

Investigating the Association Between Healthcare Professionals' Digital Skills and Workplace Organizational Structures: A Cross-Sectional Study



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Abstract

Aim: This study aims to examine the association between the digital skills of Greek healthcare professionals employed in hospitals and the organizational structures shaped by distinct work environments.

Methods: The study utilized a cross-sectional design. A structured questionnaire, developed based on Digital Competence framework, was administered. A total of 857 healthcare professionals, employed in four military and three civilian Greek hospitals, voluntarily participated. Digital skills were categorized into five subscales: information, communication, content creation, problem-solving and security skills. The values of these subscales were measured on a scale from 0 to 100. Statistical analysis was conducted using SPSS version 26.0, with p-values <0.05 considered statistically significant.

Results: Cronbach's alpha values for the five factors were all (α)>0.8, indicating high reliability. Younger participants demonstrated higher scores across all subscales ($p<0.001$). The mean scores for information skills, communication skills, content creation skills, problem-solving skills and security skills in military hospitals were calculated as 52.1 (SD=32.3), 50.6 (SD=31.8), 48.4 (SD=33.3), 49.8 (SD=30.8) and 52.8 (SD=34.1), respectively. In civilian hospitals, the respective scores were 45.1 (SD=32.2), 44.5 (SD=29.5), 41.8 (SD=32.4), 41.5 (SD=30.8) and 47.1 (SD=34.5).

Conclusions: The average scores across the subscales demonstrated high reliability. Statistically significant differences were observed between military and civilian hospitals, with military healthcare professionals exhibiting higher digital competencies. This may be attributed to the structured and resource-rich environment of military hospitals. Identifying the organizational factors that foster greater digital literacy and competence among healthcare professionals, provides essential insights for health service managers to implement targeted organizational improvements.

Keywords: Digital skills; Healthcare professionals; Military hospitals; Digital Competence framework

Introduction

The management of competencies and skills in the healthcare sector has become a focal point of study for international organizations, as a well-trained workforce is regarded as a cornerstone for delivering quality services and ensuring patient safety[1,2]. In alignment with the continuous advancements in medical technology, the necessity for healthcare professionals to

develop new skills has become increasingly urgent[3,4]. This need was starkly highlighted during the recent COVID-19 pandemic, where the heightened digital demands of healthcare services underscored the importance of sufficient digital capabilities[5,6].

In particular, digital skills are deemed critical not only for the effective management of healthcare organizations but also

for medical diagnosis, treatment monitoring, patient care, and decision-making processes[7,8]. Within the healthcare domain, digital competence encompasses knowledge of digital literacy and technology as essential tools for the patient-centered provision of quality healthcare services. It reflects the dynamic interaction between healthcare professionals, patients, and colleagues, as well as the drive to acquire professional expertise in digital technology[9,10].

It is widely recognized that digital competencies are essential for the effective integration of health technologies into routine clinical practice. Numerous processes are now carried out digitally, such as patient monitoring, where electronic health records and vital sign monitoring systems enable doctors and nurses to track patient status in real time. Material procurement is also facilitated through electronic systems, enhancing both accuracy and efficiency. Furthermore, telemedicine plays a pivotal role, particularly in military hospitals, by enabling the delivery of healthcare services to remote areas and military bases. Digital tools further support decision-making by allowing healthcare professionals to analyze data and make evidence-based decisions more efficiently[3,11,12].

In Greece, military hospitals appear to offer more structured training programs for digital skills, supported by military frameworks that emphasize the continuous professional development of their personnel. These programs encompass modules on the management of digital tools, telemedicine, and electronic patient record systems, reflecting the military's long-standing tradition of structured training and lifelong education. Additionally, military healthcare professionals are often encouraged to engage in e-learning programs to further enhance their expertise in healthcare technologies.

Conversely, in public hospitals, training programs for digital skills vary depending on the institution and the extent of technological integration. Significant advancements have been observed in large hospitals that have adopted electronic medical records; however, training opportunities remain limited due to resource constraints and time pressures. Healthcare professionals, including nurses and doctors, typically receive training through Ministry of Health initiatives or European-funded programs such as eHealth and Horizon 2020[9,10].

Despite extensive research on digital skills, a literature review from the past decade indicates a scarcity of studies that examine the digital competencies of healthcare professionals within a specific and well-defined conceptual framework. Moreover, limited research has explored the associations between digital skills and the organizational work environment. To the best of our knowledge, no prior studies have investigated differences in this domain between military and civilian healthcare professionals.

Therefore, the objective of this paper is to address this research gap by examining the relationship between the digital skills of

healthcare professionals and the organizational structures of their work environments. We aim to contribute empirical evidence regarding the organizational factors that influence healthcare professionals' digital competencies. Such findings can serve as a valuable resource for healthcare managers seeking to advance the digital transformation of healthcare systems.

Material and Methods

Study Design

A cross-sectional survey utilizing a descriptive study design was conducted to investigate the digital skills of healthcare professionals working in military and civilian hospitals in Greece. This study builds on prior research, which demonstrated that the Digital Competence Indicator tool is a reliable and valid measurement scale applicable to Greek doctors and nurses[13]. The study addressed two primary research questions: (1) How are healthcare professionals' digital skills assessed? and (2) Are there differences in the digital skills of healthcare professionals between military and civilian hospitals?

The present study was conducted as part of the research activities of the Department of Nursing at the Hellenic Mediterranean University and received ethical approval from the Review Committee (Protocol No.: 4634/29-03-2021). Additionally, the necessary permissions were obtained from the Scientific Committees of all participating hospitals (Protocol No.: 5584/1973/26-06-2021). Data were collected using a self-assessment questionnaire, with the principal investigator maintaining sole access to the collected data. Participation was entirely voluntary, and verbal consent was obtained after participants were fully informed about the study's purpose and procedures. The research adhered strictly to the European Union's General Data Protection Regulation, ensuring full compliance with personal data protection standards.

Participants and Settings

A convenience sample was drawn from seven tertiary care hospitals in Greece, comprising four military and three civilian hospitals, and was representative of medical doctors and registered nurses. The selection of hospitals was based on the diversity of organizational structures between military and civilian institutions, as well as the aim of achieving a large sample size. The study population size was calculated using a 95% confidence interval and a 5% margin of error, ensuring that the final sample accurately represented healthcare professionals in Greek tertiary hospitals.

The inclusion criteria for participation were employment in either a military or civilian hospital, professional status as a doctor or nurse, and, for nurses, registration as per the European Qualifications Framework (EQF). Exclusion criteria included incomplete questionnaire responses and unwillingness to participate.

The distribution of questionnaires was proportional to the size of each hospital, based on the number of medical and nursing staff within the institutions. Data collection occurred during staff meetings, where participants from various work positions within the hospitals were approached. After providing explanations regarding the study’s objectives and offering clarifications on completing the questionnaire, verbal consent was obtained from all participants. Data collection was conducted between July and November 2021.

Research Tool

Data were collected using a 37-item validated questionnaire based on the European Digital Competence Framework (DigComp), which comprehensively defines the elements of digital competence as a combination of skills, abilities and attitudes

essential for incorporating data processing into the professional careers of healthcare providers[14,,15].

The questionnaire consisted of two parts. The first part captured demographic characteristics, including gender, age, educational level, profession, specialty, hospital type, professional experience, administrative responsibilities, and possession of digital skills certification. The second part assessed 26 digital skills, organized into five competency domains (subscales): information, communication, content creation, problem-solving and security skills. The structure of these elements is illustrated in figure 1. Subscale values were calculated on a scale ranging from 0 to 100, with scores approaching 0 reflecting a more negative evaluation of the variable and scores approaching 100 reflecting a more positive evaluation.

Competence Area	Digital Skills
Information Skills	1. Finding information about goods and services 2. Obtaining information from public authority websites 3. Reading or downloading online news/newspapers/news magazines 4. Copying or moving a file or folder 5. Seeking health related information
Communication Skills	6.Sending/receiving emails 7.Telephoning over the internet/video calls (via webcam) over the internet 8.Participating in social networks 9.Posting messages to chat sites 10.Uploading self-created content to any website to be shared
Content Creation Skills	11.Creating websites or blogs 12.Writing a computer programme using a specialized programming language 13.Using copy and paste tools to duplicate or move information within a document 14.Creating electronic presentations with presentation software (e.g. slides), including e.g. images, sound, video or charts 15.Using basic arithmetic formulae to add, subtract, multiply or divide figures in a spread sheet
Problem Solving Skills	16.Connecting and installing new devices 17.Installing a new or replacing an old operating system 18.Modifying or verifying the configuration parameters of software applications 19.Doing an online course 20.Buying or ordering goods or services for private use (last 12 months) over the internet 21.Selling online 22.Job search or sending an application 23.Internet banking 24.Making an appointment with a practitioner via a website
Safety Skills	25.Using any kind of IT security software or tool (anti-virus, anti-spam, firewall etc.) in order to protect private computer and data 26.Updating one or more security products at least occasionally

Figure 1: Competence area and digital skills of the questionnaire

The questionnaire provided a concise yet effective assessment of the Information Technology (IT) skills of hospital doctors and nurses. Designed for ease of use and brevity, it was particularly suitable for hospital settings often characterized by high workloads and limited time for activities outside core medical and nursing responsibilities. Participants rated the extent of their computer usage for each activity on a five-point Likert scale, ranging from 1 (“not at all”) to 5 (“very much”).

Data Analysis

Statistical analysis was performed using SPSS (Statistical Package for Social Sciences) version 25.0. Continuous variables were expressed as mean ± standard deviation (SD) and categorical variables were presented as absolute numbers (n) and percentages (n%). The normality of variables was assessed using the Shapiro-Wilks test, alongside graphical methods such as the Normal Q-Q

plot, Detrended Normal Q-Q plot, and Box Plot. For all statistical tests, differences were considered significant at $p < 0.05$. The independent t-test was employed to compare the means of two groups, while one-way analysis of variance (ANOVA) was used for comparisons involving more than two group means.

Results

Participant’s Characteristics

The study population comprised 857 Greek healthcare professionals employed across seven tertiary care hospitals. The results indicate that 538 participants (62.8%) were female, while 319 (37.2%) were male, with a mean age of 39.7 years (SD = 10.0). Of the total, 657 individuals (76.7%) were employed in military hospitals, while 200 (23.3%) worked in civilian hospitals.

Specifically, among the military hospitals, 384 participants

were from the 251 Hellenic Air Force General Hospital, 110 from the 401 General Military Hospital of Athens, 66 from the Athens Naval Hospital, and 97 from the General Military Training Hospital. Among civilian hospitals, 82 participants were from the Sismanoglio General Hospital of Attika, 51 from the Asklepieio Voulas General Hospital, and 67 from the Henry Dunant Hospital Center.

The majority of participants were registered nurses (70.2%), with doctors comprising 29.8% of the sample. The average professional experience was estimated at 15.3 years. Regarding educational levels, 534 participants (62.3%) held a Bachelor of Science (BSc) degree, 269 (31.4%) had also completed a Master’s degree, and 54 (6.3%) held a PhD degree. The demographic characteristics of the study population are summarized in **table 1**.

Table 1: Demographic characteristic of participants (n = 857)

	Hospital							p-value
	Civilian hospital		Military hospital		Total			
	N	N %	N	N %	N	N %		
<i>Age (years)*</i>		40.6 (9.9)		39.4 (10)		39.7 (10)		0.143
<i>Gender</i>	Female	134	67.0%	404	61.5%	538	62.8%	0.158
	Male	66	33.0%	253	38.5%	319	37.2%	
<i>Educational level</i>	BSc	136	68.0%	392	59.7%	528	61.6%	0.092
	MSc	52	26.0%	223	33.9%	275	32.1%	
	PhD	12	6.0%	42	6.4%	54	6.3%	
<i>Profession</i>	Medical Doctor	53	26.5%	202	30.7%	255	29.8%	0.250
	Registered Nurse	147	73.5%	455	69.3%	602	70.2%	

*Note. Age expressed as mean (standard deviation)

Table 2: Mean values (SD) of Digital Competence framework (Information skills, Communication skills, Content creation skills, Problem solving skills, Security skills) per type of hospital

Civilian hospital	Hospital		
		Military hospital	Total
Information skills	Mean	45.1	54.2
	Standard Deviation	32.2	32.1
Communication skills	Mean	44.5	52.4
	Standard Deviation	29.5	32.3
Content creation skills	Mean	41.8	50.4
	Standard Deviation	32.4	33.3
Problem solving skills	Mean	41.5	52.4
	Standard Deviation	30.8	30.4
Security skills	Mean	47.1	54.6
	Standard Deviation	34.5	33.8

Digital Skills

Regarding digital skills, the mean scores for the subscales are as follows: information skills, 52.1 (SD = 32.3); communication skills, 50.6 (SD = 31.8); content creation skills, 48.4 (SD = 33.3); problem-solving skills, 49.8 (SD = 30.8); and security skills, 52.8 (SD = 34.1), as presented in **table 2**.

The reliability of the subscales was confirmed, with Cronbach’s alpha values indicating high internal consistency: information skills (5 items; $\alpha = 0.95$), communication skills (5 items; $\alpha = 0.95$), content creation skills (5 items; $\alpha = 0.95$), problem-solving skills (9 items; $\alpha = 0.97$), and security skills (2 items; $\alpha = 0.92$).

The mean scores across all five subscales of the measurement tool were found to differ significantly between military and civilian hospitals. Specifically, the mean score for the “Information skills” subscale in military hospitals was $M = 54.2$ ($SD = 32.1$), compared to $M = 45.1$ ($SD = 32.2$) in civilian hospitals, with $t(855) = -3.522$, $p < 0.001$.

For the “Communication skills” subscale, the mean score in military hospitals was $M = 52.4$ ($SD = 32.3$), while in civilian hospitals it was $M = 44.5$ ($SD = 29.5$), with $t(855) = -3.088$, $p = 0.002$.

Similarly, the “Content creation skills” subscale showed a mean score of $M = 50.4$ ($SD = 33.3$) in military hospitals versus $M = 41.8$ ($SD = 32.4$) in civilian hospitals, with $t(855) = -3.236$, $p = 0.001$. For “Problem-solving skills,” the mean score in military hospitals was $M = 52.4$ ($SD = 30.4$), compared to $M = 41.5$ ($SD = 30.8$) in civilian hospitals, with $t(855) = -4.395$, $p < 0.001$. Lastly, the “Security skills” subscale yielded a mean score of $M = 54.6$ ($SD = 33.8$) in military hospitals and $M = 47.1$ ($SD = 34.5$) in civilian hospitals, with $t(855) = -2.740$, $p = 0.006$.

The mean values (SD) of digital skills (information, communication, content creation, problem-solving, and security skills) by hospital type are illustrated in **figure 2**.

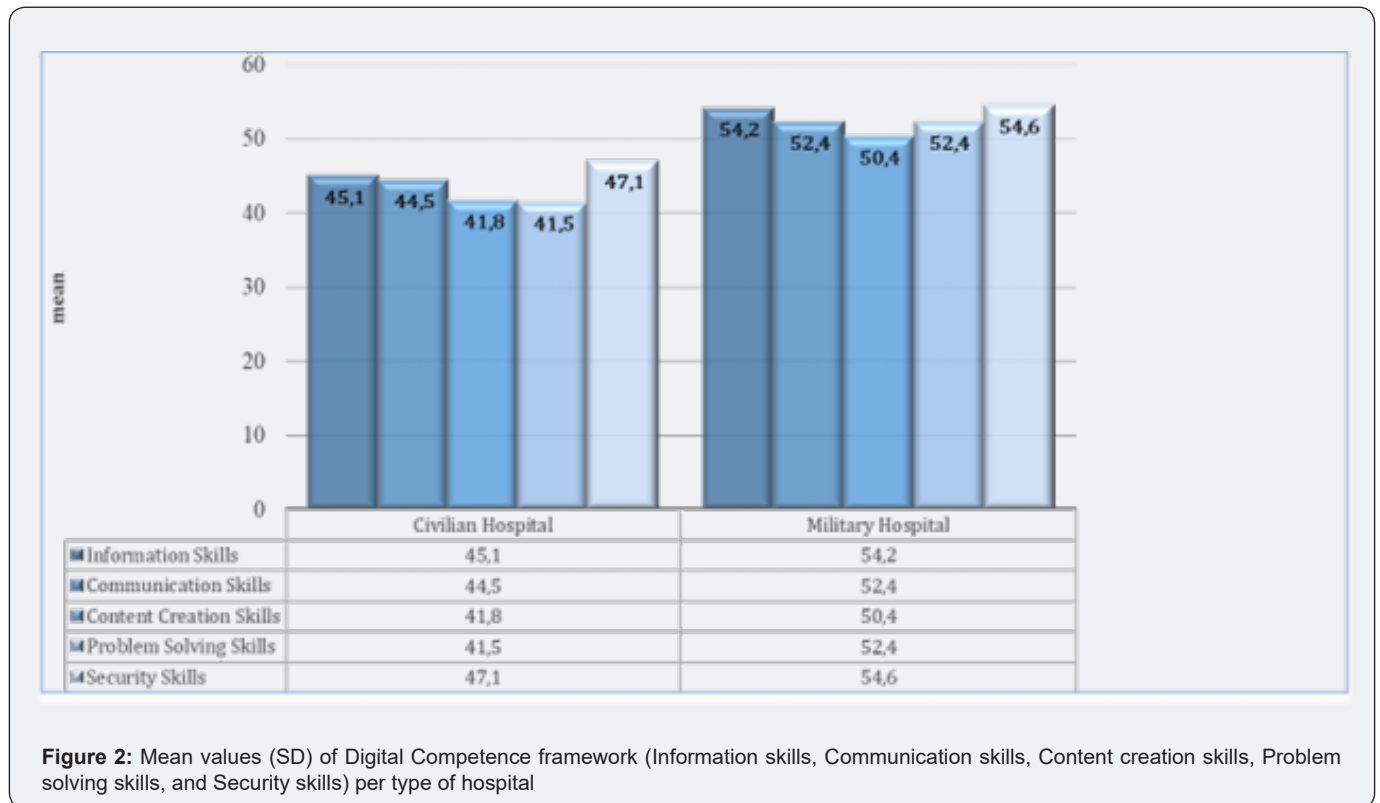


Figure 2: Mean values (SD) of Digital Competence framework (Information skills, Communication skills, Content creation skills, Problem solving skills, and Security skills) per type of hospital

Limitations

This study is subject to two key limitations. The first pertains to the educational level and qualifications of the participating nurses. All nurses involved in the study were registered nurses with European Qualifications Framework (EQF) level 6 or higher. This criterion was implemented to ensure a consistent educational level across the study population.

The second limitation arises from the use of a questionnaire as the measurement tool. As a self-assessment instrument, the questionnaire carries the potential for subjective responses, which may lead to either overestimation or underestimation of the participants’ actual skills. Consequently, these limitations may impact the generalizability of the findings.

Discussion

In the rapidly evolving landscape of modern healthcare, digital competence has transitioned from being a luxury to an essential requirement for healthcare professionals. Military hospitals, in particular, have demonstrated higher levels of digital proficiency among their staff, which can be attributed to several factors, including organizational structure and access to resources. Research underscores the critical role of the working environment in shaping digital literacy[16]. For instance, De Veer and Francke (2010) observed that attitudes toward electronic health records varied significantly depending on the type of healthcare organization[11]. Similarly, Jarva et al. (2023) as well as Rippen et al. (2013), emphasized that strong organizational support—through timely interventions and the provision of adequate resources—is essential for the successful adoption of digital technologies by healthcare professionals [9,17].

The structured and hierarchical nature of military hospitals is likely a significant factor in their ability to efficiently implement and train staff in digital technologies. These institutions often adopt new systems at a faster pace, which may explain the consistently higher levels of digital proficiency observed among healthcare personnel in military settings. Such an organizational advantage aligns with the findings of Ludwick and Doucette (2009), who emphasized that organizational readiness and robust support systems are critical to the successful implementation of electronic health records[18].

Moreover, the disparity in digital skills between military and civilian hospitals likely reflects the distinct digital transformation strategies employed by these institutions. Military hospitals, guided by strict protocols, often prioritize digital training as a central component of their operational strategies. In contrast, civilian hospitals may face a broader array of challenges, including inconsistent administrative policies and slower technology adoption due to resource constraints[19,20].

Based on the theoretical framework outlined, the findings of this study align with existing research emphasizing the growing importance of digital skills for healthcare professionals. Digital competence is essential not only for the effective delivery of healthcare services but also for ensuring patient safety and enhancing the overall efficiency of healthcare systems[21,22]. These competencies enable healthcare professionals to manage patient data effectively, navigate electronic health records[23,24], process large volumes of information,[25] and utilize telemedicine tools[26,27]—capabilities that are now indispensable in modern healthcare.

The present study contributes to the expanding body of evidence indicating that digital skills are no longer optional but a fundamental element of healthcare professionals' expertise[10,28,29]. Consistent with prior research, this study

also revealed that younger healthcare professionals demonstrated higher levels of digital competence, particularly in domains such as communication and content creation. Literature suggests that younger professionals tend to exhibit greater eHealth literacy and are more adept in the use of digital tools[30,31].

This generational disparity in digital skills highlights the need for targeted interventions aimed at providing older healthcare professionals with sufficient training and support to enhance their digital proficiency. However, the results of this study found no significant differences in digital skills based on gender, profession, specialty, or educational level.

The findings of present survey revealed significant differences in digital skills between healthcare professionals employed in military hospitals and those in civilian hospitals. Across all five categories of digital skills, healthcare professionals in military hospitals demonstrated higher competencies compared their counterparts in civilian settings. This disparity can be attributed to several factors, including the structured nature of military institutions, where digital training and protocols are more systematically integrated into daily operations[19,32]. Military hospitals often place a stronger emphasis on technical proficiency and operational readiness[33,34], which likely fosters the development of higher digital literacy among their staff.

Furthermore, the hierarchical structure of military organizations, coupled with consistent exposure to technology[32,35] and digital tools[36,37], provides healthcare professionals in these settings with more opportunities to enhance their digital skills. In contrast, civilian hospitals face a variety of challenges that may hinder the development of such competencies. These challenges include diverse administrative structures, slower decision-making processes, and limited access to resources for digital training[38,39]. The inherent flexibility within civilian hospital operations may further contribute to inconsistencies in the application and development of digital skills among healthcare professionals. This discrepancy could reflect differences in organizational priorities and the availability of technological resources within these institutions.

A noteworthy area where military healthcare professionals excel is in safety skills, likely due to the stringent data protection and cybersecurity protocols mandated within military environments[40,41]. This focus on safeguarding sensitive patient and operational data, cultivates a more advanced understanding of cybersecurity measures among military hospital staff. Although civilian hospitals also prioritize data security, they often encounter greater challenges in implementing uniform protocols due to variations in organizational structure and resource constraints.

Another significant disparity lies in problem-solving skills.

Military healthcare professionals appear to be better equipped to handle technical challenges, potentially due to the emphasis on problem-solving as an integral part of military training and operational effectiveness[42]. In contrast, the less regimented procedures commonly found in civilian hospital settings may provide healthcare professionals with fewer structured opportunities to develop and refine these skills.

While military hospitals offer a more conducive environment for the development of digital skills, civilian healthcare settings stand to benefit significantly from adopting more structured strategies aimed at enhancing digital literacy. Encouraging collaboration between military and civilian healthcare institutions could facilitate knowledge exchange and contribute to improving the overall digital competence of healthcare professionals. Specifically, civilian hospitals could benefit from integrating some of the structured approaches utilized in military hospitals. With the continuous evolution of healthcare technology, it is essential that all healthcare professionals, irrespective of their work environment, are supported in acquiring and maintaining high levels of digital competence.

Digital skills among healthcare professionals represent a burgeoning field of research that has experienced rapid growth over the past decade. The findings of this study highlight the need to further explore the role of institutional support in fostering digital skills, as well as the factors contributing to digital competence gaps among healthcare professionals across different organizational settings. These results hold international relevance, given the global significance of digital transformation in the healthcare sector. With additional research conducted in similar settings across various countries, these findings could be generalized to further advance digital literacy and transformation in healthcare systems worldwide.

Conclusion

This study underscores the critical importance of digital skills among healthcare professionals, drawing attention to notable differences between staff in military and civilian hospitals. The findings indicate that military healthcare professionals generally demonstrate higher levels of digital competence, likely attributable to the structured and resource-rich environments characteristic of military hospitals. These organizational factors, which foster a more digitally skilled workforce, serve as a foundation for identifying and implementing necessary organizational improvements that healthcare managers can leverage.

However, it is important to note that both military and civilian healthcare professionals exhibited moderate levels of digital skills overall, signifying substantial room for improvement across both settings. Strengthening digital competence across the healthcare sector remains essential for meeting the demands of modern healthcare systems.

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