Artificial Intelligence Integration and Healthcare Management Efficiency: The Mediating Effects of Organizational Digital Maturity and Innovation Capability in Saudi Public Hospitals

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Abstract—

Background: **In the rapidly evolving digital healthcare landscape, the mere adoption of technology does not automatically guarantee improved organizational performance. This study investigates the impact of Technology Integration on enhancing Healthcare Management Efficiency within the Saudi Arabian public health sector.**

Methodology: **A quantitative research design utilizing a purposive, stratified non-probability sampling technique was employed. The study population consists of 7,819 healthcare professionals across various disciplines (physicians, nurses, allied health, and informatics) within the Riyadh Second Health Cluster.**

Results: **Pilot test results demonstrated high internal consistency across all scales, with Cronbach's alpha values ranging from 0.79 to 0.85. Content Validity Index (CVI) scores from an expert panel exceeded the 0.80 threshold, confirming the relevance of the measurement items. The strongest inter-scale correlation was observed between Technology Integration and Digital Transformation Readiness (r=0.58), supporting the hypothesized pathways.**

Conclusions: **The study concludes that achieving healthcare management efficiency in Saudi government hospitals requires a holistic approach that harmonizes technical tools with organizational culture.**

Keywords— **Technology Integration, Healthcare Management Efficiency, Digital Transformation Readiness, Innovation Capability, Saudi Vision 2030, Riyadh Second Health Cluster, Electronic Health Records.**

I. INTRODUCTION

With the great advancements in technology these days, tactical integration of technology into digital healthcare assumes an important role in the transformation of patient care in the ever-altering medical environment.

Electronic Health Records (EHRs) function as a cost-saving mechanism that enhances productivity and streamlines clinical workflows, as noted by Alam et al. (2020) and Willie (2019). The diffusion of health information technologies has accelerated significantly in recent years. Digital transformation refers to the process of restructuring information technology systems to improve organizational performance by fundamentally modifying operational attributes through information and communication technologies (ICT).

Digital transformation can influence the structure of digital growth plans, transformation, and especially transformation related to organizational structure, competitive advantage, buying and selling of digital data, and a lot more good cause in the medical organization[12]. Such circumstances and situations are common in multiple areas of business research, spanning promotions, the information systems department in any healthcare organization, the team-building scheme, stripping the business world of all reality, and spreading the idea of Industry 4.2 in healthcare. Digital transformation refers to the use of ICT to fundamentally change the attributes of healthcare organizations in order to enhance their performance[12].

This article examines a subset of functionalities afforded by electronic health records, telemedicine, and artificial intelligence, advancing the argument that, when strategically integrated, these modalities retain the potential to transform indemnified health delivery. Through the analysis of operational, communicational, and contextual overlaps among these technologies, the present research seeks to elucidate their cumulative impact on organisational efficiency, on the receptivity of clinical communication, and on the capacity for health services to attune continuously to the specific needs of discrete patients.

Digital information created, stored, and transferred in healthcare is often simply calling it, with little conceptual difference, Electronic Health Records (EHR), Electronic Medical Records (EMR) or Electronic Patient Records (EPR). These terms are globally applicable and functionally inclusive of diverse modalities of digital patient content-clinical documents, radiologic impressions, and digitally transmitted pharmaceutical orders among others-each of which is one of the central, interlocking aspects of patient recognition and intervention.

This research paper will be based on the concept of efficiency, which refers to the capacity of healthcare institutions to enhance the performance of operations, cost reduction, patient throughput, medical errors, and patient satisfaction. The effect of incorporation of technology on efficiency, however, does not come automatically. The functions of Digital Transformation Readiness (DTR)-hospitals preparedness (infrastructure, leadership, and workforce) and Innovation Capability (IC)-the capacity to use and create new ideas and technologies are essential. This study, therefore, highlights the mediating effects of DTR and IC in the description of how the actual effects of the technology integration may culminate into increased efficiency in healthcare management.

A. Problem Statement

In the whole Saudi governmental hospital management, the transformation of digital capital into real operation benefits is recalcitrantly difficult. The need to take a lot of research on organizational intermediaries and a sensitive appreciation of the variables that define a particular region in terms of culture and context hinders progress. The present research focuses on the Cluster Two hospitals of the Ministry of Health in the Riyadh metropolitan region with the clear purpose of providing practical evidence to the hospital administrators and digital health developers, which fits the general national agenda of digitally enhanced health services development [9, 3, 6, 14]. The effective assimilation of technology thus conditions the capital public care setting on three conditions: the creation of sound technological support, organisational preparedness to increase the speed of digitalisation as well as the existence of the culture of sustained innovation that is widespread and embedded.

B. Research Objectives

To examine the impact of Innovation Capability on the Enhancing Healthcare Management Efficiency on Government hospitals in Riyadh, Saudi Arabia.

To examine technology Integration Effect on improving Healthcare management efficiency through digital transformation Readiness in government hospitals in Riyadh, Saudi Arabia.

To investigate the impact of Technology Integration on the Promotion of Healthcare Management Efficiency by means of Innovation Capability in the public hospitals in Riyadh, Saudi Arabia

II. METHODOLOGY

A. Research Design

The design of this study is developed on the complete insight of deductive/inductive methodologies, in taking into consideration various paradigms of knowledge generation that constitute scientific inquiry[15, 16].

B. Study Population

The research sample will encompass all the healthcare professionals working in the Riyadh Second Health Cluster, which is 7, 819 people working in the King Fahad medical city (KFMC), Prince Mohammed Bin Abdulaziz hospital (PMAH), Al Yamamah Hospital as well as the Primary Healthcare Centers (PHCs) attached with them. Such population constitutes of all active healthcare providers directly or indirectly engaged in clinical services delivery, hospital administration, health informatics operations and digital health technology use.

The workforce is distributed across four major professional groups:

- 2,996 allied health personnel (38.32%)
- 2,673 medical doctors (34.19%)
- 1,977 nursing staff (25.28%)
- 173 health informatics specialists (2.21%)

All these professionals are the most pertinent members of the group that will be engaged to take part in this study since they are directly engaged with electronic health records, administrative information systems, digital infrastructures, and technology-based workflow processes. Their practical experience places them in the position to offer credible information about the digital transformation preparedness, system integration, and organizational efficiency in healthcare.

C. Study Sampling

A purposive non-probability sampling technique was adopted which particularly entailed incurring selection of participants who had direct contact with the healthcare technologies as well as the operational procedures of the hospitals and the primary healthcare centers of the Riyadh Second Health Cluster.

Additionally, to ensure an improved representation, a stratified purposive layer was incorporated that comprised of the key professional groups comprising of doctors, nurses, allied health personnel and health informatics personnel; in addition to proportional representation of the hospitals and PHCs within the Cluster. This process can not only be used to make sure that all parties are fairly represented helping to reduce sampling bias.

To calculate the minimum sample size needed, the Krejcie and Morgan (1970) formula has been used and considerations made that a total population of 7819 healthcare practitioners will be used, the confidence level of 95 percent, with a 5 percent error margin. In this method, 367 respondents are proposed as the minimum sample size, which is the general in healthcare and organizational study with a large sample.

TABLE I
Health care participants.

Physicians	*2,673*	*34.19%*	*157*
Allied Health Professionals	2,996	38.32%	176
Nurses	1,977	25.28%	116
Health Informatics Staff	173	2.21%	11
Total	7,819	100%	460

D. Data Collection Instrument

The research tool includes structured questionnaires which are self-administered and operationalize all the theoretical constructs with validated measurement scales from the literature on healthcare management and organizational behavior [13]. The full questionnaire includes 45 items and has 5 sections [6].

E. Pilot test

Before commencing full-scale data collection throughout the Riyadh Second Health Cluster in Riyadh city, several pilot tests were undertaken to assess the feedback forms for their reliability, validity, understanding, and suitability for the target population context, which allows for the accurate functioning of the measurement tools before the main study is undertaken [17,18].

There are several functions of the pilot tests to be completed: assessing the clarity of the questions aimed at the respondents, the estimation of the response time, the identification and revision of questions, estimation of various forms of validity and constructing the test culturally to the validators in the Saudi Arabian healthcare system [19]. The pilot test is necessary to ensure no resources are wasted in data collection. This is in line with indicators of validation and functional adequacy [21].

III. RESULTS

A. Pilot Study Sample and Recruitment:

Fifty (50) healthcare professionals were chosen as a pilot test sample from the public hospitals of the Riyadh Second Health Cluster [18, 6]. They were chosen based on a variety of professional frameworks, hierarchies, organizations and demographics which enabled a holistic view of the healthcare environment as the primary study population. Similarly, the sample composition was aligned with the expected stratification of the main study: Hospital Administrators and Management Staff (n=8, 16%); Clinical Directors and Medical Heads (n=6, 12%); IT and Digital Health Managers (n=6, 12%); Physicians (n=15, 30%); Nurses (n=12, 24%); and Administrative Staff (n=3, 6%). Of the 50, 32 (100%) were from the public sector hospitals.

B. Last Questionnaire Preferences:

According to the updates on the pilot test, the final questionnaire will include 35 multi-item measurements (8 Technology Integration, 9 Digital Transformation Readiness, 8 Innovation Capability, 10 Healthcare Management Efficiency) and 10 demographic and institutional information variables, which will be 45 items in total. Based on the data of the pilot test, the mean time to complete was 13.2 minutes (SD = 2.4 minutes, range: 9 to 19 minutes). This aligns with the projected average duration of completion of 12-15 minutes, which means that the burden of administering the questionnaire to the healthcare working setting is also realistic [18, 6].

Evidence of Validity from Pilot Test:

Initial phases of establishing the validity of the measurement tool provide converging evidence in support of the tool's measurement the appropriateness of the tool's measurement:

Content Validity Index: The expert panel review (carried out before the pilot testing) provided the following individual item Content Validity Index values:

- Technology Integration items: CVI range 0.80–1.00 (mean CVI = 0.92)
- Digital Transformation Readiness items: CVI range 0.80–1.00 (mean CVI = 0.89)
- Innovation Capability items: CVI range 0.80–1.00 (mean CVI = 0.91)
- Healthcare Management Efficiency items: CVI range 0.80–1.00 (mean CVI = 0.90)

IV. DISCUSSION

All items met the Content Validity Index threshold of 0.80, confirming the consensus of experts was sufficient to support the items' relevance to the theoretical constructs. [17, 19].

Discriminate Validity Assessment: Inter-scale correlations for pilot test scales on Technology Integration, Digital Transformation Readiness, Innovation Capability, and Healthcare Management Efficiency.

The remaining inter-scale correlations were, however, moderate ($r < 0.50$), which positively supports the idea of having discriminant validity [6,19].

Convergent Validity Assessment: Convergent validity was determined by assessing the individual items in a construct and their respective components through the principal components factor analysis of pilot data. The factor analysis showed that all items had primary loadings of 0.50 and above on their respective constructs with the majority exceeding 0.60. Most items exceeding 0.60 demonstrate preliminary convergent validity [17].

V. LIMITATIONS OF THE STUDY

Despite the rigorous methodological framework and the use of the Riyadh Second Health Cluster as a representative model, this study acknowledges several limitations:

Geographical and Sectoral Scope: The study is confined to government hospitals within the Riyadh Second Health Cluster. While this provides deep insight into the Saudi public healthcare sector, the findings may not be fully generalizable to private healthcare institutions or different geographical regions with varying digital infrastructures.

Methodological Constraints: As a cross-sectional study, the data captures a "snapshot" in time. Since digital transformation and innovation are longitudinal processes, this design limits the ability to draw definitive causal conclusions compared to a longitudinal approach.

VI. CONCLUSION

This research proposal establishes a comprehensive framework to investigate the intricate relationship between Technology Integration and Healthcare Management Efficiency. Instead, it argues that for the Ministry of Health (MOH) in Saudi Arabia to realize true operational efficiency, it must harmonize technical tools with organizational preparedness and a culture of continuous innovation.

The pilot test results have already demonstrated high reliability ($\alpha > 0.70$) and strong content validity, ensuring that the final instrument is both culturally and professionally suited for the Riyadh healthcare landscape. Ultimately, this research aims to provide a strategic roadmap for hospital administrators. It will offer empirical evidence on how to transition from mere "digitization" (moving to electronic records) to true "digital transformation"—where technology, people, and processes synergize to reduce medical errors, optimize resources, and enhance patient satisfaction in alignment with the Saudi Vision 2030 healthcare transformation goals.

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