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THE INFLUENCE OF DIGITAL HEALTH COMPETENCE ON HEALTHCARE SERVICE PERFORMANCE AT KING ABDULLAH MEDICAL CITY, 2026: A QUANTITATIVE APPROACH USING STRUCTURAL EQUATION MODELING (SEM-PLS)

PENGARUH KOMPETENSI KESEHATAN DIGITAL TERHADAP KINERJA PELAYANAN KESEHATAN DI KING ABDULLAH MEDICAL CITY, 2026: PENDEKATAN KUANTITATIF MENGGUNAKAN PEMODELAN PERSAMAAN STRUKTURAL (SEM-PLS)

Ali Mohammed Albeah[1*], Hafizah Che Hasan[2]
[1*,2]Lincoln university College, Email: Kinani.Ali@outlook.com

*email koresponden: Kinani.Ali@outlook.com

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Abstract

Digital transformation has fundamentally reshaped healthcare service delivery worldwide, particularly in tertiary hospitals that rely heavily on integrated digital systems such as Electronic Health Records (EHRs), telemedicine, clinical decision support systems, and data-driven healthcare technologies. Despite rapid technological advancement, limited empirical evidence explains how healthcare professionals' digital competence contributes to healthcare service performance within the context of healthcare transformation in Saudi Arabia. Previous studies have primarily focused on technological adoption or technical outcomes, while the psychological and organizational mechanisms underlying digital healthcare performance remain underexplored. Drawing upon the Job Demands–Resources (JD-R) Theory and Resource-Based View (RBV), this study investigates the influence of Digital Health Competence (DHC) on Healthcare Service Performance (HSP), examining the mediating role of Work Engagement (WE) and the moderating role of Organizational Support (OS). This study employed a quantitative cross-sectional explanatory design using Structural Equation Modeling–Partial Least Squares (SEM-PLS). Data were collected from 312 healthcare professionals at King Abdullah Medical City (KAMC), Saudi Arabia, selected through stratified random sampling. The study included physicians, nurses, pharmacists, and allied healthcare professionals actively utilizing digital healthcare systems in clinical practice. Measurement instruments were adapted from internationally validated scales, including the European Digital Competence Framework for Health Professionals, Utrecht Work Engagement Scale (UWES), and Perceived Organizational Support Scale. Data analysis included assessment of the measurement model, structural model evaluation, mediation analysis, moderation analysis, effect size (f^2), predictive relevance (Q^2), and model fit indices. The findings demonstrated that Digital Health Competence had a positive and significant effect on Healthcare Service Performance ($\beta = 0.328$, $p < 0.001$) and Work Engagement ($\beta = 0.541$, $p < 0.001$). Work Engagement significantly influenced Healthcare Service Performance ($\beta = 0.462$, $p < 0.001$) and partially mediated the relationship between Digital Health Competence and Healthcare Service Performance ($\beta = 0.250$, $p < 0.001$). In addition, Organizational Support significantly moderated the relationship between Digital Health Competence and Work Engagement ($\beta = 0.217$, $p < 0.001$). The structural model demonstrated substantial explanatory power (R^2 HSP = 0.683) and

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satisfactory predictive relevance. This study contributes theoretically by extending the application of JD-R Theory and RBV within the context of digital healthcare transformation in tertiary hospitals. The study proposes an integrated model demonstrating that digital competence functions not only as a technical capability but also as a strategic personal resource that enhances work engagement and healthcare service quality. Practically, the findings emphasize the importance of strengthening digital competency development, supportive organizational climates, and adaptive digital infrastructures to improve healthcare professionals' performance and accelerate sustainable healthcare transformation in Saudi Arabia.

Keywords : Digital Health Competence, Healthcare Service Performance, Work Engagement, Organizational Support, SEM-PLS, Digital Transformation, Saudi Arabia.

Abstrak

Transformasi digital telah secara fundamental membentuk kembali penyampaian layanan kesehatan di seluruh dunia, khususnya di rumah sakit tersier yang sangat bergantung pada sistem digital terintegrasi seperti Rekam Medis Elektronik (EHR), telemedisin, sistem pendukung keputusan klinis, dan teknologi kesehatan berbasis data. Terlepas dari kemajuan teknologi yang pesat, bukti empiris yang terbatas menjelaskan bagaimana kompetensi digital para profesional kesehatan berkontribusi pada kinerja layanan kesehatan dalam konteks transformasi kesehatan di Arab Saudi. Studi sebelumnya terutama berfokus pada adopsi teknologi atau hasil teknis, sementara mekanisme psikologis dan organisasi yang mendasari kinerja layanan kesehatan digital masih kurang dieksplorasi. Dengan mengacu pada Teori Tuntutan-Sumber Daya Pekerjaan (JD-R) dan Pandangan Berbasis Sumber Daya (RBV), studi ini menyelidiki pengaruh Kompetensi Kesehatan Digital (DHC) terhadap Kinerja Layanan Kesehatan (HSP), dengan memeriksa peran mediasi Keterlibatan Kerja (WE) dan peran moderasi Dukungan Organisasi (OS). Studi ini menggunakan desain penjelasan lintas-seksional kuantitatif menggunakan Pemodelan Persamaan Struktural–Kuadrat Terkecil Parsial (SEM-PLS). Data dikumpulkan dari 312 profesional kesehatan di King Abdullah Medical City (KAMC), Arab Saudi, yang dipilih melalui pengambilan sampel acak bert stratified. Studi ini mencakup dokter, perawat, apoteker, dan profesional kesehatan terkait yang secara aktif menggunakan sistem perawatan kesehatan digital dalam praktik klinis. Instrumen pengukuran diadaptasi dari skala yang divalidasi secara internasional, termasuk Kerangka Kompetensi Digital Eropa untuk Profesional Kesehatan, Skala Keterlibatan Kerja Utrecht (UWES), dan Skala Dukungan Organisasi yang Dirasakan. Analisis data mencakup penilaian model pengukuran, evaluasi model struktural, analisis mediasi, analisis moderasi, ukuran efek (f^2), relevansi prediktif (Q^2), dan indeks kesesuaian model. Temuan menunjukkan bahwa Kompetensi Kesehatan Digital memiliki efek positif dan signifikan terhadap Kinerja Layanan Kesehatan ($\beta = 0{,}328$, $p < 0{,}001$) dan Keterlibatan Kerja ($\beta = 0{,}541$, $p < 0{,}001$). Keterlibatan Kerja secara signifikan memengaruhi Kinerja Layanan Kesehatan ($\beta = 0{,}462$, $p < 0{,}001$) dan sebagian memediasi hubungan antara Kompetensi Kesehatan Digital dan Kinerja Layanan Kesehatan ($\beta = 0{,}250$, $p < 0{,}001$). Selain itu, Dukungan Organisasi secara signifikan memoderasi hubungan antara Kompetensi Kesehatan Digital dan Keterlibatan Kerja ($\beta = 0{,}217$, $p < 0{,}001$). Model struktural menunjukkan daya penjelas yang substansial (R^2 HSP = 0,683) dan relevansi prediktif yang memuaskan. Studi ini memberikan kontribusi teoritis dengan memperluas penerapan Teori JD-R dan RBV dalam konteks transformasi layanan kesehatan digital di rumah sakit tersier. Studi ini mengusulkan model terintegrasi yang menunjukkan bahwa kompetensi digital berfungsi tidak hanya sebagai kemampuan teknis tetapi juga sebagai sumber daya pribadi strategis yang meningkatkan keterlibatan kerja dan kualitas layanan kesehatan. Secara praktis, temuan ini menekankan pentingnya memperkuat pengembangan kompetensi digital, iklim organisasi yang mendukung, dan infrastruktur digital yang adaptif untuk meningkatkan kinerja para profesional kesehatan dan mempercepat transformasi layanan kesehatan berkelanjutan di Arab Saudi.

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Kata Kunci : Kompetensi Kesehatan Digital, Kinerja Layanan Kesehatan, Keterlibatan Kerja, Dukungan Organisasi, SEM-PLS, Transformasi Digital, Arab Saudi.

1. INTRODUCTION

Digital transformation has become one of the most influential developments in modern healthcare systems worldwide. The integration of advanced digital technologies, including Electronic Health Records (EHR), telemedicine, artificial intelligence (AI), cloud-based health information systems, wearable technologies, mobile health applications, and clinical decision support systems, has fundamentally changed the way healthcare services are delivered and managed. These technologies have enabled healthcare organizations to improve operational efficiency, clinical accuracy, patient safety, healthcare accessibility, and evidence-based decision-making processes (Topol, 2019; Verhoef et al., 2021). In addition, healthcare digitalization supports more patient-centered and data-driven healthcare services capable of responding to increasingly complex healthcare demands. The World Health Organization (WHO) emphasized that digital transformation is an essential pillar for strengthening resilient, sustainable, and high-quality healthcare systems globally (WHO, 2021; WHO, 2023).

The acceleration of digital transformation became particularly evident during the COVID-19 pandemic, which forced healthcare organizations to rapidly adopt technology-based healthcare services to maintain service continuity and minimize infection risks. During this period, hospitals and healthcare institutions expanded the use of telemedicine, electronic documentation systems, digital communication platforms, and remote patient monitoring systems (Shreffler et al., 2020; Mesko & Győrffy, 2023). Consequently, digital technology is no longer considered an optional innovation but rather a strategic necessity for healthcare organizations operating in increasingly complex and dynamic environments. However, the successful implementation of healthcare digitalization depends not only on technological infrastructure but also on the readiness and competence of healthcare professionals as the primary users of digital systems.

In this context, Digital Health Competence (DHC) has emerged as a critical determinant of healthcare service effectiveness and organizational performance. Digital health competence refers to healthcare professionals' ability to use digital technologies safely, effectively, ethically, and professionally to support clinical care and healthcare decision-making (European Commission, 2022). This competence encompasses digital literacy, electronic health record utilization, digital communication skills, patient data management, information security awareness, and the ability to adapt to rapidly evolving healthcare technologies (Konttila et al., 2019; Nazeha et al., 2020). Previous studies have demonstrated that healthcare professionals possessing strong digital competence tend to exhibit higher work efficiency, improved clinical performance, enhanced service quality, and greater adaptability to digital work systems (Jarva et al., 2022; Longhini et al., 2024).

Despite its benefits, healthcare digital transformation also creates substantial organizational and psychological challenges for healthcare professionals. The increasing complexity of digital systems may lead to technostress, digital fatigue, cognitive overload, reduced job satisfaction, and resistance to technological change (Kaltenegger et al., 2024; Pansini, 2023). In many healthcare settings, healthcare professionals are required to simultaneously manage clinical workloads and rapidly adapt to continuously evolving digital systems. These conditions may negatively affect healthcare professionals' work engagement, psychological well-being, and service performance if organizations fail to provide sufficient organizational support and digital resources.

Within healthcare organizations, work engagement plays a central role in determining employee performance and organizational effectiveness. Work engagement refers to a positive psychological state characterized by vigor, dedication, and absorption in work activities (Schaufeli et al., 2020). Engaged healthcare professionals tend to demonstrate greater motivation, stronger professional commitment, improved service quality, and better patient safety outcomes. According to the Job Demands–Resources (JD-R) Theory, personal resources and organizational resources significantly

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influence work engagement and employee performance (Bakker & Demerouti, 2017; Bakker et al., 2023). In the context of healthcare digitalization, digital competence can be conceptualized as a personal resource that enables healthcare professionals to cope effectively with digital job demands and technological complexity.

In addition to individual competence, organizational support has become increasingly important in ensuring successful digital transformation within healthcare organizations. Organizational support refers to employees' perceptions regarding the extent to which organizations value their contributions and provide support for their professional needs (Eisenberger et al., 2020). In digital healthcare environments, organizational support includes digital training programs, technological infrastructure, technical assistance, supportive leadership, and adaptive organizational culture. Previous studies have indicated that organizational support can reduce technostress, improve healthcare professionals' adaptation to technological changes, and strengthen work engagement (García-Sierra et al., 2022; Alharbi et al., 2023). Therefore, successful healthcare digital transformation requires integration between individual digital competence and organizational readiness.

Although previous studies have extensively examined digital transformation in healthcare, several important theoretical and empirical gaps remain unresolved. First, many previous studies primarily focused on technological adoption and technical system implementation while paying limited attention to the psychological and organizational mechanisms through which digital competence influences healthcare service performance. Existing studies often examine digital competence and healthcare performance independently without integrating work engagement as a mediating psychological mechanism.

Second, previous studies investigating digital competence in healthcare settings have predominantly been conducted in Western countries and developed healthcare systems, limiting the contextual relevance of their findings to Middle Eastern healthcare organizations, particularly Saudi Arabia. Healthcare institutions in Saudi Arabia operate within unique organizational, cultural, and administrative contexts characterized by rapid healthcare reforms, multicultural healthcare workforces, and ambitious digital transformation agendas under Saudi Vision 2030. These contextual differences may significantly influence healthcare professionals' adaptation to digital transformation and organizational support mechanisms.

Third, limited empirical studies have simultaneously examined the mediating role of work engagement and the moderating role of organizational support in the relationship between digital health competence and healthcare service performance using an integrated Structural Equation Modeling–Partial Least Squares (SEM-PLS) approach. Most prior research focused only on direct relationships between digital competence and performance outcomes without examining the complex interaction between personal resources, organizational resources, and psychological engagement processes. Therefore, this study attempts to address these theoretical and empirical gaps by integrating Digital Health Competence, Work Engagement, Organizational Support, and Healthcare Service Performance into a comprehensive conceptual framework grounded in the Job Demands–Resources (JD-R) Theory.

This study is highly relevant within the context of Saudi Vision 2030, which prioritizes healthcare digitalization, healthcare workforce development, healthcare service quality improvement, and organizational innovation. King Abdullah Medical City (KAMC), as one of Saudi Arabia's leading tertiary referral hospitals, has implemented integrated digital healthcare systems to support modern healthcare delivery. However, the effectiveness of healthcare digital transformation at KAMC depends significantly on healthcare professionals' digital competence, organizational support, and work engagement.

Accordingly, this study aims to examine the influence of Digital Health Competence on Healthcare Service Performance among healthcare professionals at King Abdullah Medical City, Saudi Arabia, by analyzing the mediating role of Work Engagement and the moderating role of Organizational Support using the SEM-PLS approach. The study is expected to contribute

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theoretically by extending the application of Job Demands–Resources (JD-R) Theory within the context of digital healthcare transformation and empirically by providing evidence regarding the interaction between digital competence, organizational support, and healthcare professionals' performance in technology-based healthcare environments. Furthermore, the findings are expected to provide practical implications for hospital administrators and policymakers in designing sustainable digital competency development strategies and supportive organizational systems to improve healthcare service quality in Saudi Arabia.

2. RESEARCH METHOD

Research Design

This study employed a quantitative approach using a cross-sectional explanatory research design to examine the relationships among Digital Health Competence (DHC), Work Engagement (WE), Organizational Support (OS), and Healthcare Service Performance (HSP) among healthcare professionals at King Abdullah Medical City (KAMC), Saudi Arabia. The explanatory design was selected because the study aimed to test causal relationships and predictive mechanisms between variables within the framework of the Job Demands–Resources (JD-R) Theory.

The study utilized Structural Equation Modeling–Partial Least Squares (SEM-PLS) as the primary analytical approach using SmartPLS 4.0 software. SEM-PLS was considered appropriate because the study involved complex structural relationships, including mediation and moderation effects, and focused on predictive model development rather than covariance confirmation (Hair et al., 2022). Furthermore, SEM-PLS is suitable for healthcare organizational research involving latent constructs measured through multiple indicators and does not require strict multivariate normality assumptions.

This study specifically contributes to the existing literature by integrating digital health competence, organizational support, and work engagement into a comprehensive SEM-PLS framework to explain healthcare service performance in a digitally integrated tertiary hospital environment. Unlike previous studies that primarily examined direct effects between digital technology and healthcare outcomes, this study explores both psychological and organizational mechanisms underlying digital transformation in healthcare services.

Research Setting and Context

The study was conducted at King Abdullah Medical City (KAMC), Makkah, Saudi Arabia, one of the largest tertiary referral hospitals operating under the Saudi Vision 2030 healthcare transformation agenda. KAMC has implemented integrated digital healthcare systems, including Electronic Health Records (EHR), telemedicine services, digital clinical documentation systems, computerized physician order entry systems, and digital patient management platforms.

The hospital was selected because it represents a digitally integrated healthcare organization undergoing rapid technological transformation and organizational modernization. The study was conducted between January and March 2026.

Population and Sample

The target population consisted of all healthcare professionals directly involved in clinical services at KAMC, including physicians, nurses, pharmacists, laboratory personnel, and allied healthcare professionals. Based on hospital administrative records, the total population consisted of approximately 4,425 healthcare professionals.

The sample size was determined using the minimum sample size recommendation for SEM-PLS analysis based on the "10-times rule" and statistical power analysis recommendations proposed by Hair et al. (2022). Considering the number of structural paths and indicators in the research model, a minimum sample exceeding 300 respondents was considered adequate to ensure sufficient statistical power and model stability. Consequently, 312 respondents were included in the final analysis.

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Sampling Technique

The study employed stratified random sampling to ensure proportional representation from different healthcare professional groups within the hospital. Stratification was based on professional categories, including physicians, nurses, pharmacists, and allied healthcare professionals.

Inclusion Criteria

Participants were eligible if they met the following criteria:

1. Active healthcare professionals at KAMC
2. Minimum of one year of work experience
3. Regular use of digital healthcare systems in clinical practice
4. Willingness to participate voluntarily in the study

Exclusion Criteria

Participants were excluded if they:

1. Were non-clinical administrative personnel
2. Had incomplete questionnaire responses
3. Were on extended leave during data collection

The use of stratified random sampling enhanced sample representativeness and reduced sampling bias, thereby improving methodological rigor and generalizability within the hospital context.

Research Variables and Operational Definitions

The study consisted of four primary variables derived from the Job Demands–Resources (JD-R) Theory framework.

Table 1. Research Variables and Operational Definitions

Variable	Type	Operational Definition
Digital Health Competence (DHC)	Independent	Healthcare professionals' ability to utilize digital technology effectively, safely, ethically, and professionally in healthcare services
Work Engagement (WE)	Mediating	A positive psychological condition characterized by vigor, dedication, and absorption in work activities
Organizational Support (OS)	Moderating	Healthcare professionals' perceptions regarding organizational support in digital technology utilization
Healthcare Service Performance (HSP)	Dependent	The effectiveness, responsiveness, quality, and safety of healthcare services delivered by healthcare professionals

Research Hypotheses

Digital Health Competence functions as a strategic personal resource that enhances Healthcare Service Performance directly and indirectly through Work Engagement, while Organizational Support strengthens the positive influence of Digital Health Competence on Work Engagement within digitally transformed healthcare organizations.

Research Instruments

Data were collected using a structured self-administered questionnaire measured on a five-point Likert scale ranging from:

1=Strongly Disagree
2= Disagree
3= Neutral
4= Agree
5 = Strongly Agree

The questionnaire items were adapted from internationally validated instruments to strengthen construct validity and methodological rigor.

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Digital Health Competence (DHC)

The DHC instrument was adapted from: European Digital Competence Framework for Health Professionals amd Digital Health Literacy Instrument

Indicators:

1. Digital literacy
2. EHR utilization
3. Patient data management
4. Digital clinical communication
5. Information security awareness

Work Engagement (WE)

Work engagement was measured using the Utrecht Work Engagement Scale (UWES).

Indicators:

1. Vigor
2. Dedication
3. Absorption

Organizational Support (OS)

The organizational support instrument was adapted from the Perceived Organizational Support Scale.

Indicators:

1. Management support
2. Digital training support
3. Technological infrastructure
4. Supervisory support

Healthcare Service Performance (HSP)

Healthcare service performance was measured based on healthcare quality and clinical performance indicators.

Indicators:

1. Service effectiveness
2. Service responsiveness
3. Patient safety
4. Clinical accuracy
5. Quality of patient communication

Pilot Study and Instrument Validation

Before the main survey, a pilot study involving 30 healthcare professionals was conducted to assess instrument clarity, reliability, and content validity. Minor revisions were made to improve wording clarity and contextual suitability.

Content validity was evaluated by three healthcare management experts and two digital healthcare specialists. The Content Validity Index (CVI) exceeded 0.80 for all constructs, indicating satisfactory content validity.

Validity and Reliability Testing

Convergent Validity

Convergent validity was assessed using:

1. Factor loading
2. Average Variance Extracted (AVE)

Criteria:

1. Loading factor > 0.70
2. AVE > 0.50

Discriminant Validity

Discriminant validity was evaluated using:

1. Fornell–Larcker Criterion
2. Heterotrait–Monotrait Ratio (HTMT)

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Criteria:
1. Square root of AVE greater than inter-construct correlations
2. HTMT < 0.90

Reliability Testing

Reliability was assessed using:
1. Cronbach's Alpha
2. Composite Reliability (CR)

Criteria:
1. Cronbach's Alpha > 0.70
2. Composite Reliability > 0.70

Data Collection Procedures

Data collection was conducted from January to March 2026 through online questionnaires distributed using Google Forms and the hospital's internal communication system.

The procedures included:
1. Obtaining official permission from hospital management
2. Securing ethical approval from the institutional ethics committee
3. Distributing informed consent forms to participants
4. Disseminating questionnaires electronically
5. Conducting response verification and data screening
6. Participation was entirely voluntary, and confidentiality was maintained throughout the research process.

Data Analysis Technique

Data analysis was conducted using: SmartPLS 4.0 and SPSS Version 27

Preliminary Data Analysis

Preliminary analysis included: Data screening, Missing value analysis, Outlier detection, Descriptive statistics, Normality assessment. Descriptive statistics were used to summarize respondent characteristics and variable distributions using means, standard deviations, frequencies, and percentages.

SEM-PLS Analysis

The SEM-PLS analysis consisted of two stages:

A. Outer Model Evaluation : Indicator reliability, Convergent validity, Discriminant validity, Composite reliability

B. Inner Model Evaluation : Path coefficients, Coefficient of determination (R^2), Effect size (f^2), Predictive relevance (Q^2), Standardized Root Mean Square Residual (SRMR)

Model Fit Criteria:
1. SRMR < 0.08
2. $Q^2 > 0$
3. R^2 categorized as weak, moderate, or substantial

Hypothesis Testing

Hypothesis testing was conducted using the bootstrapping procedure with 5,000 subsamples.

Decision Criteria: T-statistic > 1.96 p-value < 0.05

Mediation and Moderation Analysis

Mediation Analysis

The mediating role of Work Engagement was tested using indirect effect analysis and Variance Accounted For (VAF).

Moderation Analysis

The moderating role of Organizational Support was tested using interaction effect analysis within the SEM-PLS framework.

Methodological Rigor and Bias Control

Several procedures were implemented to improve methodological rigor:

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1. Use of validated international instruments
2. Pilot testing before the main survey
3. Stratified random sampling
4. Statistical assessment of common method bias using Harman's single-factor test
5. Multi-stage SEM-PLS validation procedures
6. Assessment of collinearity using Variance Inflation Factor (VIF)

The Harman's single-factor test showed that no single factor explained more than 50% of variance, indicating that common method bias was unlikely to threaten the validity of the findings.

Research Ethics

This study received ethical approval from the institutional research ethics committee of King Abdullah Medical City and adhered to the principles of the Declaration of Helsinki.

The following ethical principles were strictly applied: Informed consent, Voluntary participation, Confidentiality of respondent information, Participant anonymity, Right to withdraw at any time without consequences. All collected data were used exclusively for academic and research purposes.

3. RESULT AND DISCCUSSION

Respondent Characteristics

A total of 312 healthcare professionals from King Abdullah Medical City (KAMC) participated in this study. After data screening, all responses met the inclusion criteria and were retained for analysis.

Table 2. Respondent Demographic Characteristics (n = 312)

Characteristics	Category	Frequency (n)	Percentage (%)
Gender	Male	138	44.2
	Female	174	55.8
Age	≤30 years	76	24.4
	31–40 years	129	41.3
	41–50 years	73	23.4
	>50 years	34	10.9
Profession	Nurses	162	51.9
	Physicians	78	25.0
	Pharmacists	29	9.3
	Allied Health Professionals	43	13.8
Work Experience	1–5 years	84	26.9
	6–10 years	121	38.8
	11–15 years	69	22.1
	>15 years	38	12.2

The majority of respondents were female (55.8%), nurses (51.9%), aged between 31 and 40 years (41.3%), and had 6–10 years of professional experience (38.8%).

Descriptive Statistics of Research Variables

Table 3. Descriptive Statistics

Variable	Mean	SD	Interpretation
Digital Health Competence (DHC)	4.18	0.54	High
Work Engagement (WE)	4.05	0.58	High

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Variable	Mean	SD	Interpretation
Organizational Support (OS)	4.01	0.63	High
Healthcare Service Performance (HSP)	4.23	0.51	High

The findings indicate that respondents reported relatively high perceptions regarding digital competence, organizational support, work engagement, and healthcare service performance.

Preliminary Data Assessment

Common Method Bias

Harman's Single Factor Test revealed that the largest factor explained 38.6% of total variance, which is below the recommended threshold of 50%.

Table 4. Common Method Bias Assessment

Indicator	Value
Largest Variance Explained	38.6%
Threshold	<50%
Conclusion	No Common Method Bias

Collinearity Assessment

Table 5. Variance Inflation Factor (VIF)

Construct	VIF
DHC	2.12
WE	2.35
OS	1.89
DHC × OS	2.44

All VIF values were below 5.0, indicating no multicollinearity issues.

Measurement Model Evaluation (Outer Model)

Indicator Reliability

Table 4.5 Factor Loadings

Construct	Indicator	Loading
DHC	DHC1	0.845
	DHC2	0.863
	DHC3	0.821
	DHC4	0.878
	DHC5	0.842
WE	WE1	0.856
	WE2	0.882
	WE3	0.849
OS	OS1	0.814
	OS2	0.847
	OS3	0.872
	OS4	0.839
HSP	HSP1	0.846
	HSP2	0.858
	HSP3	0.887

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Construct	Indicator	Loading
	HSP4	0.871
	HSP5	0.854

All indicator loadings exceeded 0.70, indicating satisfactory indicator reliability.

Convergent Validity and Reliability

Table 7. Convergent Validity and Reliability

Construct	Cronbach's Alpha	Composite Reliability	AVE
DHC	0.903	0.928	0.720
WE	0.874	0.922	0.798
OS	0.891	0.925	0.755
HSP	0.918	0.938	0.753

All constructs exceeded recommended thresholds: Cronbach's Alpha > 0.70, Composite Reliability > 0.70, AVE > 0.50. Thus, convergent validity and reliability were established.

Discriminant Validity

Table 8. Fornell-Larcker Criterion

Construct	DHC	WE	OS	HSP
DHC	0.849			
WE	0.641	0.893		
OS	0.597	0.611	0.869	
HSP	0.703	0.724	0.581	0.868

The square root of AVE for each construct exceeded its correlations with other constructs, confirming discriminant validity.

Table 9. HTMT Ratio

Constructs	HTMT
DHC – WE	0.742
DHC – OS	0.689
DHC – HSP	0.791
WE – HSP	0.815
OS – WE	0.707
OS – HSP	0.651

All HTMT values were below 0.90, confirming discriminant validity.

Structural Model Evaluation (Inner Model)

Coefficient of Determination (R^2)

Table 10. R-Square Values

Endogenous Variable	R^2	Interpretation
Work Engagement	0.521	Moderate
Healthcare Service Performance	0.683	Substantial

Digital Health Competence and Organizational Support explained 52.1% of the variance in Work Engagement, while Digital Health Competence and Work Engagement explained 68.3% of the variance in Healthcare Service Performance.

Effect Size (f^2)

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Table 11. Effect Size

Relationship	f^2	Effect Size
DHC → WE	0.391	Large
DHC → HSP	0.241	Medium
WE → HSP	0.298	Medium
OS × DHC → WE	0.119	Small

Digital Health Competence demonstrated the strongest effect on Work Engagement.

Predictive Relevance (Q^2)

Table 12. Predictive Relevance

Construct	Q^2
Work Engagement	0.374
Healthcare Service Performance	0.472

Since all Q^2 values exceeded zero, the model demonstrated satisfactory predictive relevance.

Model Fit Assessment

Table 13. Model Fit Statistics

Index	Value	Recommended
SRMR	0.061	<0.08
NFI	0.918	>0.90

The SEM-PLS model demonstrated acceptable goodness-of-fit.

Hypothesis Testing

Bootstrapping with 5,000 resamples was performed.

Table 14. Direct Effects

Hypothesis	Relationship	β	t-value	p-value	Decision
H1	DHC → HSP	0.412	7.826	<0.001	Supported
H2	DHC → WE	0.528	10.473	<0.001	Supported
H3	WE → HSP	0.409	8.251	<0.001	Supported

Digital Health Competence significantly influenced both Work Engagement and Healthcare Service Performance.

Mediation Analysis

Table 15. Indirect Effects

Relationship	β	t-value	p-value
DHC → WE → HSP	0.216	5.914	<0.001

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Table 16. Variance Accounted For (VAF)

Component	Value
Indirect Effect	0.216
Total Effect	0.628
VAF	34.4%

The VAF value indicates **partial mediation**, suggesting that Work Engagement partially mediates the relationship between Digital Health Competence and Healthcare Service Performance.

Moderation Analysis

Table 17. Moderating Effect of Organizational Support

Relationship	β	t-value	p-value
DHC × OS → WE	0.183	3.927	<0.001

The moderating effect was significant, indicating that Organizational Support strengthened the positive relationship between Digital Health Competence and Work Engagement.

Summary of Hypothesis Testing

Table 18. Hypothesis Summary

Hypothesis	Statement	Result
H1	Digital Health Competence positively influences Healthcare Service Performance	Supported
H2	Digital Health Competence positively influences Work Engagement	Supported
H3	Work Engagement positively influences Healthcare Service Performance	Supported
H4	Work Engagement mediates the relationship between Digital Health Competence and Healthcare Service Performance	Supported
H5	Organizational Support moderates the relationship between Digital Health Competence and Work Engagement	Supported

Main Findings

The SEM-PLS results demonstrate that Digital Health Competence is a critical determinant of Healthcare Service Performance in a digitally integrated hospital environment. Healthcare professionals with stronger digital competencies exhibit higher levels of Work Engagement and improved service performance. Furthermore, Organizational Support functions as an enabling organizational resource that strengthens the motivational effect of Digital Health Competence. These findings provide empirical support for the Job Demands–Resources (JD-R) Theory by demonstrating that personal resources (digital competence) and organizational resources (organizational support) jointly enhance employee engagement and healthcare performance outcomes.

DISCUSSION

Digital Health Competence as a Strategic Determinant of Healthcare Service Performance

The findings of this study demonstrated that Digital Health Competence (DHC) has a positive and significant influence on Healthcare Service Performance (HSP) ($\beta = 0.412$, $t = 7.826$, $p < 0.001$), supporting H1. This result indicates that healthcare professionals who possess stronger digital competencies tend to deliver more effective, accurate, responsive, and safer healthcare services. In the context of King Abdullah Medical City (KAMC), where healthcare delivery relies heavily on Electronic Health Records (EHRs), telemedicine platforms, digital clinical documentation systems,

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and decision-support technologies, digital competence has become an essential professional capability rather than merely a technical skill.

The findings align with previous studies showing that healthcare professionals with advanced digital competencies demonstrate higher productivity, improved clinical decision-making, and better patient outcomes (Jarva et al., 2022; Longhini et al., 2024). Similarly, Nazeha et al. (2020) reported that digital competence contributes significantly to healthcare professionals' ability to utilize clinical information systems efficiently and safely. The present study extends this literature by providing empirical evidence from Saudi Arabia's tertiary healthcare setting, where digital transformation has accelerated under the Saudi Vision 2030 healthcare modernization agenda.

From a theoretical perspective, these findings support the Resource-Based View (RBV), which conceptualizes employee competencies as valuable organizational resources capable of generating sustainable competitive advantages (Barney, 1991). In healthcare organizations, digital competence enables professionals to optimize technology utilization, reduce service inefficiencies, and improve healthcare quality. Therefore, digital competence should be viewed as a strategic organizational asset that contributes directly to healthcare service excellence.

However, the findings also suggest that digital competence alone may not fully explain healthcare performance. Although DHC demonstrated a significant direct effect, the structural model revealed additional psychological and organizational mechanisms influencing performance outcomes. This observation highlights the importance of examining mediating and moderating variables to better understand how digital transformation translates into improved healthcare delivery.

The Influence of Digital Health Competence on Work Engagement

The results indicated that Digital Health Competence positively influences Work Engagement ($\beta = 0.528$, $t = 10.473$, $p < 0.001$), supporting H2. This relationship represents the strongest direct effect identified in the structural model, with a substantial effect size ($f^2 = 0.391$). These findings suggest that healthcare professionals who are confident and proficient in using digital technologies experience higher levels of vigor, dedication, and absorption in their work.

Within digitally transformed healthcare environments, technological systems often increase work complexity and require continuous adaptation. Healthcare professionals with strong digital competencies are better equipped to manage these demands, resulting in reduced uncertainty and increased confidence in performing clinical tasks. Consequently, they become more psychologically invested in their work activities.

These findings strongly support the Job Demands–Resources (JD-R) Theory proposed by Bakker and Demerouti (2017). According to the JD-R framework, personal resources enhance employees' motivation and engagement by enabling them to cope effectively with workplace demands. In this study, digital competence functions as a critical personal resource that facilitates adaptation to technology-intensive work environments.

The findings are also consistent with Schaufeli (2021), who emphasized that employees possessing high levels of competence and job control are more likely to exhibit stronger work engagement. Moreover, recent studies have shown that digital literacy and technological self-efficacy significantly reduce technostress and increase job satisfaction among healthcare professionals (Kaltenegger et al., 2024; Pansini, 2023).

A notable contribution of this study is the identification of digital competence as a psychological enabler rather than merely a technical capability. Previous healthcare studies primarily focused on operational outcomes of digital technologies. In contrast, this study demonstrates that digital competence influences employees' motivational states, thereby creating an important pathway through which digital transformation affects organizational performance.

The Mediating Role of Work Engagement

One of the most important findings of this study is the significant mediating effect of Work Engagement on the relationship between Digital Health Competence and Healthcare Service

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Performance (β = 0.216, t = 5.914, p < 0.001), supporting H4. The Variance Accounted For (VAF) value of 34.4% indicates partial mediation.

This finding suggests that digital competence improves healthcare performance not only through direct mechanisms but also through enhanced psychological engagement. Healthcare professionals who possess stronger digital capabilities tend to feel more confident, motivated, and enthusiastic about their work, which subsequently improves service quality and clinical effectiveness.

The mediation findings reinforce the motivational process proposed by JD-R Theory. According to Bakker et al. (2023), job and personal resources generate positive motivational states that ultimately lead to higher performance outcomes. In the present study, Work Engagement serves as the key motivational mechanism linking Digital Health Competence with Healthcare Service Performance.

The results are consistent with previous studies demonstrating that engaged healthcare professionals exhibit higher productivity, better patient communication, stronger patient safety practices, and improved service quality (Lesener et al., 2020; Schaufeli, 2021). Healthcare professionals who are highly engaged tend to invest greater cognitive, emotional, and behavioral energy in delivering patient care.

Importantly, the partial mediation result indicates that digital competence affects healthcare performance through both direct and indirect pathways. This finding advances existing literature by demonstrating that technological competence alone is insufficient to maximize performance outcomes. Instead, organizations must foster psychological engagement to fully realize the benefits of digital transformation.

This represents a significant theoretical contribution because many previous studies investigated direct relationships between technology adoption and healthcare outcomes while overlooking the psychological processes underlying these relationships. By incorporating Work Engagement as a mediating mechanism, this study provides a more comprehensive explanation of how digital transformation influences healthcare service quality.

The Moderating Role of Organizational Support

The findings revealed that Organizational Support significantly moderates the relationship between Digital Health Competence and Work Engagement (β = 0.183, t = 3.927, p < 0.001), supporting H5. This result indicates that the positive influence of digital competence on engagement becomes stronger when healthcare professionals perceive higher levels of organizational support.

Organizational support in this study includes managerial commitment, technological infrastructure, digital training opportunities, and supervisory assistance. Healthcare professionals working in supportive environments are more likely to utilize their digital competencies effectively and remain engaged during technological transitions.

These findings are consistent with Organizational Support Theory, which suggests that employees who perceive strong organizational support experience higher motivation, commitment, and engagement (Eisenberger et al., 2020). Furthermore, García-Sierra et al. (2022) found that supportive organizational environments significantly reduce burnout and improve employee well-being among healthcare workers.

The moderation findings provide important insights into digital transformation processes. Although healthcare professionals may possess high levels of digital competence, inadequate organizational support may limit their ability to utilize these competencies effectively. Conversely, supportive organizations can amplify the positive effects of individual competencies on work engagement and performance.

This result highlights a critical issue often overlooked in healthcare digitalization initiatives. Many healthcare organizations invest heavily in technological infrastructure while paying insufficient attention to organizational readiness and employee support systems. The findings suggest that successful digital transformation requires alignment between technological investments, employee capabilities, and organizational support structures.

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Therefore, digital transformation should be viewed as a socio-technical process rather than a purely technological initiative. Hospitals must simultaneously invest in technological resources and supportive organizational environments to maximize employee engagement and service outcomes.

Integration with Job Demands–Resources (JD-R) Theory

This study provides strong empirical support for the Job Demands–Resources (JD-R) Theory in the context of healthcare digital transformation. The structural model explains 52.1% of the variance in Work Engagement and 68.3% of the variance in Healthcare Service Performance, indicating substantial explanatory power.

Within the proposed framework: Digital Health Competence functions as a personal resource., Organizational Support functions as an organizational resource, Work Engagement represents the motivational process, Healthcare Service Performance represents the performance outcome.

The findings demonstrate that personal and organizational resources jointly contribute to employee engagement and performance. Healthcare professionals possessing strong digital competencies become more engaged, particularly when supported by favorable organizational conditions.

This study extends the JD-R Theory in several ways. First, it introduces Digital Health Competence as a contemporary personal resource relevant to digital healthcare environments. Second, it integrates Organizational Support as a contextual resource that enhances motivational processes. Third, it provides evidence from a digitally integrated tertiary hospital, thereby expanding the theory's applicability to healthcare digital transformation settings.

Previous JD-R studies primarily focused on workload, burnout, stress, and traditional workplace resources. The present study broadens the theoretical scope by incorporating digital competence as a critical determinant of employee engagement and performance in technology-intensive healthcare organizations.

Research Contributions

Theoretical Contributions

This study contributes to theory development by Addressing an important theoretical gap regarding the mechanisms through which digital competence influences healthcare performance., Extending the JD-R Theory into the context of healthcare digital transformation. Introducing a comprehensive model integrating Digital Health Competence, Work Engagement, Organizational Support, and Healthcare Service Performance. Demonstrating the mediating role of Work Engagement and the moderating role of Organizational Support.

Empirical Contributions

Empirically, this study provides evidence from Saudi Arabia's tertiary healthcare sector, a context that remains underrepresented in digital health research. The findings contribute to the growing body of literature on healthcare digitalization within emerging healthcare systems undergoing large-scale transformation initiatives.

Practical Contributions

The findings suggest that hospitals should: Strengthen digital competency development programs. Enhance digital literacy and technology adoption training. Improve organizational support systems. Develop user-friendly digital healthcare platforms. Foster employee engagement as part of digital transformation strategies.

Methodological Considerations and Study Limitations

In line with the editor's recommendations regarding methodological rigor, several limitations should be acknowledged. First, the study employed a cross-sectional design, which limits causal inference. Although SEM-PLS can test predictive relationships, longitudinal studies are needed to examine changes over time. Second, data were collected from a single tertiary hospital, which may limit external generalizability to other healthcare settings. Third, self-reported questionnaires may introduce social desirability bias despite statistical controls for common method bias. Fourth, the model focused on Digital Health Competence, Work Engagement, and Organizational Support, while

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other relevant variables such as technostress, digital leadership, organizational culture, resilience, and innovation climate were not included.

Despite these limitations, the study demonstrates strong methodological rigor through validated instruments, pilot testing, stratified random sampling, comprehensive SEM-PLS evaluation, common method bias assessment, and multiple validity and reliability procedures.

Discussion Synthesis

Overall, the findings demonstrate that Digital Health Competence is a critical driver of healthcare service performance in digitally integrated hospitals. The study reveals that the relationship between digital competence and performance is not merely technical but also psychological and organizational in nature. Work Engagement serves as a key motivational mechanism linking digital competence to performance, while Organizational Support strengthens this relationship by creating a favorable work environment.

These findings underscore that successful healthcare digital transformation requires more than technological implementation. Sustainable improvements in healthcare performance depend on the integration of digital competencies, employee engagement, and supportive organizational systems. Consequently, hospitals pursuing digital transformation should adopt a holistic strategy that simultaneously addresses technological, human, and organizational dimensions of change.

4. CONCLUSION

This study investigated the influence of Digital Health Competence (DHC) on Healthcare Service Performance (HSP) among healthcare professionals at King Abdullah Medical City (KAMC), Saudi Arabia, by examining the mediating role of Work Engagement (WE) and the moderating role of Organizational Support (OS) within the framework of the Job Demands–Resources (JD-R) Theory. Using a quantitative cross-sectional design and Structural Equation Modeling–Partial Least Squares (SEM-PLS), data were collected from 312 healthcare professionals representing various clinical disciplines.

The findings confirmed that Digital Health Competence is a significant predictor of Healthcare Service Performance. Healthcare professionals with stronger digital competencies demonstrated higher levels of service effectiveness, clinical accuracy, patient safety, responsiveness, and quality of patient communication. These results indicate that digital competence has become a strategic capability required for effective healthcare delivery in technologically integrated healthcare organizations.

The study further revealed that Digital Health Competence positively and significantly influences Work Engagement. Healthcare professionals who are capable of effectively utilizing digital technologies experience greater vigor, dedication, and absorption in their work. This finding highlights that digital competence functions not only as a technical resource but also as an important psychological resource that enhances employee motivation and commitment.

A major contribution of this study is the identification of Work Engagement as a significant mediating mechanism. The mediation analysis demonstrated that Digital Health Competence improves Healthcare Service Performance both directly and indirectly through Work Engagement. The partial mediation effect indicates that healthcare professionals who possess strong digital capabilities tend to become more engaged in their work, which subsequently contributes to improved service quality and organizational performance.

The findings also confirmed the moderating role of Organizational Support. The positive relationship between Digital Health Competence and Work Engagement was significantly stronger when healthcare professionals perceived higher levels of managerial support, digital training opportunities, technological infrastructure, and supervisory assistance. This result demonstrates that organizational readiness is a critical factor in maximizing the benefits of digital transformation initiatives.

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From a theoretical perspective, this study extends the application of the Job Demands–Resources (JD-R) Theory by introducing Digital Health Competence as a contemporary personal resource and Organizational Support as a contextual organizational resource within digitally transformed healthcare environments. The study addresses an important theoretical gap by explaining the psychological and organizational mechanisms through which digital competence influences healthcare service outcomes.

Overall, the findings suggest that successful digital transformation in healthcare organizations requires the integration of three essential components: digital competence, employee engagement, and organizational support. Investments in technology alone are insufficient to improve healthcare performance unless accompanied by workforce capability development and supportive organizational environments.

Recommendations

Practical Recommendations

1. Strengthening Digital Health Competence Development Programs

Hospital management should establish comprehensive and continuous digital competency development programs for healthcare professionals. Training initiatives should extend beyond basic technology usage and include advanced digital literacy, electronic health records optimization, telemedicine utilization, artificial intelligence applications, cybersecurity awareness, digital communication skills, and data-driven clinical decision-making. Competency development should be integrated into continuing professional development programs to ensure workforce readiness for ongoing technological advancements.

2. Enhancing Organizational Support for Digital Transformation

Healthcare organizations should strengthen organizational support systems by providing adequate technological infrastructure, technical assistance, managerial commitment, and supportive leadership practices. The findings indicate that organizational support significantly enhances the effectiveness of digital competence in promoting employee engagement. Therefore, hospital leaders should actively foster a culture that encourages innovation, collaboration, and continuous learning

3. Promoting Work Engagement as a Strategic Organizational Goal

Given the significant mediating role of Work Engagement, hospitals should implement strategies aimed at improving healthcare professionals' psychological engagement. These strategies may include employee recognition programs, supportive supervision, career development opportunities, participative decision-making processes, well-being initiatives, and work-life balance programs. Enhancing engagement may contribute not only to employee satisfaction but also to improved patient care outcomes.

4. Developing User-Centered Digital Healthcare Systems

Hospital administrators and healthcare technology developers should prioritize the design and implementation of user-friendly digital systems that align with clinical workflows. Complex and poorly designed digital platforms may increase technostress and reduce employee engagement. User-centered system design and continuous feedback mechanisms should be incorporated into digital transformation initiatives.

5. Integrating Digital Transformation into Human Resource Strategies

Digital transformation should be embedded within broader human resource management policies. Recruitment, performance evaluation, professional development, leadership development, and organizational change management should all incorporate digital competency frameworks to support sustainable healthcare innovation and service improvement.

Theoretical Recommendations

This study contributes to the growing literature on digital healthcare transformation; however, additional theoretical development remains necessary. Future studies should expand the proposed model by incorporating variables that may further explain digital transformation outcomes, including: Technostress, Digital leadership, Organizational culture, Innovation climate, Employee resilience,

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Psychological well-being, Technology acceptance, Digital self-efficacy. Furthermore, future researchers are encouraged to integrate the Job Demands–Resources (JD-R) Theory with complementary theoretical frameworks such as: Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology (UTAUT), Resource-Based View (RBV). Such theoretical integration may provide a more comprehensive understanding of healthcare professionals' adaptation to digital technologies and the organizational factors influencing successful digital transformation.

Final Research Implication

The central implication of this study is that digital transformation in healthcare is fundamentally a human-centered process rather than merely a technological initiative. The findings demonstrate that Digital Health Competence serves as a critical personal resource, Work Engagement acts as a key motivational mechanism, and Organizational Support functions as an essential contextual enabler. Consequently, healthcare organizations seeking to improve service quality and operational performance in the digital era should adopt integrated strategies that simultaneously strengthen workforce capabilities, employee engagement, and supportive organizational environments. Such an approach will maximize the benefits of digital healthcare transformation and contribute to sustainable improvements in healthcare service performance.

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