

DIGITAL LITERACY AND ASSOCIATED FACTORS AMONG HEALTHCARE PROFESSIONALS(HCPS) OF PAKISTAN- IDENTIFYING BARRIERS IN THE WAY OF EFFICIENT (NATIONAL) DIGITIZATION OF HEALTHCARE

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Abstract

Objective: The objective of this study was to assess the level of digital literacy among healthcare professionals (HCPs) in Pakistan and to identify associated factors and barriers that may hinder the efficient national digitization of the healthcare system.

Introduction: Digital technologies, including Electronic Medical Records (EMRs) and Clinical Information Systems (CIS), play an integral role in improving the quality, efficiency, and safety of healthcare delivery; however, the successful implementation of digital technology largely depends upon the digital literacy of those who will use these technologies on a daily basis the healthcare professionals. In low and middle income countries such as Pakistan, limited information exists regarding the digital readiness of the healthcare professional workforce; therefore creating a critical information gap for any future efforts regarding developing a national digital health strategy.

Methodology: This research employed a cross-sectional study design on healthcare professionals within Jinnah Postgraduate and Medical Center (JPMC), one of the leading tertiary care hospitals in Pakistan, using a self-administered structured questionnaire that was adapted from the European Commission's Digital Competence Framework that assessed five main areas of Digital Literacy (information and data literacy; communication and collaboration; digital content creation; safety; and problem-solving). We employed a stratified random sampling method to ensure that there were adequate numbers of respondents from all identified health professional groupings. We performed a descriptive statistical analysis on each of my digital literacy findings, and in addition to that analyzed the relationship between each group's digital literacy scores utilizing the Mann-Whitney U test comparing digital literacy scores to socio-demographic data obtained from the cross-sectional study.

Result: A total of 117 health care professionals participated. The two areas that demonstrated the highest levels of competency were (1) information and data literacy 36.66% of respondents scored within this area and (2) communication and collaboration 35.47% of respondents scored within this area. Digital content development and problem-solving skills exhibited significant gaps in digital literacy among healthcare professionals in Pakistan. According to the survey results, 47.29% of survey respondents were identified as being at lower or lower-to-moderate competence for digital content development skills, and 52.43% demonstrated the same capabilities for problem-solving skill-sets, with only 25.64% of survey respondents being classified as demonstrating a high level of competence associated with having digital competency related to safety. The study revealed a statistically significant relationship between the various aspects of digital literacy and the following demographic factors (marital status, professional background, and problem-solving skills). The only demographic characteristic that did not show statistical significance was age. **Conclusion:** In conclusion, the study highlights the notable deficits in advanced digital literacy skills possessed by healthcare professionals in Pakistan, which presents a significant barrier for the effective implementation of healthcare digitization at a national level. Although the provision of basic digital competencies is relatively prevalent, there is an urgent need for target-focused, domain-specific training on digital content development, safety, and problem-solving. In order to successfully implement electronic medical records and to facilitate broader digital health transformation initiatives in Pakistan, healthcare professionals need to have structured capacity-building initiatives designed to enhance their digital literacy.

INTRODUCTION

The integration of digital technology into global healthcare systems continues to change dramatically due to advances in digital health technology. The way patients receive care has changed dramatically because of digital health technology's ability to deliver high-quality, efficient, and safe patient care. Digital Health Technologies such as Electronic Medical Record (EMR) systems, Clinical Information Systems, Telemedicine, and Decision Support Applications have had a huge impact on the quality of care being provided to patients and on reducing the amount of mistakes made while providing the best possible care to all Patients along the health continuum, and are essentially the backbone of digital health systems in most developed nations. However, there has been little to no consistency in the implementation of health IT systems within low- and middle-income countries, and many countries continue to face significant barriers with the implementation of health IT systems.

Clinical Information Systems (CIS) is the global classification of clinical digitized health technology

categories that enable the collection, storage, management, and delivery of clinical data to support the delivery of Clinical Services to Patients. EMRs signify the most commonly implemented type of CIS, having been shown to progress continuity of care, clinical decision-making, and patient safety only when they are used appropriately. While there is sufficient evidence demonstrating that CIS enhance patient care, evidence from worldwide studies indicates that approximately 70% of IT solutions providing healthcare services globally did not achieve their targeted outcomes for use within resource-challenged environments. Limited infrastructure, poor investment in developing a strong IT infrastructure, lack of developed policy, and a lack of ability to train healthcare professionals on using new digital tools are the primary reasons that CIS do not improve patient outcomes in many low- and middle-income countries. Currently, multiple low- and middle-income countries (LMICs), including Pakistan, are in various stages of transitioning to the digitalization of health services. National digital health initiatives are being developed;

however, the overall success of digital health technology implementation is contingent upon the readiness of an identified healthcare user group, which are the healthcare professionals. The European Commission defines "digital literacy" as the ability to confidently, critically and responsibly utilize digital tools in areas such as work, learning and citizenship; therefore, the development of digital literacy is a prerequisite for successful implementation of digital healthcare solutions. Digital literacy includes numerous domains, such as information/digital data literacy, information/digital communication/collaboration, information/digital content creation, information/digital safety and information/digital problem solving.

The current research indicates that the level of digital literacy among healthcare workers in low- and middle-income countries may be an obstacle to the successful establishment of digital health infrastructure [4, 5]. The common response to this problem has been to provide training programmes, but the results suggest that providing a generic "computer training" may not be enough. The availability of generic computer training does not guarantee that healthcare workers will be competent in using the technology that they will be using when implementing the digital health technologies. To be able to create targeted training and capacity-building programmes for specific domains, it is necessary to evaluate the healthcare worker's requirements for digital competencies within their specific domain, assess their existing digital competencies against those requirements, and determine where they have gaps in their competency [5, 6]. In order to provide the proper level of education and training, it is necessary to evaluate the digital competency level of potential users of digital devices, according to several studies. The use of Electronic Medical Record (EMR) systems, online risk assessment and decision support tools, as well as the introduction of cutting-edge medical equipment, which frequently has digital user interfaces, might all be substantially aided by the digital competency of healthcare personnel [7]. The attitude, perception, and expectations of healthcare workers towards digital technologies is also a major factor influencing the adoption rates of digital health technologies, even when the technology infrastructure is available and functioning [3]. The delay in implementing electronic

medical records (EMRs) in many different settings can be attributed to the resistance of physicians and other healthcare workers to adopting electronic medical records.

The need for digital health infrastructure and digital literacy among healthcare professionals has grown rapidly in Pakistan. Sadly, there is very little information available on the level of digital literacy among healthcare professionals at the national level. The most recent local studies are limited, and many of them are outdated; they primarily focus on basic computer skills rather than digital competencies that cover the full range of digital health technologies that are currently available in modern healthcare [8]. There is also very little research that has focused on how the domain of digital literacy has been associated with various socio-demographic factors among healthcare workers. Information on this topic is important to guide future policy development and workforce planning. Many low- and middle-income nations fail to provide comprehensive healthcare services due to financial constraints, inadequate policies, and a lack of adequate technical and human resources.² National health information systems have only been successfully deployed in a small number of low-income nations. The lack of digital literacy among medical professionals may be one factor causing this. [9]

Previous studies from other countries show a sizable research gap that will be ideal for future study and, consequently, the creation of effective and efficient training for all health professional disciplines to use this crucial digital transformation of healthcare consumers' clinical records. It is imperative to find out the knowledge and skill gaps that exist to be able to successfully move towards national level digitization of healthcare system in Pakistan [10]. The assessment of digital literacy levels among healthcare professionals in Pakistan is therefore critical. Policymakers, Health Care Administrators, and Educators will gain insight into Current Competencies and Barriers to Digital Literacy by having a better understanding of the Existing Competencies of Healthcare Workers (HCWs) within Pakistan. This Research project aims to assess the Digital Literacy Level within a Specific Area of Health Care within a Tertiary Care Facility in Pakistan (PK) and identify Demographic and Professional Factors

associated with Digital Literacy Level to provide Evidence of Digital Health Transformation in PK.

METHODOLOGY

The cross-sectional design study was performed to Identify the Digital Literacy Level of and the Factors associated with physicians, nurses, medical technologists, and other Healthcare Professionals (HCPs) working in Tertiary care-Hospital associated with Jinnah Post Graduate Medical Center (JPMC). HCPs who had been working in the Same Institution for at least 6-Months had the opportunity to be included in this study, while HCPs that had taken leave or had only been employed in the Same Facility for a Shorter Time were excluded. The researchers employed a convenience Sampling by the different Healthcare Professions to ensure Proportional Representation and to enhance the Generalizability of the Results to all the different Healthcare Disciplines in Pakistan.

The researchers utilized a Self-Administered, Structured Questionnaire adapted from the Digital Competence Framework (DigComp 2.2) developed by the European Commission to collect Data from the Respondents. The Digital Competence Framework is a Validated, Universal-based Assessment Tool for Digital Literacy across Health Care and across the Globe; thus, the Study's Researchers were able to utilize this tool to assess the HCWs' Digital Literacy levels across the different Professional Categories [11]. The evaluation instrument measured five components of digital competency, which included Information and Data Literacy; Communication and Collaboration; Digital Content Creation; Safety; and Problem Solving. Each participant indicated his/her evaluation of their ability by selecting the level at which they feel they are able to perform a computer-based activity independently, with confidence, or needed assistance. The DigComp framework has been utilized to measure readiness for implementing digital health systems in healthcare and low resource environments.

Data collection occurred over a 3-month period, after obtaining institutional approval and obtaining informed consent from all participants. Participants' identities were not disclosed and their responses remained confidential. Data collected were analyzed using SPSS (Statistical Packages for the Social

Sciences). Descriptive statistics were computed for the demographic characteristics and digital literacy domain scores using frequency, percentage, mean and standard deviation. Since the assumption of normality was not satisfied, a non-parametric statistical method was applied. The Mann-Whitney U Test was conducted to compare the digital literacy scores of participants based on their socio-demographic characteristics, specifically gender, marital status, age, and professional background; a statistically significant $p < 0.05$ was used to describe the findings.

RESULT

In total, 117 Healthcare Professionals took part in the study. As indicated in Table 1 below, most of the participants were female (75.2%) while the male participants represented 24.8%. The majority of respondents indicated that they were single (81.2%). In addition, the greater percentage of participants had a background in healthcare as shown by the 86.3% of the respondents. The majority of participants were young as shown by the 94.9% of participants in the 20-28 age group. Doctors made up the largest percentage of the professional designation at 48.7% followed by medical technologists at 39.3%, nurses at 11.1%, and physiotherapists at 0.9%.

In terms of individual items used to measure digital literacy domains, there were variations in levels of competency across multiple digital literacy domains (see Table 2 below). In the area of Information and Data Literacy, a considerable number of participants reported experiencing some level of reliance on assistance or having limited competency when managing and analysing data through software supported by digital tools, and critically reviewing or evaluating online information. In Terms of Communication and Collaboration, many participants had developed a level of independent competence with respect to the use of basic digital tools (such as sending and replying to email). However, when looking at advanced tools for collaboration or the use of online collaboration services, the percentage of respondents showing competency was significantly lower. The area of Digital Content Creation was the weakest area of digital literacy. Many respondents indicated they required assistance or had little or no knowledge about completing tasks related to Scripting,

Automating Activities and Understanding how Algorithmic Solutions work. The Safety domain indicated that a lot of people lacked the skills necessary for practical application (i.e., data recovery, secure browsing, and location privacy) even though they were aware of the risks of the Internet and the importance of protecting their privacy with regards to

data collection. On the other hand, the results were inconsistent when it came to Problem Solving skills; many of the participants experienced difficulty in both areas, either due to advanced technical troubleshooting or data-based decision-making.

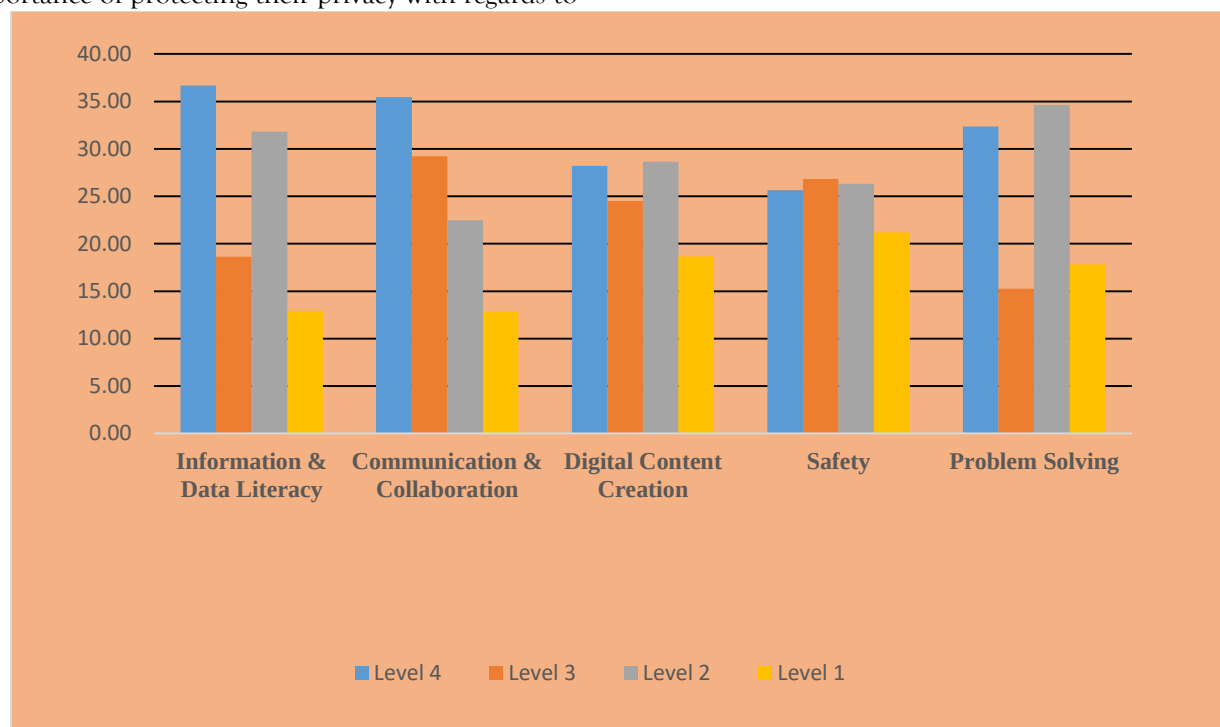


Figure 1: Distribution of Digital Literacy Level Among HCPs

As shown in Table 3, the mean scores for all nine domains of digital literacy (as compared to socio-demographic variables) did not reveal any statistically significant differences between men and women across the various domains of digital literacy. However, there was a statistically significant difference in the Problem-Solving Domain, with men showing much higher mean scores than women ($p = 0.009$). Marital status was also found to be significantly related to Digital Content Creation, with married respondents having higher mean scores than single respondents ($p = 0.003$). People with healthcare-related backgrounds were found to have significantly higher mean scores in Information and Data Literacy ($p = 0.023$) and Digital Content Creation ($p = 0.036$). There was no significant association found between the various age groups and the mean scores for any of the nine domains of digital literacy. All comparisons

were made using the Mann-Whitney U test because the data from the study were not normally distributed. The results of this study are presented in Figure 1, which presents the distribution of digital literacy levels across the nine domains of digital literacy as a series of levels, with the lowest competency level at the bottom of the figure and the highest competency level at the top. Within the domain for Information and Data Literacy, 12.92% of respondents indicated that they had a Low level of competency; 31.81% representing a Lower to Moderate level of competency, 18.61% displayed Moderate levels of competency, and 36.66% were marked as exhibiting the Highest level of competency for Information Literacy. Regarding the same domain in Communication and Collaboration, 12.82% of respondents fell into the Lowest level of competency; 22.48% fell into the Lower to Moderate level; 29.23%

had Moderate skills; and 35.47% had the Highest level of competency for Communication and Collaboration. In Digital Content Creation, the highest percentage of participants was contained within both the Lowest level (18.66%) and Lower to Moderate level (28.63%); while a lower number (24.50%) of participants were in the Moderate Level; and at the highest level (28.21%) of skills in Digital Content Creation. Referring to the Safety domain for Safety metrics, the highest percentage of participants fell into the Lowest level (21.20%) and Lower to Moderate level (26.32%); while a higher percentage of participants were in the Moderate level (26.84%) and Highest level (25.64%) of skills related to Safety. For

Problem-Solving, the highest proportion of participants were in the Lowest competency level (17.81%); a lower percentage were in the Lower to Moderate Competency (34.62%); while a third group (15.24%) of participants were identified as Moderate & the final third (32.34%) achieved the Highest Competency Level for Problem-Solving. Therefore, while all domains indicated a large number of Healthcare Professionals falling into the Lower & Intermediate Competency Levels of Digital Literacy, this suggests a large gap related to advanced Digital Literacy skills required for an effective National level Digitization of Healthcare Systems.

Table 1: Demography

Demography		Frequency	Percent
Gender	Male	29	24.8
	Female	88	75.2
Marital Status	Single	95	81.2
	Married	22	18.8
related to healthcare professional	Yes	101	86.3
	No	16	13.7
Age Group	20-28	111	94.9
	>28	6	5.1
Employment Status	Doctor	57	48.7
	Medical Technologist	46	39.3
	Nurse	13	11.1
	Physiotherapist	1	0.9

Table 2: Item-wise Result of Digital Literacy Responses among Healthcare Professionals

C1.1	I can do it on my own [49 (41.9%)]	I can do it with confidence [30 (25.6%)]	I can do it with help [28 (23.9%)]	I don't know how to do it [10 (8.5%)]
C1.2	I can do it on my own [34 (29.1%)]	I can do it with confidence [17 (14.5%)]	I can do it with help [38 (32.5%)]	I don't know how to do it [28 (23.9%)]
C1.3	I can do it on my own [35 (29.9%)]	I can do it with confidence [24 (20.5%)]	I can do it with help [44 (37.6%)]	I don't know how to do it [14 (12%)]
C1.4	Yes I do [61 (52.1%)]	Very much [19 (16.2%)]	Not much [32 (27.4%)]	Not at all [5 (4.3%)]
C1.5	I have a good understanding of this [55 (47%)]	I have no knowledge of this [13 (11.1%)]	I have only a limited understanding of this [41 (35%)]	I never heard of this [8 (6.8%)]
C1.6	I have a good understanding of this [50 (42.7%)]	I have no knowledge of this [14 (12%)]	I have only a limited understanding of this [42 (35.9%)]	I never heard of this [11 (9.4%)]

C1.7	I can do it on my own [40 (34.2%)]	I can do it with confidence [21 (17.9%)]	I can do it with help [38 (32.5%)]	I don't know how to do it [18 (15.4%)]
C1.8	I can do it on my own [37 (31.6%)]	I can do it with confidence [42 (35.9%)]	I can do it with help [23 (19.7%)]	I don't know how to do it [15 (12.8%)]
C1.9	I can do it on my own [25 (21.4%)]	I can do it with confidence [16 (13.7%)]	I can do it with help [49 (41.9%)]	I don't know how to do it [27 (23.1%)]
C2.1	I can do it on my own [37 (31.6%)]	I can do it with confidence [20 (17.1%)]	I can do it with help [38 (32.5%)]	I don't know how to do it [22 (18.8%)]
C2.2	I can do it on my own [39 (33.3%)]	I can do it with confidence [57 (48.7%)]	I can do it with help [14 (12%)]	I don't know how to do it [7 (6%)]
C2.3	I fully understand this topic [35 (29.9%)]	I have a good understanding of this [39 (33.3%)]	I have no knowledge of this [19 (16.2%)]	I have only a limited understanding of this [24 (20.5%)]
C2.4	I fully understand this topic [32 (27.4%)]	I have a good understanding of this [57 (48.7%)]	I have no knowledge of this [12 (10.3%)]	I have only a limited understanding of this [16 (13.7%)]
C2.5	Yes I do [59 (50.4%)]	Very much [17 (14.5%)]	Not much [23 (19.7%)]	Not at all [18 (15.4%)]
C2.6	I can do it on my own [40 (34.2%)]	I can do it with confidence [27 (23.1%)]	I can do it with help [37 (31.6%)]	I don't know how to do it [13 (11.1%)]
C2.7	I can do it on my own [36 (30.8%)]	I can do it with confidence [39 (33.3%)]	I can do it with help [29 (24.8%)]	I don't know how to do it [13 (11.1%)]
C2.8	I can do it on my own [47 (40.2%)]	I can do it with confidence [24 (20.5%)]	I can do it with help [30 (25.6%)]	I don't know how to do it [16 (13.7%)]
C2.9	I can do it on my own [46 (39.3%)]	I can do it with confidence [35 (29.9%)]	I can do it with help [30 (25.6%)]	I don't know how to do it [6 (5.1%)]
C2.10	I can do it on my own [44 (37.6%)]	I can do it with confidence [27 (23.1%)]	I can do it with help [31 (26.5%)]	I don't know how to do it [15 (12.8%)]
C3.1	I can do it on my own [40 (34.2%)]	I can do it with confidence [38 (32.5%)]	I can do it with help [20 (17.1%)]	I don't know how to do it [19 (16.2%)]
C3.2	I can do it on my own [48 (41%)]	I can do it with confidence [33 (28.2%)]	I can do it with help [31 (26.5%)]	I don't know how to do it [5 (4.3%)]
C3.3	I can do it on my own [46 (39.3%)]	I can do it with confidence [23 (19.7%)]	I can do it with help [38 (32.5%)]	I don't know how to do it [10 (8.5%)]
C3.4	I can do it on my own [28 (23.9%)]	I can do it with confidence [46 (39.3%)]	I can do it with help [27 (23.1%)]	I don't know how to do it [16 (13.7%)]
C3.5	I can do it on my own [27 (23.1%)]	I can do it with confidence [13 (11.1%)]	I can do it with help [46 (39.3%)]	I don't know how to do it [31 (26.5%)]
C3.6	I fully understand this topic [9 (7.7%)]	I have a good understanding of this [19 (16.2%)]	I have no knowledge of this [39 (33.3%)]	I have only a limited understanding of this [50 (42.7%)]
C4.1	I fully understand this topic [26 (22.2%)]	I have a good understanding of this [50 (42.7%)]	I have no knowledge of this [9 (7.7%)]	I have only a limited understanding of this [32 (27.4%)]
C4.2	I can do it on my own [27 (23.1%)]	I can do it with confidence [21 (17.9%)]	I can do it with help [45 (38.5%)]	I don't know how to do it [24 (20.5%)]

C4.3	I can do it on my own [37 (31.6%)]	I can do it with confidence [30 (25.6%)]	I can do it with help [28 (23.9%)]	I don't know how to do it [22 (18.8%)]
C4.4	I can do it on my own [33 (28.2%)]	I can do it with confidence [11 (9.4%)]	I can do it with help [45 (38.5%)]	I don't know how to do it [28 (23.9%)]
C4.5	I fully understand this topic [27 (23.1%)]	I have a good understanding of this [45 (38.5%)]	I have no knowledge of this [27 (23.1%)]	I have only a limited understanding of this [18 (15.4%)]
C5.1	I can do it on my own [20 (17.1%)]	I can do it with confidence [14 (12%)]	I can do it with help [47 (40.2%)]	I don't know how to do it [36 (30.8%)]
C5.2	Yes I do [41 (35%)]	Very much [11 (9.4%)]	Not much [39 (33.3%)]	Not at all [26 (22.2%)]
C5.3	I have a good understanding of this [26 (22.2%)]	I have no knowledge of this [21 (17.9%)]	I have only a limited understanding of this [58 (49.6%)]	I never heard of this [12 (10.3%)]
C5.4	Yes I do [57 (48.7%)]	Very much [22 (18.8%)]	Not much [29 (24.8%)]	Not at all [9 (7.7%)]
C5.5	I can do it on my own [48 (41%)]	I can do it with confidence [26 (22.2%)]	I can do it with help [29 (24.8%)]	I don't know how to do it [14 (12%)]
C5.6	I can do it on my own [35 (29.9%)]	I can do it with confidence [13 (11.1%)]	I can do it with help [41 (35%)]	I don't know how to do it [28 (23.9%)]

Table 3: Comparison of Mean Digital Literacy Scores across Socio-Demographic Variables

Areas	Gender	Mean±SD	P-Value	Marital status	Mean±SD	P-Value	Are you related to healthcare professional?	Mean±SD	P-Value	Age Group	Mean±SD	P-Value
Information & Data Literacy	Male	2.76 ± 0.57	0.827	Single	2.75 ± 0.55	0.072	Yes	2.75 ± 0.54	0.023	20-28	2.78 ± 0.54	0.239
	Female	2.8 ± 0.52		Married	2.97 ± 0.38		No	3.06 ± 0.35		>28	3.04 ± 0.4	
Communication & Collaboration	Male	2.89 ± 0.73	0.548	Single	2.83 ± 0.65	0.128	Yes	2.83 ± 0.65	0.078	20-28	2.86 ± 0.65	0.252
	Female	2.87 ± 0.63		Married	3.05 ± 0.64		No	3.13 ± 0.58		>28	3.13 ± 0.59	
Digital Content Creation	Male	2.62 ± 0.65	0.902	Single	2.54 ± 0.59	0.003	Yes	2.57 ± 0.61	0.036	20-28	2.6 ± 0.61	0.132
	Female	2.62 ± 0.6		Married	2.97 ± 0.6		No	2.95 ± 0.56		>28	3 ± 0.55	
Safety	Male	2.56 ± 0.51	0.727	Single	2.55 ± 0.56	0.493	Yes	2.56 ± 0.56	0.620	20-28	2.58 ± 0.54	0.542
	Female	2.57 ± 0.56		Married	2.64 ± 0.5		No	2.64 ± 0.47		>28	2.4 ± 0.66	
Problem Solving	Male	2.84 ± 0.45	0.009	Single	2.59 ± 0.51	0.097	Yes	2.59 ± 0.52	0.129	20-28	2.62 ± 0.52	0.828
	Female	2.55 ± 0.52		Married	2.77 ± 0.54		No	2.8 ± 0.48		>28	2.64 ± 0.53	

Applied Mann - Whitney Test

Table 4

Information & Data Literacy	Total	386	196	335	136
	Percentage	36.66	18.61	31.81	12.92
Communication & Collaboration	Total	415	342	263	150
	Percentage	35.47	29.23	22.48	12.82
Digital Content Creation	Total	198	172	201	131
	Percentage	28.21	24.50	28.63	18.66
Safety	Total	150	157	154	124
	Percentage	25.64	26.84	26.32	21.20
Problem Solving	Total	227	107	243	125
	Percentage	32.34	15.24	34.62	17.81

Discussion

This study showed empirical confirmation on the digital literacy levels of healthcare professionals in Pakistan and pointed out substantial gaps that may obstruct efficient national-level digitization of healthcare systems. The majority of participants showed a basic level of digital competence in some areas, but advanced digital skills across most areas were lacking. For example, in the area of Information and Data Literacy, only 36.66% of healthcare professionals demonstrated the highest level of competency, while 44.73% demonstrated a low or low to moderate level of competency, suggesting a lack of ability to critically evaluate data and manage digital information. These findings are consistent with reports from LMICs where healthcare professionals possess only basic skills to seek information but lack the advanced level of digital literacy necessary to effectively use EMRs [4,5].

In the area of Communication and Collaboration, results were somewhat better than other areas, with 35.47% of respondents achieving the highest level of competency and 29.23% achieving a moderate level of competency. However, about 35% of participants had a lower level of competency, particularly in the area of advanced digital collaboration tools and cloud-based services. Comparable findings to those of Tegegne et al. were noted in that while routine digital communication skills are present, there is a lack of advanced collaborative competencies needed to deliver integrated digital healthcare [4].

Conversely, Digital Content Creation emerged as a key area of concern. Only 28.21% of participants achieved the highest level of competency, while 47.29% were classified at low or low to moderate

levels of competency. The results of this study are consistent with those found by Shiferaw et al. in that they report low levels of digital content creation proficiency among healthcare professionals working in a low-income country, as around only 30% of them had achieved at least an adequate level of performance in this area. Therefore, this lack of proficiency could hinder the ability for healthcare professionals to adapt to the use of digital tools for creating educational materials and for successfully utilizing more advanced level health information systems.

Within the Safety domain, the distribution of competencies demonstrated was mostly equal across all competency levels where 25.64% of participants were at the highest competency level while 21.20% of participants were at the lowest competency level. Even with some degree of knowledge of concepts related to digital safety, almost half of the participants had very limited skills when it came to applying digital safety concepts in real-life instances. This lack of skills corresponds to findings by Scott et al. that indicate there are significant risks posed to both patient confidentiality and system integrity when implementing electronic medical records due to inadequate digital safety competencies.

The Problem-Solving Domain was particularly variable, with 32.34% of healthcare professionals achieving the highest competency level; on the other hand, 52.43% were classified as either in the lowest or lower-moderate competency categories. This large discrepancy indicates that while some healthcare professionals are highly proficient at trouble-shooting problems with technology, the majority of healthcare professionals are unable to demonstrate effective technical problem solving or apply data for making

informed decisions. Other studies conducted in Ethiopian and other lower-and-middle-income countries (LMIC) produced similar data, suggesting limited problem-solving ability contributes significantly to barriers preventing healthcare professionals from adopting digital health systems in a sustainable manner [4].

The socio-demographic analyses of this study helped to contextualize these findings. Although there were no significant differences in the findings by gender across most domains, males scored significantly higher on the problem-solving measure ($p = 0.009$), supporting trends found in similar LMIC studies [5]. Those who had a healthcare background scored significantly higher in Information and Data Literacy ($p = 0.023$) and Digital Content Creation ($p = 0.036$), providing evidence of how professional exposure may assist in developing digital skills. There was a significant relationship between marital status and Digital Content Creation ($p = 0.003$). There were no significant relationships between age and the level of digital literacy, as the majority of the study's participants were relatively young (94.9% were between the ages of 20-28 years).

Therefore, these results support prior research that indicates general training for using computers is not an adequate method for closing the gap between digital competencies of healthcare providers. In addition, targeted interventions specifically designed to build capacity in digital content creation, safety, and problem-solving processes are essential for the successful implementation of electronic medical records (EMRs) and the wider digitization of the healthcare system, as there is research that demonstrates enhanced digital health readiness and long-term sustainability of a digitized health system when training is aligned to a structured framework like the European Union's Dig-Comp Framework [5,6].

CONCLUSION

This research indicates that the majority of Healthcare Professionals in Pakistan do not have sufficient Digital Literacy, which inhibits the ability for the country to fully digitize its Health Care System. Some of the study participants had very basic or moderate Digital Skills, but there was very little evidence of Advanced Competency that is required to utilize

Digital Health Technologies. There appeared to be an association between varying degrees of Digital Literacy and Professional Background, Marital Status as well as Problem Solving Ability, which would indicate that exposure as well as Training, will help improve these competencies. The lack of Evidence of age and/or gender differences suggests that training of these individuals would enhance their Competency, as it relates to the complete Health Care Workforce in Pakistan. This research demonstrates that for countries and/or organizations that are attempting to digitize their Healthcare Systems, Building Competency Based Training to Global Standards would be the best approach to ensure Healthcare Professionals are Prepared for Digital Health Technology Solutions, as well as for Improving Overall Patient Care. Future Research should examine how effective targeted Digital Literacy Program(s) would be on Patient Outcomes and Digital Health Adoption in Pakistan.

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