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The Influence of Digital Health Technologies and Organizational Learning on Infectious Disease Management: The Mediating Role of Employee Engagement in Healthcare Institutions in Riyadh, Saudi Arabia.

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Abstract—

Background: **The management of infectious diseases has become a global priority, requiring healthcare systems to evolve rapidly. In Saudi Arabia, the Saudi Vision 2030 has accelerated the adoption of Digital Health Technologies (DHTs).**

Methods: **Following a positivist philosophy, this study employs a quantitative research design. The target population comprises approximately 10,000 healthcare professionals across 52 hospitals and 370 primary healthcare centers in Riyadh. Utilizing stratified random sampling, a sample size of 555 participants was targeted to ensure proportional representation of physicians, nurses, pharmacists, and administrative staff. Data was collected via a structured 45-item survey based on validated scales (e.g., TAM for technology and UWES-9 for engagement).**

Analysis: **was performed using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS to test both the measurement and structural models.**

Results: **Preliminary pilot testing (n=30) confirmed high reliability across all constructs, with Cronbach's Alpha values ranging from 0.84 to 0.90, well above the 0.70 threshold. The measurement model demonstrated strong content and construct validity. Initial path analysis suggests a positive correlation between DHTs and IDM, with Employee Engagement appearing as a significant mediator.**

Conclusions: **The study concludes that successful infectious disease management in the Riyadh healthcare cluster is not merely a technical challenge but a human-centric one. While DHTs provide the necessary infrastructure for real-time monitoring, it is the active engagement of the workforce that ensures these tools are used proactively.**

Keywords— **Digital Health Technologies, Knowledge Sharing, Employee Engagement, Infectious Disease Management, Saudi Vision 2030, Riyadh Healthcare, PLS-SEM.**

I. Introduction

Healthcare systems the world over have undergone a dynamic shift in the last few decades not only because of advancement in the use of technology but also because of the increasingly daunting nature of health threats. Infections in particular remain one of the most severe and menacing threats to the population health. [9].

One of the largest contributors to this change is the use of Digital Health Technologies (DHTs). Such technologies are telemedicine platforms, electric health records (EHRs), mobile health apps, wearable diagnostic devices, and artificial intelligence-based decision systems. DHTs have transformed the configuration of care delivery, empowering new accessibility, greater diagnostic precision, facilitating real-time monitoring of patients, and providing remote consultation, particularly in the context of limited access to physical locations, during lockdowns, geographical separation, or emergencies [4].

This research paper explains the interdependence of Digital Health Technologies (DHTs), Knowledge Sharing and their overall effect on Infectious Disease Management whereby employee engagement is used as an intervene variable. This new model is proposed to be implemented at the empirical level of healthcare institutions in the region of Riyadh in Saudi Arabia, which is actively developing digital transformation in accordance with such an initiative as Vision 2030. Instead of studying the factors individually, the study discusses how the combination of the same causes an improvement in institutional preparedness and responsiveness to infectious disease threats. Knowledge Sharing among medical personnel makes well-informed decisions in an emergency. Curiosity, Innovation, and Collaboration are core of the Employee Engagement that represents the motivation, commitment, and the readiness of employees to incorporate everything new in the work.

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The hypothesis of the study posits that using digital technologies and engaging in knowledge exchange is most likely within those institutions whose employees are engaged in the work environment. In embracing such a holistic approach, the study not only renders some theoretical knowledge on the subject, but also ends up offering working guidelines on how to heighten resiliency in assisting healthcare in Saudi Arabia [7].

A. *Background of the Study*

During a pandemic where a hospital works under high pressure, transmission of dropped information, new practices or evidence, and best practices is indeed a battle between containment and escalation[5].

The engagement of employees combines both emotional and cognitive and behavioral aspects that determine the intention of an employee towards his job and organization. [8].

B. *Problem Statement*

The effective control of infectious diseases has been an issue of heavy concern to the world healthcare systems, especially in the rapidly developing states, including Saudi Arabia. The advent of COVID-19 increased the uptake of Digital Health Technologies (DHTs) such as telemedicine platforms, electronic personal health records (ePHRs), and artificial intelligence-assisted data systems as strategic means of monitoring, prevention and response in the case of infectious disease outbreak. In spite of this quickened digital transformation, Riyadh healthcare institutions still have a significant challenge regarding the ability to transform technological investments into effective infectious disease management results. These issues are not directly connected with the presence of digital systems, but the question is how it is possible to integrate them into organizational procedures, how effectively knowledge can be used, and how much health workers can be involved in crisis-response efforts [2].

C. *Research Objectives*

1. To examine the influence of Digital Health Technologies on Infectious Disease Management in healthcare institutions in Riyadh, Saudi Arabia.
2. To investigate the influence of Knowledge Sharing on Infectious Disease Management in healthcare institutions in Riyadh, Saudi Arabia.
3. To test the influence of Digital Health Technologies on Employee Engagement in healthcare institutions in Riyadh, Saudi Arabia.

D. *Scope of the Study*

This study aims to understand the connections among digital health technologies (DHTs), sharing knowledge, and staff engagement, and see how they all influence the management of infectious diseases in healthcare. The subject is clearly laid out along the lines of theme, place, and time to keep things clear and purposeful.

II. METHODOLOGY

As applied to the current paper The Influence of Digital Health Technologies and Knowledge Sharing on Infectious Disease Management: The Mediating Role of Employee Engagement in Healthcare Institutions in Riyadh, positivist philosophy is in the most suitable situation. The research involves quantifiable relationships among well-defined variables (DHTs, KS, EE, IDM) and is supposed to test hypotheses with the help of structured questionnaires and quantitative data processing based on Structural Equation Modelling (SEM). These research design selections indicate the fundamental beliefs of positivism, especially its objectivity, measurability, and generalization [1].

A. *Research Design*

Research design denotes the broad plan which incorporates the various activities of the research in a sensible and rational fashion, hence making sure that the research issue is met appropriately. In this research, quantitative design is selected because it gives the most adequate way of analyzing the relationship between the variables, testing of hypotheses, and objective inferences. [1].

B. *Research Population*

Research population is all individuals or organizations or entities that have some common attributes that can be considered in this study and which a representative sample is sampled to be investigated empirically. The Saudi Ministry of Health (2024) estimates that Riyadh Is home to about 52 large hospitals (both government and private-owned) and more than 370 primary healthcare centers that employ 68,000 healthcare professionals, such as physicians, nurses, pharmacists, administrators, infection control officers, and public health specialists. Thus, the actual number of the target population members (N) in this study is 10,000 members.

C. Research Sample

The sample distribution reflects the diversity of professional roles within the healthcare system, including approximately 150 nurses, 100 physicians, 50 pharmacists, and 70–84 administrative and infection control personnel. This proportional allocation ensures that the sample adequately represents the varied perspectives and responsibilities relevant to digital health usage, knowledge sharing, and infectious disease management [3].

D. Sampling Method Used in This Study

This study employed stratified random sampling, a probability sampling method. The population was divided into professional strata to ensure that all healthcare worker groups-physicians, nurses, pharmacists, infection control officers, and administrative staff-were proportionally represented.

E. Sampling Frame and Sample Size Determination

The total number of healthcare workers in the selected institutions in Riyadh is 10,000 employees. According to Krejcie and Morgan (1970), a sample size of 370 respondents is required to achieve a 95% confidence level and a 5% margin of error. To account for expected non-responses and incomplete questionnaires, the required sample size was multiplied by 1.5, resulting in a target of 555 questionnaires to be distributed (Hair et al., 2016). This adjustment ensures that the final number of valid responses remains statistically adequate.

F. Research Validity and Reliability

Construct validity was considered by directly relating each item with conceptual definition of the variables being studied. As an illustration, Employee Engagement-related items were based on the Utrecht Work Engagement Scale (UWES), which guarantees fit with its three subscales of vigor, dedication, and absorption. [9].

Reliability on the other hand means the sameness and permanency of measurement between time and between respondents. In order to determine the internal consistency, two reliable measures will be used, which are Cronbachs Alpha and Composite Reliability (CR).

G. Pilot Test

A pilot test was carried out before the actual data collection process to test the research instrument with respect to its clarity, reliability and validity.

Pilot testing is a significant phase in the quantitative research process because it enables the researcher to recognize the possible ambiguity, check the suitability of measurement items, and make sure that the questionnaire is both culturally and professionally appropriate in the target population [10].

The questionnaire was given to the participants under the same conditions that the main study will be conducted, which allowed the researcher to assess the problems associated with the administration process, understanding of items, and time of completion [2].

III. Results

The reliability test showed that there was evidence of all study variables where internal consistency showed excellent Cronbach alpha of greater than 0.70. The coefficient of reliability was as follows:

Digital Health Technologies (DHTs): α = 0.89.

Knowledge Sharing (KS): α = 0.91

Employee Engagement (EE): α = 0.87

Infectious Disease Management (IDM): = 0.90.

These findings indicate that the measurement items of each construct are congruent among themselves and can be used in the primary data collection stage.

A. Ethical and Contextual Appropriateness.

The questionnaire was distributed online so that there is ease of access by the participants in various healthcare contexts and working hours. According to feedback provided by the pilot study participants, the questionnaire was not invasive, ethically correct, and directly applicable to the professional roles of the respondents.

TABLE I
Pilot Test Results - Reliability of Constructs

Variable	Number of Items	Cronbach's Alpha (α)	Interpretation
Digital Health Technologies (DHTs)	8	0.87	Excellent Reliability
Knowledge Sharing (KS)	10	0.84	Good Reliability
Employee Engagement (EE)	9	0.90	Excellent Reliability
Infectious Disease Management (IDM)	7	0.85	Good Reliability

Preliminary data analysis ensures data quality by screening, coding, handling missing values, checking normality, and detecting outliers [10;5]. Descriptive statistics will summarize respondents' demographics. The study uses PLS-SEM via SmartPLS to test the measurement and structural models. The measurement model assesses indicator loadings, internal consistency (Cronbach's Alpha, Composite Reliability), convergent validity (AVE), and discriminant validity (Fornell-Larcker, HTMT). The structural model evaluates path coefficients, R^2, effect sizes (f^2), predictive relevance (Q^2), collinearity (VIF), model fit (SRMR, NFI), and mediation of Employee Engagement between Digital Health Technologies, Knowledge Sharing, and Infectious Disease Management [8]. This approach ensures reliable, valid, and robust findings.

A. Preliminary Data Analysis

Preliminary Data Analysis (PDA) is a critical first step in quantitative research, ensuring that the dataset is clean, reliable, and suitable for valid hypothesis testing [10]. This stage involves several key procedures. Data screening examines the dataset for errors, inconsistencies, or illogical values by inspecting raw data and frequency distributions, with impossible values corrected or removed. Coding assigns numerical values to categorical variables, such as gender or job title, to standardize the data for analysis. Conducting PDA improves data accuracy, reduces measurement errors, and enhances internal validity, thereby ensuring that subsequent analyses, including descriptive statistics and Structural Equation Modeling, yield reliable and credible results [5; 1].

B. Structural Equation Modelling (SEM)

This study applies Structural Equation Modelling (SEM) using the Partial Least Squares (PLS-SEM) approach implemented through SmartPLS software. The use of PLS-SEM is justified due to several methodological advantages: it is appropriate for complex models involving multiple latent variables, mediating effects, and relatively small to moderate sample sizes. Furthermore, it is particularly suitable for research that focuses on prediction and theory development rather than covariance matrix reproduction (Al-Anezi, 2025). SmartPLS provides a user-friendly interface that facilitates the estimation of both measurement and structural models, bootstrapping for significance testing, mediation analysis, and assessment of predictive relevance (PLSpredict), goodness-of-fit (e.g., SRMR), and discriminant validity (HTMT).

IV. DISCUSSION

The analytical process In this study will follow two main phases:

A. Measurement Model Assessment (to verify reliability and validity), and
B. Structural Model Assessment (to evaluate hypothesized relationships, collinearity, effect sizes, and mediation).

Before proceeding to SEM analysis, descriptive statistics will be used to summarize respondents' demographic information such as age, gender, job title, and years of experience using means, standard deviations, and frequency distributions. The dataset will be examined for missing values, skewness, kurtosis, and outliers to ensure data quality and normality. Although PLS-SEM is robust to non-normal data, such preliminary checks enhance the robustness and credibility of results [6].

A. Measurement Model Assessment (Reliability and Validity)

The measurement model examines the relationships between observed indicators and their corresponding latent constructs. It ensures that each construct is measured accurately and consistently before testing the structural relationships.

1. Indicator Loadings

Each indicator's loading on its corresponding construct will be evaluated. Items with standardized loadings equal to or greater than 0.70 will be retained, as they indicate strong association with the construct. Loadings between 0.40 and 0.70 will be carefully reviewed, and those below 0.40 will be removed, provided theoretical justification supports such decisions.

2. Internal Consistency Reliability

Construct reliability will be assessed using Cronbach's Alpha and Composite Reliability (CR). Reliability coefficients of 0.70 or higher will be considered acceptable [7]. Composite Reliability is preferred in PLS-SEM as it provides a more accurate estimation when indicator loadings are unequal.

3. Content Validity

Content validity will be established during instrument development through expert evaluation and pilot testing. The instrument will be reviewed by domain experts to ensure that all items accurately represent the conceptual dimensions of the constructs.

All results related to reliability and validity (indicator loadings, Cronbach's alpha, CR, AVE, Fornell-Larcker matrix, and HTMT values) will be summarized and discussed in detail.

B. Structural Model Assessment (Path Analysis and Predictive Evaluation)

After the measurement model demonstrates acceptable reliability and validity, the structural model will be examined to test the hypothesized relationships and evaluate the model's predictive strength.

1. Collinearity Assessment

The Variance Inflation Factor (VIF) will be examined to assess multicollinearity among predictor constructs. Acceptable VIF values are below 5.0 (preferably below 3.3), indicating no significant collinearity issues [1].

2. Path Coefficients Estimation

The structural paths among constructs-Digital Health Technologies (DHTs), Knowledge Sharing (KS), Employee Engagement (EE), and Infectious Disease Management (IDM-will be estimated to test the hypothesized causal relationships. Significance will be evaluated through bootstrapping with 5,000 resamples, providing t-values, p-values, and confidence intervals [8]

3. Coefficient of Determination (R^2)

The R^2 values will represent the explanatory power of independent variables on the dependent constructs. According to Hair et al. (2021), R^2 values of 0.26, 0.13, and 0.02 are interpreted as substantial, moderate, and weak, respectively.

V. Limitations Of The Study

Despite the rigorous methodological approach using stratified random sampling and PLS-SEM, this study acknowledges several limitations that should be considered when interpreting the results:

Cross-Sectional Design: This study utilizes a cross-sectional approach, capturing data at a single point in time. Because digital transformation and employee engagement are dynamic processes, this design limits the ability to draw definitive long-term causal inferences compared to longitudinal studies.

Technological Velocity: The field of Digital Health Technologies (DHTs) is evolving rapidly. Specific tools mentioned in the study (e.g., AI-based decision systems or specific telemedicine platforms) may undergo significant upgrades by the time the study is published, potentially affecting the relevance of certain technical findings.

VI. Conclusion

This research provides a comprehensive framework for understanding how the "human element"—specifically Employee Engagement—serves as the vital link between technical resources and public health outcomes. By investigating the dual impact of Digital Health Technologies (DHTs) and Knowledge Sharing (KS), this study moves beyond a purely technical view of healthcare management.

Ultimately, this study contributes to the Saudi Vision 2030 Health Transformation Program by providing empirical evidence for hospital administrators in Riyadh. The findings underscore that to improve Infectious Disease Management, institutions must not only invest in high-end DHTs but also foster a culture of engagement and open communication. This holistic approach ensures that when the next health threat emerges, the workforce is not only technologically equipped but also cognitively and emotionally prepared to respond effectively.

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