



Digital Health Transformation and Organizational Performance in Healthcare Systems: The Mediating Role of Digital Leadership

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ABSTRACT

This study aimed to investigate the effect of digital health transformation on organizational performance in healthcare systems in Tehran and to determine the mediating role of digital leadership in this relationship. This applied, quantitative, cross-sectional correlational study was conducted among managers, supervisors, health information technology personnel, clinical coordinators, and professional administrative and clinical-support employees working in public and private healthcare organizations in Tehran, Iran, in 2026. A total of 420 questionnaires were distributed, of which 384 valid questionnaires were retained for analysis. Data were collected using a structured questionnaire assessing digital health transformation, digital leadership, and organizational performance on five-point Likert scales. Content validity was evaluated by academic and professional experts, while construct reliability and validity were assessed using Cronbach's alpha, composite reliability, average variance extracted, and the heterotrait-monotrait ratio. Data were analyzed using SPSS version 27 and SmartPLS 4. Partial least squares structural equation modeling and bootstrapping with 5,000 resamples were applied to test direct and indirect effects. Digital health transformation had a significant positive effect on digital leadership ($\beta = 0.684$, $t = 17.538$, $p < 0.001$) and organizational performance ($\beta = 0.268$, $t = 5.255$, $p < 0.001$). Digital leadership also significantly predicted organizational performance ($\beta = 0.531$, $t = 11.298$, $p < 0.001$). The indirect effect of digital health transformation on organizational performance through digital leadership was significant ($\beta = 0.363$, $t = 8.854$, $p < 0.001$), confirming complementary partial mediation. The total effect of digital health transformation on organizational performance was $\beta = 0.631$ ($p < 0.001$). The model explained 46.8% of the variance in digital leadership and 60.3% of the variance in organizational performance. Digital health transformation significantly improves organizational performance both directly and indirectly through digital leadership, indicating that healthcare organizations can achieve greater performance gains when technological transformation is accompanied by strong leadership capabilities that facilitate digital adoption, innovation, and strategic integration.

Keywords: Digital Health Transformation; Digital Leadership; Organizational Performance; Healthcare Systems; Healthcare Management; Structural Equation Modeling

1. Introduction

Healthcare systems throughout the world are undergoing a profound transition driven by rapid advances in digital technologies, changing patient expectations, increasing service complexity, escalating costs, workforce pressures, and the growing need for timely and data-informed decision-making. Digital health transformation has consequently moved beyond the adoption of isolated information technologies and has become a strategic organizational process through which healthcare institutions redesign clinical, administrative, managerial, and communication practices. Contemporary digital transformation in healthcare encompasses electronic health records, artificial intelligence, telemedicine, data analytics, cloud-based infrastructures, blockchain, interoperable information systems, mobile health applications, automated decision-support tools, and digitally connected service platforms. These technologies have the potential to improve accessibility, coordination, efficiency, responsiveness, quality, and continuity of healthcare delivery when they are effectively integrated into organizational structures and workflows (1, 2). However, the mere availability of digital technologies does not automatically result in organizational improvement. Their impact depends on how technologies are implemented, governed, integrated with existing routines, and translated into new forms of organizational capability and service delivery.

Digital health transformation can be understood as a multidimensional organizational change process in which digital technologies alter not only technical systems but also institutional practices, professional roles, decision structures, organizational routines, and relationships among healthcare stakeholders. Research on healthcare transformation has emphasized that digitalization must be interpreted as an organizational and social process rather than solely as a technological modernization initiative. For example, digitalization in primary healthcare may introduce new organizational logics that interact, and sometimes conflict, with established clinical, professional, and managerial logics, requiring organizations to continuously adjust their practices during implementation (3). Similarly, evidence from healthcare systems experiencing infrastructural and resource constraints demonstrates that digital health may contribute to system transformation only

when problems such as unequal access, digital literacy, infrastructure gaps, workforce readiness, and institutional capacity are addressed simultaneously (4). Accordingly, successful digital transformation requires alignment among technology, organizational processes, personnel capabilities, institutional culture, and leadership.

The strategic importance of digital transformation has become especially evident as healthcare organizations increasingly rely on complex data environments. Artificial intelligence applications, advanced analytics, automated administrative systems, predictive tools, and digitally enabled human-resource practices may reduce repetitive work, support resource allocation, accelerate information processing, and strengthen managerial decision-making. In the Palestinian health sector, for example, artificial intelligence has been conceptualized as an important driver of digital transformation and administrative performance improvement by enabling more efficient human-resource management and organizational processes (5). Artificial intelligence also contributes to value creation in healthcare through interactions among patients, healthcare professionals, organizations, and digital technologies, although its effectiveness depends on wider digital health transformation and the capacity of institutions to create meaningful value from technological applications (6). Beyond healthcare, the increasing use of artificial intelligence has similarly been associated with broader economic and sectoral transformation, illustrating the expanding strategic role of intelligent technologies across industries (7).

Digital transformation also affects healthcare organizations through the redesign of managerial support processes. Digital technologies can improve planning, monitoring, coordination, resource management, information exchange, and organizational control by creating more integrated and timely information flows. Healthcare managers can use digital systems to obtain a more comprehensive understanding of operational performance, workforce conditions, resource utilization, patient flows, and organizational risks, thereby strengthening managerial responsiveness and decision quality (8). At the operational level, digital transformation can also contribute to supply-chain visibility, traceability, inventory management, procurement coordination, and

resilience. An analytical framework developed for healthcare product supply chains indicates that digital transformation can enhance efficiency and adaptability by improving information integration and coordination among supply-chain actors (9). In addition, blockchain adoption has been associated with organizational performance in healthcare settings because of its potential to improve transparency, trust, information security, and interorganizational coordination (10). These developments indicate that digital transformation has implications for numerous dimensions of healthcare performance rather than merely for technical efficiency.

Organizational performance in healthcare is itself a multidimensional concept. It includes the effectiveness with which healthcare organizations achieve clinical, administrative, financial, strategic, and service-related objectives while using available resources efficiently. Performance may therefore be reflected in service quality, employee productivity, patient responsiveness, operational efficiency, organizational learning, innovation, financial sustainability, resource utilization, coordination, and achievement of strategic goals. Healthcare organizations operate in environments characterized by regulatory complexity, professional specialization, high uncertainty, and strong interdependence among units, making organizational performance dependent on a combination of financial, managerial, cultural, technological, and human factors. Evidence from the healthcare sector shows that capital efficiency and the effective management of financial resources are important determinants of organizational performance, particularly where institutions must balance service obligations with economic sustainability (11). Similarly, organizational culture, risk-management systems, and internal controls can influence performance by shaping accountability, organizational behavior, and the capacity to respond systematically to operational challenges (12).

The organizational context of hospitals is therefore essential when evaluating the potential performance effects of digital transformation. Hospitals are socially and professionally complex institutions in which organizational culture affects communication, teamwork, employee behavior, managerial practices, and receptiveness to change. Research conducted in hospitals affiliated with Tehran University of Medical Sciences has demonstrated the

importance of organizational culture within the Iranian healthcare context, highlighting the need to consider internal organizational characteristics when designing managerial interventions (13). Other evidence from hospitals in Tehran has shown that employee performance is shaped by job satisfaction, employee motivation, organizational culture, and the effective use of information technology, particularly in demanding environments such as the COVID-19 period (14). These findings are especially relevant to digital health transformation because new digital systems frequently require employees to modify established routines, acquire new competencies, and cooperate across professional and departmental boundaries.

Despite the potential benefits of digital transformation, organizations frequently encounter a gap between technological investment and actual organizational performance. Healthcare institutions may purchase advanced systems without achieving meaningful improvements if technologies are poorly aligned with strategic objectives, employees resist adoption, managers fail to communicate a coherent digital vision, or insufficient attention is given to organizational learning and capability development. This problem directs attention toward digital leadership as a critical organizational mechanism. Digital leadership refers to the ability of organizational leaders to formulate a digital vision, recognize technological opportunities, support innovation, develop digital capabilities, encourage technology adoption, promote collaboration, manage resistance, and align digital initiatives with broader organizational strategies. Unlike conventional leadership approaches that may focus primarily on interpersonal influence or operational control, digital leadership combines leadership competence with technological awareness, strategic agility, data-driven decision-making, and the capacity to coordinate organizational transformation in digitally intensive environments.

Recent research increasingly suggests that digital leadership can influence both employee-level and organization-level outcomes. Digital leaders can create conditions in which employees are more willing to acquire digital skills, experiment with new technologies, share knowledge, and integrate digital tools into their daily work. In this regard, digital leadership has been associated with

stronger work performance and organizational commitment because leaders can reduce uncertainty surrounding digital change and provide direction, resources, and psychological support during technological transition (15). Similarly, research on the strategic role of digital transformation has shown that digital leadership can enhance employee performance and organizational commitment by linking technological change with human and organizational processes (16). Digital leadership may therefore function not simply as an independent managerial resource but as a mechanism through which digital transformation acquires organizational meaning and becomes translated into behavioral and performance outcomes.

The relationship among digital leadership, organizational culture, and performance has also received growing empirical attention. Digital leadership may foster digital culture, strengthen employee digital capabilities, and ultimately contribute to sustainable organizational performance (17). The importance of leadership is especially pronounced because organizations cannot fully exploit digital systems unless employees possess the competence and organizational support required to use them effectively. Digital leadership can reinforce knowledge-sharing processes, encourage learning, and provide institutional support for continuous adaptation. Evidence has shown that knowledge management, digital leadership, and organizational culture are significantly related to employee performance, indicating that digital leadership operates within a broader system of organizational resources rather than in isolation (18). Adaptive leadership research similarly indicates that effective leadership in disruptive environments requires the integration of digital transformation and organizational culture to sustain employee performance under conditions of uncertainty and rapid change (19).

A particularly important theoretical proposition is that digital leadership may mediate the relationship between digital transformation and organizational performance. Digital transformation provides technological infrastructure, digital resources, new communication channels, data, and automation capabilities, but leadership determines whether these resources are strategically coordinated and effectively embedded in organizational practice. Digital leaders can translate technological possibilities into shared goals,

employee engagement, innovation behaviors, and coordinated action. Research outside the healthcare setting has found that digital leadership contributes to business performance through organizational entrepreneurship, suggesting that leaders can convert digital opportunities into innovative organizational behavior and performance improvements (20). Likewise, digital transformation and artificial intelligence may contribute to sustainable organizational performance by fostering digital leadership excellence, indicating that leadership can serve as an intermediary connecting technological change to organizational outcomes (21).

The mediating role of leadership is also theoretically consistent with studies examining other forms of transformational organizational capability. Research has shown that digital leadership and organizational culture may influence employee performance through digital transformation, illustrating the reciprocal and interconnected character of leadership and technological change (22). At the organizational level, digital transformation can also interact with leadership capabilities to enhance innovation and performance. For example, evidence concerning green human-resource management and innovation capabilities indicates that digital transformation and leadership-related factors can strengthen organizational performance through interdependent strategic mechanisms (23). These findings support the broader argument that organizational performance emerges from configurations of technological, leadership, cultural, and innovation capabilities rather than from technological adoption alone.

In healthcare institutions, leadership may be particularly important because digital transformation frequently takes place under conditions of uncertainty, service pressure, patient-safety requirements, and resistance from multiple professional groups. Leadership determines how organizations prioritize digital investments, manage implementation risks, establish accountability, encourage multidisciplinary cooperation, and maintain service continuity during organizational change. Studies of healthcare organizations have demonstrated that strategic leadership practices can enhance organizational performance and that this relationship may operate through mediating organizational mechanisms such as crisis management (24). Although strategic leadership and digital

leadership are distinct constructs, this evidence reinforces the broader theoretical proposition that leadership affects organizational performance partly by activating and coordinating intermediate organizational capabilities.

These issues are particularly important in the Iranian healthcare system, where healthcare organizations increasingly encounter pressures to improve service quality, organizational efficiency, transparency, responsiveness, and resource utilization while simultaneously adapting to rapidly developing digital technologies. Hospitals and healthcare institutions in Tehran represent a particularly relevant setting because they include large and organizationally complex institutions with substantial administrative, clinical, technological, and managerial demands. Existing Iranian evidence has documented the importance of organizational culture, employee motivation, information technology, and internal organizational characteristics for hospital performance (13, 14). However, comparatively less empirical attention has been directed toward the integrated relationship among digital health transformation, digital leadership, and organizational performance within healthcare organizations in Tehran. This gap is important because findings from general business environments or healthcare systems in other countries may not be directly transferable to the organizational, institutional, and technological conditions of Iranian healthcare institutions.

Furthermore, much of the existing literature has examined digital transformation as a direct predictor of performance or has investigated digital leadership primarily in relation to employee outcomes, organizational commitment, digital culture, or innovation. Although these studies collectively demonstrate that both digital transformation and digital leadership are important organizational resources, the mechanism through which digital health transformation contributes to overall healthcare organizational performance remains insufficiently clarified. A mediation perspective provides a more precise explanation by recognizing that digital transformation creates technological capacity while digital leadership determines how that capacity is interpreted, mobilized, and incorporated into organizational routines. Accordingly, digital leadership may explain why organizations with similar access to digital technologies achieve different levels of performance. Organizations with

stronger digital leaders are more likely to align technological initiatives with organizational objectives, support employee adoption, encourage experimentation, facilitate learning, coordinate cross-functional implementation, and institutionalize data-driven decision-making. Conversely, technologically advanced organizations may fail to achieve expected performance improvements when leadership does not provide adequate strategic direction or organizational support.

From a practical perspective, identifying this mediation mechanism has important implications for healthcare managers and policymakers. If digital leadership substantially mediates the relationship between digital health transformation and organizational performance, investments in technological infrastructure should be accompanied by leadership development, digital competency building, cultural change, employee engagement, and organizational-learning initiatives. Such an interpretation shifts digital transformation policy away from a technology-centered model toward a socio-technical and managerial model in which technological modernization and leadership capability develop concurrently. It also provides healthcare decision-makers with a more realistic understanding of why expensive digital initiatives sometimes produce limited performance improvements and why similar technologies may generate different outcomes across organizations. The increasing sophistication of digital healthcare technologies therefore makes leadership capability not less important, but more important, because organizational leaders must continuously interpret emerging technologies, evaluate strategic relevance, coordinate implementation, and align digital innovation with healthcare quality and performance objectives (1, 2, 8).

Accordingly, the aim of this study was to investigate the effect of digital health transformation on organizational performance in healthcare systems in Tehran and to determine the mediating role of digital leadership in this relationship.

2. Methods and Materials

2.1. Study Design and Participants

This study employed a quantitative, applied, cross-sectional correlational design to investigate the relationship

between digital health transformation and organizational performance in healthcare systems, with particular emphasis on the mediating role of digital leadership. The statistical population consisted of managers, supervisors, administrative personnel, health information technology specialists, clinical department coordinators, and other professional employees working in public and private hospitals and healthcare organizations in Tehran, Iran, during 2026. The inclusion of employees from different organizational and professional levels was intended to provide a comprehensive assessment of digital transformation processes, leadership capabilities, and organizational performance across healthcare settings. Participants were eligible for inclusion if they were employed full-time in a healthcare organization located in Tehran, had at least one year of organizational work experience, were directly or indirectly involved in administrative, managerial, clinical coordination, information technology, or organizational decision-making processes, and had sufficient familiarity with the digital systems and technologies used in their organization. Individuals who had less than one year of work experience, were temporary interns or trainees, or submitted substantially incomplete questionnaires were excluded from the study. A stratified convenience sampling procedure was employed to ensure the representation of employees from different types of healthcare organizations and occupational positions. Based on the requirements of structural equation modeling, the anticipated number of latent variables and observed indicators, and the need to achieve adequate statistical power for testing direct and indirect effects, a minimum sample of approximately 350 participants was considered appropriate. To compensate for incomplete or unusable questionnaires, 420 questionnaires were distributed among eligible participants. Of these, 397 questionnaires were returned, and after screening for missing data, patterned responses, and substantial incompleteness, 384 questionnaires were retained for final analysis, corresponding to a usable response rate of 91.4% of the questionnaires initially distributed. Participation was voluntary, and respondents were informed about the objectives of the study, the confidentiality of their responses, and their right to withdraw at any stage without any consequences. No personally identifiable information was

collected, and the data were analyzed only in aggregate form. Ethical principles of confidentiality, informed consent, voluntary participation, and protection of participants' organizational information were observed throughout the research process.

2.2. Data Collection Tools

Data were collected using a structured self-report questionnaire consisting of four sections: demographic and occupational characteristics, digital health transformation, digital leadership, and organizational performance. The demographic section collected information regarding participants' age, gender, educational level, organizational position, type of healthcare organization, years of professional experience, and length of employment in the current organization. Digital health transformation was assessed as a multidimensional organizational construct reflecting the extent to which healthcare organizations had integrated digital technologies into their structures, processes, services, and decision-making systems. The items addressed major dimensions of digital transformation, including digital infrastructure, implementation of electronic health information systems, interoperability and integration of organizational information, use of data analytics in clinical and managerial decision-making, digitalization of administrative and service processes, technological readiness, employee adaptation to digital systems, and organizational support for digital innovation. Respondents evaluated the extent to which each statement reflected conditions in their organization using a five-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree, with higher scores indicating a greater level of digital health transformation. Digital leadership was measured using items designed to assess leaders' capacity to provide a clear digital vision, support technological innovation, encourage employees to adopt digital technologies, allocate resources for digital initiatives, facilitate organizational learning, manage resistance to technological change, promote data-driven decision-making, and establish an organizational culture supportive of digital transformation. Digital leadership was conceptualized as the proposed mediating mechanism through which investments in and implementation of digital health transformation could be translated into superior organizational outcomes. Items were

rated on the same five-point Likert scale, with higher scores representing stronger digital leadership capabilities within the healthcare organization. Organizational performance was assessed through items examining operational efficiency, quality of healthcare services, responsiveness to patients, coordination among organizational units, productivity, effective utilization of resources, speed and accuracy of organizational processes, innovation capability, employee effectiveness, and the organization's overall capacity to achieve its strategic and service-related objectives. Higher scores represented more favorable perceptions of organizational performance.

The questionnaire was developed through a review of the theoretical and empirical literature concerning digital transformation, digital leadership, healthcare management, and organizational performance and was subsequently adapted to the organizational context of healthcare institutions. To establish content validity, the preliminary questionnaire was reviewed by a panel of university faculty members and specialists in healthcare management, health information technology, organizational behavior, and research methodology. The experts evaluated the relevance, clarity, comprehensibility, and conceptual appropriateness of the items, and minor revisions were made to improve wording and contextual suitability. A pilot study was subsequently conducted with a group of healthcare employees who were not included in the final sample to examine item clarity and preliminary reliability. Internal consistency was evaluated using Cronbach's alpha and composite reliability, with values of 0.70 or higher considered acceptable. Construct validity was examined during the main analysis through confirmatory measurement-model assessment. Convergent validity was evaluated using standardized factor loadings and average variance extracted, with standardized loadings preferably exceeding 0.70 and average variance extracted values of at least 0.50. Composite reliability values greater than 0.70 were considered evidence of satisfactory construct reliability. Discriminant validity was examined using the heterotrait-monotrait ratio of correlations, with values below 0.85 indicating adequate empirical distinction between the constructs. These procedures ensured that digital health transformation, digital leadership, and organizational

performance were measured as conceptually related but empirically distinct constructs.

2.3. Data Analysis

Data analysis was performed using IBM SPSS Statistics version 27 and SmartPLS 4. Before testing the research hypotheses, the dataset was screened for incomplete responses, data-entry errors, missing values, outliers, and response patterns that could compromise the validity of the findings. Descriptive statistics, including frequencies and percentages for categorical demographic variables and means, standard deviations, minimum values, and maximum values for continuous study variables, were calculated to describe the characteristics of the participants and the general distribution of the principal constructs. The measurement model was evaluated before assessing the hypothesized structural relationships. Indicator reliability was examined using standardized outer loadings, while internal consistency reliability was evaluated through Cronbach's alpha and composite reliability. Convergent validity was assessed using the average variance extracted, and discriminant validity was examined primarily through the heterotrait-monotrait ratio. Multicollinearity among predictor constructs was evaluated using variance inflation factor values, with values below 5 considered indicative of the absence of problematic collinearity. Partial least squares structural equation modeling was then applied to examine the hypothesized relationships among digital health transformation, digital leadership, and organizational performance. This analytical approach was selected because it enables simultaneous estimation of multiple relationships among latent constructs and provides an appropriate framework for examining mediation within a prediction-oriented organizational model.

The structural model assessment included examination of standardized path coefficients, coefficients of determination, effect sizes, predictive relevance, and overall model fit. The coefficient of determination (R^2) was used to determine the proportion of variance in digital leadership and organizational performance explained by their respective predictor constructs, while the f^2 statistic was calculated to determine the magnitude of the contribution of individual exogenous constructs to endogenous variables. Predictive relevance was evaluated using the Q^2 statistic, with values

greater than zero indicating satisfactory predictive relevance for the endogenous constructs. The standardized root mean square residual was also examined as an index of approximate model fit, with values below 0.08 interpreted as evidence of acceptable fit. The statistical significance of direct and indirect structural paths was determined using a nonparametric bootstrapping procedure with 5,000 resamples. Standardized path coefficients, *t* statistics, *p* values, and bootstrapped confidence intervals were reported for the hypothesized relationships. The mediating role of digital leadership was specifically evaluated by estimating the indirect effect of digital health transformation on organizational performance through digital leadership. Mediation was considered statistically significant when the bootstrapped confidence interval for the indirect effect did not include zero. The direct effect of digital health transformation on organizational performance was simultaneously examined to determine whether digital leadership represented partial or full mediation. All statistical tests were conducted using a significance level of $p < 0.05$, and the interpretation of findings was based on both statistical significance and the magnitude and predictive relevance of the estimated effects.

3. Findings and Results

A total of 384 valid questionnaires were included in the final analysis. Of the participants, 214 (55.7%) were male

and 170 (44.3%) were female. The mean age of the respondents was 38.64 years ($SD = 7.91$), with the largest proportion belonging to the 31–40-year age group. Regarding educational level, 54 participants (14.1%) held an associate degree or lower qualification, 176 (45.8%) held a bachelor's degree, 128 (33.3%) held a master's degree, and 26 (6.8%) held a doctoral or professional doctoral degree. In terms of organizational position, 82 respondents (21.4%) were managers or senior administrators, 91 (23.7%) were supervisors or department coordinators, 67 (17.4%) were health information technology or digital systems personnel, and 144 (37.5%) were professional administrative or clinical-support employees. A total of 248 participants (64.6%) were employed in public healthcare organizations and hospitals, whereas 136 (35.4%) worked in private healthcare institutions. The mean professional work experience was 11.28 years ($SD = 6.42$), and the mean length of employment in the current organization was 7.96 years ($SD = 5.11$). Overall, the demographic distribution indicated adequate representation of different occupational, educational, and organizational groups involved in healthcare service delivery, management, and digital system implementation, thereby supporting the suitability of the sample for evaluating perceptions of digital health transformation, digital leadership, and organizational performance.

Table 1

Descriptive Statistics and Correlations among the Main Study Constructs

Variable	Mean	SD	1	2	3
Digital Health Transformation	3.72	0.64	1.000		
Digital Leadership	3.65	0.68	0.684**	1.000	
Organizational Performance	3.81	0.61	0.631**	0.712**	1.000

As shown in Table 1, the mean scores of all three principal constructs were above the midpoint of the five-point response scale, indicating that respondents generally perceived a moderately favorable level of digitalization, leadership support for digital transformation, and organizational performance in their healthcare organizations. Organizational performance obtained the highest mean score ($M = 3.81$, $SD = 0.61$), followed by digital health transformation ($M = 3.72$, $SD = 0.64$) and digital leadership ($M = 3.65$, $SD = 0.68$). The relatively

moderate standard deviations indicated that the responses were not excessively dispersed and that the perceptions of participants showed an acceptable degree of consistency. Pearson correlation analysis further demonstrated significant positive associations among all study variables. Digital health transformation was strongly and positively correlated with digital leadership ($r = 0.684$, $p < 0.01$), indicating that organizations characterized by more extensive use and integration of digital technologies also tended to be perceived as having stronger leadership capabilities for

guiding digital change. Digital health transformation was also positively associated with organizational performance ($r = 0.631$, $p < 0.01$), suggesting that greater organizational digitalization was related to higher perceived operational effectiveness, service quality, responsiveness, and productivity. The strongest bivariate relationship was observed between digital leadership and organizational performance ($r = 0.712$, $p < 0.01$), indicating that stronger leadership support for digital vision, technological

innovation, employee adaptation, and data-driven decision-making was closely associated with better organizational outcomes. Although the correlations were relatively strong, none exceeded commonly accepted levels indicating problematic redundancy, supporting the empirical distinctiveness of the three constructs and providing initial evidence in favor of the hypothesized structural relationships.

Table 2

Measurement Model Reliability and Convergent and Discriminant Validity

Construct	Cronbach's Alpha	Composite Reliability	AVE	HTMT with DHT	HTMT with DL	HTMT with OP
Digital Health Transformation	0.924	0.936	0.621	—	0.742	0.681
Digital Leadership	0.918	0.933	0.666	0.742	—	0.783
Organizational Performance	0.929	0.941	0.641	0.681	0.783	—

The measurement model results presented in Table 2 confirmed satisfactory reliability, convergent validity, and discriminant validity for all constructs included in the structural model. Cronbach's alpha coefficients ranged from 0.918 for digital leadership to 0.929 for organizational performance, clearly exceeding the minimum acceptable threshold of 0.70 and demonstrating strong internal consistency among the indicators of each construct. Composite reliability values were similarly high, ranging from 0.933 to 0.941, indicating that the observed indicators consistently represented their respective latent constructs. Convergent validity was supported by average variance extracted values of 0.621 for digital health transformation, 0.666 for digital leadership, and 0.641 for organizational performance. Because each AVE value exceeded the recommended threshold of 0.50, the constructs explained more than half of the variance in their associated indicators, providing evidence that the measurement items adequately converged on their intended theoretical dimensions. The

standardized outer loadings of the retained measurement indicators ranged from 0.714 to 0.872 and were statistically significant at $p < 0.001$, further supporting indicator reliability. Discriminant validity was examined using the HTMT criterion. The HTMT values ranged from 0.681 to 0.783 and were therefore below the conservative cutoff value of 0.85, confirming that digital health transformation, digital leadership, and organizational performance represented empirically distinct constructs despite their theoretically expected positive associations. In addition, variance inflation factor values for the measurement and structural predictors ranged from 1.36 to 2.74, remaining well below the threshold of 5 and demonstrating that multicollinearity did not represent a significant concern. Taken together, these findings confirmed that the measurement model possessed adequate psychometric properties and provided a reliable basis for evaluating the structural relationships and mediation hypotheses.

Table 3

Structural Model Quality, Explanatory Power, and Predictive Relevance

Endogenous Construct / Model Index	R ²	Adjusted R ²	Q ²	Relevant f ²	Value / Interpretation
Digital Leadership	0.468	0.467	0.309	0.880	Strong effect of DHT on DL
Organizational Performance	0.603	0.601	0.372	0.117	Small-to-moderate direct effect of DHT on OP
Organizational Performance	—	—	—	0.331	Moderate-to-large effect of DL on OP
SRMR	—	—	—	—	0.057
NFI	—	—	—	—	0.923

Table 3 summarizes the explanatory power, predictive relevance, effect sizes, and overall adequacy of the structural model. Digital health transformation explained 46.8% of the variance in digital leadership ($R^2 = 0.468$; adjusted $R^2 = 0.467$), demonstrating that the degree to which healthcare organizations implemented digital technologies, integrated digital processes, developed information infrastructure, and supported digital innovation substantially predicted the perceived strength of digital leadership. The corresponding Q^2 value of 0.309 was greater than zero and indicated satisfactory predictive relevance for digital leadership. The effect size of digital health transformation on digital leadership was $f^2 = 0.880$, representing a large effect and indicating that digital transformation constituted a central organizational antecedent of leadership behavior oriented toward technological change. For organizational performance, the combined effects of digital health transformation and digital leadership explained 60.3% of the variance ($R^2 = 0.603$; adjusted $R^2 = 0.601$), which represents substantial explanatory power in the context of organizational and healthcare management research. The Q^2

value for organizational performance was 0.372, indicating strong out-of-sample predictive relevance and confirming that the model was not limited to explaining the observed data but also possessed meaningful predictive capacity. The direct contribution of digital health transformation to organizational performance produced an f^2 value of 0.117, representing a small-to-moderate effect, whereas the effect size of digital leadership on organizational performance was 0.331, approaching a large magnitude and indicating that leadership capability represented a particularly influential determinant of performance. Model fit was also acceptable, with an SRMR value of 0.057, which was below the conventional threshold of 0.08, and an NFI value of 0.923, indicating that the proposed model provided a satisfactory representation of the observed relationships among the latent variables. Collectively, these results demonstrated that the proposed structural model had strong explanatory and predictive capacity and provided an adequate basis for examining the direct and mediated effects hypothesized in the study.

Table 4

Direct, Indirect, and Total Effects of Digital Health Transformation on Organizational Performance

Hypothesized Relationship	β	SE	t	p	95% CI	Result
Digital Health Transformation $\rightarrow$ Digital Leadership	0.684	0.039	17.538	<0.001	[0.604, 0.756]	Supported
Digital Leadership $\rightarrow$ Organizational Performance	0.531	0.047	11.298	<0.001	[0.436, 0.620]	Supported
Digital Health Transformation $\rightarrow$ Organizational Performance	0.268	0.051	5.255	<0.001	[0.166, 0.365]	Supported
Digital Health Transformation $\rightarrow$ Digital Leadership $\rightarrow$ Organizational Performance	0.363	0.041	8.854	<0.001	[0.287, 0.447]	Supported
Total Effect: Digital Health Transformation $\rightarrow$ Organizational Performance	0.631	0.036	17.528	<0.001	[0.556, 0.698]	Supported

The hypothesis testing results presented in Table 4 demonstrated that all proposed direct and indirect relationships were statistically significant. Digital health transformation exerted a strong positive effect on digital leadership ($\beta = 0.684$, $t = 17.538$, $p < 0.001$), indicating that increased digitalization within healthcare organizations was associated with stronger leadership behaviors oriented toward digital vision, innovation support, technological learning, employee engagement, and management of digital change. The bootstrapped 95% confidence interval for this effect ranged from 0.604 to 0.756 and did not include zero,

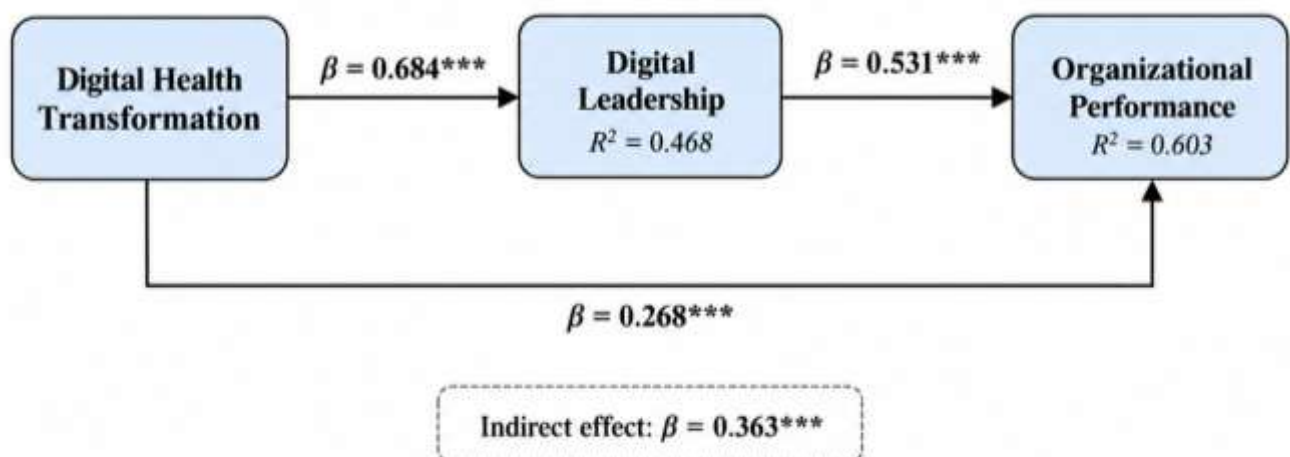
confirming the statistical stability of the relationship. Digital leadership also had a strong and significant positive effect on organizational performance ($\beta = 0.531$, $t = 11.298$, $p < 0.001$), demonstrating that healthcare organizations characterized by more effective digital leadership tended to report higher levels of service efficiency, resource utilization, interdepartmental coordination, responsiveness, innovation, and overall organizational effectiveness. The direct effect of digital health transformation on organizational performance remained positive and statistically significant after digital leadership was

introduced into the model ($\beta = 0.268$, $t = 5.255$, $p < 0.001$), indicating that digital technologies and digitally enabled processes influenced organizational performance not only through leadership mechanisms but also through direct improvements in information accessibility, process integration, workflow efficiency, decision accuracy, and service delivery. Most importantly, the indirect effect of digital health transformation on organizational performance through digital leadership was statistically significant ($\beta = 0.363$, $t = 8.854$, $p < 0.001$), with a 95% bootstrapped confidence interval of 0.287 to 0.447. Because the confidence interval excluded zero, the mediating effect was confirmed. The total effect of digital health transformation on organizational performance was $\beta = 0.631$ ($t = 17.528$, $p < 0.001$), showing that digital transformation had a substantial overall relationship with healthcare

organizational performance when both direct and leadership-mediated pathways were considered. Because both the direct path and the indirect path remained statistically significant and operated in the same positive direction, the pattern supported complementary partial mediation. Specifically, approximately 57.5% of the total effect of digital health transformation on organizational performance was transmitted through digital leadership, calculated as the indirect effect divided by the total effect. This finding demonstrates that the performance benefits of digital health transformation are realized to a considerable extent through leadership processes that translate technological capabilities into organizational action, employee engagement, coordinated implementation, and strategic utilization of digital resources.

Figure 1

Structural Model of the Relationships among Digital Health Transformation, Digital Leadership, and Organizational Performance



The structural model illustrated in Figure 1 provides a consolidated representation of the hypothesized relationships and empirically estimated standardized path coefficients. Digital health transformation demonstrated a strong positive path to digital leadership ($\beta = 0.684$, $p < 0.001$), while digital leadership exerted a substantial positive effect on organizational performance ($\beta = 0.531$, $p < 0.001$). A significant direct pathway was also observed from digital health transformation to organizational performance ($\beta = 0.268$, $p < 0.001$), confirming that the influence of digital transformation was not completely absorbed by the mediating construct. The model therefore supports a

complementary partial mediation mechanism in which digital transformation improves organizational performance both directly and indirectly through the strengthening of digital leadership. The explained variance values further demonstrate the substantive importance of the proposed model: digital health transformation accounted for 46.8% of the variance in digital leadership, while digital health transformation and digital leadership jointly explained 60.3% of the variance in organizational performance. These results indicate that digital leadership constitutes a key organizational mechanism through which technological transformation is converted into operational and strategic

performance outcomes in healthcare systems. In practical terms, the findings suggest that investment in digital infrastructure or digital technologies alone is insufficient to achieve the full performance potential of digital transformation. Rather, the effectiveness of these investments depends substantially on leaders' ability to formulate and communicate a digital vision, mobilize employees, facilitate technological adoption, support innovation, coordinate digital initiatives across organizational units, and institutionalize data-driven approaches to decision-making. The structural findings therefore provide strong empirical support for the conceptual proposition that digital leadership serves as a critical intermediary connecting digital health transformation with improved organizational performance in healthcare settings.

4. Discussion and Conclusion

The present study investigated the relationship between digital health transformation and organizational performance in healthcare systems in Tehran, with particular emphasis on the mediating role of digital leadership. The findings demonstrated that digital health transformation had a strong and statistically significant positive effect on digital leadership, digital leadership had a significant positive effect on organizational performance, and digital health transformation also exerted a significant direct effect on organizational performance. In addition, the indirect effect of digital health transformation on organizational performance through digital leadership was significant, confirming a complementary partial mediation mechanism. The model explained 46.8% of the variance in digital leadership and 60.3% of the variance in organizational performance, indicating substantial explanatory power. These results collectively suggest that digital transformation contributes to healthcare organizational performance not only through technological integration itself, but also through the leadership capabilities that translate digital resources into coordinated organizational action, employee adaptation, innovation, and more effective managerial processes.

The first major finding showed that digital health transformation had a strong positive effect on digital leadership. This result indicates that healthcare organizations with more advanced digital infrastructures,

greater use of integrated information systems, stronger data capabilities, and wider adoption of digital processes are also more likely to exhibit leadership behaviors oriented toward digital vision, innovation, technological adaptation, and organizational learning. This finding is consistent with the growing view that digital transformation and digital leadership are mutually reinforcing organizational capabilities. Digitalization alters the information environment in which leaders operate and increases the need for leaders who can interpret technological developments, align them with strategic goals, coordinate implementation across organizational units, and support employees through periods of technological change. Previous studies have similarly emphasized that digital transformation requires leadership capable of integrating technological and human processes rather than relying only on technical infrastructure (16, 21). The present finding therefore supports the proposition that digital leadership emerges and becomes particularly important in organizational environments where digital technologies are increasingly embedded in managerial and service processes.

This relationship can also be explained by the fact that digital transformation changes the role of managers in healthcare organizations. When digital technologies are introduced into decision-making, clinical coordination, resource allocation, human-resource management, and administrative processes, leaders must develop new competencies related to data interpretation, technological awareness, cross-functional collaboration, and organizational change. Digital transformation therefore creates both the need and the opportunity for stronger digital leadership. Research has shown that healthcare digitalization is not a purely technical process but involves continuous interaction between new digital logics and existing professional and organizational logics (3). From this perspective, digital leaders become essential because they must reconcile new technological practices with established healthcare routines. Similar conclusions can be drawn from studies emphasizing the need for organizational readiness, workforce capability, and institutional adaptation in digital health transformation (4). Accordingly, the strong path from digital health transformation to digital leadership observed in the present study reflects the increasingly strategic role of leadership in digitally intensive healthcare environments.

The second major finding revealed that digital leadership had a strong positive effect on organizational performance. This result indicates that healthcare organizations characterized by leaders who communicate a clear digital vision, support innovation, facilitate technology adoption, encourage learning, and promote data-driven decision-making tend to exhibit higher levels of operational efficiency, service quality, responsiveness, productivity, coordination, and overall organizational effectiveness. This finding is consistent with previous research showing that digital leadership contributes positively to work performance, organizational commitment, digital capability development, and sustainable organizational performance (15, 17). It also supports evidence that digital leadership, together with knowledge management and organizational culture, can substantially enhance employee performance by creating the conditions required for more effective use of organizational knowledge and technological resources (18).

The positive association between digital leadership and organizational performance may be explained through several mechanisms. First, digital leaders are better able to align technological initiatives with organizational priorities, thereby preventing digital investments from becoming disconnected from actual service and performance objectives. Second, they can reduce employee resistance by providing clear direction, explaining the benefits of digital change, and ensuring that staff members have access to appropriate training and organizational support. Third, digital leaders can encourage experimentation and innovation, which is particularly important in healthcare environments where service processes must continuously adapt to changing patient needs, regulatory requirements, and technological possibilities. Evidence from other sectors has shown that digital leadership may improve performance through mechanisms such as organizational entrepreneurship and innovation-oriented behavior (20). Similarly, adaptive leadership research indicates that leadership becomes especially important during periods of disruption because it helps integrate digital transformation with organizational culture and employee performance (19). These mechanisms are highly relevant to healthcare organizations, where technological change frequently intersects with professional autonomy, clinical routines, and organizational complexity.

The third major finding demonstrated that digital health transformation had a significant direct positive effect on organizational performance. This finding supports the proposition that the adoption and effective integration of digital technologies can produce direct organizational benefits by improving information accessibility, process efficiency, managerial coordination, communication, resource utilization, and decision quality. This result is consistent with prior studies showing that digital technologies can enhance managerial support processes and improve organizational decision-making within healthcare systems (8). It is also aligned with research indicating that technologies such as artificial intelligence, blockchain, and integrated digital platforms can contribute to improved administrative and organizational performance by facilitating automation, information sharing, transparency, and more efficient management processes (5, 10).

The direct performance effect can also be interpreted in light of the operational value created through digitalization. Digital systems can reduce delays, minimize repetitive administrative tasks, support more accurate documentation, enable real-time monitoring, and improve coordination between organizational units. In healthcare supply chains, digital transformation has similarly been associated with enhanced visibility, traceability, and adaptability, which can strengthen operational efficiency and resilience (9). Moreover, artificial intelligence and other digital health innovations can support value co-creation by improving the interaction among patients, clinicians, managers, and digital systems (6). These findings reinforce the conclusion that digital health transformation itself has substantial organizational value, particularly when technologies are integrated into core administrative, managerial, and service processes rather than implemented as isolated technical solutions.

The significant direct relationship between digital health transformation and organizational performance is also consistent with the broader literature on organizational competitiveness and performance. Digital transformation can improve innovation capacity, information-processing speed, strategic flexibility, and responsiveness to environmental change. Research examining digital transformation and organizational performance has shown that technological modernization may contribute to

improved sustainable performance when supported by complementary capabilities and strategic leadership (21, 23). In healthcare settings specifically, digital technologies can be expected to strengthen performance because these organizations are highly dependent on timely information, interdepartmental coordination, resource management, and rapid decision-making. The present findings therefore support the argument that digital transformation is not only a technological initiative but also a performance-oriented organizational strategy.

The most important finding of the study was that digital leadership significantly mediated the relationship between digital health transformation and organizational performance. The indirect effect was substantial, and approximately 57.5% of the total effect of digital health transformation on organizational performance was transmitted through digital leadership. Because the direct effect of digital health transformation remained statistically significant after inclusion of the mediator, the findings supported complementary partial mediation. This result indicates that digital transformation produces organizational performance benefits through two parallel mechanisms: a direct technological and process-based mechanism and an indirect leadership-based mechanism. In other words, digital transformation may improve performance by increasing automation, integration, and information availability, but a considerable portion of its effect depends on whether leaders are capable of strategically mobilizing these digital resources.

This mediation finding is consistent with previous research emphasizing the intermediary role of leadership-related capabilities in converting digital transformation into higher performance. Digital leadership has been identified as a mechanism that strengthens the relationship between technological transformation and sustainable organizational performance by enabling organizations to translate digital investments into coordinated managerial practices and employee behaviors (21). Similarly, research has shown that digital leadership can enhance employee performance and organizational commitment in the context of digital transformation (16). Studies examining digital leadership, organizational culture, and employee performance also demonstrate that leadership and transformation operate through interconnected organizational processes rather than

as isolated predictors (22). The present findings extend this reasoning to healthcare organizational performance and suggest that digital leadership is a key explanatory mechanism linking technological transformation with higher organizational effectiveness.

The mediation effect may be further explained through a socio-technical perspective. Digital transformation provides technological resources, but leadership determines how those resources are interpreted, institutionalized, and integrated into organizational routines. Without effective leadership, advanced technologies may remain underused, fragmented, or poorly aligned with organizational objectives. Healthcare managers must therefore act as translators between technological possibilities and operational realities. They must communicate why digital transformation is necessary, establish strategic priorities, coordinate departments, facilitate employee participation, and ensure that technological initiatives contribute directly to service quality and organizational goals. This interpretation is consistent with evidence showing that digitalization in healthcare creates complex organizational adjustments rather than simple technological substitutions (3). It is also consistent with research showing that healthcare transformation depends on institutional capacity, workforce readiness, and the ability to bridge organizational and technological gaps (4).

The findings are particularly meaningful in the context of Tehran healthcare organizations. Previous research conducted in Tehran has demonstrated that organizational culture, motivation, job satisfaction, and information technology are closely associated with hospital employee performance (14). Organizational culture in hospitals affiliated with Tehran University of Medical Sciences has also been identified as an important contextual factor shaping organizational behavior and management effectiveness (13). The present findings complement these studies by demonstrating that digital leadership represents another critical organizational capability in the Iranian healthcare environment. Digital health transformation is likely to be more successful when leaders can work within existing organizational cultures while simultaneously encouraging learning, adaptation, and technological acceptance. This is especially important because healthcare organizations are characterized by professional diversity,

hierarchical structures, regulatory constraints, and strong dependence on interdepartmental coordination.

The strong explanatory power of the model also deserves attention. Digital health transformation accounted for nearly half of the variance in digital leadership, while digital health transformation and digital leadership jointly explained more than 60% of the variance in organizational performance. These values indicate that the proposed model captures a substantial proportion of the organizational mechanisms underlying performance in the studied healthcare institutions. Nevertheless, organizational performance is inherently multidimensional and is also affected by financial, cultural, governance, and risk-related factors. Prior research has shown, for example, that capital efficiency can influence organizational performance in healthcare institutions (11), while organizational culture, internal control, and risk management also contribute to organizational effectiveness (12). Strategic leadership and crisis-management capability have similarly been associated with healthcare organizational performance (24). The current results should therefore be interpreted as evidence that digital transformation and digital leadership are major determinants of performance, but not the only determinants.

The findings further suggest that healthcare organizations should avoid interpreting digital transformation as a technology-purchase strategy. The increasing availability of artificial intelligence, blockchain, data analytics, and other advanced digital technologies can create substantial organizational value, but only when these technologies are meaningfully integrated into decision-making and service processes (1, 2). The broader economic and organizational effects of artificial intelligence also demonstrate that technological change can reshape industries and management systems when organizations possess the capacity to integrate new capabilities into strategic processes (7). Accordingly, the present findings reinforce a capability-based interpretation of digital transformation: digital technologies provide potential value, while digital leadership determines whether that value is effectively realized.

A further implication is that the performance consequences of digital transformation may depend strongly on organizational context. Healthcare organizations must coordinate technological, professional, cultural, and

strategic requirements simultaneously. Digital leaders therefore require more than technical knowledge; they must possess communication, change-management, strategic, and collaborative capabilities. The result is consistent with evidence showing that sustainable organizational performance depends on the interaction of leadership, organizational culture, employee capability, and technological transformation (17, 18). The present study therefore contributes to the literature by empirically demonstrating that digital leadership serves as a central bridge between digital transformation and organizational performance in healthcare systems.

The study has several limitations that should be considered when interpreting the findings. First, the cross-sectional design does not permit definitive causal conclusions regarding the temporal relationships among digital health transformation, digital leadership, and organizational performance. Although the structural model was theoretically specified and statistically supported, reciprocal relationships may also exist. Second, the study relied on self-report questionnaire data, which may be affected by common-method variance, social desirability, and subjective perceptions of organizational conditions. Third, the sample was drawn from healthcare organizations in Tehran, which may limit the generalizability of the findings to other provinces, rural healthcare systems, or countries with different institutional and technological environments. Fourth, the study examined organizational performance as a broad perceived construct and did not incorporate objective performance indicators such as patient outcomes, waiting times, cost efficiency, financial performance, or verified service-quality measures. Finally, although the model explained a substantial proportion of the variance in organizational performance, other relevant factors such as organizational culture, digital competence, employee readiness, innovation capability, governance quality, and technological infrastructure maturity were not explicitly modeled.

Future research should employ longitudinal designs to examine how changes in digital transformation and digital leadership influence organizational performance over time and to determine whether leadership capability develops before, during, or after major digitalization initiatives. Multi-source data should also be used by combining employee

perceptions with managerial evaluations, objective organizational performance indicators, and digital-system utilization data. Future studies could test more complex models incorporating organizational culture, digital readiness, employee digital competence, innovation capability, knowledge management, organizational agility, or resistance to change as additional mediators or moderators. Comparative studies across public and private hospitals, different Iranian provinces, and healthcare systems in other countries would also help determine whether the strength of the observed relationships varies according to institutional context. It would additionally be useful to investigate whether specific dimensions of digital health transformation, such as artificial intelligence adoption, interoperability, telehealth, data analytics, or blockchain use, have different effects on leadership and performance outcomes.

From a practical perspective, healthcare organizations should treat digital leadership development as an essential component of digital transformation strategy. Senior and middle managers should receive systematic training in digital strategy, data-driven decision-making, technological change management, innovation leadership, and employee engagement. Healthcare organizations should also establish clear digital transformation roadmaps that connect technological investments with measurable organizational objectives, while ensuring that employees are adequately trained and involved in implementation processes. Leaders should encourage interdisciplinary collaboration between clinical, administrative, and information-technology units, create mechanisms for continuous feedback, and identify sources of resistance before they undermine adoption. Digital transformation initiatives should be evaluated not only in terms of technology acquisition but also in relation to their effects on workflow efficiency, service quality, decision-making, employee performance, and organizational learning. Finally, healthcare policymakers and institutional managers should allocate resources simultaneously to digital infrastructure and leadership capability, because the present findings indicate that technological investment is most likely to generate meaningful performance improvement when it is accompanied by strong and strategically oriented digital leadership.

Authors' Contributions

All authors contributed substantially to the study and to manuscript development, and all approved the final version.

Declaration

The authors declare that artificial intelligence tools were used only to assist with language editing, translation, and improvement of the manuscript's readability. All conceptualization, study design, data collection, data analysis, interpretation of findings, and final approval of the manuscript were performed by the authors. The authors take full responsibility for the accuracy, integrity, and originality of the content.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

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Ethics Considerations

The study placed a high emphasis on ethical considerations. Informed consent obtained from all participants, ensuring they are fully aware of the nature of the study and their role in it. Confidentiality strictly maintained, with data anonymized to protect individual privacy. The study adhered to the ethical guidelines for research with human subjects as outlined in the Declaration of Helsinki.

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