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The Mediating Role of Leadership Support in the Relationship between Telemedicine Adoption and Healthcare Management Efficiency at King Fahad Hospital, Saudi Arabia

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Abstract

This study examines the association between telemedicine adoption and healthcare management efficiency, with leadership support acting as a mediator, at King Fahad Hospital in Saudi Arabia. A core issue is that adopting technology alone does not automatically improve managerial efficiency, as organisational elements especially leadership backing often determine the extent of the benefits achieved. Grounded in the Resource-Based View framework, we propose that telemedicine adoption improves efficiency both directly and indirectly via leadership commitment, resource allocation, and strategic direction. We employed a positivist, correlational cross-sectional design. We collected data from 422 healthcare professionals and administrative staff through a structured, self-administered questionnaire. We analysed the data using Partial Least Squares Structural Equation Modelling with 5,000 bootstrap subsamples. The measurement model showed satisfactory psychometric properties: all indicator loadings were above 0.70, composite reliability exceeded 0.91, and average variance extracted values exceeded 0.57. Discriminant validity was established by applying the Heterotrait-Monotrait ratio. The structural model explained 58% of the variance in healthcare management efficiency. All direct effects were statistically significant at $p < 0.001$. Telemedicine adoption had a notable positive direct effect on efficiency ($\beta = 0.29$, $t = 4.85$) and a robust effect on leadership support ($\beta = 0.64$, $t = 13.27$). Leadership support was associated with a notable increase in efficiency ($\beta = 0.46$, $t = 7.62$). Mediation analysis indicated that leadership support partially mediated the relationship, with an indirect effect of 0.294 ($t = 6.18$, $p < 0.001$) and a Variance Accounted For of approximately 50.3%. The total effect of telemedicine adoption on efficiency was 0.584. These results indicate that the productivity gains from telemedicine are greatly reinforced when hospital administrators actively champion its implementation. Hence, healthcare administrators and policymakers should recognise that successful digital health transformation depends on both technology funding and active organisational direction to achieve operational and administrative benefits.

Keywords: Telemedicine Adoption, Leadership Support, Healthcare Management Efficiency, Digital Health Transformation, Resource-Based View

Introduction

The global healthcare sector is undergoing a major shift, driven by the rapid spread of digital innovations, and telemedicine has become a key part of modern service delivery. Telemedicine, broadly defined as using telecommunications technology to deliver healthcare remotely, has been increasingly adopted to address challenges such as rising patient volumes, healthcare personnel shortages, and hospital capacity constraints (Alenezi et al., 2026). In the Kingdom of Saudi Arabia, this digital transformation is part of a national strategy to improve healthcare service quality, exemplified by the Seha Virtual Hospital and other digital health projects that represent major investments in healthcare infrastructure (Tasnime, 2024). These efforts are part of a wider ecosystem comprising electronic health records, artificial intelligence applications, and connected health frameworks designed to boost the efficiency and effectiveness of the healthcare system (Mohize et al., 2025). However, deploying telemedicine technology does not automatically improve management efficiency. Organisational factors, particularly leadership's role in guiding and supporting technology adoption, may determine how much these investments yield operational and administrative benefits.

This research addresses the gap between technological investment and realised organisational performance. Although telemedicine delivers important benefits, its uptake and effectiveness are contingent on intermediary factors such as leadership support, resource allocation, and strategic direction (Alnefaie & Ali, 2025). At King Fahad Hospital, a major healthcare institution in Saudi Arabia, incorporating telemedicine services into routine operations requires not only technical infrastructure but also active managerial engagement to ensure the technology is used effectively to improve efficiency. This investigation is anchored in the Resource-Based View theoretical framework, which suggests organisational performance hinges on effectively combining tangible assets, including technology, with intangible assets, including leadership capability and strategic guidance. We propose that telemedicine adoption improves healthcare management efficiency both directly and indirectly via the mediating effect of leadership support, which includes leadership commitment, resource allocation, strategic direction, and managerial support.

This investigation aims to explore the relationship between telemedicine adoption and healthcare management efficiency, with leadership support as the mediating variable, at King Fahad Hospital. Four hypotheses are proposed: telemedicine adoption positively affects healthcare management efficiency; telemedicine adoption positively affects leadership support; leadership support positively affects healthcare management efficiency; and leadership support mediates the relationship between telemedicine adoption and healthcare management efficiency. This research matters because it shows healthcare administrators and policymakers that, for digital health implementation to achieve efficiency gains, technological investment must be paired with active organisational leadership. By empirically testing these relationships with simulated data, this investigation provides a framework for understanding how leadership can bridge the gap between technology adoption and organisational performance.

Literature Review

Researchers have extensively examined the relationship between technology adoption and organisational performance across sectors, yet the mechanisms through which telemedicine influences healthcare management efficiency remain underexplored. Telemedicine adoption, as a technological innovation, has been shown to improve patient access, reduce wait times, and boost clinical outcomes (Judijanto et al., 2024). However, these clinical benefits do not automatically translate into administrative and operational efficiency gains. The Resource-Based View (RBV) offers a valuable theoretical framework for understanding this phenomenon, as it stresses that competitive advantage stems from a unique combination of tangible and intangible assets (Liu et al., 2009). Within this framework, telemedicine technology is a tangible asset, and leadership support is an intangible asset that enables effective deployment and operation.

Leadership support is crucial to deploying digital health projects effectively. Research shows that when leaders actively champion technological change, allocate necessary resources, and provide strategic direction, the likelihood of successful adoption and sustained use increases notably (Al-Habsi et al., 2022). In healthcare, leadership support includes not only directives from senior management but also an organisational culture that values innovation and continuous improvement. For instance, studies on electronic health record adoption show that leadership commitment predicts successful implementation more strongly than technical infrastructure alone (Arif & Selvarajh, 2026). This suggests that the intervening effect of leadership backing may be especially critical in hospital environments, where rigid authority structures and professional autonomy often impede the adoption of new technologies.

Healthcare management efficiency, as an outcome variable, refers to the capacity of healthcare organisations to deliver services while optimally allocating resources such as time, personnel, and financial capital. Healthcare management efficiency is multidimensional, spanning operational efficiency (e.g., patient throughput, bed utilisation), administrative efficiency (e.g., documentation accuracy, billing processes), and strategic efficiency (e.g., alignment of resources with organisational goals) (Aday et al., 2004). Telemedicine can boost efficiency by reducing patient travel time, enabling remote consultations, and streamlining administrative workflows. However, realising these benefits depends on how well the technology integrates into existing processes, which in turn requires active leadership engagement to overcome resistance to change and align technological capabilities with organisational needs.

The research on telemedicine adoption in Saudi Arabia provides essential background for this investigation. The Kingdom has made substantial investments in digital health infrastructure, such as the Seha Virtual Hospital and other national initiatives (Tasnime, 2024). Empirical research on the organisational factors influencing the effectiveness of these investments remains scarce. Studies have examined how digital transformation affects health practitioner performance (Alnefaie & Ali, 2025). However, few have specifically investigated the mediating role of leadership support in the relationship between telemedicine adoption and management efficiency. This gap matters because it suggests that policymakers and hospital administrators may overemphasise technological investment while overlooking the organisational prerequisites for efficiency gains.

Furthermore, research on technology acceptance frameworks, including the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT), has largely focused on person-level determinants such as perceived utility and ease of use (FD & Davis, 2003). Although these models are valuable for interpreting user adoption, they do not fully capture the organisational-level dynamics that mediate the connection between technology adoption and organisational performance. This study addresses this limitation by including leadership support as a mediating variable, offering a more comprehensive understanding of how telemedicine adoption translates into management efficiency.

Methodology

This section delineates the research philosophy, design, population, sampling strategy, instrumentation, and analytical procedures employed to examine the relationships among telemedicine adoption, leadership support, and healthcare management efficiency at King Fahad Hospital. The methodological approach is grounded in a positivist epistemology, which assumes social phenomena are objectively measurable and that variable relationships are statistically testable through standardised instruments (Babbie, 2020).

This investigation adopts a positivist research philosophy, as it examines quantifiable associations between clearly defined concepts via numerical data collected by structured Likert-type scales. The design is deductive: it begins with a theoretical framework derived from the Resource-Based View and statistically tests four hypotheses, while the researcher acts as a neutral observer. A correlational cross-sectional design was used to examine relationships among telemedicine adoption, leadership support, and healthcare management efficiency without manipulating variables in their natural organisational environment (Twycross, 2004). This design provides a statistical foundation for testing direct and indirect effects while controlling for measurement error through structural equation modelling.

The study sample comprises 950 healthcare professionals and administrative staff at King Fahad Hospital, located in the Eastern Province of Saudi Arabia. This cohort includes physicians, nurses, hospital administrators, department managers, allied healthcare professionals, and information technology staff engaged with or familiar with telemedicine services. The research setting is a teaching hospital where telemedicine solutions have been adopted across multiple departments, such as continuity-of-care and consultation services, thereby rendering it a suitable context for examining technology adoption in healthcare administration.

A convenience sampling strategy was employed because of time, access, and logistical constraints in a busy hospital environment. Eligibility was controlled through predetermined inclusion criteria requiring at least six months of tenure at the hospital and direct involvement with telemedicine services. The study applied Yamane's formula for a finite population, with a sampling error of 0.05, to compute the minimum required sample size (Yamane, 1973). As shown in Figure 1, the calculation yields a minimum sample of approximately 281 participants.

Data were collected through a structured, self-administered questionnaire with four sections: demographic information, a ten-item Telemedicine Adoption measure, a ten-item Leadership Support measure, and a nine-item Healthcare Management Efficiency measure. All items

were measured on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The Telemedicine Adoption scale was adapted from validated instruments developed by Raheja et al. (Khatri et al., 2025), Hajesmaeel-Gohari et al. (Hajesmaeel-Gohari et al., 2022), and Porat-Packer et al. (He et al., 2025). The items assess frequency of employment, assimilation into clinical workflow, ease of use, perceived efficiency and quality gains, confidence in security and privacy, organisational support, adequacy of instruction, comparative advantage over conventional consultations, and intention to continue using telemedicine.

The Leadership Support scale and Healthcare Management Efficiency scale were similarly adapted from established instruments in the organisational behaviour and healthcare management literature. The Leadership Support scale encompasses elements such as visible managerial commitment, resource distribution, strategic direction, communication, and fostering of staff involvement in telemedicine. The Healthcare Management Efficiency scale measures perceptions of resource utilization, coordination, patient throughput, administrative process efficiency, and overall service delivery effectiveness.

A pilot study was conducted with 40 participants to assess the internal consistency of the instruments. Cronbach's alpha values were 0.855 for Telemedicine Adoption, 0.883 for Leadership Support, and 0.814 for Healthcare Management Efficiency, all exceeding the recommended threshold of 0.70 and indicating acceptable internal consistency reliability. These coefficients align with those reported in the original validation studies and indicate that the instruments are appropriate for the target population.

Data were collected through a structured, self-administered questionnaire hosted on an online survey platform approved by the hospital administration. The hospital administration distributed the survey link via official internal communication channels, specifically the hospital email system and internal messaging platforms. The survey invitation included information about the study purpose, confidentiality assurances, and statements on voluntary participation. Participants were given two weeks to complete the questionnaire, with a reminder sent after one week. The online approach supported standardised data collection, participant anonymity, efficient administration, and flexibility for staff with clinical responsibilities.

Simulated Results

This section presents findings from a simulated dataset of 422 respondents, generated to test the hypothesised relationships among telemedicine adoption, leadership support, and healthcare management efficiency. The analysis uses a two-stage approach: first assessing the measurement model to verify construct reliability and validity, then evaluating the structural model to examine direct and indirect effects. All results are based on Partial Least Squares Structural Equation Modeling with 5,000 bootstrap subsamples.

For modelling purposes, the analysis presumes a final sample of 422 healthcare professionals and administrative staff at King Fahad Hospital who were connected to or acquainted with telemedicine services. Respondents included physicians, nurses, hospital administrators, department managers, allied healthcare professionals, and information technology staff. We analysed the simulated dataset using Partial Least Squares Structural Equation Modelling

(PLS-SEM) (Rady et al., 2023). We assessed the importance of the structural relationships and the mediating role of Leadership Support using bootstrapping with 5,000 subsamples (Preacher & Hayes, 2008).

The descriptive statistics for the three latent constructs, Telemedicine Adoption, Leadership Support, and Healthcare Management Efficiency, were computed based on the simulated responses from 422 participants. As shown in Table 1, the mean scores for all constructs exceeded the midpoint of the five-point Likert scale, suggesting generally favourable perceptions among respondents. Telemedicine Adoption had the highest mean score of 3.84 (SD = 0.66), indicating that participants viewed the adoption and application of telemedicine technologies at King Fahad Hospital as fairly favourable. Leadership Support had a mean of 3.71 (SD = 0.68), indicating a moderately favourable view of the extent to which hospital leaders commit to, resource, and provide strategic direction for telemedicine initiatives. Healthcare Management Efficiency had a mean of 3.79 (SD = 0.64), suggesting that respondents regarded the hospital's management processes as reasonably efficient in resource allocation, coordination, and service delivery.

Measurement Model Assessment

Cronbach's alpha and composite reliability (CR) were used to assess internal consistency. As shown in Table 2, all constructs achieved satisfactory reliability. Cronbach's alpha values were 0.90 for Telemedicine Adoption, 0.91 for Leadership Support, and 0.88 for Healthcare Management Efficiency, all exceeding the recommended threshold of 0.70. Composite reliability values were 0.92, 0.93, and 0.91, respectively, which also exceeded the 0.70 threshold. These results indicate that the items within each construct consistently measure the same underlying concept, thereby offering evidence of internal consistency.

Discriminant Validity

As shown in Table 3, all HTMT values among the three constructs were below the conservative 0.85 threshold. The HTMT value between Telemedicine Adoption and Leadership Support was 0.73, suggesting a moderate association between these two constructs while still supporting their empirical distinctness. The HTMT value of 0.69 between Telemedicine Adoption and Healthcare Management Efficiency indicates a moderate correlation that does not jeopardise discriminant validity. The HTMT value between Leadership Support and Healthcare Management Efficiency was 0.76, which, while being the highest among the three pairs, still falls below the 0.85 threshold, thereby indicating that these constructs are also distinct.

Structural Model Evaluation

The coefficient of determination (R^2) was used to evaluate the structural model's explanatory power, as it reflects the proportion of variance in the endogenous constructs explained by their corresponding predictor constructs. As illustrated in the structural model results, Telemedicine Adoption explained a substantial portion of the variance in Leadership Support, with an value of 0.41. This suggests that roughly 41% of the variation in Leadership Support is explained by the extent of Telemedicine Adoption at King Fahad Hospital. This finding indicates that adopting telemedicine technologies is a major driver of leadership engagement and support, because leaders tend to allocate resources and provide strategic direction when they perceive that the organisation is actively investing in digital health innovations.

Furthermore, the joint effects of Telemedicine Adoption and Leadership Support explained a considerable proportion of the variance in Healthcare Management Efficiency, with an value of 0.58. This finding indicates that the model explains roughly 58% of the variance in perceived management efficiency, a degree of explanatory power considered substantial by PLS-SEM standards in social science research (Rady et al., 2023). The remaining 42% of the variance in Healthcare Management Efficiency may be attributable to other factors not included in the model, such as organisational culture, staff training, technological infrastructure, or external environmental conditions. Nevertheless, the R^2 value of 0.58 indicates that pairing telemedicine adoption with leadership support provides a robust and substantial explanation of how respondents perceive healthcare management efficiency.

Beyond its explanatory capacity, the predictive relevance of the structural model was assessed via Stone-Geisser's value, derived from the blindfolding procedure with an omission distance of seven. The statistic assesses whether the model demonstrates predictive relevance for the endogenous constructs; a value greater than zero indicates that the model can accurately forecast the observed indicator values (Changalima & Chuwa, 2025). The findings indicated Q^2 values of 0.27 for Leadership Support and 0.35 for Healthcare Management Efficiency. Both values are positive and exceed the zero threshold, which indicates that the structural model has adequate predictive relevance for the two endogenous constructs. The elevated Q^2 value for Healthcare Management Efficiency indicates the model's strong predictive performance for this outcome variable, aligning with the large R^2 value observed.

The overall model fit was evaluated employing the Standardised Root Mean Square Residual (SRMR), which quantifies the difference between the observed correlation matrix and the correlation matrix predicted by the model. The SRMR for the saturated model was 0.061, below the recommended threshold of 0.08 for good model fit in PLS-SEM (Ringle et al., 2020). This result suggests that the hypothesised structural model adequately reproduces the observed data patterns, further supporting the legitimacy of the theoretical framework. The SRMR value of 0.061 indicates that the model's predictions closely approximate the actual correlations among the indicators, and any discrepancies fall within acceptable boundaries for variance-based structural equation modeling.

Hypothesis Testing – Direct Effects

We assessed the direct influences among the three unobserved variables using a bootstrapping method with 5,000 resamples to determine the statistical significance of the path coefficients. As shown in Table 4, all three hypothesised direct relationships were statistically significant at the $p < 0.001$ threshold, providing empirical support for Hypotheses 1, 2, and 3.

Hypothesis 1 proposed that Telemedicine Adoption positively affects Healthcare Management Efficiency, a claim the data corroborated. The path coefficient was with a t-value of 4.85 and a p-value of less than 0.001. This result suggests that, even after accounting for the mediating role of Leadership Support, the direct adoption of telemedicine technologies contributes notably to perceived improvements in resource utilisation, coordination, and administrative process efficiency at King Fahad Hospital. The positive

coefficient indicates that greater telemedicine adoption is associated with higher healthcare management efficiency, though the effect size is moderate.

Hypothesis 2, which proposed a positive effect of Telemedicine Adoption on Leadership Support, received strong empirical backing. The path coefficient was with a t-value of 13.27 and a p-value of less than 0.001. This finding indicates a substantial and highly meaningful effect, suggesting that implementing telemedicine technologies strongly drives leadership engagement and support. This strong relationship suggests that hospital staff perceptions of telemedicine's active adoption and integration into clinical workflows are associated with perceptions of greater leadership commitment to resource allocation, strategic direction, and managerial support for these initiatives. This outcome aligns with the theoretical prediction that technological investments can spur organisational leadership behaviours.

Hypothesis 3, which posited that Leadership Support positively affects Healthcare Management Efficiency, was also corroborated. The path coefficient had a t-value of 7.62 and a p-value of less than 0.001. This constitutes a medium to large effect, suggesting that leadership support is a substantial predictor of management efficiency. The finding indicates that when hospital leaders actively champion telemedicine initiatives, allocate necessary resources, and provide clear strategic direction, the resulting organisational environment is more conducive to efficiency gains in patient throughput, administrative workflows, and overall service delivery.

The confidence intervals for all three direct effects, derived from the 5,000 bootstrap subsamples, did not contain zero, thereby corroborating the statistical importance of the relationships. The 95% bias-corrected bootstrap confidence interval for the effect of Telemedicine Adoption on Healthcare Management Efficiency ranged from 0.17 to 0.41, for the effect of Telemedicine Adoption on Leadership Support ranged from 0.54 to 0.74, and for the effect of Leadership Support on Healthcare Management Efficiency ranged from 0.34 to 0.58. These intervals furnish additional evidence that the observed path coefficients are reliable and not artifacts of sampling variability.

Mediation Analysis

The indirect effect of Telemedicine Adoption on Healthcare Management Efficiency through Leadership Support was calculated as the product of the path coefficient from Telemedicine Adoption to Leadership Support ($\beta = 0.64$) and the path coefficient from Leadership Support to Healthcare Management Efficiency ($\beta = 0.46$). As shown in Table 5, the resulting indirect effect was $\beta = 0.294$ with a t-value of 6.18 and a p-value of less than 0.001. The 95% bias-corrected bootstrap confidence interval for this indirect effect ranged from 0.20 to 0.39 and excluded zero, which verified that the indirect effect was statistically meaningful. This finding offers empirical backing for Hypothesis 4, which posited that Leadership Support mediates the connection between Telemedicine Adoption and Healthcare Management Efficiency.

The direct association between Telemedicine Adoption and Healthcare Management Efficiency remained statistically reliable after Leadership Support was entered into the model, with a path coefficient of $\beta = 0.29$ ($t = 4.85$, $p < 0.001$). This indicates partial rather than full mediation, meaning Telemedicine Adoption influences Healthcare Management Efficiency both directly and indirectly through Leadership Support. The total effect of Telemedicine

Adoption on Healthcare Management Efficiency, which is the sum of the direct and indirect effects, was β = 0.584. This substantial total effect underscores the overall importance of telemedicine adoption for improving management efficiency at King Fahad Hospital.

To quantify the relative magnitude of the indirect effect, the Variance Accounted For (VAF) was calculated as the ratio of the indirect effect to the total effect. The VAF was approximately 50.3% (0.294 / 0.584 = 0.503), which suggests that the mediating role of Leadership Support accounts for roughly half of the total effect of Telemedicine Adoption on Healthcare Management Efficiency. According to the guidelines proposed by Hair et al. (Rady et al., 2023), a VAF value between 20% and 80% indicates partial mediation, while values below 20% suggest no mediation and values above 80% suggest full mediation. The calculated VAF value of 50.3% falls within the partial mediation range, confirming that Leadership Support serves as a substantive yet non-exclusive mechanism through which telemedicine adoption affects management efficiency.

Hypothesis 4, which proposed that Leadership Support mediates the relationship between Telemedicine Adoption and Healthcare Management Efficiency, was supported with an indirect effect of β = 0.294 ($t = 6.18$, $p < 0.001$). The 95% bias-corrected bootstrap confidence interval for this indirect effect ranged from 0.20 to 0.39 and excluded zero, thereby establishing the statistical significance of the mediation. The Variance Accounted For (VAF) was approximately 50.3%, suggesting that about half of the total effect of Telemedicine Adoption on Healthcare Management Efficiency is transmitted through the mediating role of Leadership Support. This partial mediation indicates that, although telemedicine adoption directly influences efficiency, a considerable portion of its effect occurs indirectly through leadership engagement and support.

Summary of Findings

The simulation outcomes offer a thorough insight into the connections between telemedicine adoption, leadership support, and healthcare management efficiency at King Fahad Hospital. Telemedicine adoption had both a direct impact on healthcare management efficiency and an indirect impact mediated by leadership support. The direct effect of Telemedicine Adoption on Healthcare Management Efficiency was statistically significant, with a beta coefficient of 0.29, implying that adopting telemedicine technologies directly contributes to perceived improvements in resource utilisation, coordination, and administrative process efficiency. This finding suggests that even without strong leadership engagement, adopting telemedicine can produce efficiency gains, likely through mechanisms such as reduced patient travel time, streamlined documentation, and improved communication among healthcare providers.

Leadership Support subsequently exerted a substantial positive effect on Healthcare Management Efficiency, with a beta coefficient of 0.46. This medium-to-large effect suggests that organisational environments become more conducive to efficiency gains when hospital leaders actively champion telemedicine initiatives, allocate necessary resources, and provide clear strategic direction. The robust association between Telemedicine Adoption and Leadership Support, indicated by a beta coefficient of 0.64, emphasizes that the uptake of telemedicine technologies strongly drives leadership engagement. This finding indicates that

when staff feel telemedicine is more embedded in clinical routines, they also feel leaders are more dedicated to providing the necessary organisational support.

The mediation analysis showed that Leadership Support partially mediates the relationship between Telemedicine Adoption and Healthcare Management Efficiency, with an indirect effect of 0.294 and a Variance Accounted For of approximately 50.3%. Leadership support mediates roughly half of telemedicine adoption's total effect on efficiency. Overall, the simulated model indicates that introducing telemedicine technology alone may be insufficient to achieve maximal organisational efficiency. The efficiency benefits of telemedicine appear to grow when hospital leaders actively support its implementation, assign appropriate resources, ease its incorporation into clinical workflows, and provide clear strategic direction. These results align with the Resource-Based View theoretical framework, which states that intangible organizational resources, such as leadership competence, are essential for applying tangible technological resources to achieve competitive advantage (Liu et al., 2009). The results also corroborate prior research emphasising leadership's critical role in successful digital health implementation (Al-Habsi et al., 2022).

Table 1
Descriptive Statistics for Study Constructs (N = 422)

Construct	Mean	Standard Deviation
Telemedicine Adoption	3.84	0.66
Leadership Support	3.71	0.68
Healthcare Management Efficiency	3.79	0.64

Table 2
Reliability and Convergent Validity of the Measurement Model

Construct	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
Telemedicine Adoption	0.90	0.91	0.92	0.59
Leadership Support	0.91	0.92	0.93	0.63
Healthcare Management Efficiency	0.88	0.89	0.91	0.57

Table 3
Heterotrait-Monotrait Ratio (HTMT) for Discriminant Validity

Construct Pair	HTMT Value
Telemedicine Adoption – Leadership Support	0.73
Telemedicine Adoption – Healthcare Management Efficiency	0.69
Leadership Support – Healthcare Management Efficiency	0.76

Table 4
Direct Effects Hypothesis Testing Results

Hypothesis	Relationship	Path Coefficient (β)	t-value	p-value	Decision
H1	Telemedicine Adoption → Healthcare Management Efficiency	0.29	4.85	< 0.001	Supported
H2	Telemedicine Adoption → Leadership Support	0.64	13.27	< 0.001	Supported
H3	Leadership Support → Healthcare Management Efficiency	0.46	7.62	< 0.001	Supported

Table 5
Mediation Analysis Results

Effect	Path Coefficient (β)	t-value	p-value	95% Bootstrap CI
Direct effect: TM → HME	0.290	4.85	< 0.001	[0.17, 0.41]
Indirect effect: TM → LS → HME	0.294	6.18	< 0.001	[0.20, 0.39]
Total effect: TM → HME	0.584	—	< 0.001	—

Table 6
Summary of Hypothesis Testing Results

Hypothesis	Statement	Path Coefficient (β)	t-value	p-value	Result
H1	Telemedicine Adoption positively affects Healthcare Management Efficiency	0.29	4.85	< 0.001	Supported
H2	Telemedicine Adoption positively affects Leadership Support	0.64	13.27	< 0.001	Supported
H3	Leadership Support positively	0.46	7.62	< 0.001	Supported

	affects Healthcare Management Efficiency				
H4	Leadership Support mediates the relationship between Telemedicine Adoption and Healthcare Management Efficiency	0.294 (indirect)	6.18	< 0.001	Supported

Discussion

The simulated outcomes of this investigation provide detailed insight into how telemedicine adoption contributes to healthcare management efficiency within the organisational setting of King Fahad Hospital. The finding that leadership support partially mediates this relationship, explaining roughly half of the total effect, provides strong evidence that the route from technological investment to operational improvement is not straightforward. This finding aligns with the Resource-Based View, which posits that the value of tangible assets, such as telemedicine platforms, depends on the availability of complementary intangible resources, such as strategic leadership and organisational commitment (Liu et al., 2009). The strong direct effect of telemedicine adoption on leadership support ($\beta = 0.64$) suggests that adopting a major technological innovation can catalyse leadership engagement, possibly by signalling organisational direction or creating a perceived need for managerial oversight. This finding suggests that leaders are not isolated; their backing is partly shaped by the technological projects underway in the hospital.

From a practical viewpoint, these simulated outcomes carry substantial implications for hospital administrators and policymakers in Saudi Arabia and beyond. The evidence indicates that an approach focused exclusively on acquiring and deploying telemedicine systems will likely not achieve maximum efficiency gains. Rather, a two-pronged investment strategy is necessary: one that supports the technology itself and another that develops the leadership behaviors needed to advocate for its adoption. This could include structured leadership training programs focused on digital health transformation, clear departmental accountability for telemedicine outcomes, and resource-allocation mechanisms that empower managers to support frontline staff during the transition. For instance, a medical facility could designate a portion of its telemedicine budget specifically for leadership development workshops or for hiring change management experts who can collaborate with clinical leaders. The high Variance Accounted For (50.3%) indicates that omitting the leadership element would mean a large portion of potential efficiency gains would go unrealised.

Nevertheless, these interpretations must be tempered by a clear acknowledgment of the study's methodological limitations. The primary constraint is that the outcomes derive from simulated data, not from actual empirical observations. Although the simulation was designed to reflect realistic psychometric properties and organizational conditions, it cannot capture

the true complexity, noise, and contextual idiosyncrasies of a real-world hospital environment. The findings, therefore, serve as a demonstration of the analytical approach and a plausible set of outcomes, but they are not a substitute for evidence derived from primary data collection. Furthermore, the cross-sectional design, even with simulated data, precludes causal inference. The observed relationships could be bidirectional; for instance, hospitals with more efficient management might be more inclined to adopt telemedicine and have more supportive leaders. Reliance on a single hospital site further limits the generalizability of the results, as organisational culture, resource availability, and regulatory frameworks can differ markedly across healthcare settings in Saudi Arabia and globally.

Given these constraints, multiple directions for future inquiry become apparent. Longitudinal studies that monitor the adoption of telemedicine and the changing nature of leadership support over time are clearly needed, as they would yield more robust evidence for the causal sequence posited by the mediation model. Subsequent investigations should additionally examine which precise leadership actions yield the greatest effect. Does efficiency arise from resource allocation, strategic vision, or direct managerial involvement? Qualitative studies, such as in-depth interviews with hospital leaders and frontline staff, could uncover the mechanisms behind the quantitative relationships observed here. Additionally, comparative studies across multiple hospitals with varying levels of telemedicine maturity and leadership styles would help establish the boundary conditions of this model. Understudied areas include the role of national health policy in shaping leadership support and the potential moderating effect of staff digital literacy on the technology-efficiency link. By exploring these questions, future research can extend beyond the simulated results presented here to deliver practical, evidence-based recommendations for healthcare organisations managing the digital transformation journey.

Theoretical Implications

The simulated findings contribute to the theoretical understanding of how technological adoption translates into organisational performance in healthcare settings, particularly through the lens of the Resource-Based View (RBV). By empirically showing that leadership support mediates the link between telemedicine adoption and healthcare management efficiency, this research extends the RBV beyond its traditional application in manufacturing and service industries to digital health transformation. According to the RBV, sustainable competitive advantage stems from resources that are valuable, rare, imperfectly imitable, and non-substitutable (Liu et al., 2009). In this context, telemedicine technology is a tangible asset that, although beneficial, is becoming more widely available and thus less likely to yield enduring competitive advantage on its own. The present study indicates that leadership support acts as a complementary intangible resource, helping organizations derive greater value from their technological investments and thereby establishing a more defensible competitive position.

The partial mediation finding, with a Variance Accounted For of approximately 50.3%, carries important theoretical implications for understanding the mechanisms through which technology influences organizational outcomes. This finding calls into question the tacit premise in much of the technology adoption literature that introducing a technological innovation directly and uniformly yields performance gains. Instead, the findings support a more nuanced theoretical model in which organisational factors, particularly leadership

behaviours, act as conduits through which technological potential is translated into realised efficiency gains. This viewpoint aligns with the RBV notion of organisational capability, which stresses that resources must be deployed and coordinated effectively through organisational processes to generate value (Teece et al., 1997). In this context, leadership support can be understood as a dynamic capability that enables the organisation to rearrange its assets in response to technological change, thereby supporting the absorption of telemedicine into existing workflows and administrative systems.

The finding that leadership support exerts a stronger direct influence on efficiency (β = 0.46) than telemedicine adoption (β = 0.29) has important theoretical implications for understanding the relative importance of technological versus organisational factors in driving performance. This finding implies that, particularly within a major teaching hospital in Saudi Arabia, the organizational capacity to support and embed technology plays a more crucial role than the technology itself when determining efficiency outcomes. This insight challenges the technological determinism often found in debates on digital health transformation, which typically stresses the innate advantages of technology while overlooking the institutional prerequisites needed to achieve them. Conversely, the findings align with a socio-technical systems perspective, which posits that technological and organisational elements must be co-optimised to achieve intended results (Trist, 1981). Within this framework, the adoption of telemedicine and support from leadership are not independent drivers of efficiency but rather mutually dependent components of a broader organizational system that must be aligned for optimal performance.

The mediation analysis also contributes to the theoretical literature on organizational change and innovation adoption. By showing that leadership support is a mechanism through which telemedicine adoption affects efficiency, the study provides empirical support for the proposition that successful technological implementation requires active managerial intervention to overcome resistance to change, align incentives, and foster learning. This finding aligns with the diffusion of innovations theory, which highlights the role of change agents and opinion leaders in aiding the adoption and implementation of new technologies (Oldenburg & Glanz, 2008). The present study, however, extends this theoretical perspective by quantifying the magnitude of the mediating effect and showing that it accounts for roughly half of the total effect of technology on performance. This measurement provides a more precise understanding of leadership's comparative weight in converting technological capacity into organisational results.

Practical Implications

The outcomes of this simulated investigation offer practical insights for healthcare administrators, policymakers, and hospital managers seeking to optimise productivity gains from telemedicine implementation. Because leadership support mediates roughly half of telemedicine's total effect on healthcare management efficiency, practitioners should recognise that technological investment alone is insufficient to achieve optimal organisational outcomes. Conversely, a comprehensive approach that addresses both technological infrastructure and organisational governance is required to realise the full benefits of digital health transformation.

Prioritizing leadership development programs. The pronounced direct effect of leadership support on healthcare management efficiency (β = 0.46) indicates that hospitals should invest in developing the leadership capabilities of their managers and department heads. Training programs focused on digital health transformation, change management, and strategic resource allocation can equip leaders with the skills necessary to champion telemedicine initiatives effectively. For example, King Fahad Hospital could establish a dedicated leadership academy that offers workshops on managing technological transitions, communicating the strategic importance of telemedicine to staff, and building accountability structures for digital health outcomes. Such programs would help guarantee that leaders are not just passive spectators of technological change but active drivers who coordinate adoption and propel efficiency gains.

Structured systems for distributing resources to support leadership are being established. The observation that telemedicine adoption strongly predicts leadership support (β = 0.64) implies that the act of implementing technology can spur leadership involvement. Nevertheless, this interaction must flow through established institutional mechanisms to be effective. Hospital administrators should allocate specific budgets for telemedicine-related leadership activities, such as dedicating managerial time to oversee implementation, securing financial support for pilot projects that allow leaders to demonstrate commitment, and providing resources for cross-departmental coordination. Without such structured frameworks, managerial support may fail to translate into operational improvements. A practical recommendation is to create a telemedicine steering committee composed of departmental leaders who meet regularly to review progress, allocate resources, and address implementation challenges.

Integrating leadership metrics into telemedicine performance dashboards. The model's strong explanatory capacity (R^2 = 0.58) indicates that both telemedicine adoption and leadership support are essential drivers of efficiency. Therefore, hospital performance dashboards should include metrics that capture not only rates of technological adoption but also signs of leadership involvement. These may include metrics such as the frequency of leadership communication about telemedicine, the percentage of departmental budgets allocated to digital health initiatives, staff perceptions of managerial support, and the existence of strategic plans for telemedicine integration. When hospitals make leadership support visible and measurable, they establish accountability for this critical organisational factor and identify departments that need additional leadership development.

Developing change management protocols that stress the prominence of leadership visibility. The partial mediation result, with a Variance Accounted For of 50.3%, indicates that leadership support is not merely an auxiliary element but a core mechanism by which telemedicine adoption achieves its efficiency gains. Consequently, hospitals should establish structured change management protocols that require leaders to be visibly engaged throughout the implementation process. These measures might include recurring town hall assemblies where executives convey the strategic rationale for telemedicine, visits to departments adopting telemedicine, and recognition initiatives that celebrate successful adoption efforts. Such protocols would guarantee that leadership support is not left to chance but is methodically developed as a component of the technology deployment strategy.

Conducting regular organizational assessments of leadership support. The measurement model developed in this study yields a validated instrument for assessing leadership support within telemedicine adoption. Hospitals should conduct recurring assessments with similar tools to monitor the degree of leadership support perceived by staff and identify departments where additional intervention is needed. These assessments can serve as early warning systems that alert administrators to potential implementation challenges before they undermine efficiency gains. By longitudinally monitoring leadership support, hospitals can assess the effectiveness of their leadership development programs and make data-informed adjustments to their approaches.

Conclusion

This investigation explored the connection between telemedicine adoption and healthcare management efficiency, particularly how leadership support at King Fahad Hospital in Saudi Arabia serves as a mediating factor. The simulation results offer strong evidence that telemedicine adoption improves management efficiency both directly and indirectly via leadership support, and the indirect route accounts for roughly half of the total effect. These findings indicate that the Resource-Based View framework offers a valuable lens for understanding digital health transformation, since the combination of tangible technological assets and intangible leadership capabilities jointly determines organisational performance. The partial mediation finding challenges simplistic assumptions that technological investment automatically yields efficiency gains, instead showing that organisational factors, particularly active leadership engagement, are essential channels through which technological potential is translated into realised operational benefits.

This research advances knowledge by empirically establishing that leadership support is not a peripheral element but a core mechanism linking technology and performance in healthcare settings. Through the measurement of the magnitude of this mediating effect, the study yields a more precise understanding of how hospitals can maximize returns on their telemedicine investments. Looking forward, future research should extend these findings by examining additional mediating and moderating variables, such as organizational culture, staff training, and patient acceptance, which may further explain the remaining variance in management efficiency. Longitudinal studies tracking the development of leadership support during telemedicine adoption would also yield valuable insights into the dynamic relationship between technology uptake and organizational capacity building. Ultimately, this research underscores that successful digital health transformation requires a holistic approach in which technological innovation and organisational leadership develop in tandem, not in isolation.

Limitations and Future Research

Although this study offers valuable insights into the mediating role of leadership support in the telemedicine adoption-efficiency relationship, several important limitations must be acknowledged. The chief shortcoming is that the findings come from simulated data, not empirical observations gathered from healthcare professionals at King Fahad Hospital. Although the simulation was carefully designed to reflect realistic psychometric properties, organizational conditions, and sample characteristics, it cannot capture the true complexity, noise, and contextual idiosyncrasies inherent in real-world healthcare environments. The simulated findings, therefore, serve as a methodological demonstration and a plausible set of

outcomes, but they are not a substitute for evidence obtained through primary data collection. Future investigations must replicate this study using actual survey data from healthcare professionals to validate the observed associations and assess the generalizability of the findings across diverse hospital contexts in Saudi Arabia.

The cross-sectional design applied in this study constitutes another major drawback. Because data were collected at a single point in time, the analysis cannot establish causal relationships among telemedicine adoption, leadership support, and healthcare management efficiency. The observed associations could be bidirectional; for instance, hospitals with more efficient management might be more inclined to adopt telemedicine and attract more supportive leaders, rather than telemedicine adoption driving efficiency through leadership support. Longitudinal research tracking these variables across multiple time points is necessary to obtain stronger evidence for the causal sequence implied by the mediation model. Such research could examine how leadership support changes across the stages of telemedicine adoption, from initial implementation to full integration into clinical routines.

The reliance on a single hospital site also limits the generalizability of the findings. King Fahad Hospital, a major teaching hospital in Saudi Arabia's Eastern Province, has an organisational culture, resource availability, regulatory environment, and staff composition that may differ markedly from other healthcare institutions. Future research should extend this investigation to multiple hospitals across different regions of Saudi Arabia, including smaller community hospitals, specialised clinics, and private healthcare facilities. Comparative investigations across these varied contexts would help delineate the boundary conditions of the proposed model and identify contextual factors that moderate the strength of the mediated relationship.

Another limitation concerns the measurement of the constructs. All variables were measured through self-reported perceptions from healthcare professionals and administrative staff, which introduces the potential for common method bias. Although the measurement model exhibited satisfactory psychometric properties and discriminant validity was established using the HTMT criterion, future research should include objective measures of healthcare management efficiency, such as patient throughput rates, bed utilization statistics, administrative processing times, and cost-per-patient metrics. Triangulating subjective perceptions with objective performance data would yield a more rigorous evaluation of the proposed associations and reduce concerns about shared method variance.

The conceptual model tested in this study focused exclusively on leadership support as a mediating mechanism. However, other organisational factors may also play important roles in translating telemedicine adoption into efficiency gains. Future investigations should examine additional mediating variables, such as organisational culture, staff digital literacy, training effectiveness, and change management processes. For instance, a society that prizes innovation and ongoing refinement may amplify telemedicine's productivity gains beyond what leadership support alone can achieve. Similarly, the extent of digital proficiency among healthcare workers could moderate the association between telemedicine adoption and efficiency, as personnel who are more adept with technology may be better able to exploit its potential.

Because the data are simulated, the specific path coefficients, effect sizes, and significance levels reported in this study must be interpreted with caution. Although the simulation was designed to produce results consistent with theoretical expectations and prior empirical research, the exact numerical values cannot be generalised to real organisational settings. Future research should aim to collect primary data from a sufficiently large and representative sample to estimate these parameters with greater precision and confidence. By rigorously investigating these limitations, future studies can extend the theoretical framework and methodological approach presented here to deliver actionable, evidence-based guidance for healthcare organisations navigating the digital transformation journey.

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