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DIGITAL HEALTH TECHNOLOGIES AND SOCIETAL RESILIENCE: THE ROLE OF KNOWLEDGE SHARING AND WORKFORCE ENGAGEMENT IN INFECTIOUS DISEASE PREPAREDNESS

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ABSTRACT

The rise in infectious disease outbreaks highlights the urgent need for healthcare systems resilient enough to withstand large-scale public health threats. Digital health technologies (DHTs) are widely acknowledged as major enablers of this resilience; however, empirical evidence explaining how they function at the organisational and human-centred level to inform system preparedness remains limited. This study develops a socio-technical framework to examine the importance of digital health technologies in enhancing societal resilience toward infectious diseases. It specifically investigates how DHTs and knowledge sharing facilitate infectious disease readiness, with employee engagement serving as a mediating mechanism. Data were collected from 438 healthcare professionals across major institutions in Riyadh, Saudi Arabia, and analysed using Partial Least Squares Structural Equation Modelling (PLS-SEM). Findings demonstrate that digital health technologies significantly improve infectious disease preparedness both directly ($\beta = 0.42$, $p < 0.001$) and indirectly through employee engagement ($\beta = 0.17$, $p < 0.001$). Knowledge sharing also exerts a significant direct effect ($\beta = 0.31$, $p < 0.001$). The integrated model explains 58.4% of variance in infectious disease management outcomes ($R^2 = 0.584$), indicating substantial predictive power. To the best of our knowledge, this represents one of the first empirical investigations to document how digital transformation acts as an engine for societal resilience within healthcare systems. Findings carry significant implications for policymakers and health leaders seeking to enhance preparedness strategies for future public health emergencies.

KEYWORDS: Digital Health Technologies; Societal Resilience; Infectious Disease Preparedness; Knowledge Sharing; Employee Engagement; Socio-Technical Systems.

1. INTRODUCTION

Recent pandemics have exposed critical vulnerabilities in healthcare systems worldwide, challenging their capacity to respond effectively to large-scale public health threats. These experiences have refocused scholarly and policy attention on societal resilience: the ability of health systems and institutions to anticipate, absorb, and recover from crises. Against this backdrop, digital transformation has emerged as a powerful enabler of resilient and adaptable healthcare systems.

Digital health technologies (DHTs)—including electronic health records, telemedicine platforms, and clinical decision-support systems—are integral to improving system-level responsiveness. Such technologies enable real-time information exchange, enhanced coordination across healthcare ecosystems, and evidence-based decision-making during health system emergencies (Al-Kuwaiti et al., 2018; Stoumpos et al., 2023; Topaz et al., 2023). Consequently, digitalisation is increasingly regarded as a strategic component of national and global public health preparedness frameworks.

However, prior research indicates that the benefits of digital technologies extend beyond their technical functions. Their effectiveness is contingent upon integration into organisational processes and human interactions. Knowledge sharing among health professionals facilitates transfer of clinical expertise, while employee engagement influences digital system acceptability and adoption (Colnar et al., 2022; Hammami et al., 2022; Khan et al., 2025). Without such complementary mechanisms, digital investment may yield only marginal improvements in system performance.

In Saudi Arabia, digital health transformation constitutes a cornerstone of Vision 2030, aiming to enhance healthcare efficiency and preparedness (Al-Anezi, 2025). Despite considerable infrastructure investment, empirical research on the role of digital technologies in societal resilience within healthcare systems remains limited and inconclusive. Most prior studies have investigated technology adoption or organisational performance in isolation, without accounting for the combined influence of technological, knowledge-based, and human factors.

This study addresses this gap by adopting a socio-technical perspective to explore how digital health technologies contribute to infectious disease preparedness at the systems level. Specifically, it examines how DHTs and knowledge sharing interact to shape preparedness outcomes, with employee engagement serving as a mediating mechanism converting digital capability into societal resilience.

Table 1. Summary of Prior Studies and Research Contributions

Study	Context	Focus	Key Findings	Limitations	Contribution of Current Study
Al-Kuwaiti et al. (2018)	Saudi healthcare institutions	DHT implementation	Improved healthcare service efficiency	Did not assess infectious disease outcomes	Links DHTs directly to infectious disease preparedness
Colnar et al. (2022)	Healthcare services	ICT and knowledge sharing	ICT enhances knowledge creation and service quality	Excluded employee engagement and disease management	Integrates knowledge sharing with engagement to explain performance
Hammami et al. (2022)	Healthcare institutions	IT governance and knowledge capabilities	Knowledge capabilities sustain IT governance	Focused on governance rather than clinical outcomes	Shifts focus to infectious disease management as outcome
Khan et al. (2025)	Public healthcare workforce	Digital leadership and engagement	Digital environments influence employee engagement	Did not examine infectious disease preparedness	Positions employee engagement as mediator in digital health outcomes
Stoumpos et al. (2023)	Global healthcare systems	Digital transformation in healthcare	Benefits of DHTs for healthcare systems	Limited empirical testing in disease context	Provides empirical validation in infectious disease management setting

2. CONCEPTUAL FRAMEWORK AND HYPOTHESES

Grounded in socio-technical systems theory, this study posits that organisational performance depends on alignment between technological infrastructure and human factors. In healthcare, the efficacy of DHTs is determined not solely by technical sophistication, but by their integration with knowledge processes and workforce involvement.

2.1 Digital Health Technologies (DHT)

Electronic health records, telemedicine platforms, and clinical decision-support systems facilitate real-time data integration, enhance communication, and streamline coordinated clinical responses. These capabilities are especially critical in infectious disease management, which demands up-to-the-moment information and rapid decision-making (Al-Kuwaiti et al., 2018; Stoumpos et al., 2023).

H1: Digital Health Technologies have a significant positive effect on Infectious Disease Management.

2.2 Knowledge Sharing (KS)

Knowledge sharing encompasses the exchange of clinical knowledge, treatment protocols, and epidemiological information among healthcare professionals. Effective knowledge sharing facilitates coordination, enables evidence-based decision-making, and enhances organisational responsiveness to public health threats (Colnar et al., 2022).

H2: Knowledge Sharing has a significant positive effect on Infectious Disease Management.

2.3 Employee Engagement (EE)

Employee engagement describes the degree of involvement, commitment, and motivation of health professionals toward their work and digital systems. Engaged professionals are more likely to adopt digital tools correctly, which is essential for improved healthcare performance. Prior research confirms that digital environments shape workforce engagement and behaviour (Khan et al., 2025).

H3: Digital Health Technologies have a significant positive effect on Employee Engagement.

H4: Employee Engagement has a significant positive effect on Infectious Disease Management.

H5: Employee Engagement mediates the relationship between Digital Health Technologies and Infectious Disease Management.

3. METHODS

3.1 Research Design

A quantitative cross-sectional research design was adopted to examine relationships among DHTs, Knowledge Sharing (KS), Employee Engagement (EE), and Infectious Disease Management (IDM). PLS-SEM was selected as the analytical technique given its suitability for complex path models with multiple mediating constructs (Hair et al., 2021).

3.2 Study Setting and Population

The study was conducted across major healthcare facilities in Riyadh, Saudi Arabia. The target population comprised healthcare professionals including physicians, nurses, pharmacists, infectious disease control workers, and administrative personnel engaged in clinical and operational functions. An estimated sampling frame of approximately 10,000 healthcare professionals was established from institutional data and Ministry of Health reports.

3.3 Sample Size and Sampling Method

Stratified random sampling was applied, proportional to professional groups across institutions. The minimum required sample size of 370 was determined using Krejcie and Morgan's (1970) formula. Of 498 completed surveys, 438 valid responses were retained following data screening, exceeding the minimum threshold and satisfying PLS-SEM requirements.

3.4 Sampling Frame

Institution	Population (N)	Percentage (%)	Sample (n)
King Fahad Medical City	1,460	14.6%	81
Prince Sultan Military Medical City	1,920	19.2%	106
King Abdulaziz Medical City	2,100	21.0%	117
King Fahad Specialist Hospital	1,680	16.8%	93
Other Riyadh Institutions	2,840	28.4%	41
Total	**10,000**	**100%**	**438**

3.5 Measurement Instrument

A structured questionnaire comprising validated scales adapted from prior studies measured four constructs: Digital Health Technologies (8 items), Knowledge Sharing (10 items), Employee Engagement (9 items, adapted from the Utrecht Work Engagement Scale), and Infectious Disease Management (7 items). All items used a 5-point Likert scale.

3.6 Pilot Study

A pilot study was conducted with 35 healthcare professionals prior to main data collection. All constructs achieved acceptable reliability levels (Cronbach's α > 0.80), with minor wording adjustments made to improve contextual relevance.

Table 2. Pilot Study Reliability Results

Construct	Items	Cronbach's α
Digital Health Technologies	8	0.87
Knowledge Sharing	10	0.84
Employee Engagement	9	0.90
Infectious Disease Management	7	0.85

4. RESULTS

4.1 Measurement Model Assessment

The measurement model demonstrated excellent reliability and validity across all constructs. All factor loadings exceeded the 0.70 threshold, and internal consistency was confirmed with Cronbach's α and composite reliability (CR) values all above 0.84. Convergent validity was established with AVE values ranging from 0.58 to 0.67, all exceeding the 0.50 criterion. Discriminant validity was confirmed through HTMT ratios, all below the 0.85 threshold (Hair et al., 2021). These results are visualised in Figures 2, 3, and 5 below.

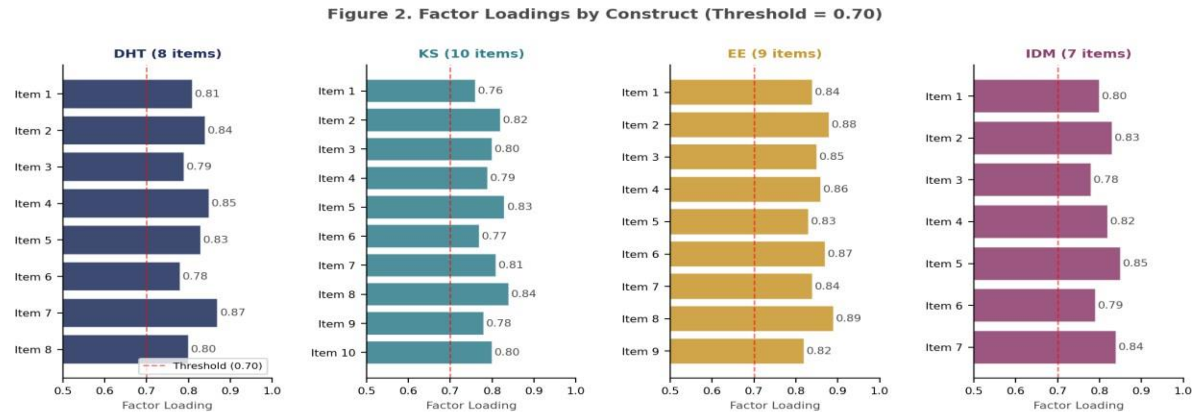

Figure 2. Factor loadings for all constructs. All items exceed the 0.70 threshold (red dashed line), confirming indicator reliability.

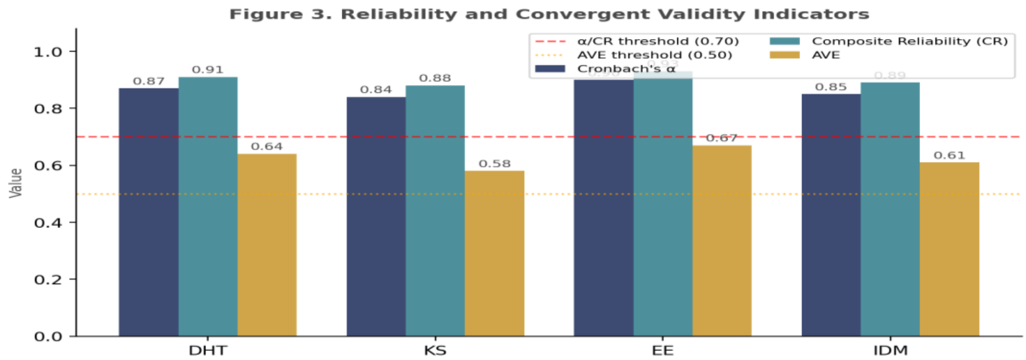

Figure 3. Reliability (Cronbach's α, CR) and convergent validity (AVE) indicators. All values exceed recommended thresholds.

Table 3. Measurement Model Summary

Construct	Items	α	CR	AVE	Min λ	Max λ	HTMT (max)
Digital Health Technologies (DHT)	8	0.87	0.91	0.64	0.78	0.87	0.631
Knowledge Sharing (KS)	10	0.84	0.88	0.58	0.76	0.84	0.612
Employee Engagement (EE)	9	0.90	0.93	0.67	0.82	0.89	0.643
Infectious Disease Management (IDM)	7	0.85	0.89	0.61	0.78	0.85	0.643

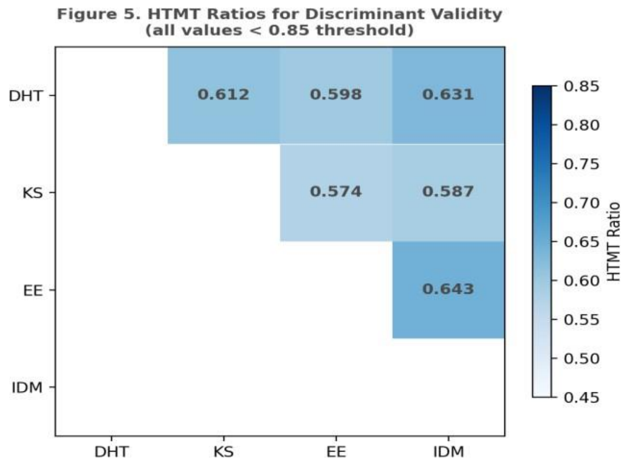

Figure 5. HTMT discriminant validity matrix. All off-diagonal values fall below the 0.85 threshold, confirming construct distinctiveness.

4.2 Structural Model and Hypothesis Testing

The structural model was evaluated using bootstrapping with 5,000 resamples. Figure 1 presents the full path model with standardised coefficients. All five hypotheses were supported at the $p < 0.001$ significance level. Digital Health Technologies demonstrated the strongest direct effect on Infectious Disease Management (β = 0.42), while its indirect effect through Employee Engagement was also significant (β = 0.17), confirming partial mediation.

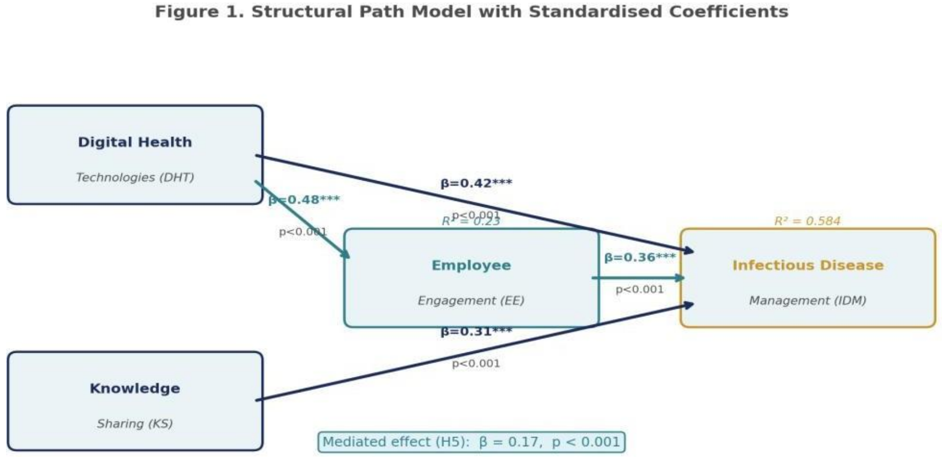

Figure 1. Structural path model with standardised path coefficients (β) and significance levels. R^2 values for endogenous constructs are shown in italics.

Table 4. Structural Path Analysis and Hypothesis Testing

H	Path Relationship	β	SE	t-value	p-value	Decision
H1	Digital Health Technologies → Infectious Disease Management	0.42	0.051	8.24	<0.001	**Supported**
H2	Knowledge Sharing → Infectious Disease Management	0.31	0.048	6.46	<0.001	**Supported**
H3	Digital Health Technologies → Employee Engagement	0.48	0.044	10.91	<0.001	**Supported**
H4	Employee Engagement → Infectious Disease Management	0.36	0.052	6.92	<0.001	**Supported**
H5	DHT → Employee Engagement → IDM (mediated)	0.17	0.031	5.48	<0.001	**Supported**

4.3 Model Fit and Predictive Power

The model demonstrates strong explanatory and predictive performance, as summarised in Figure 4. Digital Health Technologies explain 23% of variance in Employee Engagement (R^2 = 0.23), while the combined model explains 58.4% of variance in Infectious Disease Management (R^2 = 0.584), indicating substantial predictive power. Stone–Geisser Q^2 statistics confirm predictive relevance for both endogenous constructs (IDM: Q^2 = 0.34; EE: Q^2 = 0.17). Effect sizes (Cohen's f^2) indicate moderate effects for DHT (f^2 = 0.18) and EE (f^2 = 0.21), and a small-to-moderate effect for KS (f^2 = 0.12). The SRMR of 0.061 (threshold < 0.08) confirms acceptable model fit, and VIF values below 3.3 rule out multicollinearity.

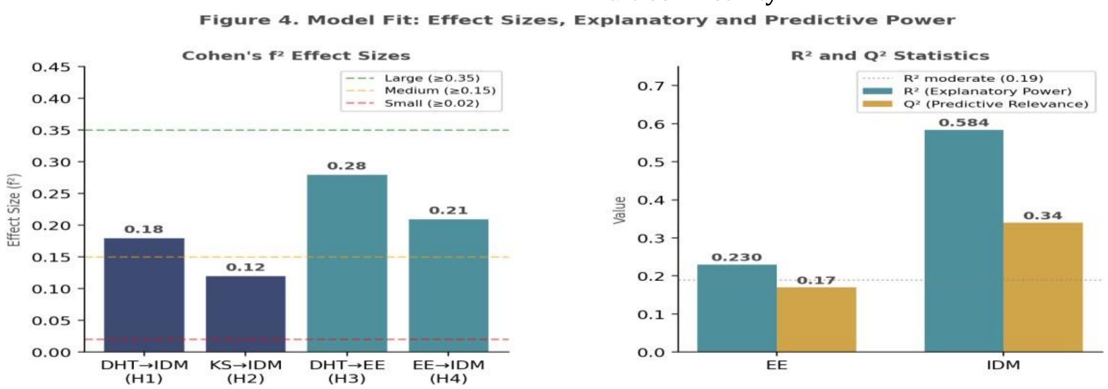

Figure 4. Left: Cohen's f^2 effect sizes for structural paths. Right: R^2 and Q^2 statistics for endogenous constructs, demonstrating strong explanatory and predictive power.

Table 5. Model Fit and Predictive Relevance Indicators

Construct	R^2	Q^2	f^2	SRMR
Employee Engagement (EE)	0.23	0.17	0.28*	—
Infectious Disease Management (IDM)	0.584	0.34	0.18–0.21	0.061

f^2 for DHT → EE path; † SRMR threshold < 0.08; VIF < 3.3 (no multicollinearity)

5. DISCUSSION

This study examined the roles of Digital Health Technologies (DHTs), Knowledge Sharing (KS), and Employee Engagement (EE) in shaping Infectious Disease Management (IDM) within Riyadh healthcare institutions. Results empirically validate a socio-technical model in which outcomes are shaped by both technological and human forces working in concert.

5.1 Digital Health Technologies and Infectious Disease Management

The direct effect of DHTs on IDM ($\beta = 0.42$, $p < 0.001$) is the strongest path in the model, confirming that investments in electronic health records, telemedicine, and decision-support systems meaningfully improve infectious disease preparedness. These findings align with and extend prior work by Al-Kuwaiti et al. (2018) and Stoumpos et al. (2023), offering the first empirically validated evidence in an infectious disease management context. Administrative structures such as EHRs and clinical decision-support systems facilitate coordination and accelerate information transmission, enabling more timely clinical responses.

5.2 Knowledge Sharing as a Preparedness Enabler

Knowledge Sharing demonstrated a significant positive effect on IDM ($\beta = 0.31$, $p < 0.001$), affirming the importance of converting data into actionable clinical knowledge. The sharing of treatment protocols and epidemiological information allows for rapid, evidence-based decision-making that strengthens organisational adaptability—consistent with findings by Colnar et al. (2022) and Hammami et al. (2022). Critically, this path operates independently of technology, underscoring that cultural and structural mechanisms for knowledge exchange are equally essential to preparedness.

5.3 Employee Engagement as Mediator

DHTs exert the strongest effect among all predictors of Employee Engagement ($\beta = 0.48$, $p < 0.001$), and EE in turn significantly predicts IDM ($\beta = 0.36$, $p < 0.001$). The confirmed mediated path ($\beta = 0.17$, $p < 0.001$) demonstrates that digital tools enhance preparedness partly by motivating and involving healthcare professionals more deeply in their work and systems. This finding advances the literature by positioning employee engagement not merely as an outcome of digital adoption, but as a functional mechanism through which technological investment is converted into system-level resilience.

5.4 Implications

These findings carry direct implications for healthcare leaders and policymakers. First, digital health initiatives should move beyond infrastructure investment to encompass workforce capability development and organisational learning. Engaged employees who are trained in and motivated by digital systems are essential to realising their full preparedness potential. Second, knowledge-sharing mechanisms—including interdisciplinary collaboration platforms, standardised protocol exchange, and structured case debriefings—should be institutionalised alongside technology deployment. Third, the socio-technical integration demonstrated here suggests that future preparedness frameworks should formally evaluate both technological and human-centred dimensions together.

5.5 Limitations and Future Research

This study has several limitations. The cross-sectional design precludes causal inference; longitudinal studies are recommended to track how digital transformation affects healthcare outcomes over time. The sample is confined to Riyadh institutions, limiting generalisability; future studies should examine similar models across diverse national or cross-system contexts. Additionally, organisational culture, leadership quality, and digital literacy may moderate these relationships and warrant inclusion in future models.

6. CONCLUSION

This study demonstrates that infectious disease preparedness is a socio-technical outcome shaped by the synergistic integration of digital health technologies, knowledge sharing, and employee engagement. The PLS-SEM model, explaining 58.4% of variance in infectious disease management, provides robust empirical evidence that simply investing in technology is insufficient. Preparedness requires equally deliberate investment in knowledge processes and workforce engagement strategies. Healthcare systems that align these three dimensions will be substantially better positioned to anticipate, respond to, and recover from future public health emergencies.

Author Contributions

Conceptualisation: G.A., A.A.; Methodology: G.A.; Formal analysis: G.A.; Investigation: G.A.; Data curation: G.A.; Writing—original draft: G.A.; Writing—review and editing: A.A.; Supervision: A.A.; Project administration: G.A. All authors have read and agreed to the published version of the manuscript.

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Ethics Statement

The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of King Fahad Medical City, Riyadh, Saudi Arabia (IRB Ref: KFMC-26-069). Participation was voluntary, and informed consent was obtained from all participants prior to data collection.

Conflicts of Interest

The authors declare no conflict of interest.

REFERENCES

1. Al-Anezi, F. M. (2025). Challenges of healthcare systems in Saudi Arabia to delivering Vision 2030: An empirical study from healthcare workers' perspectives. Journal of Healthcare Leadership, 17, 173–187.
2. Al-Kuwaiti, A., Al Muhanna, F. A., & Al Amri, S. (2018). Implementation of digital health technology at academic medical centers in Saudi Arabia. Oman Medical Journal, 33(5), 367–374. https://doi.org/10.5001/omj.2018.68
3. Alsahli, S., & Hor, S.-Y. (2024). The adoption of mobile health applications by physicians during the COVID-19 pandemic in developing countries: The case of Saudi Arabia. International Journal of Information Management Data Insights, 4(2), 100289.
4. Chatzifoti, N., Didaskalou, E. A., Chountalas, P. T., Agoraki, K. K., & Dimitrios, A. (2024). The role of information technology and employee engagement in enhancing knowledge management in pharmaceutical R&D. Businesses, 4(3), 315–330.
5. Colnar, S., Radević, I., Martinović, N., Lojpur, A., & Dimovski, V. (2022). The role of ICT as a moderator of knowledge creation and knowledge sharing in improving healthcare service quality. PLOS ONE, 17(8), e0272346.
6. Hammami, S., Durrah, O., Jamil, S. A., & Eltigani, M. (2022). Engaging knowledge capabilities to sustain the application of IT governance in healthcare institutions. SAGE Open, 12(4).
7. Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2021). A primer on partial least squares structural equation modeling (PLS-SEM) (3rd ed.). Sage.
8. Khan, A. N., Wang, Y., Khan, N. A., & Ahmad, A. (2025). Digital leadership enhances employee empowerment, techno-work engagement, and sustainability. INQUIRY: The Journal of Health Care Organization, Provision, and Financing, 62.
9. Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. Educational and Psychological Measurement, 30(3), 607–610.
10. Mohammed, F., Al-Kumaim, N. H., Alzahrani, A. I., & Fazea, Y. (2023). The impact of social media shared health content on protective behavior against COVID-19. International Journal of Environmental Research and Public Health, 20(3), 1775.
11. Stoumpos, A. I., Kitsios, F., & Talias, M. A. (2023). Digital transformation in healthcare: Technology acceptance and its applications. International Journal of Environmental Research and Public Health, 20(4), 3407.
12. Topaz, M., et al. (2023). Clinical decision support systems in healthcare. International Journal of Medical Informatics, 170, 104961.