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Investigating the Impact of Leadership Competencies on Digital Health Adoption Among Healthcare Providers: A Cross-Sectional Study Protocol

Omar Hamed Alharbi*, Farra Aidah Jumuddin**, Dhakir Abbas Ali***
*(Centre of Postgraduate Studies, Lincoln University College, Malaysia King Salman Medical City, Madinah, Saudi Arabia
Email: Omar.phdscholar@lincoln.edu.my)
**(Lincoln University College, Malaysia
Email: farraaidah@lincoln.edu.my)
***(Lincoln University College, Malaysia
Email: drdhakir@lincoln.edu.my)
**Corresponding Author: Farra Aidah Jumuddin (farraaidah@lincoln.edu.my)

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Abstract:

Digital health transformation is a strategic priority for Saudi Arabia's Vision 2030, yet healthcare organizations face persistent challenges in achieving successful adoption. This protocol describes a cross-sectional study investigating the impact of leadership competencies on digital health adoption among healthcare providers at King Salman Medical City, examining the mediating roles of change readiness and training effectiveness. An analytical cross-sectional design will recruit healthcare providers through stratified random sampling. Data collection utilizes validated instruments including the Leadership Practices Inventory, Organizational Readiness for Change Assessment, Technology Acceptance Model questionnaire, and Kirkpatrick Training Evaluation scales. Structural equation modeling will test hypothesized relationships and mediation effects. The study will provide empirical evidence regarding leadership competencies' direct effects on digital health adoption and mediating mechanisms, informing leadership development strategies and workforce preparation initiatives supporting digital transformation.

Keywords — study protocol, leadership competencies, digital health adoption, change readiness, training effectiveness, cross-sectional study, healthcare providers.

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I. INTRODUCTION

Digital health transformation represents one of the most significant contemporary shifts in healthcare delivery, encompassing electronic health records, telemedicine, artificial intelligence applications, and mobile health solutions. The Kingdom of Saudi Arabia has positioned healthcare digitization as a cornerstone of Vision 2030, with substantial investments in technological infrastructure across the healthcare system [1], [2]. However, evidence from implementation efforts globally indicates that technological availability alone is insufficient for achieving successful adoption and sustained utilization.

Research increasingly identifies human factors as critical determinants of digital health implementation success [3]. Healthcare providers, as primary system users, fundamentally influence whether digital technologies achieve their intended clinical and operational benefits. Provider resistance, inadequate preparation, and insufficient leadership support have been identified as persistent barriers to adoption across diverse healthcare contexts [4].

Leadership competencies emerge as particularly salient factors influencing digital health adoption outcomes. Leaders shape organizational culture, allocate resources for training and support, communicate vision and expectations, and model technology utilization behaviors [5]. Transformational leadership practices have demonstrated positive associations with change

implementation across organizational contexts, though specific applications to digital health adoption in healthcare settings require further investigation.

King Salman Medical City (KSMC), as one of Saudi Arabia's premier tertiary healthcare institutions serving over 1.2 million patients annually, has actively pursued digital transformation initiatives. The institution provides an ideal setting for investigating leadership and adoption dynamics within a large, complex healthcare organization advancing digital health implementation.

The primary aim of this study is to investigate the impact of leadership competencies on digital health adoption among healthcare providers at KSMC, with specific attention to the mediating roles of healthcare providers' change readiness and training effectiveness. The specific research objectives are: (1) To investigate the effect of leadership competencies on digital health adoption; (2) To test the effect of leadership competencies on healthcare providers' change readiness; (3) To examine the effect of leadership competencies on staff training effectiveness; (4) To investigate the effect of change readiness on digital health adoption; (5) To test the effect of training effectiveness on digital health adoption; (6) To examine the mediating effect of change readiness; and (7) To investigate the mediating effect of training effectiveness on the relationship between leadership competencies and digital health adoption.

II. MATERIALS AND METHODS

A. Study Design

This study will employ an analytical cross-sectional design to investigate relationships between leadership competencies, mediating variables (change readiness and training effectiveness), and digital health adoption among healthcare providers. The cross-sectional approach enables assessment of associations across the study population at a single time point while allowing statistical modeling of hypothesized mediation relationships.

B. Setting

The study will be conducted at King Salman Medical City in Madinah, Saudi Arabia. KSMC operates under the Ministry of Health as a major tertiary healthcare complex comprising multiple specialized hospitals and clinics. The institution serves the Madinah region and receives referrals from across the Western Region of Saudi Arabia. KSMC has actively implemented digital health technologies including electronic health records, telemedicine services, and clinical decision support systems as part of national healthcare digitization initiatives.

C. Study Population and Sampling

The target population includes all healthcare providers directly involved in patient care at KSMC, encompassing physicians (consultants, specialists, residents), nurses (all categories), and allied health professionals (pharmacists, laboratory technologists, radiographers, physiotherapists, and related disciplines). Clinical managers and supervisors who maintain patient care involvement will be included.

Inclusion criteria are: current employment at KSMC for a minimum of six months; direct involvement in patient care activities; exposure to digital health technologies in their work environment; and willingness to provide informed consent. Exclusion criteria include: administrative staff without patient care responsibilities; healthcare providers on extended leave during the data collection period; and temporary or visiting staff.

Sample size was calculated using G*Power software for structural equation modeling analysis, targeting medium effect size ($f^2 = 0.15$), alpha of 0.05, power of 0.80, and accounting for the number of predictors and hypothesized pathways. The minimum required sample is 320 participants; targeting 400 participants will accommodate potential missing data and enhance statistical power. Stratified random sampling will ensure representation across professional categories, hospital units, and experience levels.

D. Variables and Instruments

The study variables and their measurement instruments are presented in Table I. Leadership competencies serve as the independent variable, measured using the Leadership Practices Inventory (LPI) [6]. Change readiness and training effectiveness function as mediating variables, assessed using the Organizational Readiness for Change Assessment (ORCA) [7] and Kirkpatrick Training Evaluation Scale [8], respectively. Digital health adoption is the dependent variable, measured using the Technology Acceptance Model (TAM) questionnaire [9].

TABLE I
STUDY VARIABLES, MEASUREMENT INSTRUMENTS, AND DIMENSIONS

Variable	Type	Instrument	Dimensions
Leadership Competencies	Independent	Leadership Practices Inventory (LPI)	Model the Way, Inspire Vision, Challenge Process, Enable Others, Encourage Heart
Change Readiness	Mediator 1	Organizational Readiness for Change Assessment (ORCA)	Change Commitment, Change Efficacy, Contextual Factors
Training Effectiveness	Mediator 2	Kirkpatrick Training Evaluation Scale	Reaction, Learning, Behavior, Results
Digital Health Adoption	Dependent	Technology Acceptance Model (TAM) Questionnaire	Perceived Usefulness, Perceived Ease of Use, Behavioral Intention, Trust

E. Data Collection Procedures

Data will be collected through self-administered questionnaires distributed electronically via secure online survey platform with paper-based alternatives available. The questionnaire will be available in both English and Arabic, with translation following standard forward-backward translation protocols to ensure linguistic equivalence.

Trained research assistants will approach potential participants in their work units, explain the study purpose and procedures, obtain informed consent, and provide access to the survey. Participants will complete questionnaires during work breaks or at convenient times within a two-week response window. Follow-up reminders will be sent at one week for non-respondents. Questionnaire sections include demographic and professional characteristics, LPI items, ORCA items, training effectiveness items, and TAM items.

F. Statistical Analysis Plan

Data analysis will proceed through several phases. Preliminary analysis includes data screening for missing values, outliers, and normality assumptions. Descriptive statistics will characterize the sample and summarize variable distributions including means, standard deviations, frequencies, and percentages as appropriate.

Reliability analysis will assess internal consistency using Cronbach's alpha, with coefficients of 0.70 or higher considered acceptable. Confirmatory factor analysis will evaluate measurement model fit and construct validity prior to structural modeling. Structural equation modeling using AMOS or SmartPLS software will test hypothesized relationships. Mediation analysis following Baron and Kenny [10] procedures supplemented by bootstrapping will assess indirect effects. Model fit will be evaluated using chi-square, CFI, TLI, RMSEA, and SRMR indices. Statistical significance will be determined at alpha = 0.05.

G. Ethical Considerations

The study protocol will be submitted for ethical review and approval to the Institutional Review Board of King Salman Medical City prior to data collection. Additionally, approval will be obtained from Lincoln University College research ethics committee. Participation will be voluntary, with participants providing written informed consent prior to enrollment. Participants may withdraw at any time without consequence. Confidentiality will be maintained through anonymized identification codes, secure data storage with restricted access, and aggregated reporting of findings. No direct risks to participants are anticipated from survey completion.

III. RESULTS AND DISCUSSION

A. Expected Outcomes

This study is expected to generate several important outcomes with theoretical and practical

significance. Empirically, the study will provide evidence regarding the direct effects of leadership competencies on digital health adoption among healthcare providers in a major Saudi Arabian healthcare institution. The investigation of mediating mechanisms through change readiness and training effectiveness will advance understanding of how leadership influence operates in digital transformation contexts.

Theoretically, findings will contribute to integration of leadership theory, organizational readiness theory, and technology adoption frameworks as applied to healthcare digital transformation. The study will extend application of the Leadership Practices Inventory framework to technology implementation contexts in Middle Eastern healthcare settings [11].

B. Practical Implications

Practically, results will inform leadership development strategies targeting competencies most influential for digital health adoption success. Findings will guide workforce preparation initiatives addressing both psychological readiness and capability development. Policy recommendations will support national healthcare digitization objectives aligned with Saudi Vision 2030 [12]. The study setting at KSMC, as a leading tertiary institution actively implementing digital health technologies, enhances the relevance and applicability of findings for similar organizations.

C. Study Timeline

The anticipated study timeline is presented in Table II, spanning twelve months from ethics approval through dissemination.

TABLE II
ANTICIPATED STUDY TIMELINE

Phase	Duration
Ethics approval and administrative permissions	Months 1-2
Instrument preparation and pilot testing	Month 3
Data collection	Months 4-6
Data analysis	Months 7-9
Report writing and dissemination	Months 10-12

D. Methodological Considerations

Several methodological strengths support the study design. The use of validated instruments with established psychometric properties enhances measurement reliability and validity. Structural equation modeling enables simultaneous testing of multiple hypothesized relationships and mediation effects. Stratified sampling ensures representative coverage of diverse healthcare provider categories.

Potential limitations warrant acknowledgment. The cross-sectional design precludes causal inference; observed associations may reflect reverse causation or confounding. Self-report measures may introduce response biases including social desirability effects. Single-institution sampling limits generalizability, though KSMC's characteristics as a large, complex tertiary institution enhance relevance for similar contexts pursuing healthcare digitization.

IV. CONCLUSIONS

This protocol describes a rigorously designed cross-sectional study investigating relationships between leadership competencies, workforce factors, and digital health adoption in a major Saudi Arabian healthcare institution. The study addresses significant gaps in understanding how leadership practices influence technology adoption outcomes in healthcare settings undergoing digital transformation.

Findings from this study will contribute to the evidence base supporting effective digital health implementation strategies in healthcare organizations. The investigation of mediating mechanisms offers particular value for understanding how leadership development and workforce preparation can be optimized to support successful digital transformation aligned with national healthcare priorities under Saudi Vision 2030.

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