbreviations

AOR: Adjusted Odds Ratio; CIs: Confidence Intervals; EMR: Electronic Medical Record; HIS: Health Information Systems; IT: Information Technology; LMICs: Low-Middle-Income Countries; ORs: Odds Ratios; SPSS: Statistical Package for Social Sciences.

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Authors' contributions

AMN and YA jointly conceived and designed the study, AY and NS performed data analysis and interpretation. AMN and ZAG drafted the manuscript and the supervision of AY. AMN, NS and YA jointly undertook critical revision of the manuscript. All authors have approved the manuscript for publication.

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Data availability

The datasets used for this study are available from the corresponding author on request.

Declaration

Ethics approval and consent to participate

The Institutional Review Board of the University for Development Studies (UDS), Tamale, approved the study protocol. Moreover, written informed consent was obtained from the healthcare practitioners and the study objectives were explained to the healthcare practitioners before we administered the questionnaire. Furthermore, anonymity and confidentiality of the study data were assured. Finally, we informed the healthcare practitioners that taking part in the study was optional and that they could withdraw at any time during the process.

Consent for publication

Not applicable.

Declaration of competing interest

The authors declare that there were no competing financial interests or personal relationships that could have appeared to influence any part of the work reported in this paper.

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