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Interplay of Change Management, Digital Healthcare Performance, and Knowledge Transfer: A Mediating Model for Kingdom of Saudi Arabia

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Abstract

Objective: This study aimed to explore mechanisms and change management (CM) strategies that can increase the likelihood of better digital healthcare performance (DHP), and to examine the mediating role of knowledge transfer (KT) in the relationship between CM and DHP using Kotter's change model.

Methods: A cross sectional study was executed on 402 healthcare professionals working in the Kingdom of Saudi Arabia under the Eastern Health Cluster. Data were collected through an online survey and analyzed using SmartPLS 4.0. Partial least squares–based structural equation modelling (PLS SEM) was implemented to test the hypothetical model. A segmental approach was opted for to test mediation analysis.

Results: Effective CM strategies can significantly boost DHP. These strategies can strengthen the KT mechanism and process in the organization, which in turn welcomes digital changes and augments digital healthcare more effectively. Measurement reliability and validity met recommended thresholds; common method bias checks were satisfactory. Direct paths were significant for CM to DHP and CM to KT, and KT to DHP; the indirect CM to KT to DHP path was significant, indicating partial mediation.

Conclusion: This study offers behavioral solutions at the organizational level to achieve the true efficacy of digital technology that will subsequently be reflected in organizational performance matrices. Future researchers can explore additional facets of individuals and organizations as mediators or moderators to help shape the digital future of healthcare.

Key words: Artificial Intelligence; Digital Healthcare; Knowledge Transfer; Mediation Analysis; Change Management; SDGs

1. Introduction

Digital technologies and artificial intelligence (AI) have transformed the conventional systems and altered the fabric of society, especially in developed nations. Healthcare is the most targeted domain due to its internal potential of having an immense flow of data, which can be utilized in data-driven decisions to improve the

diagnosis, prognosis, predictive strength, efficacy of medicines, effective usage of resources and many more [1]. This potential of healthcare systems is continuously attracting inventors to develop digital solutions for effective healthcare delivery and has introduced the term "digital health". Now, every country is using its available resources to invent or customize and integrate the utility of digital technologies and AI in their health systems. This integration is needed of the time to align themselves with the sustainable development goals (SDGs) set by the World Health Organization (WHO) regarding the provision of quality health to every individual without financial constraints [2]. The Kingdom of Saudi Arabia (KSA) is also one of the countries which has been investing billions of Riyals in its national transformation program (TNP) regarding technology and innovation in the systems [3]. These adaptations modify the nature of traditional healthcare into digital healthcare. However, the usefulness of any modern technology in digital healthcare can only be examined through its periodic performance in hospitals and other health units. Therefore, digital healthcare performance (DHP) and its stimuli are the key concerns, especially for highly adaptive systems.

Change management (CM) is often considered the key to success through its capability to integrate the modern tools and techniques with the existing systems to cater for the constantly changing needs of customers [4]. It is a fundamental attribute of this management to transform the workflows and operational paradigms to boost effectiveness. There is evidence which highlights that 70% of all change efforts fail because systems are not able to comprehend these changes and implement them in a true sense [5]. The pace of digitalization of healthcare is at tremendous speed, and management has to anticipate, customize, implement and manage these changes [6]. Otherwise, low compliance can increase the likelihood of low performance and subsequently failure of organizations and increase the chance of resistance in future. It means it has become an inevitable challenge to manage complex digitalized systems and ensure the optimal performance of hospitals and healthcare providers. This challenge is multifaceted; integration of technology, resolving the potential barriers to change, preparing the humans as professional service providers, provision of optimum healthcare services and management of various stakeholders. In simple terms, CM is an important determinant of seamless implementation of digitalization and DHP [7, 8]. However, this relationship is not simple and needs multiple explanations, especially in KSA, where healthcare systems are facing severe challenges in the implementation of AI and digital solutions and DHP [9, 10]. These challenges provided the space for researchers which needs to be filled through empirical evidence.

Interestingly, knowledge transfer (KT) has gained the attention of researchers due to its potential relationship with CM and as a compulsory part of the process of change. KT is an important concept which is a process of gaining the technical knowledge, its sharing and application of these skills to achieve the required outcomes. However, this diffusion is still untapped and lacks synchronization between leaders, IT professionals and the clinical team, which is causing low DHP in KSA [11]. Researchers believe that the abundance of innovations and their integration need a mechanism through which knowledge is transferred and flows to every stakeholder of the healthcare ecosystem [12]. This mechanism prepares the employees to embrace the change, creating an environment that can offer out-of-the-box solutions, which can boost their as well as organizational performance [13]. Based on the evidence, it can be argued that DHP is a complex and novel concept which is connected with CM and KT, but in multiple ways which need to be explored, especially in KSA, where digitalization of healthcare has become a chronic challenge. This study aims to explore direct and indirect paths between CM and DHP through KT and suggests mediation analysis.

This study emphasises that only adoption of digitalization does not guarantee higher performance. It also needs new management strategies and an information workflow which provides a track to the expected outcome. This study targets all potentially internal key players of the healthcare system to acquire true information for developing an empirical model which helps to comprehend the complexity of the phenomenon. Despite the growing importance of digital healthcare, there is a lack of comprehensive studies that explore the DHP, the mediating role of KT in the CM on DHP. This study is contributing to achieving the targets of the KSA healthcare system by providing behavioral solutions at the organization level.

Theoretical Framework

Eight step CM model introduced by Kotter [14] has been used in this study, which emphasizes that managing the change is the key component of organizational success [15]. Kotter's model explains how to absorb and manage the radical transformations in the systems in a systematic way using 8 steps. This model is well-suited for digital healthcare services, where multiple departments and their services are being offered in a digitally collaborative environment. This model has eight components, which can be linked with two other constructs of this study: KT and DHP in various ways. Communicating the vision and enabling others to take action on the vision (steps 4 and 5 of Kotter's model) are the dimensions of this model, which highlights that communication about the need and ingredients of change are essential for the transformation of systems. These two steps are shaping the construct of KT.

Secondly, this whole model is developed for changing the dynamics of an organization to improve the quality and performance of the organizations, which addresses another construct of study; DHP. In the first and second steps

of Kotter's model, creating a sense of urgency and collaboration within the departments is crucial in the context of the need for digital healthcare transformation. Change can be difficult to implement in healthcare organizations since some staff members may resist change and are therefore opposed to letting go of certain practices. The management needs to use this approach to convince the workers of matters of change and encourage them to embrace the digital technologies across the various stakeholders. There are various studies which have used this model to manage the change in large-scale systems with huge technological changes [16], improve the quality of services [17, 18], transformation of oral healthcare provision [19], and even to control the COVID-related mortality [20]. These applications are various facets of performance and highlight the suitability of Kotter's Model in this study.

Hypothesis Development

Change Management and Digital Healthcare Performance

Digitalization often instigates the systems to manage the change and launch new strategies to get a competitive advantage and improve the performance of the hospitals [21]. There is evidence which argues that CM can cause higher organizational performance, especially in digitally well-equipped organizations [22]. Another Romanian study investigated that their healthcare system, its efficiency and even adoption of digitalization like electronic health records (EHR), mobile monitoring of patients, AI-based solutions, etc., depend on managers' capabilities to manage the change [23]. In a qualitative study, German and Swedish healthcare professionals highlighted that CM can be a key factor in the adoption of technology and its associated system performance [8]. Based on this evidence, we hypothesise that

H1: Change Management (CM) has a positive impact on Digital Healthcare Performance (DHP).

Change Management and Knowledge Transfer

CM has been considered an important motivation and mechanism for better KT within the organization [24]. As per Kotter's model of CM, sharing of vision with stakeholders and collaboration are the key strategies to synchronize the team players for real transformation in the organization [16]. It means, effective CM practices support KT by providing structured training and communication channels that facilitate the dissemination of information. CM initiatives that prioritize knowledge sharing are more likely to succeed in achieving their intended outcomes. Based on this, it can be hypothesize that.

H2: Change management (CM) has a positive relationship with knowledge transfer (KT).

Knowledge Transfer and Digital Healthcare Performance

The true knowledge transfer within the organization holds if it has the potential to change the fate of the organization in terms of performance [24]. Pioneer studies have also shed light on these aspects that individual and organization level trainings can enhance the skills which are required for organizational performance [25]. The extent of KT within the organization can directly impact DHP. When knowledge is effectively shared and utilized, it leads to improved patient care, operational efficiency, and overall healthcare outcomes. This relationship underscores the importance of fostering a knowledge-sharing culture within healthcare organizations. Based on this assumption, a hypothesis can be made.

H3: Knowledge Transfer (KT) has a positive impact on the digital healthcare performance (DHP).

Mediating Role of Knowledge Transfer in Change Management and Digital Healthcare Performance

Using the segmental approach of mediation as discussed in the literature [26], three possible relationships have been proposed here. Based on these three hypotheses, the role of KT can be tested as a potential mediator. Sequentially, CM directly influences DHP, as literature indirectly highlights that KT can improve the performance of an organization [27]. This organizational performance can extend to digital healthcare performance as well. KT can direct the employees to take quality initiatives, and they can also easily implement the targeted and technological strategies for patient care. These direct and indirect paths augment the potential role of KT as a mediator. Effective CM practices emphasizing knowledge sharing about the system changes that enhance the likelihood of successful digital health initiatives and performance. Based on this discussion, it is hypothesized that

H4: Knowledge transfer (KT) mediates the relationship between change management (CM) and digital healthcare performance (DHP).

Element	Summary
Problem or Issue	Digital investments in KSA health systems are substantial, but translation to consistent digital healthcare performance is uneven.

What is Already Known	CM supports adoption; KT underpins successful change. Evidence specific to DHP and Saudi settings is limited.
What This Paper Adds	An empirical mediation model showing KT partially mediates the CM→DHP link using a multi-role Saudi sample and PLS-SEM; quantified paths and predictive assessment are reported.
Who benefits	Health system leaders, clinical and non-clinical managers, informatics teams, and policymakers governing digital health programs.

2. Literature Review

Change management has emerged to understand that change is a given reality in any field; however, the health sector is going through increased rates of change due to increased technological development. This calls for a working design with a proper transition management plan to enable efficient change[28]

Change management is a more ordered approach to handling changes in healthcare organizations because it can be prepared for any issues, adjust according to need, and protect against possible difficulties. This proactive approach is critical as introducing new digital healthcare technologies may upset established practices and prompt drastic changes. For example, adopting new EHR systems or advanced AI diagnostic tools can align with efficiency and performance goals and even enhance patient care as long as employees understand the capabilities of these technologies and feel comfortable using them appropriately [29] Performance change management guarantees that the shift is seamless and that the personnel are adequately prepared to implement alternative techniques into their work practices. Thus, the fundamental concept of change management is recognizing that change is as much a social process as it is a technical one. Thus, effective change management strategies should consider workers' feelings and psychological attitudes. It is essential to understand that resistance to change is quite normal and stems from fear, insecurity, and discomfort [29].

Objectives of Change Management in Digital Healthcare

The purposes of change management in the context of digital healthcare are, therefore, complex as its fundamental goal is to effect change while ensuring ease of implementation, increased effectiveness, and optimization of patient care outcomes. One of the goals is to make sure that the new technologies and processes will be implemented in a manner beneficial to healthcare organization. This is about making preparations that ensure that when things occur, they will be accepted and flourish. To this extent, change management involves the creation of trust among the healthcare staff, training them on how to leverage digital tools efficiently knob any interruption [30]

Previous studies

Research conducted by Hussain and Khayat (2021) [31] presents compelling evidence of the positive influence of transformational leadership on job satisfaction and organizational commitment among hospital staff. Their systematic review highlights that leaders who embody transformational qualities—such as vision, empathy, and charisma—significantly enhance job satisfaction among their employees. The findings suggest that transformational leaders cultivate an environment where employees feel valued and supported. This environment encourages healthcare professionals to engage actively in their work, fostering a sense of belonging and purpose. Moreover, in an era where digital solutions are increasingly integrated into healthcare, engaged employees are better equipped to adopt and utilize new technologies effectively.

The significance of transformational leadership in digital healthcare is further illustrated by the work of Gebreheat, Teame, and Costa (2023) [32], who explored its effects specifically on nurses' job satisfaction. Their study found that transformational leaders create a supportive atmosphere that not only encourages professional growth but also promotes collaboration among healthcare workers.

In digital healthcare, where adaptation and continuous improvement are essential, such collaboration is invaluable. By encouraging knowledge sharing and teamwork, transformational leaders ensure that their organizations can swiftly respond to new challenges and opportunities, ultimately enhancing overall digital healthcare performance.

Baroudi (2022) [33] highlights the role of digital transformational leadership, particularly in crisis situations. This study examined the responses of Arab female educational leaders and revealed that effective transformational leaders demonstrate resilience and adaptability in implementing change. This trust is crucial in healthcare settings, where staff may be apprehensive about new technologies or processes.

3. Results

Participants

This study explores the assumed relationships by collecting very diverse viewpoints of employees who were working in Eastern Health Cluster (EHC), which is a specialized cluster in its healthcare services to manage the

primary care facilities and hospitals located in the Kingdom of Saudi Arabia (KSA). The employees were working at various positions and have been divided into four main groups; clinical staff (doctors, nurses, allied health staff), health informatics/ digital health staff, clinical leaders and non-clinical leaders. Further, the target group must have experience of one year in EHC and should have been involved at least in one aspect of digitally supported technology; development, implementation or usage. This inclusivity would enrich the evidence of the relationship. The total number of employees who were working at EHC were 24000 at the time of the study. The sample size of the study was estimated considering various prevalent approaches [34]. Firstly, the sample size was estimated by consulting a well-established table of Morgan [35], which uses the following statistical formula.

$$n = \frac{\chi^2 Np(1-p)}{e^2(N-1) + \chi^2 p(1-p)}$$

Where n = the estimated sample size, N = Population size, e = margin of error, which is generally 0.05 or 5%, p = proportion of the population, which is normally assumed to be 0.5 as this value provides maximum sample size, and χ^2 is called Chi-square and its table value is consulted with the degree of freedom. Based on this Table, a sample of size 378 was finalized. Secondly, structural equation modelling (SEM) is the main statistical technique, and literature suggests that a sample of size between 200-400 is good to estimate even complex models [30]. Therefore, considering the upper limit, a sample of size 400 was finalized in this study. During the pilot study, a 15% non-response was observed; therefore, considering this actual sample size was inflated to 460. Stratified random sampling was used to choose a sample of 460 from the above-mentioned sampling frame, which was heterogeneous with respect to job position. Further, equal allocation was used to choose the sample from four different strata: clinical staff (doctors, nurses, allied health staff), health informatics/ digital health staff, clinical leaders and non-clinical leaders. The electronic version of the questionnaire was shared with the selected participants of the study through their official email ID. A total of 407 questionnaires were returned, and out of these, five incomplete and straight-line answering patterns were removed from further processing. So the final sample 402 was approximately the same as required, 400. This study was executed after approval from the Institutional Review Board at Research Center King Khalid Medical City (RC-KKMC) King Fahad Specialist Hospital-Dammam, with number (CLU 0030).

Measurement Scales

The online survey consisted of a well-structured questionnaire which was divided into four sections. To develop rapport and conducive behavior, selected participants were asked about their baseline or background information. The next three sections covered three main constructs of study: KT, DHP and CM. These three constructs were measured through standardized scales; KT was measured through 10 items, which were adapted from literature [36,37], and CM was also measured through 10 adopted items, which have been used in the literature [38,39]. Lastly, DHP was assessed through a well-established 10-item scale adopted from scale [40,41]. These three scales used a five-point Likert scale, which ranges from strongly agree (5) to strongly disagree (1). These three standard scales provide theoretical foundations to test the perceived conceptual model. Before the execution of the survey, questionnaire content was also assessed through the standard protocol of content validity that ensures the quality of wording, structure and flow of the chosen scales and their items. This validity was assessed through 10 representatives of the target group of the study, as suggested in the literature [42]. The revised version of the questionnaire was also shared and consulted with two survey experts. After the refinement, this final version was used for an online survey.

Data Analysis

The baseline characteristics of study participants have been presented in the form of frequency (qualitative variables). To test the hypothetical relationships between three constructs of study, we used partial least squares-based structure equation modelling (PLS-SEM). This main analysis was performed on specialized software SmartPLS 4.0 (SmartPLS GmbH, Boenningstedt, Germany). A standard SEM model consists of two sub-models called the measurement and structural model [43]. In PLS-SEM, these two models are termed as outer and inner models, respectively. The outer model is developed to ensure the reliability and validity of constructs in the researcher's settings. The latter one is used to test the proposed hypotheses of the study and is often displayed as a path diagram. To ensure the scientific rigour and robustness, the study findings were reported as per standard protocols of PLS-SEM as suggested in the literature [44, 45]. Reliability of the constructs was measured through composite reliability (CR) and Cronbach's Alpha (α) with acceptable thresholds of a minimum 0.70 [46]. Average variance extracted (AVE) should be greater than 0.50, and factor loadings must have a value of 0.70 for each item to establish the convergent validity [47]. These thresholds are prerequisites of the measurement model and confirm the plausibility of estimating the structural model. To study the mediation impact of CM, a segmental approach was followed and reported as per guidelines [26].

Assessment of Multivariate Normality and Common Method Bias (CMB)

Although multivariate normality is not essential in PLS-SEM [48], however, it is an important assumption behind the selection of the Bootstrapping approach and has been assessed through Mardia's coefficient of multivariate skewness and kurtosis [49]. The β value of multivariate skewness was 98.6, and for kurtosis it was 237.6, and both had p-values less than 0.05. These very high values indicate the presence of a highly non-normal distribution of data. Therefore, the bootstrapping approach through PLS-SEM is the most suitable option to test the measurement model, estimation of path coefficients and their standard errors. Next, common method bias (CMB) is an important assumption that needs to be assessed before any formal analysis [50], especially the SEM model. This bias can arise from the common method of data collection, and in this study, this assumption was ensured through a full collinearity test suggested by Kock [51]. According to this test, the variance inflation factor (VIF) value should be less than 5.0 for each endogenous latent construct or variable. This test was performed by treating each construct as an endogenous variable, and the other two constructs were considered exogenous constructs. This procedure was performed separately for each of the constructs. VIF values were 2.63, 1.34, and 1.26 for CM, KT, and DHP, respectively and ensured that CMB is not a problem in this dataset.

4. Results

Table 1 contains the demographic characteristics of the study participants, which have shown that gender distribution is almost same but the majority of the employees belonged to 35-44 years of age group (49%). There were almost half of the participants had a bachelor's degree. Further, there were four types of employees in the survey as discussed above. Employees were working as Clinical Staff (Doctors, Nurses, Allied Health Staff), Health Informatics/ Digital Health Staff, Clinical Leaders and Non-clinical Leaders. As per equal allocation the total sample was divided almost equally in these four categories.

Table 1: Demographic Attributes of Study Participants

Attributes	Categories	Frequency	Percentage
Gender	Male	193	48
	Female	209	52
Job Position	Clinical Staff (Doctors, Nurses, Allied Health Staff),	100	25
	Health Informatics/ Digital Health Staff,	100	25
	Clinical Leaders	102	25
	Non-clinical Leaders.	100	25
Experience	0-5 Years	49	12.3
	6-10 Years	62	15.5
	11-15 Years	96	23.9
	16-20 Years	121	29.9
	More than 20 years	74	18.3
Level of Education	High School Diploma or Equivalent	28	7
	Bachelor's Degree	195	48.5
	Master Degree	123	30.6
	Doctoral Degree	56	13.9

Initially, the measurement model was developed and presented as per standardized guidelines in Table 2. In the measurement model, the validity and reliability of constructs have been assessed. All factor loadings are higher than 0.70, except for DHP7, which is 0.666; however, it is still close to the acceptable value of 0.7, and its inclusion does not decrease the average variance extracted (AVE) below 0.50 [44]. Therefore, all items of standardized constructs have a sufficient amount of validity; higher factor loadings and higher value of AVE. Reliability of the constructs has been assessed through two ways: the conservative way (Cronbach's Alpha) and the flexible method (composite reliability (CR)). Both methods provided values far greater than 0.7 and ensured that these constructs have very high reliability coefficients, and this data can be trusted for further processes. Table 3 presents the presentation of discriminant validity of these three constructs, which has been assessed through the HTMT ratio. The findings have shown that all constructs have an HTMT ratio less than 0.90 as suggested in the guidelines. The highest value was 0.85 and significantly less than 0.9, and assure the divergent validity between constructs. It ensures that each construct is unique in its measurement. Overall, these results have confirmed the study constructs, CM, KT, and DHP are having acceptable level of reliability and valid constructs for further processes.

Table 2: Assessment of Reliability and Validity of Constructs (Measurement Model)

Construct	Items	Loadings	Alpha	CR	AVE
Change Management (CM)	CM1	0.796	0.914	0.961	0.767
	CM2	0.890			
	CM3	0.889			
	CM4	0.900			
	CM5	0.903			
	CM6	0.908			
	CM7	0.913			
	CM8	0.892			
	CM9	0.837			
	CM10	0.822			
Digital Healthcare Performance (DHP)	DHP1	0.718	0.898	0.926	0.555
	DHP2	0.773			
	DHP3	0.759			
	DHP4	0.723			
	DHP5	0.747			
	DHP6	0.808			
	DHP7	0.666			
	DHP8	0.782			
	DHP9	0.743			
	DHP10	0.724			
Knowledge Transfer (KT)	KT1	0.753	0.913	0.950	0.692
	KT2	0.751			
	KT3	0.886			
	KT4	0.881			
	KT5	0.838			
	KT6	0.878			
	KT7	0.859			
	KT8	0.831			
	KT9	0.831			
	KT10	0.798			

Table 3: Assessment of Discriminant Validity using HTMT Ratio

	Change Management (CM)	Digital Healthcare Performance (DHP)	Knowledge Transfer (KT)
Change Management (CM)			
Digital Healthcare Performance (DHP)	0.535		
Knowledge Transfer (KT)	0.471	0.853	

In the next phase, a structural or path model was estimated to test the proposed hypotheses and presented in Table 4 and Figure 1. There were four hypotheses that were tested through direct and indirect paths. This model has been estimated through a complete bootstrapping approach by taking 10000 resamples from the original sample. Results have shown that CM has a significant positive influence ($\beta = 0.168$, p-value = 0.000) on DHP and support the first hypothesis. The positive coefficient indicates the direction of the relationship. Bootstrapped based lower and upper limits (2.5%-97.5%) of path coefficients have also been reported here. This range must have a similar direction in both coefficients for significant findings. In the next path, CM has also shown a statistically significant positive impact on the potential mediator, KT, as β was 0.458 with a p-value less than 0.05. In direct relationships, KT has the most significant positive effect on DHP ($\beta = 0.739$, p-value = 0.000) and ensures the conditions of mediation analysis through a segmental approach. Effect sizes for each direct path have also been reported here, which indicate that relationships of CM□DHP and CM□ KT have small (≥ 0.02) and moderate (≥ 0.15) levels of effect size, respectively. However, KT□ DHP has a substantial effect size (≥ 0.35) and is the most important path of this interplay. Thresholds of effect sizes provided by Cohen [47] were followed for this interpretation. Figure 1 also shows the value of a good R2 in the circles of endogenous constructs and confirms the suitability of the model.

In the segmental approach, three possible hypotheses were made and tested. Overall, results have confirmed the significant interplay of CM, KT, and DHP. The mediation path was also assessed through Hayes [52] approach and reported here; please see the last row of Table 4. The strong positive role of KT as a mediator has been confirmed

through its path coefficient (β = 0.339, p-value = 0.000), which is the product of two indirect paths; 0.458*0.739 = 0.339. In the presence of two indirect paths, the direct path was still significant and ensured the presence of a partial mediating role of KT in the relationship of CM to DHP.

Table 4: Direct and Indirect Hypotheses Testing

Hypothesis	**Relationship**	**Std. Beta**	**SE**	**t-statistic**	**p-value**	**BS. LL**	**BS. UL**	**f^2**
H1	Change Management (CM) → Digital Healthcare Performance (DHP)	0.168	0.045	3.712	0.000	0.080	0.260	0.072
H2	Change Management (CM) →Knowledge Transfer (KT)	0.458	0.049	9.363	0.000	0.357	0.550	0.266
H3	Knowledge Transfer (KT) → Digital Healthcare Performance (DHP)	0.739	0.029	25.188	0.000	0.679	0.793	0.810
H4	Change Management (CM) → Knowledge Transfer (KT) → Digital Healthcare Performance (DHP)	0.339	0.039	8.675	0.000	0.264	0.416	

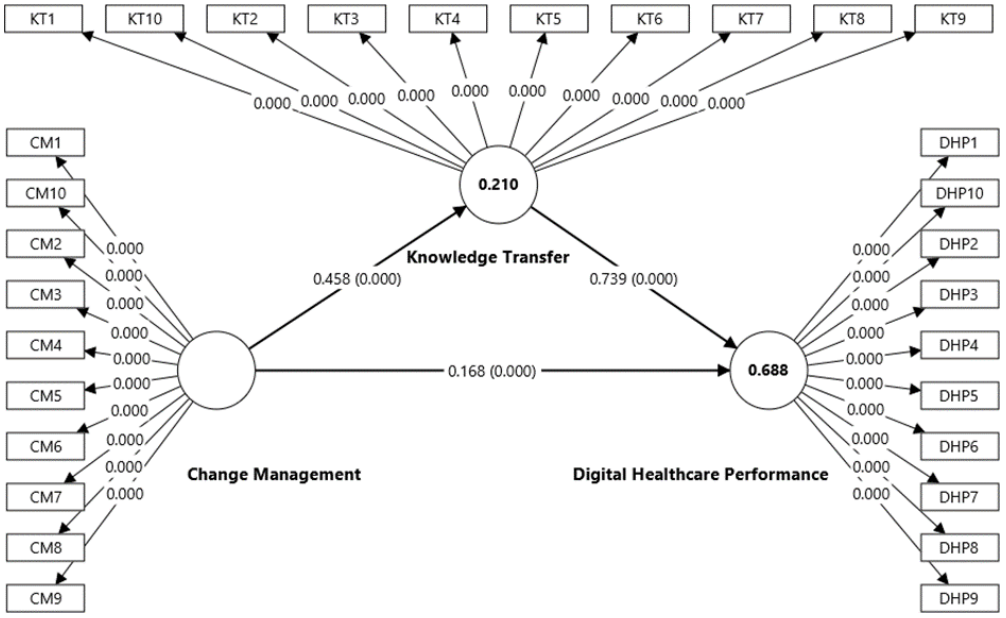

Figure 1: Path Model (Developed by Author through Data Analysis)

By following the modern literature [53], PLSpredict was also used to check the PLS-based model suitability for prediction purposes as compared to LM and IA models. These results were estimated through a holdout sample and yield case-level predictions, which help in assessing the predictive relevance of various models, considering PLS as the baseline model. Table 5 shows that PLS based predictions have less predictive loss for both endogenous constructs as compared to LM and IA models. Further, a Q2 statistic value that is not close to 0 indicates the predictive relevance of the PLS PLS-based model.

Table 5: Predictive Capability of PLS-SEM Model

	Q^2	PLS loss	IA loss	LM loss
Digital Healthcare Performance (DHP)	0.250	0.975	1.132	0.994
Knowledge Transfer (KT)	0.203	1.187	1.380	1.196

5. Discussion

In the traditional systems, CM is an important stimulus of healthcare performance. However, the predominance of digitalization in modern healthcare systems needs new management strategies which can ensure the efficacy of these digital tools for digital health. This study tries to develop an empirical model for CM and a relatively new performance concept, "digital healthcare performance". This study reveals a strong connection between CM and DHP in KSA, as expected. This model has been explored through Kotter's CM model and using the perspective of four main stakeholders of the healthcare system: managers, health informatics professionals, clinicians, information technology experts and support staff. This study also explored the direct and indirect positive role of KT in causing high DHP. These findings have been derived through a segmental approach of mediation analysis following the guidelines provided in the literature [26].

KSA's healthcare system is facing severe issues in its performance metric, and its millions of dollars are at stake. In the last decade, the conventional system has been transformed into a digital system with the aim of providing high-quality services to patients and their service providers as well. This study highlights that the inclusion of novel technologies in healthcare systems needs new but effective CM strategies at organization level. These strategies should be adopted by leaders, and they will prepare the employees to anticipate the market trends regarding patients' needs and expectations. These leaders should develop organizational strategies rather than individual strategies, considering the AI based modifications in the systems which are derived through data not human judgments. This liaison is important to transmit and transfer the required knowledge to the managers who are actually responsible for implementing the digital technologies in the systems. This whole process potentially boosts the digital healthcare performance directly and indirectly through KT. The significant relationships between CM and KT with DHP reflect that both CM and KT are strong predictors of DHP. It indicates the partial mediating effect of KT in the relationship between CM and DHP and guides practitioners that CM and KT both play their roles in boosting the performance matrices. The findings of our study are consistent with the literature which mainly studied healthcare performance [7, 8, 23, 24].

This study's findings have shown that both mediating paths are significantly exist and ensure the presence of these alternative paths in the way of transmission of effects. Transformational leadership can build a vision and specific culture that helps in embracing the change, adapting new working environment and a dynamic learning environment [54] These efforts and strategies help in overcoming the fear of technology by clinicians and practitioners. In continuation, knowledge transfer operationalize the vision which has been set by the leadership [55]

The other mediating path of this study is: Change Management -> Knowledge Transfer -> Digital Healthcare Performance, which has been explored and proven in this study. The total indirect effects value is 0.115 with a p-value of 0.001, which indicates the presence of mediation analysis. Like transformational leadership, the impact of change management on digital healthcare performance is mediated through knowledge transfer. As it has already been discussed that digitalization and its expected outcomes need various organizational shifts, especially technological, cognitive and cultural [56,57] This change management generally serves as a structural transition [58,59] and knowledge transfer acted as procedural flows and frameworks (Argote, 2024) [60] that facilitated in achieving the required healthcare performance.

This study has various implications for practitioners. Firstly, this study mainly explored the mediation role of KT. Mediation analysis is always important to break down the apparently simple relationship into two parts: direct and indirect paths. Strategically, this split is important to understand that only direct path is not the only solution to cause the change; alternative paths or indirect paths can also augment and reinforce the change. For the practitioners, this study suggests that the required level of DHP can be achieved through CM, which is further strengthened by an innovative KT mechanism. Therefore, both constructs need attention to attain required level of DHP.[61,62]

Theoretically, this study used Kotter's model of CM to understand the mechanism of performance improvement by KT and extends its application with a variety of constructs. In the literature, there are various other models which have been used to explain healthcare performance, like transformational leadership theory [63,64], social exchange theory [65], KT model [66]. However, other models mainly deals with individual behaviors which later translate into organizational behaviors. Kotter's approach is developed for organizational change and have large scope. Therefore, our study enhances the applicability of Kotter's model to grasp the CM, KT and its outcome, DHP. This study has also social implications as well. The digitalization in the healthcare system would enhance

the efficacy of service delivery for patients, like highly precise treatment, accurate diagnosis, application-based monitoring, mhealth, HER, transparent resource allocation, and many more. This efficiency and high performance of the system can help to facilitate the patients without long delays, and patients will get the best services without man-made delays and errors.

Like every study, this study has certain limitations which need to be considered while explaining the findings of the study. This study has considered CM as the main stimulus of DHP and used Kotter's CM model. Usage of other theoretical foundations can change the interpretation of findings. KT is an important mediator in this study; however, future researchers can also consider the transformational leadership role as an important determinant of KT and DHP. This study has used cross-sectional data, which can restrict the findings for trends and patterns in the datasets. Future researchers can utilize longitudinal datasets and explore the time-based variations in the study phenomenon.

6. Conclusion

This study explored the complex interplay of CM, KT and DHP in Kingdom of Saudi Arabia. This study empirically proved that DHP can be enhanced through effective CM and transferrable mechanism of knowledge in the healthcare organizations. Further, the required level of performance can be achieved directly through CM and indirectly through KT, and both pathways are essential for the success of the system. Only the inclusion of digital technology does not ensure its effectiveness and need customized strategies. The findings furnish valuable suggestions for the leaders and management of healthcare systems at help the policymakers to align themselves with SGDs set by WHO.

7. Data Availability Statement

Data from this study is available with the corresponding author and can be furnished on request.

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