

SKILLS FOR TOMORROW'S HEALTHCARE: A STUDY ON HEALTHCARE PROFESSIONALS*

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Abstract

This study aims to assess the current and needed skills of healthcare professionals. A descriptive and cross-sectional study was conducted using a questionnaire with healthcare professionals at a Turkish private hospital. Skill levels of healthcare professionals in digital and artificial intelligence, communication, interdisciplinary, and green skills were assessed. Participants scored 3.83 (out of 5) on average on the questionnaire, with mean scores of 4.02 for interdisciplinary skills, 4.0 for communication skills, 3.87 for green skills, and 3.57 for digital skills. Participants predict that in the next 5-10 years, skills such as foreign language proficiency, digital skills, green skills, problem solving and time management will be needed in healthcare. The majority stated that the organization does not address skill gaps and offers no training for most skills. Healthcare professionals demonstrated high skill levels, with digital and artificial intelligence skills being the lowest. Participants expressed concerns about skill gaps in education and organizational support. This study contributes valuable insights into the healthcare professionals' skill landscape, emphasizing the urgency of addressing educational and organizational gaps for the sustained growth of global healthcare systems.

Keywords: Healthcare Professionals, Digital Skills, AI Skills, Skill Gaps

JEL Codes: I18, J24, M12, M53

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INTRODUCTION

Society has transformed from an economic structure based on manual labor and material assets to a human-based economic structure that requires extensive knowledge and qualifications (Van Laar et al., 2020). Skills are critical in building a strong economy and society. Individuals need to acquire various skills and apply these skills effectively to adapt to today's conditions (OECD, 2023). Therefore, it is particularly important for individuals to be open to skill development (Van Laar et al., 2020). At this point, Zhang (2019) defines skill as expertise acquired through experience and training and expresses it as the basis for achieving maximum efficiency with minimum energy and time expenditure. In short, skill is known as the ability to do the job well, and it is seen as one of the components of professional competence alongside attitude and knowledge (South et al., 2013).

The growing elderly population, increasing burden of chronic diseases, and financial crises are causing many challenges in healthcare delivery. To address these challenges, healthcare providers have focused on creating new models and planning new organizational structures. To achieve improvements in performance, organizational flexibility, and innovation, healthcare professionals must acquire new skills (Dias & Escoval, 1996). At this point, it should not be overlooked that human resources are a critical element for corporate success and that they are especially valuable in providing competitive advantage and achieving better health outcomes (Sisodia & Agarwal, 2017). In addition, it is expected that healthcare professionals will assume different tasks and roles in the future health service delivery than they do today. They will need skills such as collaborating with different professional teams, analyzing new data, using new digital health tools, and working with Artificial Intelligence (AI). New skills and knowledge will be essential for continuous development, needing to be acquired throughout their careers (WHO, 2025). The ability to use AI, communication skills, interdisciplinary skills, and green skills is among the skill groups that will lead to positive outcomes for healthcare professionals and thus for the healthcare sector (BeWell, 2023).

In the field of healthcare, artificial intelligence, telemedical and digital applications have been widely used in diagnosis and treatment processes. Digitalization processes have enabled the use of personalized medicine and e-health applications (Hege et al., 2020). The integration of AI into healthcare systems enables important strategies. For example, it provides support in areas such as contributing to clinical decision-making processes, guiding the aging population, controlling increasing healthcare costs, managing chronic disease burden, analyzing electronic medical records to determine health consumer behaviors, and managing health workforce (Shinners et al., 2020). In short, the importance of human interaction in healthcare is

crucial, but the importance of artificial intelligence in achieving more accurate, faster results and reducing cognitive biases should not be overlooked (Gazquez-Garcia et al., 2025).

As the applications of AI and digitalization in healthcare increase, healthcare professionals will encounter the beneficial and harmful effects of these tools. Therefore, healthcare professionals will need basic skills to work efficiently, fairly, safely, and effectively in the digitization processes of healthcare services. However, the qualifications of these skills have not yet been explained (Russell et al., 2023). In this context, some studies have been conducted to identify skills. For example, a study emphasized the skills related to the use of AI in primary care as basic knowledge, critical evaluation, medical decision-making, technical use, patient communication, and awareness of unintended consequences (Liaw et al., 2022). In another study, it was emphasized that healthcare professionals should have six competency areas regarding the use of AI-based tools: basic AI knowledge, social and ethical implications of AI, AI-supported clinical encounters, evidence-based evaluation of AI-based tools, workflow analysis for AI-based tools, and practice-based learning and improvement (Russell et al., 2023). Another study focuses on the key issues related to digital skills of health professionals and strategies for developing digital skills. In this context, digital skills, telemedical, artificial intelligence and EHR (Electronic health records), while digital literacy, lack of privacy and cost were identified as challenges (Ferreira et al., 2025).

Interpersonal communication is critical in the provision of effective healthcare services. While communication between patients and healthcare providers is important, it is also critical among the providers themselves. Through communication skills training, healthcare professionals master both theoretical and practical approaches (Dickson et al., 1996). Effective communication of information helps to develop communication skills. Communication skills are a valuable tool used in empathizing with healthcare professionals and patients, ensuring patient participation, obtaining information from the patient and processing this information (Mata et al., 2021). For example, a Cochrane review of 17 studies found that healthcare professionals improved their communication with cancer patients after receiving supportive communication skills training, and that they were more communicative when explaining the patient's condition (Moore et al., 2018).

Poor communication between healthcare professionals and patients reduces the quality of care and increases human and economic costs. For this reason, communication in healthcare organizations is seen as a core skill required in medical practice (Stein et al., 2005). Communication skills and relational abilities are core skills associated with less malpractice, better patient compliance, better health outcomes and increased satisfaction with care. In a study, the communication skills of healthcare professionals in communicating with cancer patients were evaluated. It was emphasized that the patient's needs, preferences,

concerns, and the effects of concerns should be revealed through communication skills including giving advice, giving information, determining the care and treatment plan (Schofield et al., 2008). However, healthcare organizations do not pay enough attention to communication skills training (Meyer et al., 2009). In a study conducted in 67 pediatric diabetes services, in the United Kingdom, it was determined that 16% of healthcare professionals did not receive any training in communication skills and 47% did not receive any training after graduation (Hambly et al., 2009).

Interdisciplinarity is considered a competence resulting from a set of knowledge, skills, and attitudes. Interdisciplinary skills are important for healthcare professionals as they contribute to improving patient care, increasing patient safety, and communication within the healthcare team (Barnhill et al., 2020). This holistic approach strengthens the relationship between these two knowledge groups by focusing on both the caregiver and the care recipient. This approach does not focus solely on the illness. Furthermore, this allows the services provided to reach both the caregiver and the collective more clearly (Giacomini & Rizzotto, 2023). Interdisciplinary collaboration, which is critical to the quality of healthcare, provides a comprehensive approach to healthcare, with disciplines working together to address different patient needs (Bendowska & Baum, 2023). The interdisciplinary collaboration of healthcare professionals is also critical in improving the recovery rate of patients. Each individual is equipped with the skills and knowledge to do his or her own job. By combining the different strengths of each discipline in the team, gaps in patient care can be addressed. Effective interdisciplinary collaboration increases patient satisfaction, reduces hospital costs, increases patient safety, and reduces mortality and morbidity by minimizing errors. In addition, professional relationships between employees will improve and employee satisfaction will increase (Allen et al., 2006).

The need to update traditional curricula, the complexity of health problems, and the need to create and reflect a more global vision have led to the emergence and widespread use of the interdisciplinary approach (de Faria Pereira et al., 2023). Similarly, the development of healthcare systems has made it necessary for healthcare professionals to work with different disciplines and professions. Innovative technologies in the field of health have started to play a significant role. Therefore, healthcare professionals are expected to collaborate with different professions and disciplines. However, it is quite difficult to achieve interprofessional or interdisciplinary cooperation. For this, individuals should be provided with interdisciplinary training to gain these skills (van Baalen & Boon, 2024). In a study, a training program was organized for medical, nursing, and physiotherapy students to work together in applying their knowledge and creating clinical management plans. Students expressed positive opinions on the results of interdisciplinary service delivery training and requested more joint courses in the learning of clinical courses

(Pomeroy & Philp, 1994). In a study conducted in Canada, two palliative care teams working in different disciplines were formed and these teams were compared. It was found that patient and patient relatives' satisfaction increased due to the high communication power of the team members, regular meetings, and the team consisting of at least doctors, nurses, and physiotherapists (Kuziemy et al., 2009).

Population growth, urbanization, and industrialization lead to rapid and thoughtless consumption of natural resources, which exacerbates environmental problems. Building energy use is a critical issue to address in reducing environmental damage. Global problems such as environmental degradation, climate change and unsustainable use of resources not only threaten future generations, but also negatively affect those living today. This situation emphasizes the importance of ideas such as environmental awareness, sustainability, and reducing carbon footprint (Karaca et al., 2018). On the other hand, when we look at the health sector, the emergence of ecological and climate crises as health threats and the fact that the health sector is the fifth largest carbon emitter have led the health community to feel a greater sense of responsibility and motivation for green skills (Stanford et al., 2023).

Green skills refer to a skill set that includes environmentally friendly and sustainable practices, and can be applied in various sectors, and covers different occupational fields. Green skills in healthcare encompass a set of skills that enable healthcare professionals to minimize the environmental impact of healthcare activities. These skills include, but are not limited to, waste reduction, energy and water efficiency, sustainable food, resource conservation, and sustainable procurement practices in healthcare settings. Developing green skills in healthcare professionals facilitates the provision of environmentally sound healthcare delivery (Pinzone et al., 2019).

The green skills of healthcare professionals encompass the knowledge, skills and values needed to address environmental and climate-related challenges in healthcare. These skills are crucial for promoting sustainable practices and mitigating the impacts of climate change on health and the environment (Laing et al., 2023). Green skills are recognized as core skills that should be included in vocational and professional education, including in the health sector (Buckley et al., 2020). There is a lack of education and knowledge among healthcare professionals on the links between environment and health. The importance of green skills in the health sector and the need for more education and training to increase environmental health literacy among healthcare professionals are recognized (Walekhwa et al., 2022). Green training, which aims to develop green-related skills, has been found to increase employee engagement in pro-environmental behaviors and job satisfaction (Jagals & Ebi, 2021). Additionally, medical equipment, instruments, chemicals, and pharmaceuticals account for the majority of healthcare emissions. Providing education and training in green skills (including technical and practical skills) for clinical providers is critical to ensuring

sustainable healthcare (Stanford et al., 2023). In summary, these findings emphasize the importance of incorporating green skills into the training and professional development of healthcare professionals to ensure that they can effectively address environmental and climate issues.

This study focused on the four skills needed by healthcare professionals and aimed to provide a more comprehensive analysis. Different levels of skills and competencies carry varying importance for each professional group within the healthcare sector. For example, digital and AI skills are critical for nurses in enhancing patient safety and quality of care. Similarly, competencies related to digital technologies and AI are of great importance for physicians in improving diagnostic accuracy and supporting treatment decisions. For technicians and administrative staff, digital skills are associated with the efficiency of workflow processes, while for managers, ensuring the integration of all these skills affects the strategic sustainability of the organization. On the other hand, the collaboration of different professional groups in the healthcare sector highlights the importance of interdisciplinary skills and underscores the necessity of communication skills. Therefore, taking into account the specific needs of each professional group is essential for the effectiveness of skill development programs. When the studies were examined, no study focusing on four skills was found. It was aimed to determine the current and future needs of healthcare professionals regarding digital and AI, communication, interdisciplinary, and green skills. For this aim the answers to the following research questions were investigated.

- What skills do healthcare professionals evaluate themselves as adequate/inadequate?
- What skills do healthcare professionals consider necessary for their own development?
- What skills do healthcare professionals predict becoming more important in the next 5-10 years?
- How do healthcare professionals evaluate their skill levels based on characteristics such as gender and education level?
- Are there any skill development programs available for healthcare professionals within the organization?

MATERIAL AND METHOD

Research Type

This research was conducted as descriptive and cross-sectional study.

Study Population and Sample

The population of this study consisted of all healthcare professionals working in a private hospital in Türkiye (N=381). The aim was to reach healthcare professionals who voluntarily agreed to participate in the study without selecting a sample, and 150 healthcare professionals participated.

Data Collection Tools

The data were collected between 10 December 2023 and 5 January 2024 with a questionnaire developed by researchers based on the literature (BeWell, 2023; Longhini et al., 2024; Joseph et al., 2019; Mohammed et al., 2024). The form used is not a scale or scale development study, but rather a questionnaire designed as a data collection tool for the purpose of the study. The questions in the questionnaire were developed based on the conceptual framework in the literature and in line with the opinions of field experts, and specific sub-dimensions and statements from a scale were not included. The questions were prepared in a clear and understandable manner appropriate to the purpose of the study, reviewed by two experts in terms of language and content, revised in line with their recommendations, and implemented. The survey form consists of 3 sections. The questions in the first section are designed to assess the skill levels of healthcare professionals in the areas of digital and AI skills (9 questions), communication skills (8 questions), interdisciplinary skills (4 questions), and green skills (6 questions), and includes a total of 27 questions. A 5-point Likert scale was used to answer the questions in this section (1: strongly disagree, 5: strongly agree), with an additional no opinion option available. In the second section, 3 questions were asked about what the most important skills for success in the job might be, which skills might become more important in the healthcare sector in the future, and what skills are not sufficiently addressed in education. Healthcare professionals were asked to select more than one option from the 18 skills listed in the survey. The third section included 6 questions to determine the socio-demographic characteristics of the participants, such as gender, age, education level, occupation, and length of service at the organization, as well as 4 questions to determine the opinions of healthcare professionals about the skills and practices of their organizations, which were to be answered with “Yes,” “No,” or “No opinion.” When the internal consistency of the questionnaire was analyzed, Cronbach's Alpha was 0.87 for the whole questionnaire, 0.74 for Digital and AI Skills, 0.71 for Communication Skills, 0.57 for Interdisciplinary Skills, and 0.73 for Green Skills.

Data Analysis

For the study's data analysis, it was evaluated whether the normality assumption was met. In order to determine the analyses to be performed, a normality test was performed and the skewness and kurtosis values of the distribution were examined. As a result of the analysis, skewness and kurtosis values were

found to be within ± 1 , therefore it is accepted that the data are normally distributed (George & Mallery, 2016). Since the data showed normal distribution, independent sample t-test was applied for the comparison of two groups and one-way ANOVA test was applied for the comparison of more than two groups. In order to determine between which groups the averages differed, firstly the homogeneity of the variances was checked, and after determining that the variances were homogeneous, the “Tukey” test, one of the Post Hoc tests, was used. In addition, socio-demographic characteristics and questionnaire scores of healthcare professionals were evaluated using frequency, percentage, and mean analyses. SPSS v.23 software was used for data analysis, and significance level was set at 0.05 in the analyses.

Ethical Considerations

Ethics committee approval for this study was obtained from the Kahramanmaraş Sütçü İmam University Ethics Committee at the meeting dated December 15, 2023, numbered 2023-43, with decision no. 21.

RESULTS

Table 1 shows the demographic characteristics of healthcare professionals. Of the participants, 64.0% were female, 38.7% had bachelor’s degrees or graduate degrees, and 50.7% were nurses. The average age of the participants in the study was 28.79 years, the average length of service in the organization was 4.10 years, and the average length of service in the profession was 7.11 years. 43.3% of the participants stated that the organization conducts programs to identify their skill gaps. 44.0% of the respondents stated that training is provided by the organization to improve their skills. 46.0% of individuals stated that the organization conducts practices to improve their physical and mental health.

Table 1. Socio-demographic characteristics of healthcare professionals

Variables	Frequency (N)	Percent (%)
Gender		
Female	96	64.0
Male	54	36.0
Total	150	100
Educational Level		
Highschool	42	28.0
Associate degree	50	33.3
Bachelor’s Degree and Graduate	58	38.7



Total	150	100
Profession/Job		
Nurse	76	50.7
Technician	46	30.7
Administrative staff	28	18.6
Total	150	100
Has your organization conducted a study to identify the skill gaps?		
Yes	65	43.3
No	67	44.7
No opinion	18	12.0
Total	150	100.0
Has your organization provided any training to improve the skills (excluding mandatory in-service training)?		
Yes	66	44.0
No	52	34.7
No opinion	32	21.3
Total	150	100.0
Has your organization implemented any practices to improve physical health?		
Yes	69	46.0
No	68	45.3
No opinion	13	8.7
Total	150	100.0
Has your organization implemented any practices to improve resilience and mental health of healthcare professionals?		
Yes	69	46.0
No	68	45.3
No opinion	13	8.7
Total	150	100.0
Average age	28.79± 5.00	
Average length of service in the organization	4.0± 3.18	
Average total working time in the profession	7.11± 4.48	

The skill requirements asked of healthcare professionals are presented in Table 2. According to the participants, the 5 most important skills required to be successful in the role are teamwork (n= 75), patient-centered care (n= 74), resilience (n= 74), empathy (n= 63), interdisciplinary skills (n= 58). According to the healthcare professionals who participated in the research, the top 5 skills that will become important for the healthcare sector in the next 5-10 years are digital and AI skills (n= 89), foreign language knowledge (n=



66), emotional intelligence (n= 50), problem identification and solving, analytical thinking (n= 50), green skills (n= 49). According to participants, the 5 skills that are not adequately addressed in high school or university teaching are foreign language knowledge (n=67), understanding and using legislation (n=51), patient-centered care (n=47), digital and AI skills (n=44), time management (n=42).

Table 2. Skill requirements by healthcare professionals

Skills	What are the most important skills needed to succeed in your role?	Which skills do you foresee will become more important in the healthcare sector in the next 5-10 years?	What are the skills (if any) that are not adequately addressed in your high school or university education?
	n	n	n
Resilience	74	34	39
Change management	42	41	6
Digital and artificial intelligence skills	53	89	44
Interdisciplinary skills	58	24	25
Emotional intelligence	48	50	23
Teamwork	75	34	24
Economic and financial analysis	28	40	35
Empathy	63	29	26
Patient-centered care	74	37	47
Quality and accreditation	32	44	40
Communication skills	44	25	22
Clinical leadership	29	35	31
Crisis management	36	19	30
Understanding and using legislation	41	43	51
Problem identification and solving, analytical thinking	41	50	41
Foreign language knowledge	51	66	67
Green skills	31	49	36
Time management	21	46	42
Total*	841	755	629

The mean scores of the questionnaire based on participants' demographic characteristics are presented in Table 3. Statistically significant differences were observed in the overall mean, interdisciplinary skills, and green skills based on gender ($p < 0.05$), with women scoring higher in these measures. High school graduates had higher overall and sectional mean scores compared to other groups. Statistically significant differences were found in the overall mean, digital and AI skills, and green skills based on education level ($p < 0.05$). According to Tukey post-hoc test results, significant differences were observed between high school and associate degree graduates, as well as between bachelor's and graduate degree holders.

When analyzed by profession, nurses had higher overall mean scores and communication skills scores, however, this difference was not statistically significant ($p > 0.05$). The mean score for digital and AI skills was higher among technicians compared to other professions, but this difference was also not statistically significant ($p > 0.05$). A statistically significant difference was found in the overall mean score, digital and AI skills, and green skills based on whether an organizational program was conducted to determine skill gaps ($p < 0.05$). According to Tukey post-hoc test results, a significant difference was observed between those who answered "yes" and those who answered "no". In digital skills, a significant difference was found between those who answered "yes" and both "no" and "no idea" while for green skills, a significant difference was observed only between those who answered "yes" and those who answered "no". This suggests that running a program to identify skill gaps would lead to staff having higher digital skills.

Statistically significant differences were found between digital and AI skills and green skills based on the provision of training programs aimed at skill improvement within the organization ($p < 0.05$). Tukey post-hoc test results indicated a significant difference in digital and AI skills mean scores between those who answered "yes" and both "no" and "no idea". In green skills, a significant difference was observed only between those who answered "yes" and those who answered "no". This suggests that running a program to improve the skills would lead to staff having higher digital skills. Similarly, statistically significant differences were found in the overall mean score, digital and AI skills, and green skills based on whether practices to improve physical health was implemented in the organization ($p < 0.05$). A significant difference was found between those who answered "yes" and both "no" and "no idea" in the overall mean score. A significant difference was also found in digital skills mean scores between those who answered "yes" and both "no" and "no idea" while for green skills, a significant difference was observed only between those who answered "yes" and those who answered "no".

Finally, a statistically significant difference was found in digital and AI skills based on whether an program to improve resilience and mental health was implemented ($p < 0.05$). Tukey post-hoc test results

indicated a significant difference in digital skills mean scores between those who answered "yes" and both "no" and "no idea".

Table 3. Mean scores of the questionnaire according to socio-demographic variables of healthcare professionals

	Skills Questionnaire Overall Mean Score	Digital and AI Skills Mean Score	Communication Skills Mean Score	Interdisciplinary Skills Mean Score	Green Skills Mean Score
Variables	Mean± SD	Mean± SD	Mean± SD	Mean± SD	Mean± SD
Gender					
Female	4.07± 0.40	3.88± 0.60	4.10± 0.46	4.26± 0.45	4.20± 0.49
Male	3.91± 0.50	3.73± 0.72	4.07± 0.41	4.06± 0.54	3.86± 0.72
	$t= 2.183$ $p= \mathbf{0.031^*}$	$t= 1.259$ $p= 0.211$	$t= 0.402$ $p= 0.688$	$t= 2.517$ $p= \mathbf{0.013^*}$	$t= 3.070$ $p= \mathbf{0.003^*}$
Educational Level					
Highschool	4.21± 0.33	4.12± 0.40	4.21± 0.57	4.24± 0.43	4.33± 0.40
Associate degree	3.91± 0.38	3.65± 0.58	3.99± 0.33	4.18± 0.42	4.04± 0.55
Bachelor's degree and graduate	3.96± 0.53	3.77± 0.78	4.10± 0.40	4.16± 0.59	3.93± 0.71
	$F= 6.195$ $p= \mathbf{0.003^*}$	$F= 6.817$ $p= \mathbf{0.001^*}$	$F= 2.980$ $p= 0.054$	$F= 0.382$ $p= 0.683$	$F= 5.945$ $p= \mathbf{0.003^*}$
Profession					
Nurse	4.03± 0.41	3.86± 0.58	4.13± 0.49	4.14± 0.46	4.05± 0.53
Technician	4.01± 0.54	3.87± 0.78	4.05± 0.44	4.18± 0.54	4.07± 0.72
Administrative staff	3.99± 0.38	3.67± 0.59	4.07± 0.25	4.32± 0.50	4.17± 0.58
	$F= 0.053$ $p= 0.948$	$F= 1.064$ $p= 0.348$	$F= 0.508$ $p= 0.603$	$F= 1.330$ $p= 0.268$	$F= 0.363$ $p= 0.696$
Has your organization conducted a program to identify the skill gaps?					
Yes	4.17± 0.36	4.11± 0.46	4.17± 0.47	4.19± 0.51	4.25± 0.44
No	3.89± 0.45	3.58± 0.69	4.04± 0.42	4.21± 0.45	3.92± 0.65
No opinion	3.94± 0.55	3.71± 0.71	4.03± 0.78	4.10± 0.61	4.08± 0.75
	$F= 7.633$ $p= \mathbf{0.001^*}$	$F= 13.097$ $p= \mathbf{0.000^*}$	$F= 1.647$ $p= 0.196$	$F= 0.386$ $p= 0.681$	$F= 5.371$ $p= \mathbf{0.006^*}$

Has your organization provided any training to improve the skills (excluding mandatory in-service training)?					
Yes	4.11± 0.35	4.04± 0.50	4.10± 0.44	4.12± 0.44	4.24± 0.46
No	3.93± 0.52	3.66± 0.75	4.07± 0.38	4.22± 0.54	3.96± 0.71
No opinion	3.95± 0.46	3.67± 0.65	4.11± 0.53	4.28± 0.51	3.94± 0.61
	$F= 2.835$	$F= 6.426$	$F= 0.101$	$F= 1.268$	$F= 4.230$
	$p= 0.062$	$p= 0.002*$	$p= 0.904$	$p= 0.285$	$p= 0.016*$
Has your organization implemented any practices to improve physical health?					
Yes	4.18± 0.33	4.12± 0.44	4.15± 0.46	4.20± 0.46	4.29± 0.40
No	3.88± 0.47	3.59± 0.70	4.07± 0.41	4.17± 0.50	3.88± 0.66
No opinion	3.85± 0.58	3.53± 0.70	3.89± 0.43	4.21± 0.64	4.03± 0.78
	$F= 9.398$	$F= 14.927$	$F= 2.015$	$F= 0.064$	$F= 9.231$
	$p= 0.000*$	$p= 0.000*$	$p= 0.137$	$p= 0.938$	$p= 0.000*$
Has your organization implemented any practices to improve resilience and mental health of healthcare professionals?					
Yes	4.10± 0.39	4.03± 0.55	4.09± 0.51	4.21± 0.46	4.16± 0.49
No	3.95± 0.49	3.69± 0.69	4.10± 0.38	4.17± 0.51	3.99± 0.70
No opinion	3.91± 0.45	3.48± 0.65	4.10± 0.32	4.19± 0.60	4.13± 0.61
	$F= 2.374$	$F= 7.138$	$F= 0.023$	$F= 0.140$	$F= 1.332$
	$p= 0.097$	$p= 0.001*$	$p= 0.978$	$p= 0.870$	$p= 0.267$

The overall mean score of the skills of the healthcare professionals participating in the study was 4.02±0.45, Digital and AI Skills at 3.83±0.65, Communication Skills at 4.09±0.44, Interdisciplinary Skills at 4.19±0.49, and Green Skills at 4.08±0.60 (Table 4).

Table 4. Total and sectional mean scores of the skill questionnaire

Questionnaire Sections	Mean ±SD	Min-Max
Digital and AI Skills	3.83± 0.65	2.22- 5.00
Communication Skills	4.09± 0.44	3.00- 5.00
Interdisciplinary Skills	4.19± 0.49	2.50- 5.00
Green Skills	4.08± 0.60	2.33- 5.00
Questionnaire Mean	4.02± 0.45	2.70- 4.81

The mean scores of each item were examined and in the Digital and AI Skills questions, the highest mean was for the item “I can use electronic health record systems (automation, HIS, etc.) to enter and analyze patient data” ($\bar{x}=4.47$), and the lowest mean was for the item “I have a general level of digital literacy to use various software applications, communication tools and emerging technologies” ($\bar{x}=3.35$). Among the Communication Skills questions, the highest mean was for the item “I can show empathy and

compassion in patient interactions and provide understanding and emotional support” ($\bar{x}=4.21$), and the lowest mean was for the item “I can manage conflicts or disagreements constructively and be focused on their resolution” ($\bar{x}=4.03$). Among the Interdisciplinary Skills questions, the highest mean was for the item “I can use information from different disciplines in decision-making processes” ($\bar{x}=4.31$) and the lowest mean was for the item “I can communicate clearly and effectively with healthcare professionals from different disciplines” ($\bar{x}=4.11$). Among the Green Skills questions, the highest mean was for the item “I pay attention to using electricity economically” ($\bar{x}=4.25$) and the lowest mean was for the item “I prefer reusable products instead of disposable products” ($\bar{x}=3.83$).

DISCUSSION

This study aimed to examine the skill levels of healthcare professionals across four critical skills including Digital and AI, Communication, Interdisciplinary, and Green. These skills represent key pillars in modern healthcare, reflecting the growing demands for effective collaboration, technological adaptability, cross-disciplinary integration, and environmental consciousness.

The results of this study indicate that healthcare professionals exhibit the lowest proficiency in digital and AI-related skills. Similarly, in another study the use of digital technologies was found to be the area with the poorest skill scores (Longhini et al., 2024). A systematic review revealed that 40% of studies reported low levels of AI knowledge and preparation among healthcare professionals (Kimiafar et al., 2023). Another study reported that 64% of surveyed healthcare professionals had never encountered AI applications in their work, and 87% could not differentiate between machine learning and deep learning (Castagno & Khalifa, 2020). Moreover, many healthcare professionals currently lack skills in data interpretation, critical thinking, and AI ethics (Božić, 2023). A Delphi study on the future of smart hospitals suggests that staff shortages and inadequate digital skills pose major challenges to AI adoption. These findings align with global concerns about the preparedness of healthcare professionals in adopting digital technologies, which have become essential for service delivery. Hospitals are expected to transition toward more digitized and AI-assisted individualized medicine and home care, but achieving this vision requires substantial workforce upskilling (Jovy-Klein et al., 2024). Structured training programs are critical to increase the digital and AI skills of healthcare professionals. Training on ethical and responsible AI practices is necessary to reduce data bias and protect patient safety (Antweiler et al., 2023; Bures et al., 2023). Collaborations between developers, academic institutions and healthcare professionals will contribute to innovative healthcare delivery by supporting the effective acquisition of digital skills (Malerbi et al., 2023).

Effective communication is essential for healthcare professionals as it directly impacts patient satisfaction, safety, and the quality of care. Communication skills were one of the highest-rated skills in this study, with strong capabilities in empathizing with patients and collaborating with colleagues across disciplines. Patients expect better communication from nurses, with one study finding that only 14.3% of nurses exhibited good verbal communication skills (Rostami et al., 2012). A study analyzing the patient complaints highlights that “relationship issues” including delayed, incorrect, or absent communication, were a significant domain of patient complaints (Çınar et al., 2024). Studies indicate that the communication skills of healthcare professionals vary widely, with gaps in key areas such as active listening, feedback, and patient interaction. To address these issues, recommendations include prioritizing communication skills in nursing education, conducting training courses for healthcare professionals, and implementing appropriate communication technologies such as voicemail, e-mail with acknowledgment, and improved support for role-based contact (Coiera & Tombs, 1998). Structured training programs play a critical role in improving the communication skills of healthcare professionals. Gaps in education and training programs regarding communication need to be addressed to improve patient satisfaction and care outcomes (Arifoğlu & Razi, 2011; Şen et al., 2013). These training sessions should cover topics such as verbal and non-verbal communication techniques, role-playing exercises, and effective communication with patients (Moeini et al., 2019; Payton, 2018).

Interdisciplinary skills are also critical in healthcare service delivery, where medical, psychological, and social support teams must collaborate to provide holistic patient care. Interdisciplinary skills were the highest-rated skills in this study, with strong capabilities in effective collaboration with healthcare professionals across disciplines and integration of diverse disciplinary insights into decision-making. These findings are in line with the core skills outlined for healthcare professionals (Knebel & Greiner, 2003). While many healthcare professionals work in interdisciplinary teams, gaps in communication, coordination, and role awareness hinder effective collaboration (Hale et al., 2023). Interdisciplinary skills play a key role in patient violence prevention, where healthcare professionals must develop crisis response strategies and team-based de-escalation techniques (Morton, 2002). These skills are essential but often underdeveloped, requiring structured training and interprofessional collaboration.

Green skills among healthcare professionals are generally low, with significant gaps in knowledge, attitudes, and practices related to environmental sustainability in healthcare settings. This study identified a moderate level in green skills among healthcare professionals, with strengths in energy conservation but limited knowledge of sustainable healthcare practices and waste management strategies. Studies have shown that solid waste management and proper waste segregation remain major challenges in hospitals, with many staff members lacking the necessary knowledge to dispose of medical waste sustainably (Mohammed et al.,

2024). While hospitals generate large amounts of waste and consume significant energy resources, many healthcare professionals lack the necessary training to implement sustainable practices effectively (Joseph et al., 2019; Mohammed et al., 2024). Many nursing staff have low levels of perception and awareness regarding green hospitals and effective waste management (Joseph et al., 2019; Mohammed et al., 2024). Green management programs have been proven to significantly improve awareness and environmental safety practices (Elksas et al., 2024). Therefore, structured training on topics such as green waste management, sustainable food handling, energy conservation and low-carbon emission operating room practices can increase environmental responsibility and improve work efficiency. Both training and operational strategies should be developed to overcome institutional support and financial barriers so that sustainable hospital management can be effectively implemented.

This study identified digital and AI skills, foreign language, emotional intelligence, and analytical thinking as the skills that will become more important in the next 5-10 years. This finding is in line with the Healthcare Without Harm report. The report states that digitalization and big data management will play a key role in healthcare (Karliner et al., 2020). Since the development of artificial intelligence and data analysis skills of healthcare professionals will enable patients to receive better care (Topol, 2019), there is a need for training programs on this subject. By conducting structured training programs, skills gaps should be identified and existing skills should be improved. In a study, 80% of respondents stated that their hospital does not conduct skills deficiency assessments, and 74% reported a lack of training programs beyond basic communication courses. This finding, which aligns with our findings, suggests a systemic issue in workforce development and highlights the need for structured, ongoing training initiatives. Workforce planning must be proactive, ensuring that healthcare professionals receive continuous professional education that aligns with emerging healthcare trends (Batenburg & Kroezen, 2022).

The training programs need to be improved not only in workplace but also in the education system. This study revealed that abilities to speak a foreign language, understand legislation provide patient-centered care and have digital skills are not adequately addressed in high school and university education. This result is consistent with the study which emphasized the need to adapt health education programs to the needs of the age (Frenk et al., 2010). Previous research has emphasized the importance of integrating digital health skills into medical and nursing curricula, as many healthcare professionals struggle with digital tools upon entering the workforce (Mollart et al., 2021). The inclusion of AI literacy and digital training in professional development programs could enhance healthcare professionals' ability to leverage technology effectively. Structured training for university teachers and the development of national capability frameworks for AI

and Digital Medicine tools are being pursued to guide educational strategies in healthcare (Abdulhussein et al., 2021; Hege et al., 2020).

Interdisciplinary education also benefits student healthcare professionals by improving knowledge, skills, and attitudes (Cooper et al., 2001). Healthcare education should focus on developing teamwork skills and overcoming barriers to effective multidisciplinary collaboration (Dawe et al., 2024). Integrating medical students into interprofessional hospital roles significantly enhances their systems-based knowledge and interdisciplinary communication (Hale et al., 2023). To address the current gaps in green skills, recommendations include incorporating environmental health practices into healthcare curricula, encouraging research on green hospitals, and promoting continuous education programs for healthcare professionals (Elksas et al., 2024; Joseph et al., 2019). These efforts aim to enhance occupational safety, reduce environmental impact, and improve overall healthcare delivery. Incorporating environmental health practices into healthcare curricula can prepare new professionals to meet sustainability challenges (Joseph et al., 2019).

LIMITATIONS

The findings should be interpreted with caution as the study has some limitations. As the research was conducted in a single private hospital in Türkiye, the findings may not be fully generalizable to other healthcare institutions. Since the study relied on self-reported data collected through a survey, respondents may have overestimated or underestimated their skill levels. In addition, the fact that the study group consisted predominantly of women and nurses should be considered another limitation. Since future projections were obtained from a single question, only limited interpretations could be made in this regard. Future research should consider longitudinal designs, objective skills assessments, and a more diverse sample of hospitals to strengthen the reliability and applicability of the findings.

CONCLUSIONS AND RECOMMENDATIONS

As a result, hospitals and healthcare professionals are in a continuous cycle of change and development with innovative practices such as digital and green transformation to meet changing needs and expectations in the healthcare sector. Healthcare professionals have a key role for strong and sustainable health systems, so it is essential that they keep themselves up-to-date in critical skill areas and are open to development. At this point, taking into account the developments in the world, it is thought that equipping healthcare professionals with various skills that are prominent today, such as communication skills, interdisciplinary skills, green skills, digital technologies and skills to use artificial intelligence, will

contribute to the sustainability of health systems (BeWell, 2023; European Health Management Association, 2022).

From this point of view, as a result of the analysis of the questions determined in order to evaluate the current skill levels of healthcare professionals in the fields of digital and artificial intelligence, communication, interdisciplinary and green skills, comprehensive findings were obtained on related issues. In the light of these findings, meaningful conclusions were reached regarding the research questions.

It was concluded that the healthcare professionals who reported that programs were carried out to identify skill gaps within the organization and that training was provided for skill development generally had higher mean scores in green skills. This situation is interpreted as the increased awareness and knowledge on the subject with the conduct of programs to identify skill gaps and the provision of training for skill development affect them to have higher skill scores.

While the area in which the participants feel most competent is interdisciplinary skills, the area in which they feel least competent is digital and artificial intelligence skills. This situation is interpreted as the participants need improvements in digital and artificial intelligence skills.

The most important skills required to be successful in their job are teamwork, patient-centered care, resilience, empathy, interdisciplinary skills, digital and artificial intelligence skills, while the skills that are predicted to be important in the health sector in the next 5-10 years are digital and artificial intelligence skills, foreign language skills, emotional intelligence, problem identification and solving, analytical thinking, green skills and time management. In addition, the participants stated that the skills that are not sufficiently addressed in high school or university education are foreign language skills, understanding and using legislation, patient-centered care, digital and AI skills, time management, problem identification and solving, and analytical thinking. Within the scope of these findings, it is seen that the digital and AI skills emphasized by the participants in different contexts have critical importance in all areas from task success to future needs and gaps in education and training. In addition, the prominence of patient-centered care, foreign language skills, problem identification and solving, and analytical thinking skills indicate that all these skills should be prioritized in the theoretical and practical training programs of education and training institutions and healthcare institutions. Thus, by increasing training and development opportunities that focus on these skills, institutions will be able to respond more effectively to the current and especially future needs of health institutions.

Various recommendations were developed in the light of the results obtained. In this direction, programs should be carried out periodically to determine the skill levels of the personnel within the hospital to identify areas in need of skills and it should be aimed to raise awareness on this issue. It is recommended that training should be provided for the improvement and sustainability of the skills in which healthcare professionals feel competent, the development of digital and AI skills, which is the area in which they feel least competent, and re-skilling in this area. Staff can be encouraged to participate in developing new skills and continuous improvement by measuring the contribution of the training to the staff, their reflection on the way they do business and emphasizing their concrete outputs for the health system. Process management can be done correctly by monitoring and evaluating the performance of the personnel. It is important to determine the current status of the skill levels of the healthcare professionals as well as the trainers who will contribute to the development of the staff in these skill areas, and to prioritize skill development and reskilling by identifying the areas that need improvement in this direction. It is recommended that training contents and materials be prepared by targeting professional development and lifelong learning, and that policies and strategies be prioritized by decision-makers to contribute to the sustainability of the process. It is recommended that existing training curricula be updated to better address foreign language skills, the ability to understand and use legislation, patient-centered care, and digital and artificial intelligence skills for future healthcare professionals. Since different results may emerge in different hospitals and in different professional groups, similar analyses can be conducted to compare the results, and strategic intervention plans and training programs can be developed to address these needs by identifying areas where there are skill gaps and needs for healthcare professionals in a broader scope. In order to effectively manage the changes that may occur at all stages of this process, to implement evidence-based decision-making mechanisms and to carry out needs analyses correctly, it is recommended to adopt appropriate systematic approaches.

AUTHORS' STATEMENT

The authors declare that all contributions to this manuscript were made by the listed authors. The authors also declare that there are no conflicts of interest.

Ethics committee approval for this study was obtained from the Kahramanmaraş Sütçü İmam University Ethics Committee at the meeting dated December 15, 2023, numbered 2023-43, with decision no. 21.

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