# DIGITAL TRANFORMATION IMPACT ON EGYPT'S GOVERNMENTAL DEVELOPMENT FOCUSING ON HEALTH CARE SECTOR DEVELOPMENT USING ARTIFICAIL INTELIGENCE TECHNIQUES

**Research Paper for Scientific Journal**

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## ABSTRACT

Digital transformation could reshape any sector after applying it, and in light of importance of healthcare and how digital transformation could dramatically improving its service for better patient outcomes, This dissertation investigate the impact of digital transformation on governmental development, focusing on healthcare service improvement, particularly discuss using following tools Electronic Health Records (EHR), Artificial Intelligence (AI), and the Internet of Medical Things (IOMT), and how the COVID-19 pandemic accelerated these

efforts, output recommendations & strategies according to best practices.

Using a mixed-methods approach, the study analyzed quantitative data from a survey of 426 healthcare employees globally, supplemented with qualitative insights from interviews with healthcare professionals in the Middle East. Chi-square and F-tests were used to analyze the data.

The results revealed significant differences in perceptions of digital transformation across different organizational stages and country classifications, highlighting the influence of digital maturity and national context on technology adoption and perceived benefits. The study recommends developing tailored digital transformation strategies that account for an organization's specific stage of digital maturity, investing in training to enhance digital skills, prioritizing the integration of advanced technologies like AI to improve diagnostic accuracy, EHR improve efficiency and IOMT for real time medical status reporting, establishing robust data governance frameworks, fostering cross-border collaborations, and implementing change management strategies to address cultural barriers.

**Keywords:** Digital Transformation; HealthCare; SDG3; Artificial Intelligence, Electronic Health record; Internet of Medical things; Covid-19

**الملخص العربي:**

تناولت هذه الأطروحة تأثير التحول الرقمي على التنمية الحكومية، مع التركيز على تحسين خدمات الرعاية الصحية، وخاصة من خلال مناقشة الأدوات التالية: السجلات الصحية الإلكترونية(EHR) ، الذكاء الاصطناعي(AI) ، وإنترنت الأشياء الطبية(IoMT) ، وكيف أن جائحة COVID-19 قد سرعت هذه الجهود. باستخدام نهج مختلط، قامت الدراسة بتحليل البيانات الكمية من استبيان شمل ٤٢٦ موظفًا في مجال الرعاية الصحية على مستوى العالم، مدعومًا برؤى نوعية من مقابلات مع محترفي الرعاية الصحية في الشرق الأوسط. تم استخدام اختبارات كاي-تربيع واختبارات F لتحليل البيانات. كشفت النتائج عن اختلافات كبيرة في تصورات التحول الرقمي عبر مراحل تنظيمية مختلفة وتصنيفات دولية، مما يبرز تأثير النضج الرقمي والسياق الوطني على تبني التكنولوجيا والفوائد المدركة. توصي الدراسة بتطوير استراتيجيات تحول رقمي مخصصة تأخذ في الاعتبار المرحلة المحددة لنضج الرقمي في المنظمة، والاستثمار في التدريب لتعزيز المهارات الرقمية، وإعطاء الأولوية لدمج التقنيات المتقدمة مثل الذكاء الاصطناعي وإنترنت الأشياء الطبي، وإنشاء أطر حوكمة بيانات قوية، وتعزيز التعاون عبر الحدود، وتنفيذ استراتيجيات إدارة التغيير لمعالجة الحواجز الثقافية.

**الكلمات المفتاحية :** التحول الرقمي. الرعاية الصحية.اهداف التنمية المستدامة. الذكاء الاصطناعي. سجلات المرضى الإلكترونية. إنترنت الأشياء الطبية. كوفيد ١٩.

# CHAPTER ONE
# AN OVERVIEW

## 1.1 Introduction

The world is changing at a pace never before seen due to a digital revolution. The way individuals communicate and share information, do business, and engage with the public and private sectors has all been altered by digital technology. To successfully navigate the digital revolution and capitalize on the vast amount of value generated by the digital economy,

Digital transformation has gained the greatest importance during the 21st century. It has revolutionized all areas of all sectors, including the healthcare sector. "The integration of digital technology into businesses has transformed their structure, infrastructure, processes, operations, communication, culture, behavior, and customer experience" (Brinkmann & O'Brein, 2010; Herrmann et al., 2018). In this dynamic era, all healthcare organizations strive to enhance their digital strategies to increase effectiveness and efficiency within the contemporary healthcare environment, leading to improvements in quality, cost-effectiveness, and accessibility.

A future-oriented paradigm is shown by "the Sustainable Development Goals" (SDGs) established by the United Nations (UN) in 2015. The United Nations established a sustainable development agenda of 17 goals aimed at transforming the world and advancing five Ps: People, Planet, Prosperity, Peace, and

Partnership by 2030 (Fleming, Wise, Hansen, & Sams, 2017; Wysokińska, 2017). Goal three, Sustainable Development Goal 3 (SDG3), "impacts healthcare and seeks to ensure healthy lives and promote well-being for all individuals at every age" It has focused on the strategies of healthcare organizations and their long-term objectives for accomplishing this aim by 2030 (Fleming et al., 2017). This study will examine diverse cases representing various stages of digital transformation, focusing on countries with high digital transformation indices. it will analyze nations already advanced in their digital transformation journey, examining their strategies, best practices, and achieved benefits. also, it will investigate countries at the beginning of their digital transformation, referred to as the "Watch Out Group," to understand the challenges and barriers they face in adopting new technologies. By comparing these two groups, the study aims to identify solutions to overcome these challenges, determine realistic timeframes for achieving efficient outcomes, and assess the impact of digital transformation on societal factors like citizen confidence, business growth, government spending and the improvement of public services.


**Figure.1.1: United Nations Sustainable Development Goals**

**Source:** The 17 United Nations' sustainable development goals: a status by Rainer Bruggemann (2020)

As illustrated in figure 1.1 shows all 17 goals where SDG3, which is "Ensure healthy lives and promote well-being for all at all ages" (World Health Organization, 2018); healthcare is the cross-cutting role of all SDGs.

## 1.2 Research Gap

The study of digital transformation's impact on Egypt's governmental development, particularly in the healthcare sector through the application of Artificial Intelligence (AI) techniques, reveals several research gaps that warrant exploration. There is limited empirical evidence on how AI specifically influences healthcare development in Egypt. Existing studies often focus on developed countries, with less attention given to developing

nations like Egypt, which have unique socio-economic and infrastructural contexts. Furthermore, there is a lack of investigation into how planning and implementation of AI can facilitate access, quality, and affordability from the health policies and systems perspective of Egypt. Bridging this gap may provide country-specific lessons learned, and frameworks for implementing AI to improve healthcare outcomes in Egypt.

**1.3 Problem Statement:**

This study aims to "Investigating the impact of Digital transformation on government development by measuring KPI improvement and focus mainly on transformation of Health care sector and output recommendations & strategies according to best practices"

**1.4Research Objectives**

According to the study problem, the study aims to do the following:

1 To assess whether perceptions of digital transformation strategies are consistent across different country groups, identifying any potential uniformity in strategic clarity.

2 To determine if the pandemic's influence on digital transformation acceleration is perceived similarly across various countries, indicating a global or regionally varied impact.

3 To evaluate whether the prioritization of key digital transformation factors is consistent among country groups,

suggesting a shared understanding of transformation priorities.

4 To assess whether the effectiveness of EHR in improving healthcare efficiency is perceived uniformly across different stages of digital transformation, indicating stage-independent valuation.

5 To explore whether country classification influences perceptions of AI's effectiveness in minimizing treatment errors, indicating a globally consistent or varying perception.

6 To investigate whether the usage of IOMT in improving healthcare patient's outcome is perceived uniformly across different stages of digital transformation, indicating stage-independent valuation.

**1.5 Research Questions**

According to the study objectives need to achieve, the study was based on several questions as follows:

Q1. Do country groups perceive their digital transformation strategies similarly, with no significant differences?

Q2. Is there a uniform perception among country groups regarding the impact of the COVID-19 pandemic on accelerating digital transformation?

Q3. Are digital transformation priorities, including data management, talent acquisition, and budgeting, perceived equivalently across different country groups?

Q4. Does the stage of digital transformation affect perceptions of Electronic Health Records' (EHR) impact on healthcare efficiency?

Q5. Are there consistent perceptions across countries regarding AI applications' ability to reduce treatment errors in healthcare?

Q6. Does the stage of digital transformation affect perceptions of IOMT affect patient outcomes improvements?

## 1.6 Research Approach

This study employs descriptive analytical approach through a mix of quantitative research to explore the variances in digital transformation perceptions across different country groups. Utilizing structured surveys and statistical analysis procedures, such as chi-square and F-tests, the research aims to quantify perceptions related to digital strategies, the impact of the COVID-19 pandemic, and prioritization of transformation factors like data, talent, and budget. supplemented with qualitative insights from interviews with healthcare professionals in the Middle East.

## 1.7 Research Importance

The importance of the study consists of applied importance and theoretical importance, which are as follows:

### 1.7.1 Theoretical Importance

This study contributes to the theoretical understanding of digital transformation in healthcare by providing a comparative

analysis across diverse country groups and organizational stages. It enhances existing theoretical frameworks on digital transformation by examining the influence of contextual factors, such as cultural differences, pandemic-induced pressures, and varying levels of technological readiness, on the perception and implementation of digital health strategies. More over to link digital transformation impact healthcare improvement to SDG3 achievement, the findings offer valuable insights into the complex interplay between technological advancements, organizational factors, and external pressures in driving digital transformation in the healthcare sector. Finally, this study further emphasizes that future development and implementation should take into account the specific context and level of digital maturity.

### 1.7.2 Practical Importance

Research findings have important practical implications for health care leaders, policy makers, and technology vendors. Through a nuanced understanding of the dimensions that lead to the successful transformation of an organization's digital aspect, the study offers guidance to organizations that seek to take their digital health strategies in the right direction. This comparison over groups helped to elaborate a useful benchmark across country groups and organizational stages for healthcare organizations to understand their digital maturity in the observed areas and define targets for improvement. Additionally, the results can help

implement tailored interventions and policies that support the digital transformation and burden in healthcare trenches, eventually resulting in enhanced patient care, enhanced efficiency, and reduced costs. The insights on the perceived impact of EHR, AI, and other digital health technologies can guide investment decisions and implementation strategies for healthcare organizations and technology providers.

## CHAPTER TWO
## LITERATURE REVIEW

### 2.1 Introduction

This chapter navigated the existing literature in healthcare for digital transformation Strategies and efficient tools supporting Sustainable Development Goal 3 (SDG3). This study's objective was to Explain the digital transformation strategies with priorities that healthcare leaders need to follow for supporting achievement of Sustainable Development Goal 3 on the UN's agenda by 2030 by studying which digital tools are more efficient. also study pandemic impact on moving pace toward transformation, highlighting key challenges and how to overcome them, and highlighting the benefits of this development. After identify debate and analyze gaps and critically evaluate to give a clear picture of status of knowledge

### 2.2 Digital Transformation

Digital transformation denotes the transition from systems that rely on non-digital technology to those that incorporate

digital technologies. "Digital transformation involves both the technical conversion of information from paper to digital formats and a socio-technical shift in the application of digital technology" (Yoo et al., 2010).

Given the unprecedented shifts in technology, demographic patterns, and patterns of consumption, there is a shared belief that sustainable development is the only approach to stave off social and environmental disasters. The Sustainable Development Goals for the 2030 Agenda were adopted by United Nations Member States in 2015 as new global agreements between Earth and People (United Nations,2019). The 2030 Agenda for Sustainable Development consists of 17 Sustainable Development Goals (SDGs) which have under them 169 targets and 304 indicators of development

**2.٣ Digital Transformation in Healthcare sector**

The growing importance and popularity of digital transformation in terms of health-related processes and services increasingly becomes vital parts of regional policies as well as strategic choices of global healthcare institutions (Bara-Slupski, 2016; Preko & Boateng, 2020; Biancone et al., 2021). The term 'e-health' has found its place in the healthcare organizations since the 1990s and digital technologies have been essential to this transition (Aceto et al., 2018; Tortorella et al., 2020a). The implementation of digital technologies in hospitals has increased due to compact size, improved accessibility,

### 2.٣.1 Digital Transformation Trends in Healthcare

The digital transformation of healthcare has produced several key trends reflecting the growing convergence of sophisticated technology with healthcare systems. One of the biggest trends is the increasing use of artificial intelligence (AI) and machine learning for several healthcare applications. Such technologies are used to build models that predict outbreaks, organize treatment strategies, and customize patient care (Reddy et al., 2021).

Telemedicine is yet another trend that was vital to this transformation, the pandemic turned telemedicine into an essential part of healthcare delivery. The swift embrace of telemedicine has led the majority of healthcare providers to incorporate virtual visits into their standard practices. Both patients and health care providers recognize the ease of access and quality of care provided remotely (Smith et al., 2021), thus, this trend is likely to remain

The rise of wearables smart watch and smartphone health apps also indicate how healthcare will change with the times. Such technologies enable patients to report on their health in real-time and transmit relevant data to providers, placing the patient in a more active role in managing health. This proactive approach has been proven to be helpful for better health outcomes and more personalized care (Sultan, et al., 2021).

The widespread adoption of Internet of Things (IOT) devices in daily life has stimulated the proposal of novel methods for measuring biomedical and biometric variables. The most significant among these innovations is the idea of digital twins (DTs), which are being increasingly coupled with artificial intelligence (AI) technologies in health care. This trend is exemplified in a recent heart digital twin proof of concept case study. This app analyzes electrocardiogram (ECG) signals using an AI component and is intended to be a holistic platform for overseeing/caring cardiac health concerns. The goal of this system is to improve the relationship between patient and doctor, as well as to establish an entirely new paradigm so that patients can respond with a unique degree of freedom in medical treatment against cardiac pathologies (Avanzato et al., 2023).

**2.٣.2 AI in Healthcare Digital Transformation**

Artificial intelligence (AI) in healthcare has a wide field of potential applications, most of which are still developing and show promise to accelerate digital transformation by supporting clinical and administrative roles. This techno--dysphemism is statistics, linguistics and computer science applied through rule-based systems, regression, predictive analytics and DL. Much has been made about AI already, offering much promise for transforming health and health systems through their unparalleled ability to analyze vast amounts of complex data (OECD 2019).

AI algorithms are now being used in clinical environments for the analysis of medical images, prognosis and diagnosis of complex diseases. In fact, AI-guided imaging tools have shown more accuracy than traditional diagnosis methods in some types of cancer that allow prompt and optimal treatment outcomes (Gulshan et al., 2020). Furthermore, AI is supporting the industry to progress in the right direction by considering a more personalized medicine which focuses on patient specific treatment based on those individual features.

AI is being applied in a range of healthcare aspects, as shown in [Figure 2.1]). This image may be illustrated the various uses of AI across the health care continuum, from clinical diagnosis and treatment to administrative tasks and public health surveillance. This is impressive and the somatic visualization gives a good grid for introduction to AI breadth journey in healthcare.

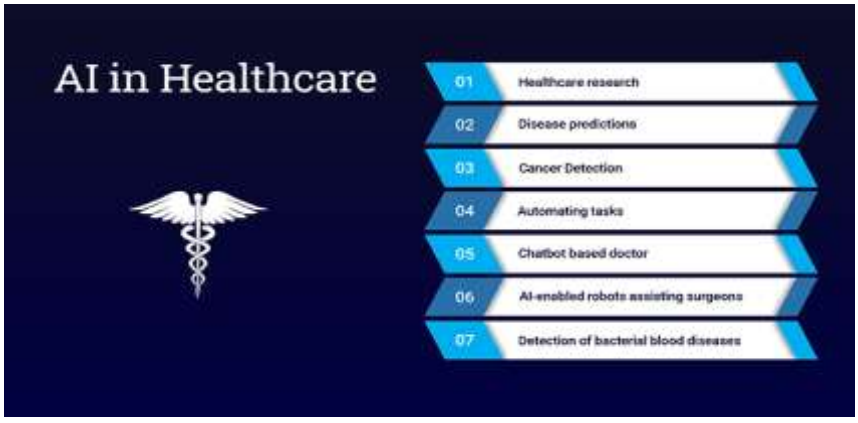


**Figure. 2.1: Emerging Use of AI in Healthcare**

**Source:** IEEE, 2023

### 2.٣.3 Blockchain in Healthcare Digital transformation

The blockchain technology is considered to be a revolutionary component in these systems and will assist in making the electronic health record much more efficient by allowing data to flow Information from multiple stakeholders such as hospitals, diagnostic laboratories, pharmacies and healthcare providers. Blockchain technology has a decentralized approach that enables secure, transparent and efficient data sharing which is the need of the hour in a field where accuracy and confidentiality matter the most. Using blockchain, healthcare institutions can minimize the chance of mistakes and fraudulent actions.

the first feature of the blockchain in healthcare that we are going to discuss is security & integrity of medical records. Traditional systems are always susceptible to vulnerabilities that can result in data breaches and unwarranted access. On the other hand, blockchain uses cryptographic methods to guarantee that once information has been entered, no one can change or delete it without agreement from all players on the network. Such immutability capability,

### 2.٤ Pandemic in healthcare sector

Perhaps no event has acted as a more powerful lever of transformation within the healthcare sector than the COVID-19 pandemic, which not only expedited existing trends related to consumer preferences but also catalyzed new mechanisms of care

delivery. Healthcare systems faced survival, and many transformed their mindset to the digital economy with a sharp focus on consumers while delivering overall improved service. Consumers expressed interest in health systems were spotlighted with the need for greater immediate access to care options during this crisis, highlighting the continued importance of convenience (Deloitte Center for Health Solutions, 2021).

Deloitte Center for Health Solutions partnered with the Scottsdale Institute to deep dive into how health systems are rearchitecting themselves using digital capabilities to effectively and efficiently deliver healthcare. The research included surveys with technology execs at 25 health systems, interviews with five tech leaders and moderated panel sessions including those from three other systems. These different methods which all played a complementary role, served as an informative starting point to assess the digital transformation landscape within health care (Deloitte Center for Health Solutions, 2021).

It was useful during lockdowns and social distancing, so telemedicine became one of the most important tools that allowed us to continue gaining access to care. Studies show that telemedicine provided successful continued support for patients with chronic diseases, mental health services, and routine visits during the pandemic (Reay et al., 2020).

## 2.٥ Egypt and Digital Transformation

Egypt takes lead among Nations in Middle East and North Africa (MENA) region to transform its economy with digital solutions that improves lives of citizen. In Egypt, the government has realized the vast potential of Information and Communication Technology (ICT) as an engine for economic growth and social development.

Egypt has signaled its commitment to work towards the Sustainable Development Goals (SDGs) beginning with its launch of a Sustainable Development Strategy: Egypt Vision 2030 in February 2016. It links to the 17 SDGs

by 30 June 2024 the Egypt Health Authority highlighted its achievements over the five years since the implementation of universal health coverage in Egypt since start implementation of universal health coverage by Port Said City then scope expanded to cover over 5 million citizens in the six governorates have registered for the universal health insurance system provision of more than 44 million medical and therapeutic services to beneficiaries under the universal health coverage system in these governorates, including 16 million services in Port Said, over 16 million in Luxor, 9.5 million in Ismailia, 1.3 million in South Sinai, 510,000 in Aswan, and one million medical services in Suez.

## CHAPTER THREE
## RESEARCH METHODOLOGY

## 3.1 Introduction

This chapter describes the approach used to analyze how digital transformation effects healthcare service improvement and its association with Sustainable Development Goal 3. The research employs a mixed-methods strategy to both solve the cause-and-effect dichotomy and the confounding of the relationship between digital health technologies, healthcare service improvement and by COVID-19 pandemic impact. The research design, informed by change leadership theory, culture change theory, and learning organization theory, involves a cross-sectional survey of healthcare employees globally and unstructured interviews with healthcare professionals and HIS providers in the Middle East. Data collected through questionnaires and interviews will be analyzed using SPSS V.26 to test hypotheses related to the influence of digital transformation on efficiency, diagnostic accuracy, and patient outcomes.

## 3.2 Research Method and Design

This study falls under the category of experimental research, which is cause and effect-focused research. To ascertain their influence on a variable known as the dependent variable, a relationship between one or more variables of interest, referred to as the independent variables, is explored. According to the researcher's ontological perspective

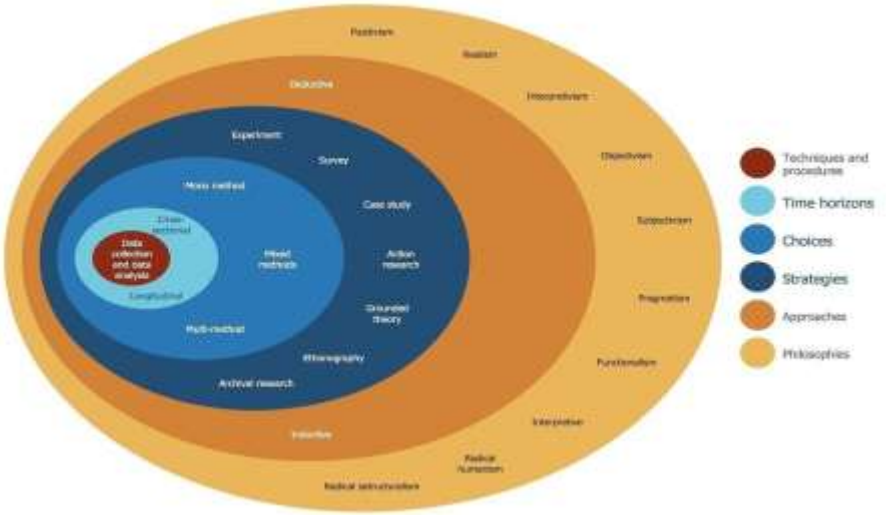


**Figure 3.1: The Research Onion**
**Source:** Saunders et al.'s (2012)

## 3.3 The research design overview

The research aims to investigate how DT technologies impact various aspects of healthcare service improvement (the dependent variables). Figure 3.2 visually outlines the components and structure of the research design. It suggests a mixed-methods approach, combining quantitative and qualitative data collection and analysis techniques. The study appears to be exploratory and hypothesis-driven, with minimal researcher interference, indicating an observational approach. The cross-section time horizon suggests data will be collected over a period of time, potentially to track the long-term effects of digital transformation in healthcare. The flowchart emphasizes the importance of carefully considering each element of the research design, from

defining the study's purpose and population to selecting appropriate data collection and analysis methods

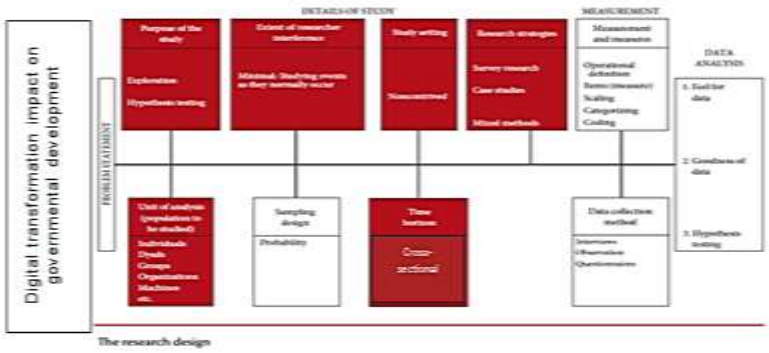


**Figure 3.2: Key Considerations in Research Design**

## 3.4 The Research Design Strategy

This section describes the research methods that will be applied in this study in order to investigate and measure the research variables.

**Table 3.2: Research Design Strategy**

| Research Element | Method | Description |
|---|---|---|
| **Research Approach** | Qualitative | Interview with DT experts and CIOs |
| | Quantitative | Qualitative research is for understanding the problem and narrowing down the research variables and measures. |
| **Purpose of Research** | Descriptive | help in describing and understanding the characteristics and quality of the various data sets |
| **Extent of Research Interference** | Interference | Suitable for testing cause and effect between the independent and dependent variables. |
| **Time Horizon** | Cross-sectional study (one shot) | The data is collected once for a period of multiple years. |
| **Population** | Healthcare organization employee worldwide | Will spread the questionnaire to many countries, trying to cover responses from countries in different groups of DT classification. |
| **Sampling** | Simple random sampling (SRS) | probability sampling in which the researcher randomly selects a subset of participants from a population. Each member of the population has an equal chance of being selected |
| **Method of Data collection** | Administered Questionnaire | |
| **Intended Data Analysis** | SPSS V.26 Analysis | SPSS is statistical software developed by Microsoft |

### 3.5 The Conceptual Framework

This study's conceptual framework is founded on examine relation between some DT tools as IV on healthcare improvement by measure perception of some patient outcomes as KPI, in light of different factors such as demographic and stage of organization DT stage.

### 3.6 Conceptual Framework Description:

#### 3.6.1 Independent variables (IVs):

In light of Organization Digital transformation stage the independent variables of Digital Transformation enablement In Health Care are:

- Electronic Health Records (EHR)
- Artificial Intelligence (AI) for Diagnosis and Predictive Analytics
- Internet of Medical Things (IoMT)

#### 3.6.2 Dependable variables (DVs):

The dependent variable Healthcare Service Improvement to be measured by sub variables:

- Efficiency for admission.
- Diagnostic accuracy
- Patient outcome: (like patient recovery times, readmission rate and mortality rate)

### 3.6.3 Moderating variable

This is a variable that influences the strength or direction of the relationship between the independent and dependent variables. In this case, the moderating variable is:

- Impact of COVID-19 Pandemic.

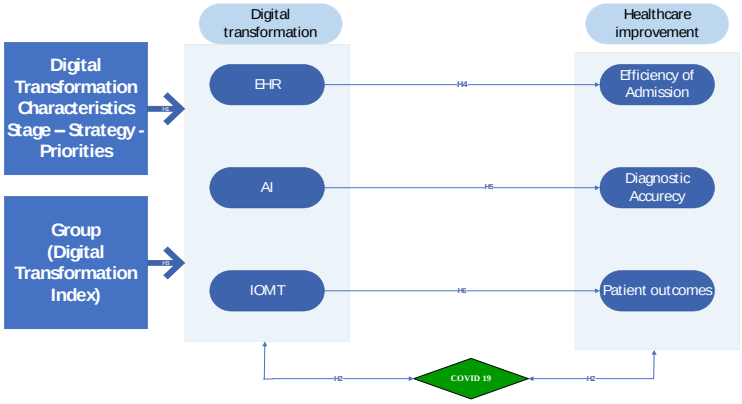


**Figure 3.3: Conceptual research framework**

## 3.7 Research Hypotheses

The study hypothesizes the following:

- **H1:** There are no differences at a significance level of $\alpha \leq 0.05$ in perceptions of having a well-defined digital transformation strategy across country groups.
- **H2:** There are no differences at a significance level of $\alpha \leq 0.05$ in how the COVID-19 pandemic has accelerated digital transformation efforts across these groups.
- **H3:** There are no differences at a significance level of $\alpha \leq 0.05$ in prioritizing digital transformation factors such as data, talent, and budget among country groups.

- **H4:** There are no differences at a significance level of $\alpha \leq 0.05$ in the impact of EHR on healthcare efficiency based on the stage of digital transformation across country groups.
- **H5:** There are no differences at a significance level of $\alpha \leq 0.05$ in the perception of AI applications reducing treatment errors among different stage of digital transformation and country classifications.
- **H6:** There are no differences at a significance level of $\alpha \leq 0.05$ in perceptions regarding IOMT affect patient outcomes improvements across the categories of proximity to the ideal digital state and country classification.

### 3.8 Research Population and Sample

#### 3.8.1 Research Population

The unit of analysis in this research are individual employees in healthcare organizations across the world to measure perception and recommendations globally" Sekaran (2003).

#### 3.8.2 Research Sample

According to research condition will use Simple random sampling (SRS) and to calculate sample size according to condition of undefined population will use the Cochran's sample size formula, which is designed for an undefined population. Here is a breakdown of how this formula works and why it often results in a sample size of 384.

Cochran's Sample Size Formula

The Cochran's formula for determining sample size is given by:

$$n_0 = Z^2 \cdot p \cdot (1-p) / e^2$$

Where:

- $n_0$ = the required sample size., Z = Z-value (the number of standard deviations from the mean corresponding to the desired confidence level), For a 95% confidence level, Z=1.96
- P = estimated proportion of the population (since this is often unknown, researchers typically use p=0.5 as this maximizes variability and thus requires a larger sample size),
- e = margin of error (often set at 5%, or 0.05).

$$n_0 = (1.96)^2 \cdot 0.5 \cdot (1-0.5) / (0.05)^2 = 384$$

The initial sample size of 384 was calculated using Cochran's formula, which is a standard method for determining sample size in research. However, the final sample size was increased to 426.

**3.9 Sampling technique**

A questionnaire has been published through different communication channel globally for health care sector staff from administrator and medical staff for quantitative analysis of countries in different stages of Digital transformation according to 4 groups of Global digital transformation index published by HBR: Germany, UK, UAE and Qatar: as sample of standout group and Egypt: as one of Watch out group

For qualitative analysis a pilot study used unstructured interview with questionnaires and survey for sample of healthcare sector members with different responsibilities

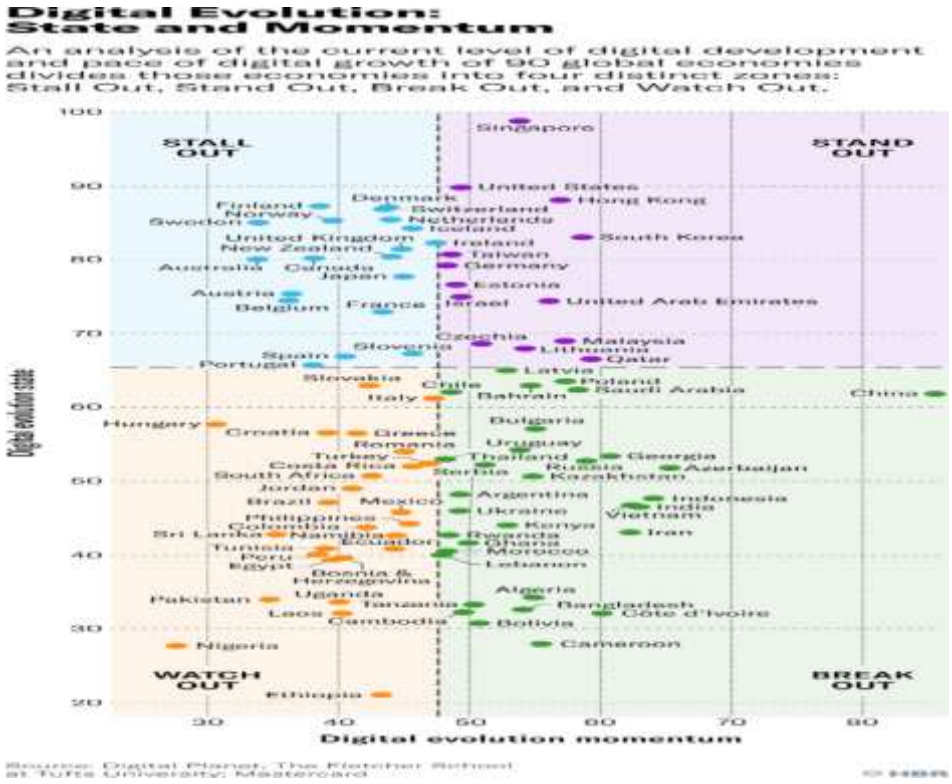


**Figure 3.2: Global Digital Evolution: State and Momentum**

## 3.10 The Sources of Data Collection

This research's design will be inductive research based on mix of:

### 3.10.1 Qualitative Research Data

Unstructured interview of the qualitative research inducted during direct face-to-face and online interviews with the panel from Digital transformation experts like CIO, CDTO as well as from medical members whom can feel improvement of patient outcomes. The experts were interviewed individually and it was agreed to keep their answers anonymous.

### 3.10.2 Quantitative Research Data

For the quantitative research the instrument used for data collection is questionnaires with an ordinal five-point Likert scale for measuring research variables and some questions with 2 answers like Yes/No or selection between 2 opinions. A number of questions is defined for each research variable based on the literature review. Each question constitutes an independent measure of the variable.

## 3.11 Time Horizon:

Cross-sectional study to test respondent perception after applying digital transformation at different level to their organization where is very difficult to approach same sample to answer questions for same variable across different time

# CHAPTER FOUR
# RESEARCH RESULTS AND FINDINGS

## 4.1 Introduction

This chapter presents the findings of the study regarding the digital transformation experiences of various organizations,

specifically focusing on the utilization and impact of Electronic Health Records (EHR), Artificial Intelligence (AI) and Internet of Medical Things (IOMT) applications in healthcare settings. Analyzing feedback from interview during pilot study as well as quantitative analysis of questionnaire responses using statistical tool

## 4.2 Data Analysis

### 4.2.1 Qualitative Research result

Exploratory research was conducting during the pilot study by interviewing a panel of Digital transformation experts and medical members some are working at Egyptian Medical organization and some are working abroad at counties represent different stage of transformation.

The interviews conducted with digital transformation experts provide crucial insights into the role of digital technologies in transforming the healthcare sector, as well as show response to the COVID-19 pandemic. Below is a synthesis of the key themes and expert opinions derived from these interviews, organized to reflect the relationship between different technologies and healthcare outcomes.

**COVID-19 Accelerated Digital Transformation in Healthcare**

- Unanimous agreement among interview participants emphasized that the COVID-19 pandemic acted as a significant catalyst for digital transformation in healthcare.

- Experts noted that telemedicine adoption surged during the pandemic to maintain healthcare access amid lockdowns and social distancing measures.
- Several experts mentioned that government initiatives supporting the rollout of digital platforms were expedited during the pandemic, accelerating a shift that would otherwise have taken years to accomplish.

**EHRs: Efficiency Gains over efficiency and Diagnostic Accuracy**

- Most experts agreed that EHR systems enhance efficiency in healthcare operations by improving data management, care coordination, and communication among healthcare providers.
- Administrative burdens were reduced through automated workflows enabled by EHRs, allowing providers to focus more on patient care.
- Several experts suggested that EHRs are most effective in facilitating continuity of care across healthcare settings, which aligns with efforts to improve overall healthcare efficiency.

**AI: A Key Driver of Diagnostic and Treatment Accuracy**

- A consensus emerged among experts that AI-powered solutions significantly enhance diagnostic accuracy and treatment outcomes.

- AI-based image analysis tools, such as those used for cancer detection or cardiology, were highlighted as outperforming traditional diagnostic methods in certain cases.
- Predictive analytics enabled by AI are being used to identify high-risk patients and prevent disease progression through targeted interventions.
- Experts further stressed that AI applications are transforming personalized medicine by tailoring treatment plans based on patient-specific data, improving outcomes and minimizing errors.
- Some interviewees noted the importance of training healthcare staff to work effectively with AI tools, ensuring seamless integration into clinical workflows.

**IoMT: Incremental Impact on Patient Outcomes**

- Experts acknowledged the potential of Internet of Medical Things (IOMT) technologies, such as wearable devices and remote sensors, in contributing to healthcare delivery.
- IoMT devices allow for continuous remote monitoring of patients' vital signs, which can lead to timely interventions.
- Wearables such as fitness trackers and heart rate monitors help patients take an active role in managing chronic conditions.
- However, most experts agreed that the impact of IOMT on patient outcomes is less pronounced compared to AI or EHR adoption.

- IoMT was described as complementary to other digital tools, with limited effectiveness unless integrated into larger healthcare systems, such as EHRs and AI-driven platforms.
- IoMT solutions play a supportive role by enabling remote monitoring, but their impact on patient outcomes is relatively modest compared to other digital tools.

### 4.2.2 Quantitative Research results

Analyzing demographic characteristics, perceptions of digital technology effectiveness, and differences across organizational stages, the results reveal significant trends and variances in how organizations view their progress in digital transformation. The statistical evaluations, including F-values and P-values from ANOVA test, indicate where significant differences exist among group responses with results comparison, also using crosstabulation including chi-square providing valuable insights into the relationship between an organization's stage of digital transformation and its perceptions of technological impacts. Overall, this chapter serves to synthesize and present the empirical data gathered, highlighting the implications for future practices and strategies in healthcare digitalization.

## 4.3 Demographic Characteristics of Study Participants

Understanding the demographic characteristics of study participants is crucial for interpreting the results and ensuring

that the sample adequately represents the broader population relevant to the research.

**Table 4.1: Demographic Characteristics of Study Participants**

| Variables | Items | (%) |
|---|---|---|
| Gender | Male | 62 (61.5%) |
| | Female | 64 (38.5%) |
| Age | 18 | (0.9%) |
| | 8-24 | (0.2%) |
| | 5-34 | 0 (16.4%) |
| | 5-44 | 22 (52.1%) |
| | 5-54 | 04 (24.4%) |
| | 5-64 | 5 (3.5%) |
| | 65 | 0 (2.3%) |
| Country of residence | Egypt | 62 (61.5%) |
| | Germany | 4 (15.0%) |
| | Iraq | (0.7%) |
| | Kuwait | (2.1%) |
| | Netherlands | (1.9%) |
| | Qatar | (1.9%) |
| | Saudi Arabia | 8 (6.6%) |
| | Sweden | (0.9%) |
| | Turkey | (0.9%) |
| | United Arab Emirates | 0 (2.3%) |
| | United Kingdom | 4 (3.3%) |
| | United States | 2 (2.8%) |
| | Total | 26 (100.0%) |

In Table 4.1, the demographic breakdown reveals that:

- **Gender**: The study is male-dominated, with Group 2 having the highest percentage of males (92.9%), and Group 4 showing the most balanced gender ratio (55.4% male, 44.6% female).
- **Age**: The majority of participants fall within the 35-44 age group across all groups, especially in Group 1 and Group 2, where it constitutes more than 60% of participants. Group 3 includes the youngest participants, with 11.4% under 18

years. Group 4 has older participants, with 5.6% aged 55-64 years and 3.7% over 65 years.

- **Country of Residence**: Geographic clustering is evident, with Group 1 dominated by participants from Germany, Group 2 exclusively from Saudi Arabia, Group 3 including participants from the UK, Kuwait, Netherlands, and Sweden, and Group 4 dominated by participants from Egypt (97.4%).

**4.4 Evaluation of Organizational Proximity to Ideal Digital State**

This analysis aims to compare how close organizations perceive themselves to be to the ideal digital state in terms of utilizing digital technologies and capabilities.

Furthermore, it will show opinion of priorities and barriers according percentage of responses of each stage.

**Table 4.2: Comparison of Organizations' Proximity to Ideal Digital State**

| | Farthest from ideal digital state | Far from ideal digital state | Midway to ideal digital state | Close to ideal digital state | Closest to ideal digital state | Total | F | P value |
|---|---|---|---|---|---|---|---|---|
| **Current Stage of Digital Transformation** | | | | | | | | |
| Planning road map | 20 (4.7%) | 4 (5.3%) | 20 (4.7%) | 10 (2.3%) | 0 (0.0%) | 64 (15.0%) | 54.786 | 0.000 |
| > 5 years remaining | 10 (2.3%) | 8 (1.9%) | 22 (5.2%) | 8 (1.9%) | 1 (0.2%) | 49 (11.5%) | | |
| 3 - 5 years remaining | 2 (0.5%) | 2 (0.5%) | **31 (19.0%)** | 38 (8.9%) | 1 (0.2%) | 124 (29.1%) | | |
| 1 - 2 years remaining | 0 (0.0%) | 4 (0.9%) | 29 (6.8%) | **9 (12.4%)** | 0 (0.0%) | 86 (20.2%) | | |
| Initial Transformation Complete; Planning Next Round | 2 (0.5%) | 0 (0.0%) | 24 (5.6%) | **7 (11.0%)** | **30 (7.0%)** | 103 (24.2%) | | |
| **Well-defined Digital Transformation Strategy** | | | | | | | | |
| Strongly Disagree | 6 (1.4%) | 2 (0.5%) | 0 (0.0%) | 0 (0.0%) | 0 (0.0%) | 8 (1.9%) | 20.239 | 0.000 |
| Disagree | 4 (0.9%) | **6 (1.4%)** | **12 (2.8%)** | 0 (0.0%) | 0 (0.0%) | 22 (5.2%) | | |
| Neutral | 12 (2.8%) | 4 (3.3%) | **64 (15.0%)** | 19 (4.5%) | 2 (0.5%) | 111 (26.1%) | | |
| Agree | 8 (1.9%) | 4 (0.9%) | **90 (21.1%)** | **15 (27.0%)** | 14 (3.3%) | 131 (54.2%) | | |
| Strongly Agree | 4 (0.9%) | 2 (0.5%) | 10 (2.3%) | **12 (5.2%)** | **16 (3.8%)** | 54 (12.7%) | | |
| **COVID-19 and Digital Transformation in Healthcare** | | | | | | | | |
| Disagree | 2 (0.5%) | 0 (0.0%) | 1 (0.0%) | 8 (1.9%) | 0 (0.0%) | 10 (2.3%) | 1.921 | 0.106 |
| Neutral | 10 (2.3%) | 4 (0.9%) | 26 (6.1%) | 21 (4.9%) | 0 (0.0%) | 61 (14.3%) | | |
| Agree | 8 (1.9%) | 6 (1.8%) | **55 (12.9%)** | **5 (10.6%)** | 14 (3.3%) | **138 (32.4%)** | | |
| Strongly Agree | 14 (3.3%) | 8 (1.9%) | **95 (22.3%)** | **2 (19.2%)** | 18 (4.2%) | **117 (50.3%)** | | |
| **Priorities for Digital Transformation [Data Quality/Access]** | | | | | | | | |
| Data Quality | 20 (4.7%) | 6 (3.8%) | **95 (22.3%)** | **108 (25.4%)** | 24 (5.6%) | 163 (61.7%) | 2.612 | 0.035 |
| Data Access | 14 (3.3%) | 12 (2.8%) | **81 (19.0%)** | **8 (11.3%)** | 8 (1.9%) | 63 (38.3%) | | |
| **Priorities for Digital Transformation [Skills/Talent]** | | | | | | | | |
| Skills Set | 18 (4.2%) | 10 (4.7%) | 134 (31.3%) | 112 (26.3%) | 24 (5.6%) | 108 (72.3%) | 1.091 | 0.360 |
| Talent | 16 (3.8%) | 8 (1.9%) | 42 (9.9%) | 44 (10.3%) | 8 (1.9%) | 118 (27.7%) | | |
| **Priorities for Digital Transformation [Budget and ROI]** | | | | | | | | |
| Budget | 18 (4.2%) | 12 (2.8%) | **130 (30.5%)** | **116 (27.2%)** | 24 (5.6%) | 300 (**70.4%**) | 4.572 | 0.001 |
| ROI | 16 (3.8%) | 6 (5.8%) | 46 (10.8%) | 40 (9.4%) | 8 (1.9%) | 126 (29.6%) | | |
| **Priorities for Digital Transformation [Management/Leadership]** | | | | | | | | |
| Management of Implementation | 22 (5.2%) | 6 (3.8%) | 131 (30.8%) | 104 (24.4%) | 22 (5.2%) | 195 (69.2%) | 2.104 | 0.079 |
| Leadership | 12 (2.8%) | 12 (2.8%) | 45 (10.6%) | 12 (12.2%) | 10 (2.3%) | 131 (30.8%) | | |
| **Priorities for Digital Transformation [Key Barriers]** | | | | | | | | |
| Lack of Ownership and Communication | 14 (3.3%) | 10 (4.7%) | 80 (18.8%) | 84 (19.7%) | 14 (3.3%) | 112 (49.8%) | 3.142 | 0.015 |
| Cultural Barrier | 20 (4.7%) | 8 (1.9%) | 96 (22.5%) | 72 (16.9%) | 18 (4.2%) | 114 (50.2%) | | |
| **Access to Telemedicine Teleconsultation Before Pandemic** | | | | | | | | |
| Yes | 14 (3.3%) | 8 (1.9%) | 74 (17.4%) | 88 (20.7%) | 18 (4.2%) | 202 (47.4%) | 6.841 | 0.000 |
| No | 20 (4.7%) | 10 (4.7%) | 102 (23.9%) | 68 (16.0%) | 14 (3.3%) | 224 (52.6%) | | |
| **Access to Telemedicine Teleconsultation During and After Pandemic** | | | | | | | | |
| Yes | 22 (5.2%) | 10 (4.7%) | 148 (34.7%) | 140 (32.9%) | 28 (6.6%) | 358 (84.0%) | 3.253 | 0.012 |
| No | 12 (2.8%) | 8 (1.9%) | 28 (6.6%) | 16 (3.8%) | 4 (0.9%) | 68 (16.0%) | | |
| Total | 34 (8.0%) | 18 (6.6%) | 176 (41.3%) | 156 (36.6%) | 32 (7.5%) | 426 (100.0%) | | |

In Table 4.2, the analysis summarizes participants' perceptions regarding their organizations' proximity to the ideal digital state across several dimensions, highlighting significant differences among categories. The F value of 54.786 with a P value of 0.000 for the current stage of digital transformation indicates a statistically significant difference among responses regarding their proximity to the ideal state, leading to the rejection of the null hypothesis for H1 that postulated no differences across groups.

Also, results show that a percentage of 18% of participants agree their organization is close to or closet to the ideal stage out of 24% who consider their initial transformation phase has been completed.

On the other hand, a percentage of 8% of participants agree their organization is far or farthest from the ideal stage out of 15% who consider their organization in the road map planning phase.

Which reflects a clear image about respondent perceptions of organizations utilizing digital transformation technologies and the current stage

For assessing the well-defined digital transformation strategy, the F value of 20.239, also with a P value of 0.000, further supports this significance, rejecting the null hypothesis for H1 as well.

In contrast, the highest percentage of participants who consider their organization close and closest to the ideal stage consider their organization to have a well-defined strategy.

About perception Covid 19 accelerating digital transformation at healthcare organization, The F Value of 1.921, also with a P Value of 0.105 with percentage of 83.3% to select **Agree and Strongly Agree with Covid 19 accelerated Digital transformation** which supports acceptance of null hypothesis of H2 and rejected alternative.

While the priority for "Data Quality/Access" shown an F value of 2.612 with a P value of 0.035, indicating statistical significance,

with percentage of 61.7% consider **Data Quality** is more prior than Data Access.

the priority for "Budget and ROI" shown an F value of 4.572 with a P value of 0.001, indicating statistical significance, with percentage of 70.4% consider **Budget** is more prior than ROI.

the dimension of "Management of Implementation" produced an F value of 2.104 with a P value of 0.079, which does not meet the threshold for significance ($p < 0.05$), allowing for the acceptance of the null hypothesis in that context.

Key Barrier prospective "Lack of Ownership and Communication / Cultural Barrier " shown an F value of 3.142 with a P value of 0.015, indicating statistical very near percentages of 48.9% and 50.2% respectively.

These results lead to partially accept null hypothesis of H3 for some priorities like data and budget while accept null for skills/talent priority

Overall, significant differences were observed in various aspects of digital transformation, illustrating varied perceptions based on several demographic factors, thereby affirming the scope for targeted strategic interventions.

**4.5 Assessment of EHR and AI Influence on proximity to the Ideal Digital State**

This analysis aims to evaluate the perceptions of organizations concerning their advancements in Electronic

Health Record (EHR) management and Artificial Intelligence (AI) applications relative to the ideal digital state.

**Table 4.3: EHR, AI and IOMT Influences on the Proximity to Ideal Digital State**

| | Farthest from ideal digital state | Far from ideal digital state | Midway to ideal digital state | Close to ideal digital state | Closest to ideal digital state | Total | F | P.Value |
|---|---|---|---|---|---|---|---|---|
| **HR Improvement: Efficiency** | | | | | | | | |
| o Improvement | (0.9%) | (0.0%) | (0.0%) | (0.0%) | (0.0%) | (0.9%) | .972 | .004 |
| imited nprovement | (0.5%) | (0.0%) | (1.4%) | (0.0%) | (0.0%) | (1.9%) | | |
| ome nprovement | (1.4%) | (0.0%) | 8 (4.2%) | 0 (2.3%) | (0.0%) | 4 (8.0%) | | |
| ignificant nprovement | (0.9%) | 2 (2.8%) | 13 (26.5%) | 13 (26.5%) | 2 (2.8%) | 54 (59.6%) | | |
| xtensive nprovement | 8 (4.2%) | 6 (3.8%) | 9 (9.2%) | 3 (7.7%) | 0 (4.7%) | 26 (29.6%) | | |
| **HR Improvement: Accuracy** | | | | | | | | |
| imited nprovement | (0.5%) | (0.0%) | (0.2%) | (0.2%) | (0.0%) | (0.9%) | .996 | .094 |
| ome nprovement | (2.1%) | (0.0%) | 4 (3.3%) | (1.4%) | (0.0%) | 9 (6.8%) | | |
| ignificant nprovement | (1.2%) | 0 (2.3%) | 5 (10.6%) | 2 (5.2%) | (0.9%) | 6 (20.2%) | | |
| xtensive nprovement | 8 (4.2%) | 8 (4.2%) | 16 (27.2%) | 27 (29.8%) | 8 (6.6%) | 07 (72.1%) | | |
| **I Imaging Applications** | | | | | | | | |
| isagree | (0.5%) | (0.0%) | (0.0%) | (0.5%) | (0.0%) | (0.9%) | .762 | .000 |
| eutral | 0 (2.3%) | (0.0%) | 9 (4.5%) | (2.1%) | (0.5%) | 0 (9.4%) | | |
| gree | 6 (3.8%) | 0 (2.3%) | 5 (17.6%) | 8 (13.6%) | (0.5%) | 61 (37.8%) | | |
| trongly Agree | (1.4%) | 8 (4.2%) | 2 (19.2%) | 7 (20.4%) | 8 (6.6%) | 21 (51.9%) | | |
| **I Predictive Analytics** | | | | | | | | |
| eutral | (0.5%) | (0.0%) | (0.2%) | (0.7%) | (0.0%) | (1.4%) | .259 | .286 |
| gree | 1 (2.6%) | (0.0%) | 1 (4.9%) | 0 (2.3%) | (0.7%) | 5 (10.6%) | | |
| trongly Agree | 1 (4.9%) | 8 (6.6%) | 54 (36.2%) | 43 (33.6%) | 9 (6.8%) | 75 (88.0%) | | |
| **I Reducing Treatment Errors** | | | | | | | | |
| isagree | (0.0%) | (0.0%) | (0.0%) | (0.2%) | (0.0%) | (0.2%) | .139 | .000 |
| eutral | 0 (2.3%) | (0.5%) | 4 (5.6%) | 3 (5.4%) | (0.7%) | 2 (14.6%) | | |
| gree | 9 (4.5%) | 5 (3.5%) | 05 (24.6%) | 5 (17.6%) | 1 (2.6%) | 25 (52.8%) | | |
| trongly Agree | (1.2%) | 1 (2.6%) | 7 (11.0%) | 7 (13.4%) | 8 (4.2%) | 38 (32.4%) | | |
| **emote Vital Sign Monitoring** | | | | | | | | |
| isagree | (0.5%) | (0.0%) | (0.9%) | (0.0%) | (0.0%) | (1.4%) | .906 | .000 |
| eutral | (1.9%) | (0.5%) | 4 (5.6%) | 0 (4.7%) | (0.0%) | 4 (12.7%) | | |
| gree | 6 (3.8%) | 0 (2.3%) | 9 (20.9%) | 8 (20.7%) | 2 (2.8%) | 15 (50.5%) | | |
| trongly Agree | (1.9%) | 6 (3.8%) | 9 (13.8%) | 8 (11.3%) | 0 (4.7%) | 51 (35.4%) | | |

| FID Impact on Digital Transformation | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| isagree | (0.0%) | (0.0%) | (0.0%) | (1.4%) | (0.0%) | (1.4%) | | |
| eutral | (1.9%) | (0.5%) | 0 (4.7%) | 2 (5.2%) | (0.9%) | 6 (13.1%) | | |
| gree | 4 (3.3%) | 4 (3.3%) | 8 (18.3%) | 4 (17.4%) | 2 (2.8%) | 92 (45.1%) | .117 | .000 |
| trongly Agree | 2 (2.8%) | 2 (2.8%) | 8 (18.3%) | 4 (12.7%) | 6 (3.8%) | 72 (40.4%) | | |
| otal | 4 (8.0%) | 8 (6.6%) | 76 (41.3%) | 56 (36.6%) | 2 (7.5%) | 26 (100.0%) | | |

In Table 4.3, significant findings on EHR, AI and IOMT influences on healthcare organizations based on proximity to the ideal digital state are presented. EHR improvements in efficiency (F=3.972, p=0.004) and accuracy (F=1.996, p=0.094) are observed, with **89.2%** of respondents reporting significant or **extensive efficiency improvements** and 92.3% noting significant or extensive accuracy enhancements. Strong positive perceptions of AI applications are demonstrated, with 89.7% agreeing or strongly agreeing on AI imaging benefits (F=9.762, p<0.001), 98.6% on predictive analytics (F=1.259, p=0.286), and 85.2% on reducing treatment errors (F=8.139, p<0.001). Remote vital sign monitoring is viewed favorably by 85.9% of respondents (F=6.906, p<0.001), while RFID technology's impact on digital transformation is recognized by 85.5% (F=5.117, p<0.001). Based on these results, the null hypotheses for H4, and H6 are rejected, as **significant differences** are observed in the impact of EHR on healthcare **efficiency** and in the perception of AI applications **reducing treatment errors** also IOMT tools improve patient's outcomes across different groups. The alternative hypotheses for H4, and H6 are accepted, indicating that differences exist in the impact of EHR on healthcare improving efficiency based on the stage of digital

transformation and in the perception of AI applications reducing treatment errors among different country classifications.

## 4.6 Comparative Analysis of Digital Transformation Tools Across Country Groups

This table explores the impact of DT applications in healthcare across varying stages of digital transformation. While analyzing the perceptions of EHR's effectiveness in improving record management efficiency and accuracy, chi-square tests revealed no significant differences at the 0.05 level among various stages, supporting the hypothesis of uniform perceptions across transformation stages. Interestingly, attitudes toward AI applications in medical imaging processing and their capability to reduce treatment errors varied significantly across groups,

**Table 4.4: Comparative Analysis of Digital Transformation Across Country Groups**

| Question | Group 1 | Group 2 | Group 3 | Group 4 | Total | F | P-value |
|---|---|---|---|---|---|---|---|
| **To what extent do Electronic Health Records (EHR) improve healthcare in terms of efficiency of patient record management?** | | | | | | | |
| No Improvement | (0.0%) | (0.0%) | (0.9%) | (0.0%) | (0.9%) | 0.274 | .000 |
| Limited Improvement | (0.0%) | (0.0%) | (0.0%) | (1.9%) | (1.9%) | | |
| Some Improvement | (0.0%) | (0.0%) | (0.0%) | 4 (8.0%) | 4 (8.0%) | | |
| Significant Improvement | 0 (14.1%) | 2 (2.8%) | 6 (6.1%) | 56 (36.6%) | 54 (59.6%) | | |
| Extensive Improvement | 4 (8.0%) | 6 (3.8%) | (1.2%) | 1 (16.7%) | 26 (29.6%) | | |
| **To what extent do Electronic Health Records (EHR) improve healthcare in terms of accuracy (reducing medical errors)?** | | | | | | | |
| Limited Improvement | (0.0%) | (0.0%) | (0.5%) | (0.5%) | (0.9%) | 4.753 | .000 |
| Some Improvement | (0.0%) | (0.0%) | (0.5%) | 7 (6.3%) | 9 (6.8%) | | |
| Significant Improvement | (1.2%) | (0.5%) | (0.5%) | 7 (18.1%) | 6 (20.2%) | | |
| Extensive Improvement | 9 (20.9%) | 6 (6.1%) | 9 (6.8%) | 63 (38.3%) | 07 (72.1%) | | |
| **To what extent do you agree that AI applications support medical imaging for better diagnosis?** | | | | | | | |
| Disagree | (0.0%) | (0.0%) | (0.0%) | (0.9%) | (0.9%) | .767 | .513 |
| Neutral | (1.4%) | (0.5%) | (1.9%) | 4 (5.6%) | 0 (9.4%) | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Agree | 7 (8.7%) | 2 (2.8%) | (0.5%) | 10 25.8%) | 61 (37.8%) | | |
| Strongly Agree | 1 (12.0%) | 4 (3.3%) | 5 (5.9%) | 31 30.8%) | 21 (51.9%) | | |
| **To what extent do you agree that predictive analytics in AI identifies patterns for better healthcare outcomes?** | | | | | | | |
| Neutral | (0.0%) | (0.2%) | (0.0%) | (1.2%) | (1.4%) | | |
| Agree | (1.6%) | (0.7%) | (1.9%) | 7 (6.3%) | 5 (10.6%) | .635 | .181 |
| Strongly Agree | 7 (20.4%) | 4 (5.6%) | 7 (6.3%) | 37 55.6%) | 75 (88.0%) | | |
| **To what extent do you agree that AI reduces treatment errors?** | | | | | | | |
| Disagree | (0.0%) | (0.0%) | (0.0%) | (0.2%) | (0.2%) | | |
| Neutral | 0 (2.3%) | (0.5%) | (1.2%) | 5 (10.6%) | 2 (14.6%) | | |
| Agree | 0 (11.7%) | 8 (4.2%) | 3 (3.1%) | 44 33.8%) | 25 (52.8%) | .849 | .138 |
| Strongly Agree | 4 (8.0%) | (1.9%) | 7 (4.0%) | 9 (18.5%) | 38 (32.4%) | | |
| **To what extent does remote monitoring positively impact healthcare transformation?** | | | | | | | |
| Disagree | (0.0%) | (0.0%) | (0.0%) | (1.4%) | (1.4%) | | |
| Neutral | (0.0%) | (0.9%) | (0.9%) | 6 (10.8%) | 4 (12.7%) | | |
| Agree | 4 (12.7%) | 4 (3.3%) | 5 (5.9%) | 22 28.6%) | 15 (50.5%) | .484 | .004 |
| Strongly Agree | 0 (9.4%) | 0 (2.3%) | (1.4%) | 5 (22.3%) | 51 (35.4%) | | |
| **To what extent does RFID positively impact healthcare digital transformation?** | | | | | | | |
| Disagree | (0.0%) | (1.4%) | (0.0%) | (0.0%) | (1.4%) | | |
| Neutral | (1.9%) | (0.9%) | 0 (2.3%) | 4 (8.0%) | 6 (13.1%) | | |
| Agree | 2 (9.9%) | (1.4%) | 2 (2.8%) | 32 31.0%) | 92 (45.1%) | .434 | .004 |
| Strongly Agree | 4 (10.3%) | 2 (2.8%) | 3 (3.1%) | 03 24.2%) | 72 (40.4%) | | |
| Total | 4 (22.1%) | 8 (6.6%) | 5 (8.2%) | 69 53.1%) | 26 100.0%) | | |

In Table 4.4, significant differences across country groups in perceptions of HER, AI and IOMT applications in healthcare are presented. EHR improvements in efficiency ($F=10.274$, $p<0.001$) and accuracy ($F=14.753$, $p<0.001$) are observed, with 89.2% of respondents reporting significant or extensive efficiency improvements and 92.3% noting significant or extensive accuracy enhancements.

Strong positive perceptions of AI applications are demonstrated, with 89.7% agreeing or strongly agreeing on AI imaging benefits ($F=0.767$, $p=0.513$), 98.6% on predictive

analytics (F=1.635, p=0.181), and 85.2% on reducing treatment errors (F=1.849, p=0.138).

Remote monitoring is viewed favorably by 85.9% of respondents (F=4.484, p=0.004), while RFID technology's impact on digital transformation is recognized by 85.5% (F=4.434, p=0.004). Based on these results, the null hypothesis for H4 is rejected, as significant differences are observed in the impact of EHR on healthcare efficiency based on the stage of digital transformation. However, the null hypothesis for H5 is accepted, as no significant differences are found in the perception of AI applications reducing treatment errors among different country classifications.

## CHAPTER FIVE
## DISCUSSION OF RESULTS AND RECOMMENDATIONS

### 5.1 Introduction

The dissertation examines the impact of digital transformation in improving efficiency and accuracy of health care services using digital tools including EHR, AI, IoMT towards achieving Sustainable Development Goal 3 (SDG 3), which Targets to be attained at all age groups, ensuring healthy lives and well-being.

The study involves how digital transformation initiatives increase operational efficiency, accessibility, and quality of healthcare services. The insights also discuss the implications for how lessons from the COVID-19 pandemic have fast-tracked by illustrating how digital tools can reshape care delivery, improve

decision-making and optimize patient outcomes. Alongside these, SDG 3 calls for ending child mortality, reducing communicable diseases and providing access to health care as a right through sustained systems.

The next section will evaluate these findings against the backdrop of recent literature, highlighting points of agreement and disagreement.

**5.2 Discussion of Results**

This chapter the data analysis presented in this chapter offers relevant experience to healthcare organizations from the perspective of Electronic Health Records (EHR), Artificial Intelligence (AI), and Internet of Medical Things (IoMT) applications. The way that we analyzed demographic characteristics; perceptions of technology effectiveness and differences across the different stages of the organizations compliments other research approaches used in comparing healthcare digitalization

**Demographic Characteristics of Study Participants**

As for the demographic breakdown of participants, out of 426 respondents 262 (61.5%) were male. Research has previously identified this gender gap in leadership positions within the healthcare sector (Kuhlmann et a., 2017), and hence may affect perception and decision-making regarding digital transformation initiatives. With majority falling in the 35-44 age range (52.1%), we seem to have a mid-career professional perspective dominating the study. These findings are consistent with

Elgohary & Abdel-Aziz (2022) who found that employee demographics have impact on digital transformation in public sector.

The geographic diversity, with Egypt (61.5%) and Germany (15.0%) being the most represented countries, can offer an interesting perspective on digital transformation of healthcare in both developing as well as developed economies with different cultural backgrounds.

**Perceptions of Digital Technology Utilization Across Demographic Groups**

Examining perceptions of digital technology usage reveals some intriguing demographic patterns. The results show that 41.3% of participants feel that their organization is halfway to the perfect state in terms of digital transformation, while another 36.6% agree they are close to this ideal state, a sign of relative optimism regarding progress overall. Such optimism again correlates with the findings of (Ghoneim, 2021) where a robust economic growth and investment was taking place towards the ICT sector in Egypt too which depicts an apparent positive response toward digitization.

The gender difference in perceptions, with more males (23·9%) being closer to the ideal digital state than females (12·7%), prompts us to reflect on male and female leaders during this digital transformation. This inequality is consistent with concerns expressed by Kuhlmann et al. Patricks, S. (2017), for

example: Gender equity at the Senior Executive level in health care leadership.

Interestingly, the insight on age groups indicating a significant optimism within the 35-44 age group suggests that this mid-career demographic cluster may be predictive of who is driving digital transformation initiatives. This result backs the claim given by Bresciani et al. (2021) Top Organizational Key Attributes of Successful Digital Transformation: The role of Workforce Practices in Times of Crisis.

**Evaluation of Organizational Proximity to Ideal Digital State**

The statistical analysis of organizational proximity to the ideal digital state statistically sound findings. The current stage of digital transformation has an F value of 54.786 ($p < 0.001$), suggesting that organizations exhibit strong differences in self-reported current stage. This variation between perceptions is in agreement with the findings of Wahab 2022 where significant differences were found among healthcare providers and patients' digital transformation during COVID-19 pandemic.Also, this aligns with Chuck Appleby, Janice Wurz, & John Hendricks. Digital transformation from Buzzword 2021 to an Imperative for Health systems, The COVID-19 pandemic was the catalyst for a number of converging trends in the health care industry, most notably consumers placing greater preference on convenience and access to care. For most leading health systems, digital transformation is not only about being more consumer-centered

but also a shift in operations, culture and technology. For the health care sector, this status quo changed dramatically with the COVID-19 pandemic. The model of zero-contact virtual health and care delivered in the home was not only one of necessity, but also preference. But this was no sudden shift, though it might seem so. If anything, the pandemic accelerated many trends, consumer behavior changes and technology acceleration, However, the only perception on which the groups differed significantly was that of whether or not organizations have a well-defined digital transformation strategy ($F = 20.239$, $p < 0.001$) – indicating varying degrees of strategic clarity between organizations at different stages of transformation. Our finding supports the argument made by Hess et al. (2016) highlights the need to define and execute precise strategies in order to leverage digital transformation and improve process efficiency and effectiveness.

The differences in the importance assigned to data quality/access ($F = 2.612$, $p = 0.035$) and budget/ROI ($F = 4.572$, $p = 0.001$) across digital maturity levels also reveals that organizations emphasize different dimensions of transformation at different stages of maturity

**Assessment of EHR and AI Influence on the Ideal Digital State**

Based on the analysis of EHR and AI effects to closeness to an ideal digital organizations state, perceptions play a significant

role auto-filtering through standards. Significant differences exist among professions on EHR efficiency improvements ($F = 3.972$, $p = 0.004$) and AI imaging applications ($F = 9.762$, $p < 0.001$), with organizations at different stages of digital maturity appearing to view the benefits of these technologies differently.

With the exception of improvements in perceptions of EHR accuracy ($F = 1.996$, $p = 0.094$) where higher levels stages experienced more uniformity in perception, these differences suggest that stages may perceive this benefit differently as digital maturity develops This uniformity in perception may be due to the largely recognized role of EHR in decreasing medical errors as pointed out by Baird et al. (2021).

Differences in the perceptions that artificial intelligence (AI) could alleviate treatment error ($F = 8.139$, $p < 0.001$), and remote vital sign monitoring impact ($F = 6.906$, $p < 0.001$), which are significant suggest a higher awareness of advanced technologies as organizations become more digitally mature. Which is consistent with Jiang et al. (2021) emphasized on the increasing importance of AI in healthcare management decision-making and patient care.

**Comparative Analysis of Digital Transformation Across Country Groups**

Country groups EHR & AI impact analysis the findings indicate notable differences in perceptions across country groupings. The relatively high significance ($p < 0.001$) in

perceptions of whether EHR improved efficiency and accuracy indicates that the benefits of EHR are not seen consistently across different healthcare settings.

Country groups showed significant differences in perceptions of AI applications for medical imaging ($p = 0.004$) and remote vital sign monitoring ($p < 0.001$), suggesting differences between wide adoption and perceived benefits of advanced healthcare technologies across the globe. This corroborates the results of El-Kased et al. (2021) that AI adoption in healthcare differs by region.

In contrast, the absence of significant differences in perceptions that AI reduces treatment errors ($p = 0.351$) indicates a more similar vision of this potential benefit across the healthcare systems.

**Current Stages of Digital Transformation Across Organizations**

Studies of stages of digital transformation show wide differences in both the progress and perceptions of organizations. The high significance ($F = 54.79$, $p < 0.001$) across stages in perceived distance to the ideal digital state suggests that organizations can be confident or less so about their status in striving for digital maturity.

The substantial difference ($F = 20.24$, $p < 0.001$) in the extent to which organizations exhibit strategic clarity over the various stages of digital maturity (3–5 groups with equal levels of

maturity measured every two years) suggests that a defined form of digital transformation strategy emerges as an organization moves through its journey to Digital transformation or innovation ability within its industry. This proves the point that Hess et al. Digital transformation strategy November 2, 2016 Bridging the Organization Gap: Why Can Clarity of Strategy Drive Change.
Since the effect of COVID-19 on digital transformation was not much different (F =1.921, p=0.11), it indicates that even if an organization was at a certain stage of digital transformation, it did not matter for the role of pandemic as an impetus for acceleration in digitization process. The uniform perception is consistent with the global nature of COVID-19 pandemic's impact on digitalization of healthcare.

**Captions of EHR and AI Impact on Healthcare Transformation Across Organizational Stages**

Interestingly, the impact of EHR and AI concerns differs by organizational stage. The result implies that organization with idle or non-evolving stage of digital maturity perceive fewer benefits from EHR Systems witnessed by 78.8% responding as Significant and extensive Improvement on efficiency in comparison to the extreme level differences amongst perceptions of EHR Efficiency improvements ($F = 3.972$, $p = 0.004$). Differences in perceived benefits of AI applications for medical imaging ($F = 9.762$, $p < 0.001$) and predictive analytics ($F = 1.259$, $p = 0.286$) are also statistically significant at the high level

implying that digitally mature organizations realize relatively higher benefit in these advanced technologies too This confirms the findings of Jiang et al. (2021),

**Relationship Between Country Classification and Perceptions of Digital Transformation**

The analysis of EHR and AI perceptions across country groups reveals significant variations. The high significance in views on EHR's efficiency ($\chi2 = 84.443$, $p < 0.001$) and accuracy improvements ($\chi2 = 61.842$, $p < 0.001$) suggests that the benefits of EHR systems are perceived differently across different healthcare contexts.

the large differences between perceptions for applications such as AI in medical imaging ($\chi2 = 23.902$, $p = 0.004$) or AI for remote vital sign monitoring ($\chi2 = 29.670$, $p < 0$. Feedback also suggests that failure rates are low compared to the country groups obey an equally distributed rule of high take up away into adoption and perceived benefits from similar advanced healthcare technologies.

Furthermore, the little variation in perceptions like role of AI in predictive analytics ($\chi2 = 9.784$, $p = 0.134$) and role of AI in reducing treatment errors ($\chi2 = 9.988$, $p = 0.351$) agency suggests a more consensus view towards such potential advantages among systems holding herein on all these apparent benefits. suggesting complimentary views about them across different systems. This

consistency may be indicative of global recognition of the potential for AI to improve healthcare (Topol, 2020).

**Relationship Between Digital Transformation Stages and Perceptions of Technological Impact**

Evaluation of the relationships identifies major connections across several technologies, demonstrating an approach through the lens of digital transformation stages (Stage-based analysis) vs. technology impact perceptions (Type-based Technology Impact Perceptions). The high significance level associated with perceptions of EHR efficiency improvements ($\chi2 = 55.988$, $p < 0.001$) suggests that organizations which are more effortful in digital transformation initiative can better identify the gain initiative derived from employing EHR systems. The differences in perceptions of AI applications for medical imaging ($\chi2 = 54.435$, $p < 0.001$) and predictive analytics ($\chi2 = 15.935$, $p = 0.043$) were statistically significant indicating that organizations at more advanced stages of digital transformation tend to perceive greater benefits associated with these two sophisticated technologies as well. The consistent differences in AI's role in decreasing treatment errors ($\chi2 = 47.034$, $p < 0.001$) and approach of IoMT on patient safety ($\chi2 = 44.374$, $p < 0.001$) with respect to the different stages of transformation show that organizations at more progressed digital transformation stages are likely to use such technologies for effective patient care. This results in a huge disparity of perception regarding the

impact of RFID technology ($\chi 2 = 33.161$, $p = 0.001$) across transformation stages suggesting that organizations with more digitally mature processes are more likely to observe better patient identification and tracking using this technology.

**The Role of Digital Transformation in Healthcare and SDG 3**

The integration of digital health technologies significantly contributes to achieving SDG 3. Digital transformation that acts directly upon multiple SDG 3 targets in healthcare,

Decreasing maternal and child mortality: With remote monitoring, telemedicine and IoMT — individuals have adequate access to prenatal or neonatal care, even in distant places.

Epidemic detection and management: The use of AI and predictive analytics for tracking outbreaks, including during the COVID-19 pandemic.

Equitable access to UHC: The implementation of EHRs and telehealth platforms improves access to care, especially for vulnerable populations.

Enhancing mental health and reducing non-communicable diseases (NCDs): Digital transformation helps in improving treatment regimens, as well as early detection of disease leading to reduced NCD mortality.

**5.3 Study Recommendations**

• Develop digital transformation strategies which are indicative of what phase an organization finds themselves in digital maturity, solving for issues or opportunities throughout each

level of maturity.
• Top down with training programs to enhance digital capabilities of health care personnel; ensuring the workforce is capable in using new technologies.
• Integrating AI and IoMT in health-care systems, such as medical imaging, predictive analytics, and remote patient monitoring for quality and efficient care.
• Instead build data governance frameworks for quality, access, security and etc., across all digital platforms to enable informed decision making as well as keeping up with the trust of every patient.
• Promotion of Cross-Border Projects and as there are Countries in the World which are Behind on Digital Transformation, Also Promote Sharing Knowledge Between them.
• Make sure that change management programs include culture and keep in mind that digital transformation initiatives need to be embraced at all levels of the organization.
• Standardize measures on how the digitization is transforming healthcare outcomes, operational efficiency, and patient experience to measure the progress and ROI of digital transformation.

**5.4 Limitations and Future Research Directions**

While this study aimed to provide valuable insights into the impact of digital transformation on healthcare service improvement, it is important to acknowledge some limitations.

Time limitation: the cross-sectional design of the study means that perceptions and experiences represent a snapshot in time. Longitudinal studies would be indeed helpful in tracking lessons learned through the impact of digital transformation initiatives over time to test before and after applying digital transformation.

Though important, the reliance of this study on self-reported data from healthcare professionals may introduce bias. Future research may supplement this work with objective indicators of improvement in accessibility, such as secondary data access to outcome data or health system efficiency.

The sample is large enough therefore to include the full range of perspective, but in doing so its likely averages over differences at sub-national level in what are arguably both the experiences of and digital transformation outcomes. Future research may examine a single geography or health system allowing for greater context-specific detail.

Although the study includes three important technologies (EHR, AI, and IoMT), future studies could examine a broader spectrum of digital technologies underpinning the facilitation of positive effects within healthcare service improvement dimensions. This opens up opportunities for future research on the fact that blockchain technology, perhaps similar to what Massaro (2021) spoke of.

## 5.5 Conclusion

Digital transformation is essential for attaining SDG 3 by enhancing healthcare delivery, accessibility, and health outcomes. However, to truly accomplish those objectives, it is essential to develop more comprehensive strategies that address the hurdles to technology adoption and establish sustainable systems. Long-term Solutions to the Data Challenges of Digital Transformation in Healthcare are Infrastructure, Capacity Building and Collaborations.

It also noted that aligning digital transformation with the goals of Egypt vision 2030 will achieve sustainability and provide well-being for all. With sound policy based on digital technology, Egypt has the potential to deliver UHC and equitable Essay. The research findings support the positive impact of digital transformation technologies in improving healthcare services. In the discussion of integrating and contextualizing the findings within literature, in particular these results demonstrate that Electronic Health Records contribute in strong and significant improvement of efficiency rather than diagnosis accuracy, Artificial Intelligence participate strongly and significantly in improvement of digenesis accuracy and less treatment errors, and Internet of Medical Things can lead to better patient outcome according to contemporary discourse. The more mature the organization is in terms of digital transformation practice applies it first for AI and EHR and then IOMT.

This research also points towards the fact that digital transformation initiatives are happening at top speed owing to COVID-19 pandemic, signifying the onset of rapid technology adoption and innovation in healthcare. However, the results make clear that organizational capabilities, skills development and culture are components critical for delivering successful digital transformation initiatives. Further, the results can help in informing delivery policy and practice; encouraging ongoing investment in digital while taking steps to build organizational capacity needed, addressing culture barriers to change. Health systems globally are being challenged with demands to provide quality effective care in a time-friendly manner and this study offers critical direction that will assist those going through digital transformation.

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