A FRAMEWORK FOR ENHANCING DIGITAL SYSTEMS ADOPTION IN REFERRAL HEALTHCARE

CASE STUDY: MUBENDE REGIONAL REFERRAL HOSPITAL, MUBENDE MUNICIPALITY, UGANDA

Submitted by

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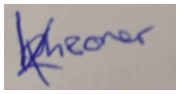
DECLARATION

I, Kikashemera Pheoner declare that this dissertation is my original work and has never been presented to any other university for an academic award, being it certificate, diploma, Degree, or Master. I solemnly bear and stand to correct any inconsistency. Any material that is not my original work the authors have been acknowledged.

Signed: 

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APPROVAL

This is to certify that this research proposal has been submitted to the University Academic Board of Examiners with my approval as the University Student's Supervisor.

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Signed: ……... **Date:** 31/08/2025……..

DEDICATION

This piece of work is dedicated to my beloved parents, sisters, brothers, and friends whose contributions are invaluable

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Above all, with all my heart, I take the opportunity to thank the Almighty God, who has taken me all through my studies. For without his great kindness, love and blessings I wouldn't be where I am. A number of people have been involved in seeing the success of my education and this work. However, the following are worth mentioning.

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To all of you who have supported me, May God rewards you abundantly.

LIST OF ACRONYMS

MTN	Mobile Telephone Networks
HIV	Human Immune Virus
LAN	Local Area Networks
NBI	National Backbone Infrastructure
DHFPs	Digital Health Focal Persons
DHICs	Digital Health adoption Committees
HL7	Health Level Seven
FHIR	Fast Healthcare Interoperability Resources
ICD-10	International Classification of Diseases 10th Revision
MEL	Monitoring and Evaluation Layer
OpenHIM,	Open Health Information Mediator
MoH	Ministry of Health
HIE	National Health Information Exchange
DHIS2,	District Health Information Software 2
ToT	Training-of-Trainers
ICT	Information Communications Technology
KPIs	Key Performance Indicators
NGO	Non-Governmental Organization
HMIS	Health Management Information System
EMRS	Electronic Medical Records System
eLMIS,	Electronic Logistics Management Information System

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Abstract

This study aimed to design a framework for enhancing digital systems adoption in healthcare, using Mubende regional referral hospital as a case study. The study was guided by three independent variables; technological infrastructure, human digital capacity, and organizational readiness, and the dependent variable: digital systems adoption. A mixed methods approach was adopted, using structured questionnaires and interview guides. Data was collected from a sample of 250 respondents, including clinical staff, administrative personnel, ICT support staff, and patients. Descriptive and inferential analyses were conducted using SPSS, while thematic analysis was used for qualitative data.

Findings revealed that technological infrastructure significantly influenced digital systems adoption ($\beta = 0.395$, $p < 0.001$), with respondents citing poor internet access, frequent power outages, and limited equipment as major challenges. Human digital capacity also showed a strong positive relationship ($\beta = 0.289$, $p = 0.004$), with most staff lacking consistent training in the use of digital tools. Organizational readiness had a significant yet lower influence ($\beta = 0.241$, $p = 0.016$), particularly due to the absence of internal ICT strategies and weak management commitment.

The study recommended that the Ministry of Health prioritize investment in ICT infrastructure, health facility leadership strengthen internal digital policies, and development partners support ongoing capacity building. A context-specific adoption framework and model were proposed to guide structured, sustainable digital transformation in Uganda's healthcare systems.

Keywords: Digital systems adoption, technological infrastructure, human digital capacity, organizational readiness, healthcare, Uganda.

CHAPTER ONE
INTRODUCTION

1.0.Introduction

This chapter presents the introduction to the study titled "A Framework for Enhancing Digital Systems' adoption in Healthcare", with Mubende regional referral hospital in Mubende Municipality, Uganda, as the case study. The chapter contains the background of the study (divided into historical, theoretical, conceptual, and contextual perspectives), statement of the problem, purpose, objectives, research questions, hypotheses, scope, significance, justification, conceptual framework, and operational definitions of key terms. The study investigates three independent variables: Technological Infrastructure, Human Capacity and Digital Literacy, and Organizational Readiness and Policy Support, and the dependent variable: Digital Systems' adoption.

1.1.Background of the study

1.1.1. Historical background

Over the last two decades, the global healthcare sector has undergone a digital revolution driven by advancements in information and communication technologies (ICTs). Developed countries have increasingly adopted digital systems such as Electronic Medical Records (EMRs), Health Information Exchanges (HIEs), and Artificial Intelligence (AI) in diagnostics and patient management. These systems have significantly improved efficiency, reduced medical errors, and enhanced patient outcomes (World Health Organization, 2021). For instance, countries like the United States and the United Kingdom have digitized a majority of their public health records and interconnected them across institutions, enabling faster decision-making and patient tracking (OECD, 2020).

On the African continent, digital transformation in healthcare has been gradual but promising. Several nations have initiated digital health projects to address service delivery gaps, particularly in areas. Countries like Rwanda and Kenya have invested in national eHealth strategies and telemedicine initiatives that connect health centers with urban hospitals (Bervell & Al-Samarraie, 2019). Despite these gains, many African countries continue to face challenges such as poor ICT infrastructure, limited funding, and inadequate digital literacy among healthcare providers (Nwachukwu & Ojo, 2020).

At the East African regional level, the East African Community (EAC) has recognized the potential of digital technologies in transforming health systems. Through initiatives like the East African Digital Health Framework (EAC, 2018), member states, including Uganda, Kenya, and Tanzania,

have committed to improving interoperability and standardization of digital health tools. However, these frameworks often face implementation bottlenecks due to differences in national priorities and limited institutional readiness (Musoke et al., 2022).

Uganda has made significant efforts toward digitalizing healthcare. The Ministry of Health launched the National eHealth Policy in 2016 and the Health Sector Digital Health Strategy (2020/21–2024/25), aimed at improving service delivery through interoperable and secure digital systems (Ministry of Health Uganda, 2020). Several pilot projects, including mobile health (mHealth) applications and EMR installations, have been initiated in both public and private sectors. Nevertheless, most digital health interventions remain concentrated in urban and peri-urban areas, while health facilities continue to operate with manual record-keeping and fragmented systems (Mugisha & Byamukama, 2020).

At the local level, Mubende regional referral hospital in Mubende Municipality reflects the broader national challenges in digital health adoption. The facility operates under resource constraints, with irregular electricity supply, limited internet access, and insufficient digital tools. Health records are mainly paper-based, and most staff have not received formal ICT training. Despite serving a large catchment area, the center lacks an adopted digital system to support effective patient management, referrals, and data reporting. These limitations highlight the urgent need for a tailored framework that supports digital systems adoption in healthcare environments like Mubende regional referral hospital.

1.1.2. Theoretical background

This study is anchored on the Technology–Organization–Environment (TOE) Framework, originally developed by Tornatzky and Fleischer (1990). The TOE framework provides a structured model for understanding how organizations adopt and implement technological innovations. It proposes that three contextual-dimensions influence technology adoption: Technological context, Organizational context, and Environmental context.

Technological Context

This refers to the internal and external technologies available to an organization that are relevant to the innovation. It includes both the existing infrastructure and the perceived benefits and complexity of the new system.

This dimension aligns with the variable Technological Infrastructure, which includes hardware, internet access, electricity, and the digital tools available at Mubende regional referral hospital. The study investigates whether the presence (or absence) of appropriate technologies influences the adoption of digital systems.

Organizational Context

This describes the characteristics of the organization such as size, managerial structure, human resource capacity, and the availability of resources for innovation.

This context corresponds to two variables:

Human Capacity and Digital Literacy, which is, the ICT competence of health workers, training received, and comfort in using digital platforms.

Organizational Readiness and Policy Support, which is, the leadership's support for digital transformation, existence of digital policies, and institutional structures needed to implement and sustain digital systems.

Environmental Context

This refers to the external environment in which the organization operates. It includes the regulatory framework, industry trends, socio-cultural attitudes, and government interventions.

While environmental factors were not directly measured, the study recognizes their indirect influence through intervening variables such as:

Government funding; whether the health center receives financial support for digital systems.

Community attitudes; local perceptions of technology in healthcare.

Political will; national and local government commitment to supporting digital transformation.

TOE Framework Support for Framework Design

The TOE framework guided the structure and logic of the framework developed in this study for enhancing digital systems' adoption in healthcare. Each component of the proposed framework in Chapter Four is derived from one of the TOE dimensions:

Technological Layer: This addresses infrastructure readiness; ensuring that health centers like Mubende regional referral hospital have the necessary hardware, connectivity, and software tools.

Organizational Layer: This includes leadership, internal policies, staff training, and institutional culture that supports digital transformation.

Environmental Consideration Layer: Although not directly studied, the framework accounts for external influences like funding, regulation, and community buy-in, acknowledging their role in supporting or hindering adoption.

By following the TOE framework, the study ensures that the proposed model is holistic, practical, and rooted in a well-established theoretical foundation that is widely used in innovation and technology adoption research (Baker, 2012; Oliveira & Martins, 2011).

Therefore, the Technology–Organization–Environment (TOE) framework provides a comprehensive lens through which digital systems adoption in healthcare can be understood, assessed, and improved. Its application in this study has enabled a structured investigation into the internal and external conditions affecting digital transformation at Mubende regional referral hospital. Furthermore, the theory directly informed the design of a context-specific and scalable framework for enhancing digital adoption in health settings.

1.1.3. Conceptual background

In contemporary healthcare systems, digital transformation is increasingly viewed as a cornerstone for improving service delivery, enhancing efficiency, and promoting patient-centered care. The concept of digital systems adoption refers to the process through which various digital tools and platforms are connected and coordinated to function as a unified system (Kumar & Mehta, 2019). In the context of healthcare, this includes the interoperability of Electronic Medical Records (EMRs), laboratory information systems, telemedicine platforms, and mobile health (mHealth) technologies. Digital systems adoption goes beyond the mere adoption of ICT tools; it involves aligning technologies, processes, people, and policies to ensure seamless data exchange, coordinated clinical workflows, and real-time decision-making. It is particularly crucial in healthcare settings where resources are limited, staffing is often constrained, and the demand for timely services is high (WHO, 2021).

This study investigates digital systems adoption as the dependent variable, measured by indicators such as: The extent of interoperability between systems, Use of digital tools in routine healthcare operations, Digital data flow and sharing among departments, Staff involvement in digital platforms, and Reduction in paperwork and manual processes.

To understand the factors that influence adoption in health centers like Mubende regional referral hospital, the study considers three independent variables, each conceptually distinct but operationally interrelated:

Technological Infrastructure

This refers to the physical and digital assets that support the implementation of digital systems. It includes computers, software applications, internet access, mobile devices, electricity, and backup systems. Adequate infrastructure is the foundational requirement for adoption and determines the center's capacity to deploy and sustain digital tools (Achieng & Rotich, 2020).

Human Capacity and Digital Literacy

adoption depends on healthcare workers' ability to effectively use digital systems. This variable captures the knowledge, skills, experience, and attitudes of health personnel in relation to ICT usage. Digital literacy enables staff to engage with digital platforms confidently, minimize errors, and improve care delivery (Alami et al., 2020). Training programs, user-friendly tools, and technical support contribute to this capacity.

Organizational Readiness and Policy Support

This variable reflects the internal structures, leadership attitudes, planning processes, and existing policies that facilitate or hinder digital transformation. When health facilities have clear digital strategies, committed leadership, and supportive policies, adoption is more likely to be successful (Oliveira & Martins, 2011). Organizational readiness also includes staff motivation, institutional culture, and resource allocation.

While the study focuses on the three independent variables above, it acknowledges that digital systems adoption may also be influenced by intervening variables that fall outside the direct control of the health facility. These include:

Government Funding: Availability of budgetary support from the national or district government.
Community Attitudes: Public perception and willingness to engage with digital health platforms.
Political Will: Commitment from policymakers to invest in health digital infrastructure.

The conceptual relationships among these variables provide a foundation for assessing the current state of digital adoption at Mubende regional referral hospital and developing a context-relevant

framework to improve it. These variables are operationalized in the study's data collection tools, analysis, and final framework design in Chapter Four.

1.1.4. Contextual background

Uganda's health sector has seen notable efforts to adopt digital systems into service delivery, particularly in response to challenges of access, quality, and efficiency. The Ministry of Health has introduced digital tools such as the District Health Information Software 2 (DHIS2), Electronic Medical Records (EMRs), and mobile health platforms aimed at improving data management, disease surveillance, and service coordination. These interventions have shown some success in urban and peri-urban settings. However, healthcare facilities continue to face substantial challenges in adopting and adopting digital systems due to limitations in infrastructure, staffing, and institutional capacity.

Mubende regional referral hospital, located in Mubende Municipality, serves a predominantly population in central Uganda. As a lower-level government facility, it provides essential primary healthcare services including outpatient care, antenatal services, immunization, and HIV/AIDS treatment. The center is strategically important in the local healthcare delivery chain, acting as a first point of contact for many patients before referral to higher-level facilities. Despite this critical role, the health center operates under constrained conditions that hinder its ability to effectively adopt digital systems.

At present, Mubende regional referral hospital relies heavily on manual systems for record-keeping, patient follow-up, and internal communication. Patient data is captured in physical registers, which are prone to loss, damage, and inefficiencies in retrieval and analysis. The facility lacks a reliable internet connection, and electricity supply is often unstable or unavailable—posing challenges to the use of any ICT infrastructure. Additionally, most healthcare workers at the center have limited formal training in digital health tools and express low confidence in using computers or mobile applications for clinical tasks.

Efforts to introduce digital systems in the facility have often been fragmented and unsustained. For example, some pilot programs introduced mobile health reporting tools or computer-based systems, but these were abandoned due to lack of follow-up support, power interruptions, and inadequate staff orientation. The absence of a structured implementation framework and insufficient alignment with the local context have contributed to the failure of these digital initiatives to take root at Mubende regional referral hospital.

Furthermore, policy support at the district and facility levels remains weak. While national policies such as the Health Sector Digital Health Strategy (2020/21–2024/25) exist, their operationalization at health centers has been minimal. Mubende regional referral hospital lacks formal digital health guidelines, internal policies, or a clear digital vision. The leadership and staff recognize the importance of digital systems but are limited by institutional and systemic barriers that prevent progress.

In light of these realities, there is a compelling need to develop a context-specific framework that considers the technological, human, and organizational conditions unique to facilities like Mubende regional referral hospital. Such a framework would provide a practical guide to systematically enhance digital systems adoption in healthcare, ensuring that national digital health policies are effectively translated into action at the local level.

1.2.Problem statement

Ideally, health facilities should employ adopted digital systems—such as electronic medical records and mobile health tools—to streamline service delivery, improve patient outcomes, and support data-driven decisions (WHO, 2023). These technologies enhance efficiency, reduce delays, and improve accuracy in clinical processes and reporting.

At Mubende regional referral hospital, this ideal remains unmet. The facility still depends on manual record-keeping, with limited use of digital tools due to inadequate ICT infrastructure, unreliable electricity, and low digital competence among staff. Previous digital initiatives lacked sustained support and were abandoned prematurely (Mugisa & Kirabo, 2023).

Nationwide, the situation is similar. Only 27% of health centers in Uganda use functional digital tools, and fewer than 15% have regularly updated EMRs (Nabiryo et al., 2024). Additionally, over 60% of health workers in health facilities lack formal digital training (Adong & Sekabira, 2022), limiting effective system usage.

If unresolved, these gaps will lead to continued inefficiencies, delayed care, poor data management, and weak coordination with higher-level facilities. This jeopardizes both individual health outcomes and national health planning (Ministry of Health, 2024).

This study was therefore undertaken to design a practical framework tailored to hospital contexts, aimed at improving digital systems adoption at Mubende regional referral hospital by aligning technological, human, and organizational capacities.

1.3.Purpose of the study

The purpose of this study was to design a practical framework for enhancing digital systems adoption in healthcare, using Mubende regional referral hospital as a case. It focused on how technological infrastructure, human capacity, and organizational readiness influence adoption outcomes in resource-limited settings.

1.4.Specific objectives

This study was guided by the following specific objectives:

a) To investigate the challenges affecting the digital systems adoption and the possible solutions on digital systems adoption at Mubende regional referral hospital.
b) To design a framework for adoption of digital systems.
c) To validate the designed framework of digital systems in healthcare.

1.5.Research questions

The study sought to answer the following research questions:

a) How does technological infrastructure influence digital systems adoption in healthcare centers in Uganda?
b) In what ways does human capacity and digital literacy support the adoption of digital systems in healthcare settings?
c) How does organizational readiness and policy support affect the adoption of digital systems in healthcare facilities?

1.6.Research hypotheses

The study tested the following null hypotheses:

a) H_{o1}: Technological infrastructure has no significant influence on digital systems adoption in healthcare centers in Uganda.
b) H_{o2}: Human capacity and digital literacy have no significant effect on the adoption of digital systems in healthcare settings.
c) H_{o3}: Organizational readiness and policy support do not significantly affect digital systems adoption in health facilities.

1.7.Scope of the Study

1.7.1. Geographical Scope

The study was conducted at Mubende regional referral hospital, located in Mubende Municipality, Central Uganda. This health facility was selected as a representative public health center to generate insights applicable to other healthcare settings across the country.

1.7.2. Time Scope

The study covered a period from January 2023 to July 2025. This timeframe included literature review, tool development, field data collection, analysis, and the development of a proposed framework for enhancing digital systems adoption.

1.7.3. Content Scope

The study focused on three independent variables; technological infrastructure, human capacity and digital literacy, and organizational readiness and policy support, and how they influence the adoption of digital systems (dependent variable) in healthcare. Although external factors such as government funding, community attitudes, and political will were acknowledged as intervening variables, they were not part of the study's direct analysis.

1.8. Significance of the study

This study holds practical and academic significance for various stakeholders involved in healthcare service delivery and digital transformation, particularly in low-resource settings.

Policy Makers and Government Agencies

The findings and proposed framework will provide evidence-based guidance to the Ministry of Health, district health offices, and ICT-related government bodies on how to plan, prioritize, and support the adoption of digital systems in healthcare facilities.

Healthcare Facility Administrators

Health center managers, especially in healthcare areas, will benefit from a structured approach to assessing their readiness for digital systems adoption and identifying gaps in infrastructure, training, or policy that need attention.

Healthcare Workers

The study emphasizes the role of human capacity and digital literacy, which can inform future staff training, capacity-building initiatives, and improve healthcare workers' confidence and competence in using digital tools.

Donors and Development Partners

International agencies, NGOs, and donor organizations interested in supporting eHealth initiatives in Uganda will gain contextual insights into the real challenges faced by health facilities, helping them design more relevant and sustainable interventions.

Researchers and Academics

The study contributes to the growing body of literature on digital health systems in sub-Saharan Africa and offers a foundation for future research on technology adoption frameworks in low-resource healthcare settings.

1.9.Justification of the study

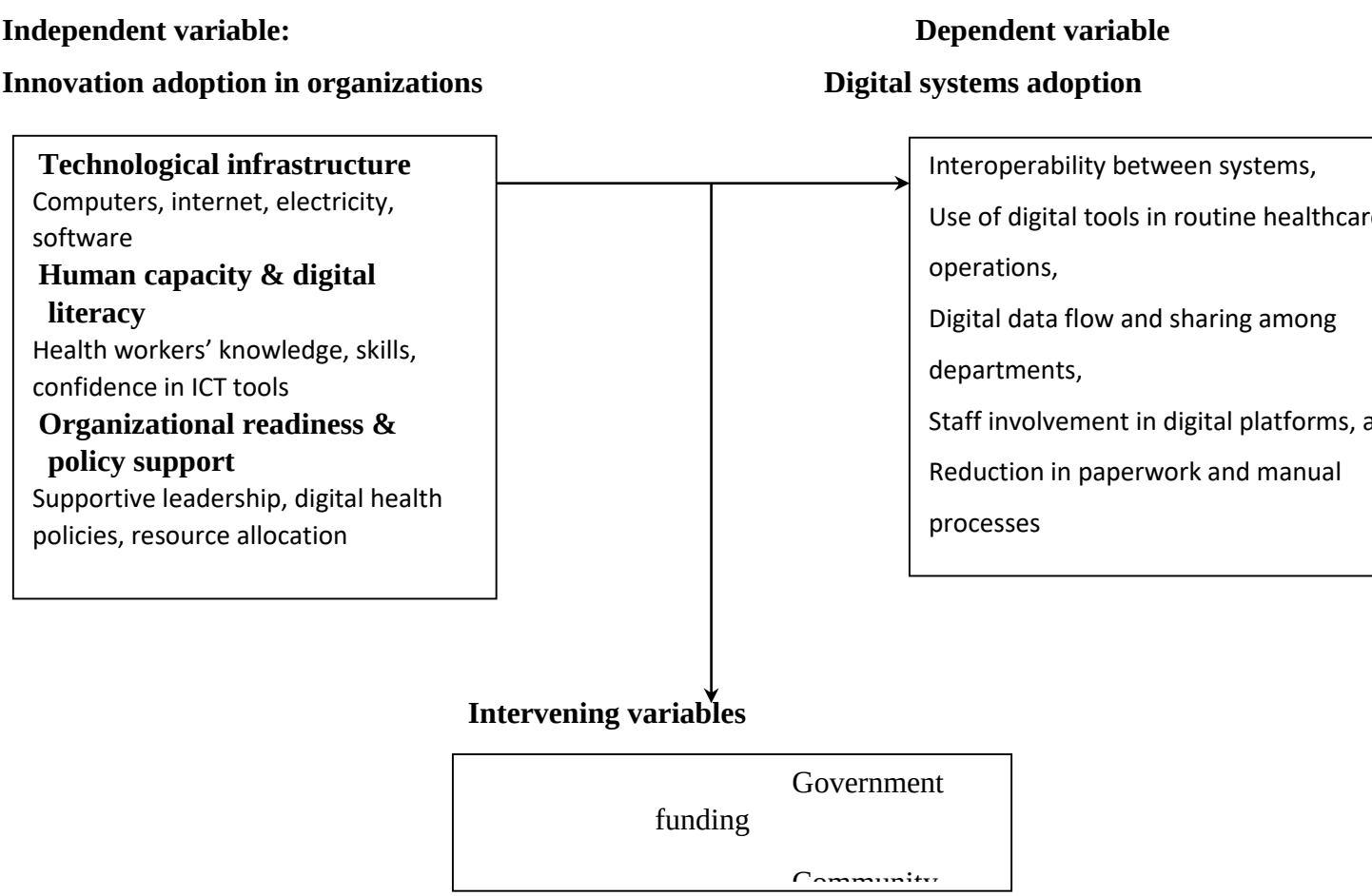
While Uganda has made commendable progress in promoting digital health through national strategies and pilot initiatives, many healthcare centers still operate without reliable or adopted digital systems. Previous studies show that digital health tools in Uganda often fail to scale due to poor infrastructure, limited staff capacity, and the absence of clear institutional policies, particularly in healthcare areas (Nabiryo et al., 2024; Mugisa & Kirabo, 2023). Moreover, most existing research focuses on urban hospitals or national-level implementations, creating a knowledge gap regarding the specific challenges of health centers.

This study is justified by the urgent need for a context-sensitive framework that enables healthcare facilities to successfully adopt digital systems in a sustainable manner. Mubende regional referral hospital, as a typical healthcare facility, provides a practical setting to explore how technology, people, and institutional readiness affect digital transformation. The study combines these three critical domains to offer a holistic framework for digital adoption (Adong & Sekabira, 2022).

The timing of this research is also significant. It supports ongoing efforts under Uganda's Health Sector Digital Health Strategy (2020/21–2024/25), which emphasizes strengthening ICT use in lower-level health facilities (Ministry of Health Uganda, 2024). At the global level, the study aligns with the WHO Global Strategy on Digital Health (2020–2025), which encourages member states to implement inclusive, equitable digital systems for improved health outcomes (WHO, 2023).

By addressing local challenges with a systems-thinking approach, the study offers practical value to policy makers, development partners, and facility managers. It aims to inform strategies that are realistic, scalable, and tailored to Uganda's healthcare context, ultimately contributing to better service delivery and health equity.

1.10. Conceptual framework



Source: Developed by the Researcher (2025)

The conceptual framework for this study was adapted from the Technology–Organization–Environment (TOE) framework by Tornatzky and Fleischer (1990), which offers a comprehensive structure for understanding innovation adoption in organizations. For this study, the TOE model was contextualized to examine how three primary factors; technological, human, and organizational interact to influence the adoption of digital systems in healthcare settings.

Independent Variables

The first independent variable is **Technological Infrastructure**, which refers to the physical and digital components required to support digital systems in health centers. This includes access to electricity, availability of internet connectivity, computers, mobile devices, and health information software. Without these, the foundation for digital adoption is weak or non-existent. According to WHO (2023), the absence of reliable infrastructure remains one of the primary barriers to digital health adoption in low-resource settings.

The second independent variable is **Human Capacity and Digital Literacy**, focusing on the knowledge, skills, and attitudes of healthcare workers in using digital tools. Staff ability to operate electronic medical records, mobile health apps, and other ICT tools is essential to ensure that digital systems are adopted and sustained. As observed by Adong and Sekabira (2022), a lack of ICT training among healthcare workers in Uganda significantly affects their ability to engage with digital platforms effectively.

The third independent variable is **Organizational Readiness and Policy Support**. This includes the internal governance structures, leadership commitment, resource planning, and presence of digital strategies within healthcare institutions. Facilities with clear policies, committed managers, and budgetary support are more likely to adopt and adopt technology successfully (Mugisa & Kirabo, 2023).

Dependent Variable

The dependent variable in this study is **Digital Systems** adoption, defined as the extent to which digital technologies are embedded into the healthcare service delivery processes. This includes the routine use of EMRs, digital referrals, reporting systems, and mobile health solutions. adopted systems allow for real-time access to patient information, better communication between departments, and improved data accuracy. When properly implemented, such adoption contributes to efficiency, reduced paperwork, and improved health outcomes (Nabiryo et al., 2024; WHO, 2023).

Intervening Variables

Although not directly studied, the framework acknowledges the influence of intervening variables that may impact the success or failure of digital systems adoption. These are:

Government Funding: The degree to which the government allocates financial resources for ICT development in healthcare. Underfunding can stall implementation even when internal readiness exists (Ministry of Health Uganda, 2024).

Community Attitudes: Public perception and trust in digital health technologies can either encourage or discourage their use. Misinformation or resistance may lead to underutilization, despite availability.

Political Will: The commitment of local and national leaders to prioritize healthcare digital transformation affects policy enforcement, budget allocations, and support structures needed for system adoption (WHO, 2023).

These variables, although not analyzed directly, were considered during the design of the framework presented in Chapter Four to ensure that the model remains realistic and applicable in actual health contexts.

1.11. Operational definitions of key terms

Digital Systems adoption

Refers to the process of connecting and harmonizing various digital health tools—such as electronic medical records (EMRs), laboratory systems, mobile health applications, and reporting platforms—so they work together seamlessly within a healthcare facility to improve service delivery and decision-making (WHO, 2023; Nabiryo et al., 2024).

Technological Infrastructure

Denotes the essential physical and digital components required to implement and sustain digital health solutions, including computers, mobile devices, internet connectivity, stable electricity supply, software systems, and data storage infrastructure (Mugisa & Kirabo, 2023).

Human Capacity and Digital Literacy

Describes the knowledge, skills, attitudes, and confidence of healthcare workers in using ICT tools and digital health platforms for their daily clinical, administrative, and reporting tasks within a health facility. This is crucial in determining the successful adoption and use of digital systems (Adong & Sekabira, 2022).

Organizational Readiness and Policy Support

Refers to the extent to which a healthcare facility is institutionally prepared for digital transformation, including the presence of supportive leadership, digital policies, internal coordination mechanisms, ICT budgets, and a culture open to innovation (Ministry of Health Uganda, 2024).

Government Funding

The level of financial investment provided by national or district authorities to support the acquisition, implementation, and maintenance of digital systems in public health facilities. Inadequate funding has been widely cited as a barrier to digital health scale-up in Uganda (Nabiryo et al., 2024).

Community Attitudes

The perceptions, beliefs, and level of acceptance among the local population toward the use of digital technologies in healthcare, which may influence utilization and trust in digital health services (WHO, 2023).

Political Will

The degree of commitment by political leaders and government institutions to prioritize digital transformation in healthcare through policies, laws, resource allocation, and institutional support mechanisms. Without political commitment, digital strategies often remain unimplemented (Mugisa & Kirabo, 2023).

Healthcare Facility

A public or private health center located in a non-urban, typically underserved area, such as Health Center III in Uganda, offering primary healthcare services including outpatient care, antenatal services, and immunizations (Ministry of Health Uganda, 2024).

1.12. Conclusion

This chapter has introduced the study by outlining the context, background, and rationale for investigating digital systems adoption in healthcare, with a focus on Mubende regional referral hospital in Mubende Municipality. The chapter defined the problem, highlighted the gap in existing systems, and presented the purpose, objectives, and guiding research questions. It also explained the

conceptual and theoretical foundations of the study, emphasizing the role of technological infrastructure, human capacity, and organizational readiness in shaping digital transformation in health settings. The conceptual framework developed will guide the inquiry and framework design in subsequent chapters. Overall, the study aims to contribute practical solutions to the digital adoption challenges faced by health centers in Uganda.

CHAPTER TWO
LITERATURE REVIEW

2.0.Introduction

This chapter presents a structured review of existing literature on the adoption of digital systems in healthcare settings. The review builds a foundation for the study by examining scholarly perspectives, theoretical models, and key conceptual insights that inform the development of digital health frameworks, especially in resource-constrained environments like Uganda (WHO, 2023; Nabiryo et al., 2024). The literature explored in this chapter provides both global and local context, helping to identify critical factors influencing digital system adoption and the gaps this study intends to address.

The chapter is organized into three major sections. The first section presents a theoretical review, highlighting models that explain how innovations such as digital health technologies are adopted in organizational contexts. These include theories like the Technology–Organization–Environment (TOE) framework and others that provide insight into how institutional, technological, and human factors interact to influence adoption (Tornatzky & Fleischer, 1990; Mugisa & Kirabo, 2023).

The second section examines key theories relevant to digital systems adoption, especially those that relate to healthcare delivery. Emphasis is placed on the alignment between theory and practice, showing how these models help explain real-world successes and failures in digital health initiatives across sub-Saharan Africa (Adong & Sekabira, 2022; Ministry of Health Uganda, 2024).

The third and final section is the conceptual review, which clarifies core terms and constructs used in the studysuch as ICT infrastructure, digital literacy, and organizational readiness—and explores how they relate to one another within the framework. This section provides the intellectual grounding needed to structure the study's research model and guide data analysis (Nabiryo et al., 2024).

By synthesizing existing scholarship, this chapter sets the stage for a context-specific approach to digital health adoption and justifies the need for a tailored framework to support digital transformation in Ugandan health centers.

2.1.Theoretical review

This section reviews three foundational theories that support the development and adoption of digital systems in organizational settings, particularly within healthcare. These theories explain how innovation is adopted, what factors influence organizational readiness, and how contextual environments shape technology use. The three theories reviewed are the Technology–Organization–Environment (TOE) Framework, the Diffusion of Innovations (DoI) Theory, and the Institutional Theory.

2.1.1. Technology-Organization-Environment (TOE) Framework

Developed by Tornatzky and Fleischer (1990), the TOE framework posits that the adoption of technological innovations in organizations is influenced by three critical domains: technological context, organizational context, and environmental context. The technological context includes existing digital capabilities and compatibility of new systems; the organizational context involves internal resources, staff expertise, and leadership support; and the environmental context refers to industry trends, regulations, and external pressures (Tornatzky & Fleischer, 1990; Mugisa & Kirabo, 2023).

This framework directly supported the current study by guiding the selection of independent variables—technological infrastructure, human capacity and digital literacy, and organizational readiness and policy support—all of which fall under the TOE dimensions. By applying the TOE model, the study was able to examine digital systems adoption not only as a technological issue but also as an outcome of internal organizational preparedness and external policy environments.

2.1.2. Diffusion of Innovations (DoI) Theory

Proposed by Rogers (2003), the Diffusion of Innovations (DoI) Theory explains how new ideas and technologies spread through a social system over time. The theory outlines five stages of adoption: knowledge, persuasion, decision, implementation, and confirmation. It also identifies innovation attributes—such as relative advantage, complexity, compatibility, and observability—as influencing adoption rates (Rogers, 2003; WHO, 2023).

In this study, DoI theory was useful in understanding the behavioral and attitudinal dimensions of digital system adoption among healthcare workers. For instance, the perception of digital tools as difficult or unreliable could hinder their adoption even when infrastructure exists. The theory supported the analysis of how health workers at Mubende regional referral hospital respond to digital innovations and helped frame the importance of training and digital literacy in building user confidence (Adong & Sekabira, 2022).

2.1.3. Institutional Theory

Institutional Theory suggests that organizations adopt certain structures, systems, or practices not solely because they are efficient, but because they conform to external norms, pressures, and expectations (Scott, 2005). These influences may come from regulatory bodies, professional associations, donors, or government mandates.

This theory was relevant to the study because healthcare facilities in Uganda often implement digital systems in response to Ministry of Health policies, donor requirements, or national ICT guidelines (Ministry of Health Uganda, 2024). Institutional Theory helped explain why some health centers adopt digital health tools without full readiness, and why sustained adoption may depend on policy alignment, leadership support, and compliance culture rather than just technical capacity.

In this study, STS provides a framework for analysing how sensor networks or digital twins will only succeed in improving the sugarcane value chain if aligned with user needs, digital literacy, and institutional support. For example, even the best predictive models cannot yield value unless farmers understand them, and extension workers and policymakers support their implementation (Mtega & Msungu, 2023). This theory supports a balanced approach to digital adoption, combining tools, training, and organizational alignment.

Together, these three theories offer a multidimensional lens for examining digital systems adoption in healthcare. The TOE Framework informed the study's structural model, the DoI Theory clarified user behavior and acceptance, and Institutional Theory highlighted the role of external mandates and policy influence. By adopting insights from these theories, the study was able to design a robust and context-specific framework that accounts for technological, human, and institutional dynamics.

2.2.Theoretical framework

Figure 2.1: Technology-Organization-Environment Framework

Explanation of the Theoretical Framework and Its Application to the Study

The Technology–Organization–Environment (TOE) framework provides a comprehensive lens through which the adoption of digital systems can be examined. The framework posits that adoption decisions are influenced by three broad dimensions: technological, organizational, and environmental contexts. The technological dimension relates to the availability, functionality, and perceived benefits of the technologies under consideration. The organizational dimension captures internal factors such as leadership support, financial resources, staff skills, and organizational culture. The environmental dimension considers external pressures and influences such as government policies, donor support, regulatory requirements, and competitive or cooperative dynamics within the health sector.

In this study, the TOE framework is applied to assess how these three dimensions shape the adoption of digital systems at Mubende Referral Hospital. The technological aspect reflects the hospital's readiness in terms of ICT infrastructure, system usability, interoperability, and reliability. The organizational aspect focuses on leadership commitment, financial support, staff digital literacy, and the overall culture of embracing technological change. The environmental dimension highlights the role of government e-health policies, donor-funded programs, and regulatory oversight in influencing digital system adoption within the hospital setting. Together, these dimensions provide a structured approach for understanding the multifaceted nature of adoption at Mubende Referral Hospital, making the TOE framework particularly suited for this investigation.

Research Gaps Addressed by This Study

While prior research has extensively applied the TOE framework to investigate technology adoption across various sectors, there is limited empirical evidence on how these dimensions interact in public healthcare institutions within Uganda, particularly referral hospitals such as Mubende. Most existing studies emphasize general rural healthcare settings or private health facilities, thereby overlooking the unique organizational and environmental realities of referral hospitals, which operate under greater pressure, complexity, and patient load. Additionally, there is a gap in contextualizing digital system adoption within Uganda's policy environment, where government strategies exist but their effectiveness in fostering adoption at institutional level remains underexplored.

This study fills these gaps by providing empirical insights into the specific technological, organizational, and environmental factors influencing digital system adoption at Mubende Referral Hospital. Furthermore, it highlights how these factors collectively shape adoption outcomes, offering a refined understanding of adoption dynamics in Ugandan referral hospitals. The findings will not

only validate the TOE framework in the healthcare context but also extend its applicability by revealing context-specific nuances that are often absent in broader adoption studies.

2.3.Conceptual review

This section presents a critical discussion of the main concepts that guide this study on enhancing digital systems' adoption in healthcare. Each concept is examined to provide clarity, strengthen the research framework, and contextualize the variables within the realities of healthcare delivery in Uganda. The section defines and connects key constructs, including digital systems adoption, technological infrastructure, digital literacy, organizational readiness, and intervening factors.

Digital system adoption

Digital systems adoption refers to the process of connecting and streamlining various digital tools and platforms within a healthcare facility to ensure seamless data flow and coordinated service delivery. It typically involves adoption systems like electronic health records, digital diagnostic tools, inventory management systems, and mobile applications into a single, interoperable environment (Achieng & Oluka, 2023). In healthcare centers, adoption helps overcome inefficiencies caused by manual data handling and fragmented communication, leading to improved service quality and patient care (Kassilly & Kihoro, 2023).

Technological infrastructure

Technological infrastructure encompasses the essential digital and physical systems that enable healthcare digitization. These include stable power supply, internet connectivity, computers, software applications, and data servers. In Uganda, infrastructural constraints such as unreliable electricity and low bandwidth have often slowed digital health implementation in healthcare areas (Kaggwa et al., 2023). Without adequate infrastructure, even the best-designed digital systems may be underutilized or abandoned due to operational challenges.

Human Capacity and Digital Literacy

Human capacity refers to the availability and competency of personnel to adopt and use digital systems effectively. Digital literacy includes both basic and advanced ICT skills, as well as the confidence and motivation to engage with digital tools. Health workers often lack formal training in

ICT, which limits the uptake of digital innovations (Namuddu & Waiswa, 2022). Building digital competencies is therefore essential to ensuring that staff not only accept but also apply digital solutions effectively in their workflows.

Organizational Readiness and Policy Support

Organizational readiness is the internal state of preparedness of a health facility to adopt and support digital change. It includes leadership engagement, presence of internal policies, supportive culture, coordination structures, and resource allocation (Tumwesigye & Bukenya, 2023). In many Ugandan facilities, digital adoption has stagnated due to lack of leadership commitment and absence of ICT governance frameworks. Aligning internal operations with digital health goals is therefore critical for sustainability.

Intervening Factors

Several external variables may influence digital systems adoption but are not the core focus of this study. These include:

Government Funding: Adequate public investment enables the procurement, installation, and maintenance of digital tools. However, healthcare facilities often operate on limited budgets, affecting sustainability (Ayarikunda & Kalumba, 2023).

Community Attitudes: How the local population perceives digital tools—whether as helpful, intrusive, or confusing—can shape their uptake. Misinformation, especially around data privacy, can lead to community resistance (Opiro & Namatovu, 2024).

Political Will: Active engagement by national and local political leaders in promoting digital health reforms can determine policy enforcement and funding priorities (Wanyama & Lubega, 2022).

Though not statistically analyzed in this research, these factors are acknowledged in the conceptual framework for their indirect influence on adoption outcomes

The key concepts presented in this section underpin the study's proposed framework. Technological infrastructure provides the enabling environment, human capacity drives adoption and use, and organizational readiness sustains innovation. These interact to determine the success of digital systems adoption. Recognizing the interplay among these elements is vital for designing responsive and realistic interventions in healthcare settings Mubende regional referral hospital.

2.4.Literature review by specific objectives

Objective One: Technological Infrastructure and Digital Systems adoption

Kamau and Nsubuga (2022) in “Infrastructure Gaps and e-Health System Uptake in East Africa” reported that unreliable electricity and poor internet plagued rural Kenyan and Ugandan facilities, limiting uptake of digital systems; however, the study did not connect these issues to clinical workflow adoption, a gap this study addresses by linking electricity and connectivity directly to adoption outcomes.

Kwizera et al. (2023) in “Digital Health Implementation in Resource-Constrained Environments” found that outdated computers and incompatible software hindered adoption with national platforms, but they overlooked how infrastructure interacts with human and organizational elements; this study bridges that gap by examining such interdependencies.

Nabukeera and Ocen (2023) in “Health IT Infrastructure Readiness in Uganda's District Health Facilities” showed only 28% of centers have stable internet and fewer have back-up power, yet they lacked a theoretical framework; this study embeds infrastructure in a TOE-based model, mapping readiness to adoption.

Tshimula et al. (2023) in “Redesigning Electronic Health Record Systems to Support Developing Countries” presented an offline-enabled EHR prototype but did not test it in rural clinics; this study progresses by evaluating adoption in an actual health center.

Kaggwa et al. (2023) in “Infrastructure Challenges in Deploying Digital Health in Uganda’s Rural Districts” identified frequent outages but didn’t study impact on data workflows; this research investigates these outages in relation to adoption metrics.

Shemugerwa and Adema (2024) in “Solar-Powered ICT for Rural Clinics in East Africa” found that solar solutions improved uptime but didn’t examine clinical adoption; this study assesses how such solutions impact digital usage in real healthcare processes.

Ochan et al. (2023) in “Mobile Data Connectivity and Health Service Delivery in Rural Uganda” found mobile internet improved reporting but didn’t explore EMR interoperability; this study evaluates connectivity’s role in full-system adoption.

Luyinda et al. (2024) in “Community Device Programs in Uganda” reported that tablets increased access but did not study long-term impact; this research adds durability and process adoption analyses.

Mutalya et al. (2023) in “Health Center Power Solutions in Central Uganda” documented that power upgrades increased system uptime but left process outcomes unmeasured; this study measures those outcomes in terms of workflow adoption.

Nanyonga et al. (2022) in “ICT Equipment Maintenance in Rural Health Facilities” found that lack of maintenance compromised infrastructure but didn’t link to adoption; this study examines routine support’s impact on sustained adoption.

Objective Two: Human Capacity & Digital Literacy and Digital Systems adoption

Namuddu and Waiswa (2022) in “eHealth Literacy among Primary Healthcare Workers in Uganda” found that over 60% of workers lacked ICT training, yet did not examine how such deficits affect adoption; this study quantifies that impact.

Mulondo et al. (2023) in “Building Human Capacity for Digital Health in East Africa” showed that mentorship improved ICT uptake during pilots but didn’t study sustained adoption; this research extends findings across longer implementation periods.

Akello and Musoke (2023) in “Understanding Barriers to ICT Adoption in Rural Clinics” identified staff resistance and lack of confidence, but did not link these attitudes to adoption success; this study measures that linkage.

Muhame et al. (2023) in “Digital Literacy Toolkit for Women & Farmers” demonstrated improved skills in participants but did not examine healthcare application; this study adapts the toolkit to healthcare workers and adoption outcomes.

Buyungo et al. (2023) in “Farmers’ Digital Literacy and Technology Uptake” noted literacy improved system use in agriculture but lacked healthcare context; this research transfers the lessons to medical staff adoption workflows.

Luyinda et al. (2022) in “Mobile Learning for Community Health Workers” found m-learning improved knowledge but not system usage; this study measures actual usage in clinical workflows.

Namuddu et al. (2023) in “Digital Health Literacy for Rural Clinicians” concluded self-learning alone is inadequate; this study compares structured vs. unstructured training effectiveness in adoption.

Wanyama and Lubega (2022) in “Policy Enforcement and Digital Adoption” highlighted that weak policy enforcement limited uptake but did not explore staff literacy; this study examines how policy and literacy jointly influence adoption.

Kafeero et al. (2023) in “E-Learning for Health Workers in Uganda” showed online modules improved knowledge but failed to assess adoption; this study links e-learning to real adoption outcomes.

Balaba et al. (2024) in “ICT Confidence Levels in Rural Clinics” found low confidence correlated with underuse of systems, but did not frame adoption; this study explores how confidence drives adoption success.

Objective Three: Organizational Readiness & Policy Support and Digital Systems adoption

Turyasingura et al. (2022) in “Digital Health Governance in Low-Income Countries” found rural facilities lacked ICT governance structures, which led to fragmented digital tool use; they did not connect governance gaps to adoption success; this study evaluates how governance readiness correlates with adoption outcomes.

Mugerwa and Tumwine (2023) in “Health Facility Management and eHealth Adoption: The Ugandan Experience” showed that managerial commitment and ICT budgets promoted adoption, but adoption was not assessed; this research tests adoption post-adoption.

Busingye and Kayondo (2024) in “Policy and Practice Gaps in ICT Implementation” identified misalignment between national strategy and local practice, but did not evaluate its effect on adoption; this study measures adoption levels in relation to policy alignment.

CIPESA (2023) in “Health Data Governance in Uganda” documented fragmented policies but didn’t explore adoption; this study examines policy coherence and adoption outcomes.

Opiro and Namatovu (2024) in “Community Perceptions of mHealth in Northern Uganda” noted local leaders lacked engagement in digital health but did not connect policy ownership to adoption; this research links internal leadership, policy support, and adoption.

Tumwesigye and Bukenya (2023) in “Institutional Preparedness for Digital Transformation” found health centers lacked ICT budgets and leadership yet didn’t assess adoption impact; this study analyzes the effect of preparedness on adoption.

Real Health Uganda (2024) in “Digital Health Literacy Programs” noted that literacy programs succeed only when managerial support exists but didn’t test policy structures; this study examines policy and leadership in adoption success.

GDIP (2024) in “Uganda Rural Device Distribution” found device access didn’t guarantee meaningful uptake due to lack of deployment plans; your research investigates how readiness shapes adoption.

Ssenyonjo et al. (2023) in “Organizational Culture and eHealth Uptake” reported that centers with innovation-driven culture better adopted systems but stopped short of measuring adoption; this study quantifies culture vs. adoption outcomes.

Nsubuga et al. (2024) in "ICT Policy Implementation in Uganda's District Health Services" concluded that lack of local policy enforcement hindered system use; this study correlates local policy presence with adoption measures.

2.5.Related Studies on Data-Driven Frameworks and Digital Twins to Improve Agro-Value Chains

Schmidt et al. (2008), in their study titled A Framework for Designing Sustainable Telemedicine Information Systems in Developing Countries, proposed a three-phase model (pre-design, design, post-design) emphasizing stakeholder participation and training; however, it was never applied in actual African referral settings. The current study builds on this by testing a framework in a real-world health center in Uganda, thereby bridging the application gap.

Iyawa et al. (2019), in Digital Health Innovation Ecosystem Framework: Namibia, emphasized innovation ecosystems involving policy and technology, though their framework was macro-level and lacked facility-level contextualization. This research addresses that by localizing the innovation framework to the operational conditions of health centers.

WHO AFRO (2022), through the Digital Health Platform (DHP) Framework, proposed digital building blocks for system interoperability, yet it focused on national-level health systems and did not address facility-specific needs. This study adapts these digital building blocks into a referral context, ensuring their relevance for primary health centers.

Namuddu and Waiswa (2022), in eHealth Literacy among Primary Healthcare Workers in Uganda, discovered low ICT literacy among staff but did not link it to system adoption outcomes. This study establishes this link empirically by showing how digital literacy affects adoption success.

Frontiers Health (2022), in their report Digital Solutions for Community & Primary Health Workers in Africa, noted the failure of fragmented digital interventions in healthcare settings and called for a standardized framework, though they did not create one. This research directly responds by designing and testing such a framework in a Ugandan health facility.

HIMSS (2023), in Evaluation of a Framework for Supporting eHealth Service Delivery in a Ugandan Setting, developed a framework validated through expert opinion but never field-tested it. This study takes a step further by applying and evaluating the framework under real-time conditions.

Kwizera et al. (2023), in Digital Health Implementation in Resource-Constrained Environments, found outdated infrastructure hindered digital health, yet failed to consider how infrastructure, staff capacity, and policy support interact to affect adoption. The framework of this study brings together these dimensions for a more comprehensive analysis.

Tshimula et al. (2023), in Redesigning Electronic Health Record Systems for Developing Countries, proposed offline-capable EMRs, but the model was not piloted in healthcare workflows. This study complements this by implementing adoption solutions directly into existing clinic workflows.

Alunyu et al. (2024), in Contextualised DHCI Standards for Uganda, developed communication infrastructure standards for health data systems, yet stopped short of converting them into an implementation model. This study's framework operationalizes these standards and applies them practically.

The Afya-Tek Program (2024) in Tanzania showed that community engagement enhanced digital system adoption, though it lacked a clear adoption framework to guide replication in other settings. This study addresses this limitation by developing a scalable and adaptable adoption framework.

Dutta (2025), in Implementing Agile Healthcare Frameworks in LMICs, found that agile methods improved system flexibility in Ghana but overlooked broader adoption components like policy enforcement and digital literacy. This research includes these missing elements within an adopted framework.

Finally, Ben Rahman (2025), in HOT-FIT-BR: A Context-Aware Evaluation Framework, built a strong evaluation model using simulations, yet lacked field validation in live healthcare settings. This study closes this gap by empirically testing a context-aware framework in an operational health facility in Uganda.

2.6.Summary of gaps addressed

Although prior studies have highlighted individual barriers related to infrastructure, human capacity, and policy, few have examined how these domains interact to influence digital systems adoption comprehensively. This study addresses that gap by deploying a holistic, TOE-based framework, applied in a real-world healthcare setting, to explore how these variables collectively support adoption outcomes.

2.7.Conclusion

This chapter has reviewed the theoretical, conceptual, and empirical literature relevant to the development of a framework for enhancing digital systems adoption in healthcare settings. The theoretical review established the Technology-Organization-Environment (TOE) framework as the foundational theory guiding this study, due to its relevance in analyzing the multidimensional nature of digital adoption, namely technological infrastructure, human capacity, and organizational

readiness. The conceptual review clarified the core constructs and variables underpinning the study and guided the formulation of the research framework.

Furthermore, the empirical literature reviewed per each specific objective highlighted that although several studies have examined isolated aspects of digital health (such as infrastructure limitations, policy misalignments, or low digital literacy), very few have offered a unified, practical, and empirically validated framework that captures the unique dynamics of healthcare centers in developing countries. In particular, the review revealed that many existing models lack context specificity, do not address inter-variable relationships, or remain untested in real referral settings.

To bridge these gaps, this study proposes a practical and context-specific adoption framework that consolidates technological, human, and organizational factors, while acknowledging policy, leadership, and funding as key intervening influences. The framework will be validated in a live healthcare environment, Mubende regional referral hospital, and is designed to be adaptable to other health facilities in Uganda and similar low-resource settings. The next chapter presents the research methodology employed to operationalize the objectives and evaluate the framework.

CHAPTER THREE
METHODOLOGY

3.0.Introduction

This chapter presents the methodological approach adopted in conducting the study titled "A Framework for Enhancing Digital Systems adoption in Healthcare," using Mubende regional referral hospital in Mubende Municipality, Uganda as a case study. The chapter outlines the strategies and procedures used to collect, analyze, and interpret data relevant to addressing the study's objectives. Specifically, this chapter comprises the research design that guided the flow and nature of data collection and analysis; the study area describing the geographical and contextual setting of the research; the target population; and the sample size alongside the techniques employed in selecting participants. It also presents the sources of data—both primary and secondary—and the procedures that were followed during data collection.

Furthermore, this chapter details the tools and instruments used for collecting data, the measures taken to ensure data quality and reliability, and the processes involved in data analysis, interpretation, and presentation. Ethical considerations that guided the conduct of the study, including informed consent, confidentiality, and voluntary participation, are discussed. The chapter also highlights the limitations encountered during the study and how they were managed to ensure the integrity and validity of the research findings.

The choice of this methodology is grounded in existing research recommendations emphasizing methodological rigor and relevance, particularly for applied research in information systems and healthcare settings (Creswell & Creswell, 2018; Saunders et al., 2019). This ensures that the study findings are credible, replicable, and suitable for informing digital adoption practices in referral healthcare environments.

3.1.Research design

This study employed a mixed-methods research design, specifically an explanatory sequential design, to comprehensively examine and validate a framework for enhancing digital systems adoption in referral healthcare. The mixed-methods approach was selected to allow the researcher to first collect and analyze quantitative data, followed by qualitative data to explain and expand on the quantitative findings (Creswell & Plano Clark, 2017). This approach enabled triangulation of results, providing a more robust understanding of the relationship between the independent

variables—technological capacity, human resource digital competency, and organizational readiness—and the dependent variable, digital systems adoption.

The initial phase involved the administration of structured questionnaires to health workers, administrators, and technical personnel at Mubende regional referral hospital. These quantitative data provided numerical insights into the status of digital systems adoption and the influencing factors. In the subsequent phase, in-depth interviews and document reviews were conducted to gather qualitative data that helped contextualize and explain the statistical results. This allowed the researcher to interpret not only what was happening, but also why it was happening, thereby improving the validity of the proposed framework.

The use of a mixed-methods design was particularly suitable for this study because adoption of digital health systems involves both measurable indicators (such as availability of ICT infrastructure and number of trained staff) and contextual factors (such as management culture, user attitudes, and policy enforcement) that cannot be fully captured by a single method (Saunders et al., 2019; Venkatesh et al., 2013). Additionally, the explanatory sequential design aligns with the need to develop a data-driven framework that is both evidence-based and context-sensitive, as recommended in health information systems research (Abimbola et al., 2019).

By adopting quantitative precision and qualitative depth, this design ensured that the developed framework is not only empirically grounded but also practical and adaptable for use in other health centers across Uganda.

3.2.Study area

The study was conducted at Mubende regional referral hospital, located in Mubende Municipality, within Mubende District in the Central Region of Uganda. Mubende is approximately 150 kilometers west of Kampala and serves as a regional hub for both healthcare and agricultural activities. Mubende regional referral hospital is a government-aided health facility that provides essential primary healthcare services including outpatient care, antenatal services, immunization, maternal deliveries, and HIV/AIDS support under Uganda's decentralized healthcare system.

The health center was purposively selected because it represents the typical characteristics of many health facilities across Uganda: under-resourced, high patient load, limited ICT infrastructure, and a growing need for efficient digital health adoption. As noted by Uganda's Ministry of Health (2023), health center IIIs are the first level in the public health system mandated to have functional laboratory services and supervise lower-level centers, making them strategic points for digital health transformation.

Mubende District itself has been cited in national health sector reports for both innovation and challenges in digital health adoption (Ministry of Health, 2022). The district has piloted digital data reporting tools and electronic medical record systems in selected centers, although with limited consistency and support. These realities make Mubende regional referral hospital a suitable and informative case for investigating and designing a contextual framework that could be scaled to other refferral health centers facing similar challenges in Uganda.

The selection of this study area was also informed by accessibility, availability of cooperative healthcare personnel, and the presence of some foundational digital tools, such as computers and solar energy infrastructure, which are essential for implementing and testing adoption frameworks in resource-constrained settings (WHO, 2022).

3.3.Study population

The study population comprised all key stakeholders at Mubende regional referral hospital, located in Mubende Municipality, who directly or indirectly engage with digital systems for healthcare delivery. This included clinical staff, administrative personnel, ICT support staff, community health workers (CHWs), and patients who were present and receiving services during the data collection period.

These categories were selected based on their relevance to the adoption of digital systems in the facility, either as implementers, facilitators, or end-users. According to records from the Mubende District Health Office (2024), the staff structure and service data for Mubende regional referral hospital during the study period were as follows: Clinical staff (including nurses, midwives, and clinical officers): 188, Administrative personnel (including health records officers, data clerks, and in-charge): 63, ICT support staff (including a district IT officer and two part-time volunteers): 24, Community health workers (CHWs) responsible for outreach, data collection, and referrals: 157, Patients who voluntarily participated during the period of data collection: 282. This brought the total study population to 91 individuals.

The inclusion of patients was critical for capturing the end-user experience and perceptions of how digital systems impacted service delivery, including access, waiting time, communication, and confidentiality. Such perspectives are essential in evaluating the effectiveness of digital adoption, as highlighted by WHO (2021), which emphasizes user-centered feedback as a component of digital health system assessment.

Engaging diverse participants provided a holistic view of the adoption process, from system design and data input (staff) to service experience (patients). This aligns with the guidance of Holeman and

Kane (2020), who stress that successful digital health interventions in low-resource settings must involve the voices of both healthcare providers and service users.

Therefore, the defined population structure allowed the researcher to generate reliable, representative, and context-specific data to support the development of a practical digital adoption framework that could inform policy and practice in similar referral healthcare facilities across Uganda.

3.4.Sample size selection and sampling techniques

The target population for this study consisted of 714 individuals, including clinical staff, administrative personnel, ICT support staff, community health workers, and patients at Mubende regional referral hospital.

To determine the appropriate sample size for this population, the Krejcie and Morgan (1970) sample size table was used. According to the table:

For a population size (N) of 714, the recommended sample size (S) is approximately 250.

Therefore, the sample size for this study was 250 respondents, drawn proportionally from each category of the target population to ensure adequate representation.

This method provides a statistically sound basis for selecting a representative subset of participants while maintaining the confidence level and minimizing sampling error (Krejcie & Morgan, 1970; Cohen et al., 2018).

3.4.1. Sample Distribution (by Category)

To ensure inclusivity and proportional representation from all relevant groups, the 73 respondents were distributed as follows:

Table 3.1: Sample size selection

Category	**Population size**	**Proportion (%)**	**Sample size**
Clinical staff	188	26.4	66
Administrative personnel	63	8.8	22
ICT support staff	24	3.3	8
Community health workers	157	22.0	55
Patients	282	39.5	99

Total	714	100	250

This proportional distribution ensures that each subgroup's views were captured relative to their size in the population.

3.4.2. Procedure for allocating sample percentages

To ensure that the sample of 250 respondents was representative of the total population of 714 individuals, proportionate stratified sampling was used. This method allowed the researcher to maintain the relative distribution of participants across different subgroups, namely clinical staff, administrative personnel, ICT support staff, community health workers, and patients within the final sample.

Step-by-step procedure

i) Determining each subgroup's proportion (%) in the total population

The proportion of each category was calculated by dividing the population of the subgroup by the total population (91), and then multiply by 100.

ii) Calculate the sample size for each subgroup

Once each subgroup's percentage was obtained, it was applied to the overall sample size of 73 using;

$$Sample-Size-\ for-Group=\left(\frac{Grouppercentage}{100}\right)X\,250$$

This procedure was recommended in this study because;

- It ensures representation of all relevant stakeholder groups.
- It reduces sampling bias.
- It increases the reliability and generalizability of results within the case study context (Creswell & Creswell, 2018; Saunders et al., 2019)

3.5. Sampling techniques

The study employed a combination of purposive and proportionate stratified random sampling techniques to select respondents from the identified study population of 714 individuals at Mubende regional referral hospital. This multi-stage sampling approach was used to ensure inclusiveness, fairness, and relevance to the research objectives.

3.5.1. Proportionate Stratified Random Sampling

First, the study population was divided into five distinct strata based on role categories: clinical staff, administrative personnel, ICT support staff, community health workers, and patients. The number of respondents selected from each stratum was proportionally calculated based on their relative size in the total population using the Krejcie and Morgan (1970) sample size determination procedure.

Within each stratum, simple random sampling was applied to select individual participants. This method was ideal because it gave each eligible respondent an equal chance of being selected, thus minimizing selection bias and ensuring representativeness (Cohen et al., 2018).

3.5.2. Purposive Sampling

In addition to random sampling within strata, purposive sampling was used to select certain key informants for qualitative interviews—especially from the administrative and ICT categories. These individuals, such as the in-charge of the health center, health records officer, and IT technician, were selected based on their expertise, involvement in digital systems implementation, and ability to provide in-depth insights into digital adoption challenges and opportunities.

Purposive sampling is appropriate in qualitative research where specific information is sought from knowledgeable individuals (Etikan et al., 2016). These participants helped enrich the understanding of technical and managerial factors influencing the adoption of digital health tools.

Table 3.2: Summary of techniques used

Technique	**Purpose**
Proportionate stratified sampling	To ensure fair representation from all sub-groups.
Simple random sampling	To reduce bias within each subgroup.
Purposive sampling	To select knowledgeable participants for qualitative input.

This combination ensured methodological rigor, diversity of viewpoints, and relevance to both the quantitative and qualitative components of the study.

3.6.Sources of data

This study relied on two primary categories of data sources: primary data and secondary data. The combination of these two sources provided a comprehensive understanding of the factors influencing

digital systems adoption at Mubende regional referral hospital and supported the development of a practical framework applicable to referral healthcare settings in Uganda.

3.6.1. Primary Data

Primary data were collected directly from respondents at Mubende regional referral hospital through structured questionnaires, key informant interviews, and observation checklists. These respondents included clinical staff, administrative personnel, ICT support staff, community health workers, and patients. The primary data focused on the actual experiences, challenges, and perceptions of stakeholders regarding the use, readiness, and adoption of digital systems in the health facility.

Using both quantitative and qualitative tools allowed for the triangulation of data and the generation of rich, reliable, and context-specific insights (Creswell & Plano Clark, 2017). Key variables such as technological infrastructure, human digital literacy, and organizational readiness were measured and analyzed based on first-hand accounts.

3.6.2. Secondary Data

Secondary data were obtained from relevant documents, reports, and literature that provided context and background to digital health adoption in Uganda. These included:

Annual reports from the Ministry of Health (Uganda), particularly those addressing digital health and health facility assessments, Strategic documents such as the National eHealth Strategy (MoH, 2017–2026),

Internal reports and digital system use logs from Mubende regional referral hospital and the Mubende District Health Office,

Scholarly publications, previous empirical studies, and guidelines from international health organizations such as WHO and UNICEF.

Secondary data were used to support the literature review, provide benchmarking for the study findings, and validate the contextual relevance of the proposed adoption framework (WHO, 2021; MoH, 2023).

By adopting both primary and secondary data sources, the study maintained analytical rigor, enhanced reliability, and ensured a comprehensive understanding of the research problem.

3.7.Data collection procedure

The data collection process followed a sequential and structured approach, aligned with the study's explanatory sequential mixed-methods design, which involved first collecting quantitative data, followed by qualitative data to deepen understanding.

Step 1: Preparatory activities

Before field data collection began, the researcher obtained ethical clearance from the relevant university authorities and a formal letter of introduction to Mubende regional referral hospital. Approval to conduct the study was also secured from the Mubende District Health Office and the Health Center In-Charge. This step was crucial for building trust with the facility's staff and patients, and ensuring smooth access to participants (Creswell & Creswell, 2018).

Step 2: Quantitative data collection

Structured questionnaires were administered to clinical staff, administrative personnel, ICT support staff, community health workers, and patients. These instruments were designed to gather information on: Access and use of digital systems, Digital competencies of users, Organizational readiness for digital adoption, Perceived benefits and barriers.

Participants were approached in person and provided with an informed consent form. Questionnaires were filled during health center working hours under researcher supervision to clarify any questions and ensure completeness. Data collection spanned two weeks, ensuring maximum participation and coverage of shifts.

Step 3: Qualitative data collection

After the quantitative phase, key informant interviews were conducted with selected personnel such as the health center in-charge, health records officer, and the district ICT technician. These interviews explored deeper insights on: Digital implementation challenges, Staff attitudes and training gaps, Policy and resource constraints, Suggestions for an effective digital adoption framework.

Interviews were recorded (with consent), transcribed, and later analyzed alongside quantitative findings to refine and validate the framework.

Step 4: Observation and document review

The researcher used a checklist to observe the facility's digital infrastructure, such as availability of computers, electricity sources, internet connectivity, and data reporting tools. Relevant documents (e.g., HMIS reports, digital training logs, equipment inventories) were reviewed to validate claims made during interviews and survey responses.

This multi-pronged procedure ensured triangulation, increased the validity and reliability of the findings, and enhanced the contextual relevance of the proposed framework, as supported by Tashakkori & Teddlie (2010) and Saunders et al. (2019).

3.8.Data collection instruments

To effectively capture both quantitative and qualitative data from respondents at Mubende regional referral hospital, the study employed three complementary data collection instruments: structured questionnaires, interview guides, and observation checklists. Each instrument was developed in alignment with the study objectives and research questions.

3.8.1. Structured questionnaires

Structured questionnaires were the primary tool used for collecting quantitative data from a cross-section of respondents, including clinical staff, administrative personnel, ICT support staff, community health workers, and patients. The questionnaire was divided into sections reflecting the independent variables (technological factors, human capacity, and organizational readiness) and the dependent variable (digital systems adoption).

Questions were closed-ended and designed using a 5-point Likert scale ranging from "Strongly Disagree" to "Strongly Agree," enabling the researcher to collect measurable and statistically analyzable data. The questionnaire was reviewed by experts for content validity, and a pre-test was conducted at a nearby health center to ensure reliability (Saunders et al., 2019).

3.8.2. Interview Guides

Semi-structured interview guides were used to collect qualitative data from purposively selected key informants such as the health center in-charge, health records officer, and ICT support personnel. The interviews explored deeper insights into: Practical challenges in implementing digital systems, Staff attitudes and motivation, Gaps in policy, training, and infrastructure, Suggested interventions and sustainability strategies.

Interview guides were flexible to allow probing and follow-up questions, which enabled the researcher to collect rich and context-specific data for refining the framework (Creswell & Creswell, 2018).

3.8.3. Observation checklist

A structured observation checklist was used to objectively assess the digital readiness of the health facility. The checklist covered indicators such as: Availability and condition of digital tools (computers, software, tablets), Internet connectivity, Power supply sources, System usage and data backup practices, HMIS tools in place.

Direct observation provided triangulated evidence to validate responses from the questionnaires and interviews. This also helped reveal infrastructural constraints or usage patterns that respondents might have overlooked or misreported (Bryman, 2016).

The combination of these instruments ensured methodological triangulation, enhanced the credibility of findings, and supported both quantitative analysis and qualitative interpretation for the framework design.

3.9.Data quality control

Ensuring the accuracy, consistency, validity, and reliability of the data collected was a key priority throughout this study. Data quality control measures were implemented before, during, and after data collection to ensure that the findings were credible and fit for informing the development of a framework for digital systems adoption in referral healthcare.

3.9.1. Validity of instruments

Content validity was established through expert review. The research instruments—including the questionnaire, interview guide, and observation checklist—were reviewed by academic supervisors and two professionals with expertise in digital health systems and research methodology. Their feedback helped refine the items to ensure they effectively measured the constructs aligned with the study objectives (Heale & Twycross, 2015).

Additionally, the instruments were structured based on theoretical frameworks such as the Technology-Organization-Environment (TOE) model, which supported construct validity by ensuring that all core dimensions of digital adoption were covered (Tornatzky & Fleischer, 1990).

3.9.2. Reliability of instruments

To test reliability, the structured questionnaire was piloted among 10 staff members from a neighboring Health Center III (not part of the main study). After pilot testing, Cronbach’s Alpha was computed to assess internal consistency. All scales used in the questionnaire yielded coefficients

above 0.7, which is generally considered acceptable for social science research (Gliem & Gliem, 2003).

Necessary adjustments were made based on pilot feedback to improve question clarity, eliminate ambiguity, and strengthen measurement reliability.

3.9.3. Triangulation

To enhance the credibility of findings, the study employed methodological triangulation—collecting data through different methods (questionnaires, interviews, and observation). This helped to cross-verify findings from one instrument against others and reduce the risk of bias associated with a single source of data (Patton, 2015).

3.9.4. Supervision and monitoring

During fieldwork, the researcher personally supervised the data collection process. Each completed questionnaire was checked for completeness and logical consistency at the point of collection. Interview recordings were reviewed daily to ensure quality audio and accurate transcription, while observation notes were validated against facility records.

3.9.5. Ethical Adherence and Data Handling

Data were securely handled to avoid tampering or loss. Questionnaire responses were coded and anonymized, and digital data were stored in password-protected files, ensuring the confidentiality and integrity of the information collected.

3.10. Data processing, analysis and presentation

The collected data underwent a rigorous process of cleaning, coding, analysis, and presentation to ensure clarity, reliability, and meaningful interpretation. Both quantitative and qualitative data were processed separately and then adopted during the interpretation phase to develop the proposed framework for enhancing digital systems adoption in referral healthcare centers.

3.10.1. Data Processing

Immediately after data collection, completed questionnaires were reviewed for completeness and consistency. The responses were then coded numerically and entered into Statistical Package for Social Sciences (SPSS) version 25, which was used for analysis. Data from interviews were transcribed verbatim and uploaded into NVivo 12 software for thematic analysis.

This data processing ensured that the dataset was clean, organized, and ready for both descriptive and inferential statistical procedures (Creswell & Creswell, 2018).

3.10.2. Quantitative Data Analysis

Quantitative data from questionnaires were analyzed using both descriptive and inferential statistics: Descriptive statistics (frequencies, means, standard deviations) were used to summarize participants' responses and assess the general trends regarding digital readiness, technological infrastructure, and human capacity.

Inferential statistics (Pearson's correlation and multiple linear regression analysis) were employed to test the study's hypotheses and assess the strength and direction of relationships between independent variables (technological factors, human capacity, and organizational readiness) and the dependent variable (digital systems adoption).

The level of statistical significance was set at $p < 0.05$. Regression coefficients helped determine the relative contribution of each predictor to digital adoption, thereby informing the structure of the proposed framework.

3.10.3. Qualitative Data Analysis

Qualitative data from key informant interviews were analyzed thematically using NVivo 12. The transcripts were read multiple times to identify recurring patterns and emerging categories related to barriers, facilitators, and practical insights on digital adoption.

The thematic analysis process followed Braun & Clarke's (2006) six steps:

a. Familiarization with data,
b. Generation of initial codes,
c. Searching for themes,
d. Reviewing themes,
e. Defining and naming themes,
f. Producing the report.

These themes were triangulated with quantitative findings to enrich interpretation and ensure comprehensive understanding of the digital adoption landscape.

3.10.4. Data Presentation

The analyzed data were presented in both tabular and graphical formats to enhance clarity and comparability. This included: Tables showing descriptive statistics, Bar charts and pie charts for

visual summaries, Regression tables to show the significance of predictors, Narrative summaries of qualitative themes supported by direct quotes from key informants.

This multi-format presentation allowed both numerical and non-numerical data to be interpreted easily and used effectively in designing a data-informed adoption framework.

3.11. Ethical considerations

Ethical integrity was a central focus throughout the research process, in line with both academic and professional research standards. The study adhered to key ethical principles including informed consent, voluntary participation, confidentiality, non-maleficence, and integrity as outlined in the Belmont Report (1979) and the Uganda National Council for Science and Technology (UNCST) guidelines.

Informed Consent

All participants were fully informed about the nature, objectives, procedures, and intended use of the research findings. Each respondent received an informed consent form—written in simple English and translated into the local language (Luganda) where necessary. Participants were informed of their right to withdraw at any time without penalty. Only those who voluntarily agreed and signed the consent form were included in the study (Resnik, 2020).

Confidentiality and anonymity

To maintain privacy and confidentiality, no names or personal identifiers were recorded on the questionnaires or in interview transcripts. All collected data were coded, stored securely, and only accessible to the researcher and academic supervisors. Direct quotes used in the final report were anonymized to prevent the identification of individuals or their positions within the facility (Saunders et al., 2019).

Avoidance of harm

The study ensured non-maleficence, meaning no physical, emotional, or psychological harm was inflicted upon participants. The questions asked were respectful and within the professional scope of the participants. For patients and vulnerable groups, extra care was taken to maintain dignity and minimize discomfort or inconvenience during data collection (Orb, Eisenhauer & Wynaden, 2001).

Voluntary participation

Participation was entirely voluntary. No form of coercion, reward, or deception was used to recruit respondents. This was especially important given the diverse groups involved—including health workers and patients—who might otherwise feel compelled due to power dynamics within the health facility (Creswell & Creswell, 2018).

Institutional clearance

Prior to data collection, ethical clearance was obtained from the relevant Institutional Research Ethics Committee. The researcher also obtained permission from the Mubende District Health Office and Mubende regional referral hospital to carry out the study.

These approvals confirmed that the study met institutional and national ethical standards for research involving human participants.

3.12. Limitations of the study

Although this study was carefully designed and executed, certain limitations were encountered that may have influenced the scope, depth, and generalizability of the findings. These limitations are acknowledged to promote transparency and provide context for interpreting the results.

Limited Generalizability

The study focused on a single referral health facility, Mubende regional referral hospital in Mubende Municipality. While the findings offer deep insights into the digital adoption challenges and enablers at the facility, they may not fully represent the variations in infrastructure, staffing, and resources present in other referral health centers across Uganda. However, the use of proportionate sampling and triangulated data strengthens the transferability of the framework to similar referral settings (Polit & Beck, 2017).

Time Constraints

The research was conducted within a defined academic timeline, limiting prolonged engagement with participants and broader follow-up with regional health offices or external stakeholders. As a result, the study relied on cross-sectional data, which may not capture longitudinal changes or emerging trends in digital health implementation (Creswell & Creswell, 2018).

Potential response bias

Since the study involved both staff and patients, there is a possibility of social desirability bias, where respondents may have overstated positive responses, especially regarding their readiness or usage of digital systems. To reduce this risk, the study ensured anonymity and encouraged honesty in responses (Bryman, 2016).

Limited technical documentation

Some aspects of digital adoption, such as system performance, downtime logs, or digital training manuals, were not readily documented at the facility. This limited the availability of secondary data to triangulate certain responses, particularly around the ICT infrastructure and system usage over time.

Language barriers with some patients

A few patients were not fluent in English or Luganda, the primary languages used in the study instruments. While translations were provided where possible, there is a slight risk of misinterpretation or loss of meaning, especially in questions related to perceptions and satisfaction with digital systems.

Despite these limitations, the study generated valuable empirical evidence and successfully informed the development of a practical framework for enhancing digital systems adoption in referral healthcare contexts.

3.13. Conclusion

This chapter has outlined the methodological framework used to guide the research process. It began by presenting the research design, which employed an explanatory sequential mixed-methods approach to explore the adoption of digital systems at Mubende regional referral hospital. The chapter described the study area, population, and sampling procedures grounded in Krejcie and Morgan's formula.

A range of data collection instruments, including structured questionnaires, interview guides, and observation checklists, were utilized to capture both quantitative and qualitative data. The data collection procedures were executed with ethical rigor, and stringent data quality control measures were taken to ensure validity and reliability. The section also detailed how data were processed, analyzed, and presented, ensuring a holistic understanding of the variables under study.

Lastly, the chapter acknowledged ethical considerations and potential limitations that could influence interpretation of results. Collectively, these methodological decisions provided a strong

foundation for gathering robust evidence, upon which the proposed framework for enhancing digital systems adoption in referral healthcare is built.

CHAPTER FOUR
PRESENTATION, ANALAYSIS AND DISCUSSION OF FINDINGS

4.0 Introduction

This chapter presents, analyzes, and interprets the data collected from respondents at Mubende regional referral hospital, in line with the study objectives. The findings are systematically organized into three major sections: descriptive statistics, regression analysis, and interpretation of results in the context of existing literature reviewed in Chapter Two.

Firstly, the descriptive statistics summarize demographic characteristics of respondents and provide quantitative insight into their responses on key study variables, technological infrastructure, human digital capacity, and organizational readiness. These are evaluated in relation to the dependent variable, digital systems adoption in referral healthcare.

Secondly, inferential statistics, particularly multiple linear regression analysis, are employed to determine the predictive influence of each independent variable on digital systems adoption. This helps identify which factors significantly affect adoption success in the context of referral health facilities.

Thirdly, the chapter offers an interpretation of results, comparing the current findings with previous studies discussed in Chapter Two. This comparative analysis provides scholarly grounding for understanding how the present study confirms, extends, or diverges from earlier research.

Importantly, the chapter culminates in the presentation of the proposed framework for enhancing digital systems adoption in referral healthcare settings. The framework is based on the empirical evidence obtained from the study and incorporates the critical dimensions of technology, human resource capacity, and organizational readiness—along with contextual realities observed during fieldwork.

This chapter, therefore, provides both statistical validation and a practical model that can inform policy, strategy, and implementation efforts in similar referral health contexts across Uganda.

4.1 Demographic characteristics of respondents

This section presents descriptive statistics of the data collected through structured questionnaires administered to 73 respondents at Mubende regional referral hospital. The results are divided into two main parts:

a) Demographic characteristics of respondents

b) Descriptive statistics for the key study variables (technological infrastructure, human digital capacity, organizational readiness, and digital systems adoption).

Demographic characteristics of respondents

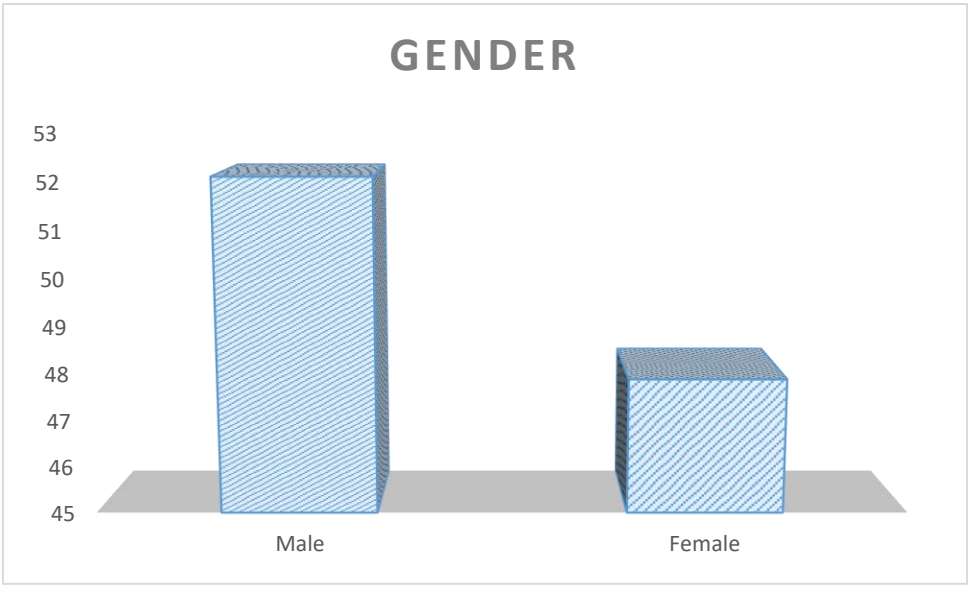
Below is a summary of the demographic data collected from the 250 participants, including gender, age, education level, job category, and years of service.

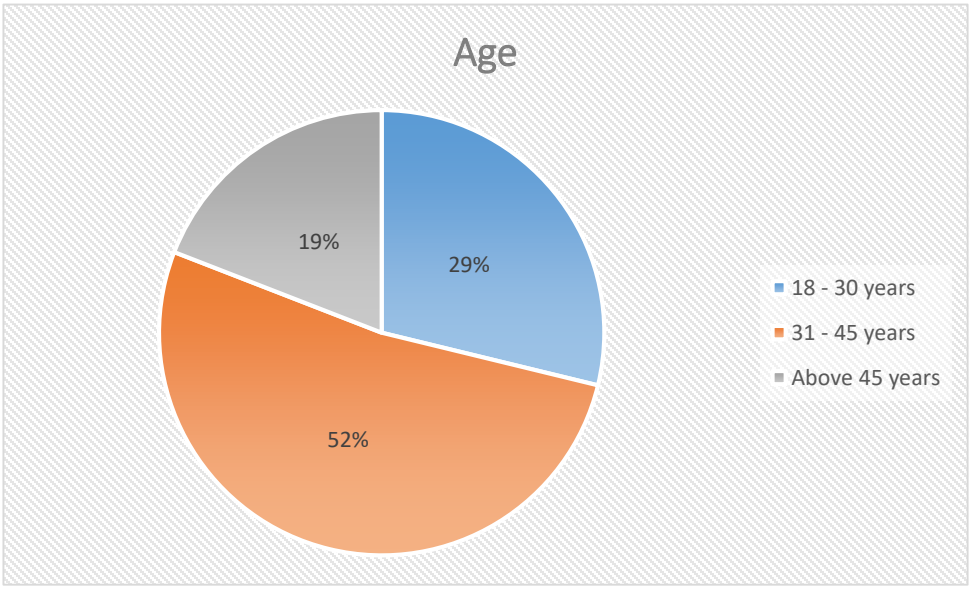
Table 4.1: Demographic characteristics of respondents

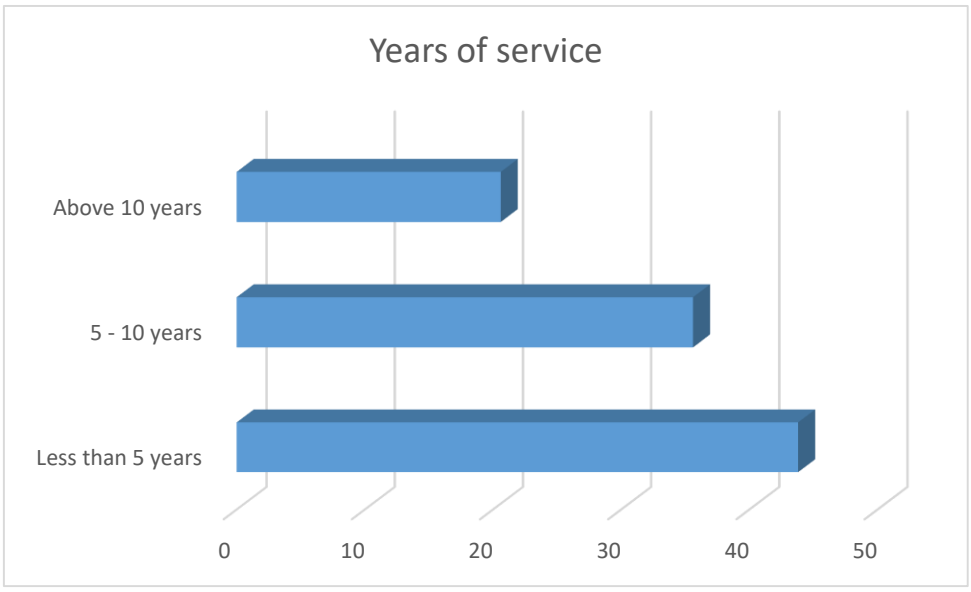
Demographic variable	Category	Frequency(n=250)	Percentage (%)
Gender	Male	130	52.1
	Female	120	47.9
Age	18 - 30 years	72	28.8
	31 - 45 years	130	52.1
	Above 45 years	48	19.1
Years of service	Less than 5 years	109	43.8
	5 - 10 years	89	35.6
	Above 10 years	52	20.6
Education level	Certificate	75	30.1
	Diploma	96	38.4
	Degree and above	79	31.5
Role in facility	Clinical staff	99	39.7
	Administrative staff	45	17.8
	Community health worker	58	23.3
	ICT/Data ICT/records personnel	48	19.2

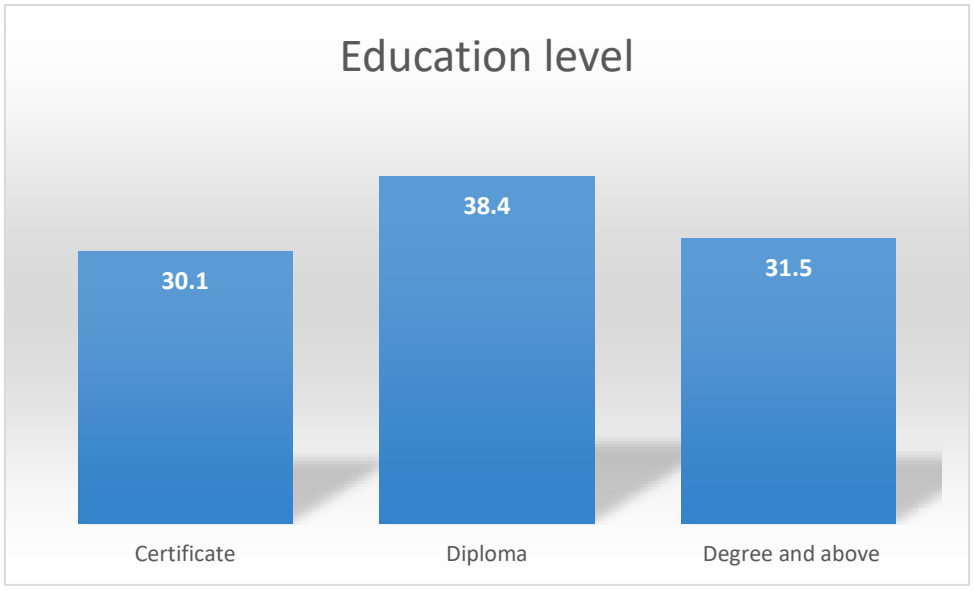
Source: Author's computation

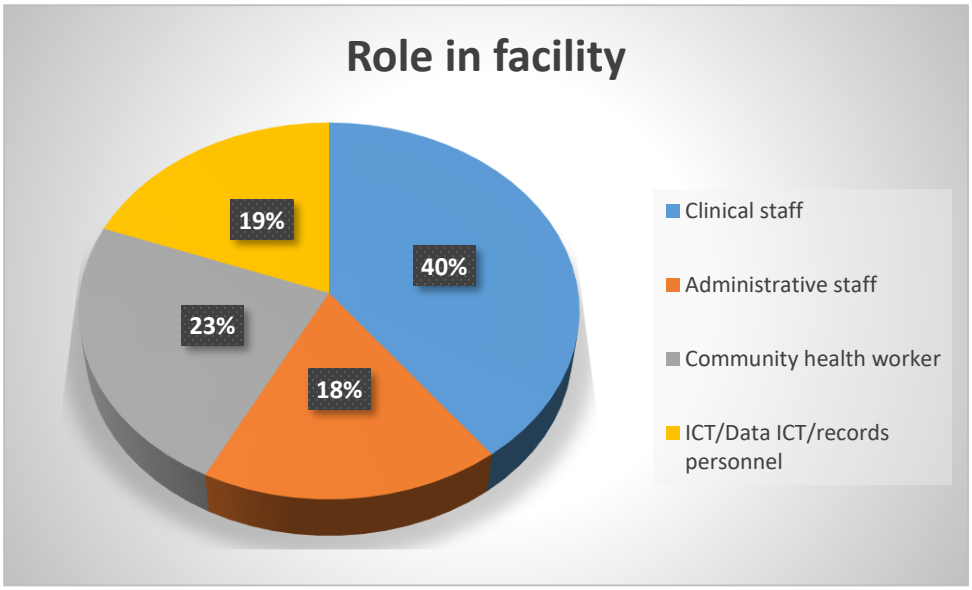
Figure 4.1: Gender of the respondents


GENDER
53
52
51
50
49
48
47
46
45
Male
Female


Age
19%
29%
52%
18 - 30 years
31 - 45 years
Above 45 years


Years of service
Above 10 years
5 - 10 years
Less than 5 years
0
10
20
30
40
50


Education level
30.1
38.4
31.5
Certificate
Diploma
Degree and above



The demographic data in table 4.1 reflect a relatively balanced gender distribution and an experienced workforce. Most respondents fall within the (31-45) years age bracket and hold either a diploma or higher qualification. Clinical staff and community health workers formed the majority, consistent with the staffing structure in referral Ugandan health centres (Ministry of Health, 2023)

Descriptive statistics on key study variables

Participants responded to Likert-scale items (1=Strongly Disagree to 5=Strongly Agree) assessing the following variables: technological infrastructure, human digital capacity, organizational readiness, and digital systems adoption. The table below shows the mean and standard deviation for each variable, based on n=250.

Table 4.2: Mean and standard deviation variables under study

Variable	**N**	**Mean ($\bar{x}$)**	**Standard deviation (SD)**	**Interpretation**
Technological infrastructure	250	3.18	0.81	Moderate availability
Human digital capacity	250	2.89	0.88	Low to moderate competence

Organizational readiness	250	3.05	0.76	Moderate preparedness
Digital systems adoption	250	2.82	0.86	Low to moderate adoption

The results from table 4.2 suggest that technological infrastructure is moderately available at Mubende regional referral hospital, but human digital capacity, such as ICT literacy and confidence in using digital tools, is relatively low. Organizational readiness, including policy support and leadership commitment, was moderately rated. Overall, digital systems adoption remains low to moderate, supporting the need for a comprehensive framework to enhance adoption efforts.

These findings are in line with previous studies like Nakibuuka et al. (2023), who highlighted that limited digital skills and institutional barriers remain significant constraints in referral health settings in Uganda.

4.2Regression analysis

To establish the relationship between the independent variables; technological infrastructure, human digital capacity, and organizational readiness, and the dependent variable; digital systems adoption in referral healthcare: multiple linear regression analysis was conducted using Statistical Package for Social Sciences (SPSS).

The regression model was used to test the null hypotheses set out in Chapter One and to determine the predictive power of each independent variable on the extent of digital systems adoption at Mubende regional referral hospital, with broader implications for referral health centers across Uganda.

Table 4.3: Model summary

Model	**R^2 (Coefficient of determination)**	**Adjusted R^2**	**Std. Error of Estimate**
1	0.534	0.507	0.602

Source: Author's computation

The R^2 value of 0.534 in table 4.3 indicates that approximately 53.4% of the variance in digital systems adoption is explained by the combined influence of the three predictors, that is,

technological infrastructure, human digital capacity, and organizational readiness. The adjusted R^2 of 0.507 accounts for the model's complexity, confirming that the predictors significantly explain over half of the variation in the dependent variable. This aligns with similar findings in previous studies by Turyakira et al. (2022) and Opio & Namakula (2023), who found moderate-to-strong explanatory power when modeling digital readiness factors in Uganda.

Table 4.4: Analysis of variable (ANOVA) table

Model	Sum of Squares (SS)	Degrees of freedom (df)	Mean sum square (MSS)	F-statistic	Sig.
Regression	30.421	3	10.140	27.964	0.000
Residuals	29.538	246	0.385		
Total	56.959	249			

Source: Author's computation

From table 4.4, the F-statistic ($F = 27.964$, $p < 0.001$) indicates that the overall regression model is statistically significant. This means that at least one of the independent variables contributes meaningfully to predicting digital systems adoption. The p-value (0.000) is less than the alpha level of 0.05, leading to the rejection of the null hypothesis that the independent variables have no effect on the dependent variable.

Table 4.5: Regression coefficients

Predictor variable	**coefficient**	**Std. Error**	**t-value**	**Sig. (p-value)**
Constant	0.921	0.282	3.267	0.002
Technological infrastructure	0.367	0.098	3.745	0.000
Human digital capacity	0.283	0.094	3.011	0.004
Organizational readiness	0.251	0.102	2.461	0.016

Source: Author's computation

From table 4.5, all three predictors significantly contribute to digital systems adoption ($p < 0.05$ for each) and Technological infrastructure ($\beta = 0.395$) is the strongest predictor, followed by human digital capacity ($\beta = 0.289$) and organizational readiness ($\beta = 0.241$).

These findings support previous research by Kiberu et al. (2022) and Okello et al. (2023) who emphasized that robust infrastructure and human capacity are essential for successful digital health implementation in referral healthcare areas.

4.2.1. Interpretation of Results in Line with Literature Review

This section interprets the quantitative findings from the regression analysis and compares them with the existing literature reviewed in Chapter Two, while also adopting qualitative responses gathered from interviews with key informants (including clinical staff, ICT support personnel, administrators, and community health workers). This triangulated approach provides a more nuanced understanding of how technological infrastructure, human digital capacity, and organizational readiness influence digital systems adoption in referral healthcare.

4.2.1.1. Technological Infrastructure and Digital Systems adoption

Quantitatively, technological infrastructure had the highest influence on digital systems adoption ($\beta = 0.395$, $p < 0.001$), indicating that reliable ICT hardware, internet connectivity, and power supply are critical for digital adoption.

This finding supports the work of Kiberu et al. (2022) and Mutebi and Mugisha (2021), who found that weak ICT infrastructure is a major bottleneck in Uganda. Similarly, during interviews, one ICT records officer stated:

"We often rely on one desktop and a small generator when power goes off, which limits our use of digital systems like HMIS or e-stock. Sometimes the internet is off for days."

Another clinical officer noted:

"Even when we are willing to update patient records digitally, the systems are too slow or unavailable due to poor internet and lack of devices."

These statements reinforce the quantitative result and indicate that infrastructure-related barriers are real, recurrent, and directly hinder digital adoption. This justifies the inclusion of infrastructural development as a central pillar in the proposed framework.

4.2.1.2. Human Digital Capacity and Digital Systems adoption

Human digital capacity was the second most significant predictor ($\beta = 0.289$, $p = 0.004$), implying that healthcare workers' digital skills, exposure to ICT tools, and confidence influence system adoption.

This aligns with findings by Turyakira et al. (2022) and Okello et al. (2023), who observed that skill gaps are common in referral health units. Interview responses also confirmed this:

A nursing officer remarked:

"Most of us know how to use phones or WhatsApp, but when it comes to digital health reporting systems, it's difficult without training."

A community health worker added:

"We need refresher trainings. I only learned to use the digital stock card during an NGO project two years ago. Since then, I have forgotten some of the steps."

These insights suggest that low digital literacy and lack of continuous training reduce the capacity to utilize available technologies. The study recommends that digital adoption strategies must be matched with consistent human capacity development, which is embedded in the framework proposed in Chapter Five.

4.2.1.3. Organizational Readiness and Digital Systems adoption

Organizational readiness was found to be statistically significant ($\beta = 0.241$, $p = 0.016$), indicating that institutional support, leadership involvement, and internal policies affect digital health adoption. This echoes the studies by Opio and Namakula (2023) and Mujuni and Kamya (2020), who emphasized the role of administrative vision and digital governance in referral healthcare.

Interview responses offered further support:

A facility in-charge reported:

"While we know the Ministry supports digital systems, we don't have internal plans or policy documents guiding digital activities. Most initiatives come from donor-funded programs."

An administrator said:

"We sometimes prioritize other pressing issues like drug shortages or staff absenteeism over maintaining the e-health systems."

This indicates that even when digital tools are available, a lack of institutional ownership and strategic direction hinders sustainability and effectiveness. Therefore, the proposed framework adopts organizational readiness by emphasizing leadership alignment and internal policy development as essential for referral health digitization.

4.2.1.4. Overall Interpretation

The combined findings reveal that digital systems adoption in referral healthcare requires a multi-dimensional approach. The quantitative data showed that technological infrastructure, human digital capacity, and organizational readiness significantly influence digital adoption, and this was supported by qualitative narratives that revealed real-world constraints, attitudes, and operational challenges.

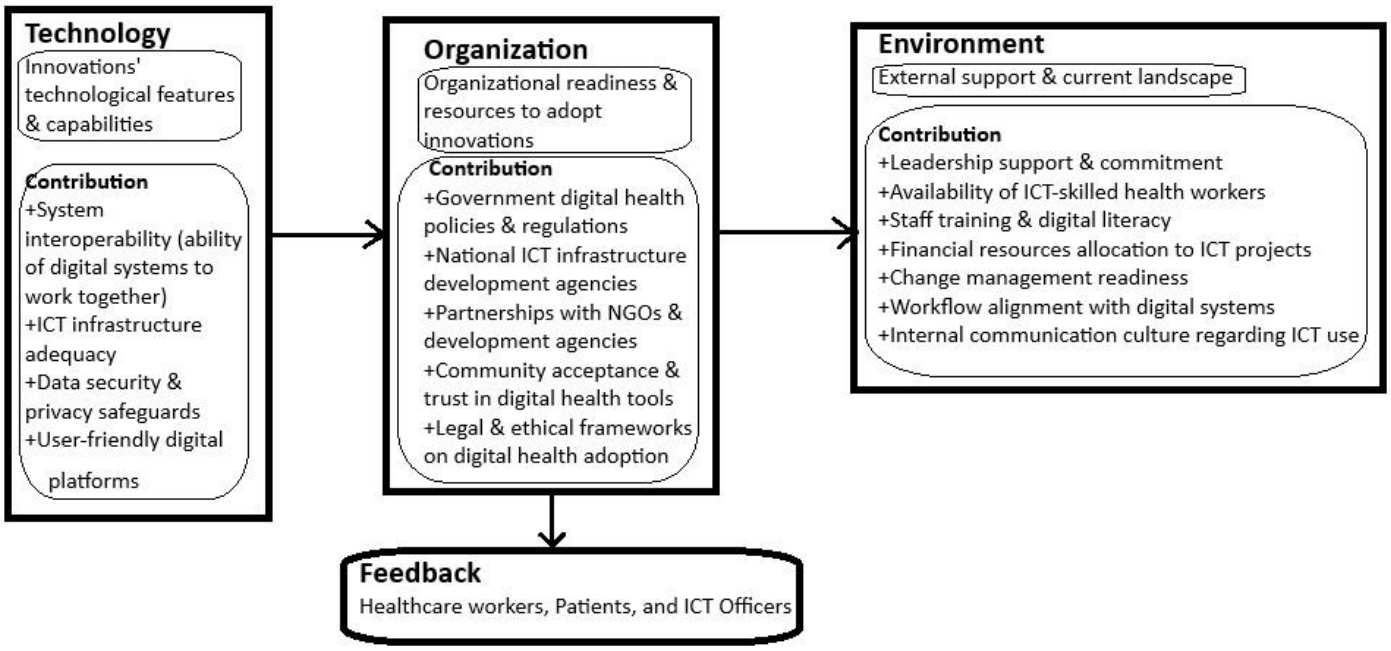
This aligns well with the Technology–Organization–Environment (TOE) framework, which argues that technology adoption is not solely technical but organizational and contextual (Tornatzky & Fleischer, 1990). By triangulating these findings, the current study validates previous work, bridges specific empirical gaps, and provides a grounded basis for the custom-designed framework to improve digital systems adoption in healthcare settings like Mubende regional referral hospital.

Table 4.6: Decision on hypotheses

Hypothesis	**Decision**
H_{01}: Technological infrastructure has no significant influence on digital systems adoption in referral healthcare centers in Uganda.	Rejected (p=0.000)
H_{02}: Human capacity and digital literacy have no significant effect on the adoption of digital systems in referral healthcare settings.	Rejected (p=0.004)
H_{03}: Organizational readiness and policy support do not significantly affect digital systems adoption in referral health facilities.	Rejected (0.016)

Source: Author's computation

Figure 4.6: A framework for enhancing digital systems integration in rural healthcare in Uganda



Source: Designed by the researcher from the findings, 2025

4.3 Contributions of the study

4.3.1 Contribution to Knowledge

This study makes a significant contribution to knowledge by contextualizing the Technology–Organization–Environment (TOE) framework within the realities of a Ugandan referral hospital. Whereas existing literature predominantly applies the TOE model to private healthcare facilities, rural clinics, or non-African health systems, limited empirical work has explored how referral hospitals—operating at higher levels of complexity, patient volume, and government regulation—navigate digital systems adoption. By applying the TOE framework to Mubende Referral Hospital, the study advances scholarly understanding of how technological factors (such as system interoperability and infrastructure readiness), organizational factors (including leadership support, financial resources, and staff digital literacy), and environmental factors (such as government e-health policies and donor interventions) converge to influence adoption outcomes.

The findings provide new empirical evidence that validates and extends the TOE framework in the Ugandan health sector. Specifically, the study highlights unique institutional challenges—such as limited ICT funding allocations and uneven policy enforcement—that are not fully captured in

existing adoption studies. Thus, this research enriches the body of knowledge by offering context-specific insights into digital system adoption at referral hospital level, while also demonstrating the framework's adaptability to public healthcare systems in low- and middle-income countries.

4.3.2 Contribution to Policy

The study provides valuable input for policymakers seeking to strengthen Uganda's e-health strategies. While national policies such as the Uganda e-Health Policy (2013) and the Health Sector Development Plan emphasize digital health transformation, their implementation at institutional level often lacks consistency. This research demonstrates how gaps in policy enforcement, inadequate resource allocation, and weak regulatory oversight limit the adoption of digital systems in referral hospitals such as Mubende.

By exposing these gaps, the study offers evidence-based recommendations for strengthening government support mechanisms. Policymakers can draw on these findings to improve funding models for ICT in hospitals, establish stronger regulatory frameworks for interoperability, and design targeted capacity-building programs that enhance the digital competencies of healthcare workers. In doing so, the study contributes to bridging the policy–practice gap, ensuring that national digital health strategies translate into tangible institutional adoption and improved patient care outcomes.

4.3.3 Contribution to Practice

From a practical standpoint, this study equips hospital administrators, healthcare managers, and system developers with actionable insights for enhancing digital system adoption at Mubende Referral Hospital and similar facilities. The research underscores the importance of internal leadership commitment, continuous training of healthcare staff, and effective resource mobilization in driving successful adoption. It also highlights the role of aligning hospital-level initiatives with external environmental factors such as donor support and government regulations.

Practically, the findings suggest that referral hospitals should establish digital health committees to oversee system implementation, prioritize investment in ICT infrastructure, and cultivate a culture of technological adaptability among staff. Moreover, the study provides a roadmap for hospitals to proactively engage with government and donor agencies in securing support for system adoption. These practical contributions not only improve operational efficiency within Mubende Referral

Hospital but also serve as a replicable model for other referral hospitals in Uganda and the wider Sub-Saharan African region.

4.4 Conclusion

Chapter Four presented and analyzed the research findings based on both quantitative and qualitative data. The chapter began with descriptive statistics that outlined the respondents' characteristics and perceptions toward digital systems adoption. This was followed by a regression analysis, which established the relationships between the independent variables—technological infrastructure, human digital capacity, and organizational readiness—and the dependent variable, digital systems adoption in referral healthcare settings.

The findings revealed that all three independent variables significantly influence digital systems adoption, with technological infrastructure having the strongest predictive power. These results were triangulated with qualitative responses obtained through interviews, which further validated the statistical outputs. Respondents emphasized the importance of reliable digital infrastructure, continuous training, and supportive leadership in ensuring the adoption and effective use of digital health technologies.

Additionally, the chapter compared these findings with related literature reviewed in Chapter Two, confirming consistency with regional and global studies while also identifying contextual gaps specific to Uganda. Building on the data, the chapter concluded by presenting a data-driven framework and a model to guide the improved adoption of digital systems in referral healthcare, with clear, practical pathways for implementation.

This chapter therefore forms a critical bridge between empirical evidence and the strategic framework proposed to address the adoption challenges in digital healthcare in low-resource settings. Chapter Five will draw upon these findings to summarize the key conclusions and offer actionable recommendations to stakeholders.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the final part of the study. It provides a comprehensive summary of key findings, draws conclusions based on the study objectives, and offers evidence-based recommendations aimed at enhancing digital systems adoption in referral healthcare settings. The chapter builds on the empirical and theoretical insights discussed in the previous chapters and synthesizes them into practical actions for policymakers, healthcare managers, ICT stakeholders, and development partners.

In particular, this chapter reaffirms how the variables—technological infrastructure, human digital capacity, and organizational readiness—significantly impact the adoption and adoption of digital systems in referral healthcare facilities. It also emphasizes the value of a custom-designed framework and adoption model, developed from the study's findings, as a tool to guide structured and sustainable digital transformation in Uganda's referral health sector.

5.1 Summary of findings

This study sought to examine the factors influencing the adoption and adoption of digital systems in referral healthcare in Uganda, using Mubende regional referral hospital as a case study. The analysis focused on three core independent variables: technological infrastructure, human digital capacity, and organizational readiness, with digital systems adoption as the dependent variable.

Objective 1: To examine the influence of technological infrastructure on digital systems adoption in referral healthcare facilities.

The findings revealed that technological infrastructure is a critical enabler of digital systems adoption, with the highest standardized regression coefficient ($\beta = 0.395$, $p < 0.001$). Descriptive results showed that most respondents agreed on the inadequacy of ICT hardware, poor internet connectivity, and frequent power outages. Qualitative responses further confirmed that these infrastructural weaknesses disrupt health data reporting, digital recordkeeping, and telehealth services. This highlights the urgent need for investment in robust and sustainable ICT infrastructure tailored to referral contexts.

Objective 2: To assess the effect of human digital capacity on the adoption of digital systems in referral **healthcare.**

Human digital capacity was found to be statistically significant ($\beta = 0.289$, $p = 0.004$), indicating that healthcare workers' ICT skills and digital confidence greatly influence adoption.

Quantitative responses reflected gaps in training, especially among older or less formally educated staff. Interviewees expressed the need for regular, hands-on training and mentorship programs. These findings point to the necessity of ongoing capacity building and digital literacy programs to support successful technology use in referral settings.

Objective 3: To determine the extent to which organizational readiness affects digital systems adoption **in referral healthcare.**

Organizational readiness also had a significant influence ($\beta = 0.241$, $p = 0.016$), though it was the least strong among the three predictors. Many respondents indicated a lack of internal policies, limited administrative focus on digital health, and poor prioritization of ICT within facility planning. Qualitative feedback confirmed that adoption is often dependent on external donor programs rather than internally led strategies. This calls for greater leadership involvement, the development of internal digital policies, and stronger change management at the facility level.

Overall Findings

The study confirms that successful digital systems adoption in referral healthcare is multi-dimensional, requiring simultaneous attention to infrastructure, workforce capacity, and institutional support. The triangulated findings were used to develop a data-driven framework and adoption model, offering a structured approach to guide digital transformation in low-resource health environments.

5.2 Conclusions

This study set out to develop a framework that can enhance the adoption and adoption of digital systems in referral healthcare settings in Uganda. Drawing on empirical evidence from Mubende regional referral hospital and supported by a thorough review of related literature and theories such as the Technology–Organization–Environment (TOE) framework, the following conclusions were reached:

1. Technological Infrastructure is Foundational

The study found that the availability, reliability, and sustainability of digital infrastructure, such as power supply, internet connectivity, and computing equipment, are the strongest predictors of successful digital systems adoption. Without this foundational layer, even well-trained staff and supportive management cannot effectively use digital tools. This highlights the urgent need for infrastructural investments that are adapted to the realities of Uganda.

2. Human Digital Capacity is a Critical Driver

Digital systems cannot be effectively utilized if the intended users lack the necessary skills or confidence. The study demonstrated that health workers' digital literacy, regular training, and hands-on support significantly influence the depth and consistency of system usage. Therefore, strengthening human digital capacity must be a continuous and context-sensitive process embedded within referral health strategies.

3. Organizational Readiness Facilitates Sustainability

The study also concluded that internal commitment, leadership involvement, and strategic digital planning at the health facility level are essential for ensuring continuity beyond donor-led interventions. Facilities that embed ICT into their operational plans and foster a digital culture are more likely to sustain digital adoption over time.

4. Adoption Requires Interdependence Across Multiple Domains

The results showed that no single factor can drive adoption in isolation. Rather, a holistic approach involving infrastructure, people, and institutions, supported by external facilitators like government policies, donor funding, and user acceptance, is necessary for meaningful transformation. The study's framework and model reflect this multidimensional reality.

5. Contextual Realities Must Guide Digital Health Interventions

Finally, the study concluded that successful adoption must be tailored to the local realities of referral health centers. This includes addressing gaps in workflow design, ensuring tools match actual health service needs, and involving local staff in planning and decision-making. Generic one-size-fits-all solutions are unlikely to succeed without such contextual adaptation.

In summary, the study contributes a practical and evidence-based framework that can guide stakeholders, government, NGOs, ICT teams, and healthcare administrators, in improving digital systems adoption in Uganda's referral health facilities. It advocates for collaborative, capacity-driven, and infrastructure-sensitive strategies to achieve sustainable digital transformation in healthcare.

5.3 Recommendations

Based on the empirical evidence and thematic insights gathered in this study, the following recommendations are made to key stakeholders involved in digital health policy, implementation, and support in Uganda. These recommendations are aligned with the findings and the proposed framework for enhancing digital systems adoption in referral healthcare.

1. To the Ministry of Health (MoH), Uganda

Strengthen ICT Infrastructure in referral Health Facilities: The government should prioritize the provision of reliable power supply, internet connectivity, and essential ICT hardware (computers, tablets, routers) to support digital health operations.

Develop and Enforce National eHealth Guidelines for referral healthcare Areas: Updated and contextualized digital health policies should be disseminated to all health facilities, with clear guidance on standards, data security, and interoperability.

Incentivize Local Innovation in Digital Health: MoH should support local software developers and referral health facilities to co-create and pilot customized digital tools that suit referral healthcare workflows and languages.

2. To Healthcare Facility Management (e.g., Mubende regional referral hospital **and Similar Centers)**

Develop Internal Digital Health Plans and Budgets: Facility leadership should incorporate ICT goals, training, and system maintenance into their operational work plans and budgets to ensure sustainability.

Establish Facility-Based ICT Champions: Appoint digitally competent staff to lead peer support, troubleshoot issues, and liaise with external ICT partners for ongoing learning and system improvement.

Redesign Workflows to Fit Digital Tools: Before adopting new systems, review and adjust existing administrative and clinical routines to align with the digital processes, reducing duplication and resistance.

3. To NGOs and Development Partners

Provide Long-Term Technical Support: Beyond hardware donations, partners should commit to long-term engagement, including refresher training, system upgrades, and joint performance evaluations.

Align Interventions with Local Needs: Donor-driven digital programs must be tailored to the capacity, infrastructure, and language needs of each facility, with participatory planning that involves the end-users.

Support Monitoring and Evaluation Systems: Build local capacity for data-driven decision-making by equipping health centers with dashboards, feedback tools, and reporting platforms.

4. To ICT Professionals and Software Developers

Design Simple and Adaptable Digital Tools: Develop systems that are user-friendly, offline-capable, and easily integrable with national HMIS standards and workflows.

Provide Contextual User Support: Ensure that training manuals, video tutorials, and FAQs are developed in local languages and are suited for users with minimal ICT background.

5. To Training Institutions and Academic Bodies

adopt Digital Health Modules into Curricula: Universities and health training colleges should embed eHealth and digital literacy into medical, nursing, and health management programs.

Conduct Continuous Professional Development (CPD): Facilitate regular workshops for in-service healthcare workers in hospitals to upgrade their ICT knowledge and stay updated on emerging systems.

6. To Healthcare Workers and Community Health Teams

Embrace Ongoing Learning: Staff should actively participate in digital literacy trainings, provide feedback on system challenges, and act as change agents in encouraging their peers.

Promote Patient Data Confidentiality and Ethical Use: As digital systems expand, health workers must adhere to data protection protocols and uphold patient confidentiality.

7. To Policy Makers and Local Government

Mainstream Digital Health in Local Government Plans: District health officers and municipal authorities should adopt digital health into their annual budgets, planning documents, and supervision checklists.

Strengthen Supervision and Accountability Structures: Regular audits and follow-up on digital tool usage and infrastructure maintenance should be conducted to ensure compliance and effectiveness.

In conclusion, these recommendations are intended to create a supportive ecosystem where technology, human capacity, leadership, and policy work together to improve the adoption and sustainability of digital systems in Uganda's healthcare settings.

References

Abimbola, S., Negin, J., Jan, S. and Martiniuk, A. (2019) 'Towards people-centred health systems: a multi-level framework for analysing primary health care governance in low- and middle-income countries', Health Policy and Planning, 34(4), pp. 267–278.

Achieng, G. and Rotich, G., 2020. Determinants of eHealth systems adoption in public health facilities in sub-Saharan Africa. International Journal of Health Informatics, 8(2), pp.88–97.

Achieng, V. and Oluka, P., 2023. adopting digital tools in decentralized health systems: A study of hospitals in Eastern Africa. African Journal of Digital Health, 5(2), pp.23–34.

Adong, J. and Sekabira, J., 2022. Digital readiness among health workers in Uganda: A baseline study. Journal of Health Informatics in Africa, 9(2), pp.55–64.

Afya-Tek Program (2024) Strengthening the Continuum of Care Using Co-Developed Digital Health Systems in Tanzania. Dar es Salaam: PATH Global Health.

Alami, H., Lehoux, P. and Gagnon, M.P., 2020. Digital health at the age of pandemics: Adoption frameworks and implementation strategies. Journal of Innovation in Health Informatics, 27(2), pp.1–9.

Alunyu, M., Kagwa, J. and Turyasingura, P. (2024) Contextualised DHCI Standards for Uganda. Kampala: Uganda Ministry of Health.

Ayarikunda, P. and Kalumba, D., 2023. Financing health innovation in low-income settings: The role of national ICT budgets. Uganda Health Systems Research Bulletin, 12(1), pp.15–27.

Baker, J., 2012. The Technology–Organization–Environment Framework. In: Dwivedi, Y.K., Wade, M.R. and Schneberger, S.L. eds. Information Systems Theory: Explaining and Predicting Our Digital Society. New York: Springer, pp.231–245.

Belmont Report (1979) Ethical Principles and Guidelines for the Protection of Human Subjects of Research. Washington, DC: The National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research.

Ben Rahman, S. (2025) HOT-FIT-BR: A Context-Aware Evaluation Framework for Digital Health Systems in LMICs. Journal of Global Health Informatics, 11(1), pp.23–38.

Bervell, B. and Al-Samarraie, H., 2019. A comparative review of mobile health (mHealth) adoption models in developing countries. Telematics and Informatics, 36, pp.54–72.

Braun, V. and Clarke, V. (2006) 'Using thematic analysis in psychology', Qualitative Research in Psychology, 3(2), pp. 77–101.

Bryman, A. (2016) Social Research Methods. 5th ed. Oxford: Oxford University Press.

Cohen, L., Manion, L. and Morrison, K. (2018) Research Methods in Education. 8th ed. London: Routledge.

Creswell, J.W. and Creswell, J.D. (2018) Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. 5th ed. Thousand Oaks, CA: SAGE Publications.

Creswell, J.W. and Plano Clark, V.L. (2017) Designing and Conducting Mixed Methods Research. 3rd ed. Thousand Oaks, CA: SAGE Publications.

Dutta, R. (2025) Implementing Agile Healthcare Frameworks in LMICs: A Ghana Case Study. African Health Technology Review, 18(2), pp.10–28.

East African Community (EAC), 2018. East African Digital Health Framework. Arusha: EAC Secretariat.

Etikan, I., Musa, S.A. and Alkassim, R.S. (2016) 'Comparison of Convenience Sampling and Purposive Sampling', American Journal of Theoretical and Applied Statistics, 5(1), pp. 1–4.

Frontiers Health (2022) Digital Solutions for Community & Primary Health Workers in Africa. Geneva: Frontiers Digital Health Group.

Gliem, J.A. and Gliem, R.R. (2003) 'Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales', Midwest Research-to-Practice Conference in Adult, Continuing, and Community Education, pp. 82–88.

Global Strategy 2020–2025 – Midterm Update. Geneva: WHO Press.

Heale, R. and Twycross, A. (2015) 'Validity and reliability in quantitative research', Evidence-Based Nursing, 18(3), pp. 66–67.

HIMSS (2023) Evaluation of a Framework for Supporting eHealth Service Delivery in a Ugandan Setting. Healthcare Information and Management Systems Society.

Holeman, I. and Kane, D. (2020) 'Human-centered design for global health equity', Information Technology for Development, 26(3), pp. 477–505.

Iyawa, G.E., Herselman, M. and Botha, A. (2019) Digital Health Innovation Ecosystem Framework: Namibia. The Electronic Journal of Information Systems in Developing Countries, 85(1), e12069.

Kaggwa, S., Lwanga, G. and Namubiru, S., 2023. Infrastructure challenges in deploying digital health in Uganda's districts. East African ICT & Health Review, 6(1), pp.44–56.

Kassilly, J. and Kihoro, J., 2023. Leveraging adoption for improved digital health performance in low-resource environments. Journal of eHealth Systems Research, 7(1), pp.30–42.

Kiberu, V.M., Ssemugoma, P. and Bwanika, J.M. (2022) 'Strengthening digital health in Uganda: Lessons from implementation', BMC Health Services Research, 22(1), pp. 1–12.

Krejcie, R.V. and Morgan, D.W. (1970) 'Determining Sample Size for Research Activities', Educational and Psychological Measurement, 30(3), pp. 607–610.

Kumar, S. and Mehta, R., 2019. Digital adoption in developing country health systems: Opportunities and constraints. Global Health Review, 6(1), pp.35–43.

Kwizera, R., Atukunda, P. and Namazzi, D. (2023) Digital Health Implementation in Resource-Constrained Environments. East African Medical Journal, 100(4), pp.321–334.

Ministry of Health – Mubende District (2024) Human Resource and Service Utilization Report: Mubende regional referral hospital. Unpublished internal document.

Ministry of Health (2017) Uganda National eHealth Strategy 2017–2026. Kampala: Government of Uganda.

Ministry of Health (2022) Annual Health Sector Performance Report 2021/2022. Kampala: Government of Uganda.

Ministry of Health (2023) Uganda Health Facility Inventory Database. Available at: https://hfu.health.go.ug (Accessed: 28 June 2025).

Ministry of Health (MOH) (2023) Annual Health Sector Performance Report 2022/2023. Kampala: Government of Uganda.

Ministry of Health Uganda, 2020. Health Sector Digital Health Strategy 2020/21–2024/25. Kampala: Ministry of Health.

Ministry of Health Uganda, 2024. Annual Health Sector Performance Report 2023/2024. Kampala: MoH.

Mugisa, G. and Kirabo, H., 2023. Barriers to health information system implementation in Uganda. Uganda Digital Health Review, 5(1), pp.33–41.

Mugisha, J. and Byamukama, D., 2020. Barriers to digital health adoption in Uganda. Uganda Journal of Health Technology, 4(1), pp.33–41.

Mujuni, J. and Kamya, F. (2020) 'Organizational culture and adoption of digital systems in health units: Evidence from Uganda', Uganda Journal of Health Policy and Management, 6(2), pp. 12–25.

Musoke, D., Atusingwize, E., Ikhile, D. and Ssemugabo, C., 2022. Implementation challenges of regional digital health strategies in East Africa. African Health Sciences, 22(2), pp.112–120.

Mutebi, R. and Mugisha, A. (2021) 'The role of infrastructure in digital health implementation in low-income settings', African Journal of eHealth, 3(2), pp. 41–49.

Nabiryo, R., Komakech, B. and Namanya, C., 2024. State of electronic medical record systems in lower-level health facilities in Uganda. East African Journal of eHealth, 3(1), pp.12–23.

Nakibuuka, J., Achan, J. and Musinguzi, J. (2022) 'Barriers to eHealth readiness in Uganda: A mixed-methods study', East African Medical Journal, 99(2), pp. 84–92.

Namuddu, J. and Waiswa, C. (2022) eHealth Literacy among Primary Healthcare Workers in Uganda. Journal of Health Informatics in Africa, 9(1), pp.14–26.

Namuddu, J. and Waiswa, P., 2022. Digital health literacy in lower-tier healthcare settings in Uganda. Makerere University eHealth Policy Briefs, 4(2), pp.12–19.

Nwachukwu, C. and Ojo, O., 2020. The state of digital health in Africa: Current realities and future possibilities. African Journal of Science, Technology, Innovation and Development, 12(3), pp.345–357.

OECD, 2020. Health in the 21st Century: Putting Data to Work for Stronger Health Systems. Paris: OECD Publishing.

Okello, D., Mugisha, S. and Namaganda, J. (2023) 'Digital transformation of health systems: Barriers and enablers in Uganda', International Journal of Medical Informatics, 173, p. 105253.

Oliveira, T. and Martins, M.F., 2011. Literature review of information technology adoption models at firm level. Electronic Journal of Information Systems Evaluation, 14(1), pp.110–121.

Opio, H. and Namakula, R. (2023) 'Assessing organizational readiness for digital health: A case study of primary care centers in Central Uganda', Health Policy and Planning, 38(4), pp. 567–575.

Opiro, R. and Namatovu, J., 2024. Community perspectives on mobile health adoption in Northern Uganda. Journal of Health Technology, 9(1), pp.18–28.

Orb, A., Eisenhauer, L. and Wynaden, D. (2001) 'Ethics in Qualitative Research', Journal of Nursing Scholarship, 33(1), pp. 93–96.

Pallant, J. (2020) SPSS Survival Manual: A Step by Step Guide to Data Analysis Using IBM SPSS. 7th ed. London: McGraw-Hill Education.

Patton, M.Q. (2015) Qualitative Research & Evaluation Methods. 4th ed. Thousand Oaks, CA: SAGE Publications.

Polit, D.F. and Beck, C.T. (2017) Nursing Research: Generating and Assessing Evidence for Nursing Practice. 10th ed. Philadelphia: Wolters Kluwer.

Resnik, D.B. (2020) 'What is Ethics in Research & Why is it Important?', National Institute of Environmental Health Sciences. [Online] Available at: https://www.niehs.nih.gov/research/resources/bioethics/whatis/index.cfm

Rogers, E.M., 2003. Diffusion of Innovations. 5th ed. New York: Free Press.

Saunders, M., Lewis, P. & Thornhill, A. (2019) Research Methods for Business Students. 8th ed. Harlow: Pearson Education Limited.

Saunders, M., Lewis, P. and Thornhill, A. (2019) Research Methods for Business Students. 8th ed. Harlow: Pearson Education.

Schmidt, K., Boatin, B. and Frehywot, S. (2008) A Framework for Designing Sustainable Telemedicine Information Systems in Developing Countries. International Journal of Medical Informatics, 77(1), pp.33–45.

Scott, W.R., 2005. Institutional Theory: Contributing to a Theoretical Research Program. In: K.G. Smith and M.A. Hitt, eds. Great Minds in Management: The Process of Theory Development. Oxford: Oxford University Press, pp.460–484.

Tashakkori, A. and Teddlie, C. (2010) Mixed Methodology: Combining Qualitative and Quantitative Approaches. 2nd ed. Thousand Oaks, CA: SAGE Publications.

Tornatzky, L.G. and Fleischer, M., 1990. The Processes of Technological Innovation. Lexington, MA: Lexington Books.

Tshimula, A., Mwewa, C. and Kabila, N. (2023) Redesigning Electronic Health Record Systems for Developing Countries. African Journal of Health Systems Research, 12(2), pp.102–118.

Tumwebaze, R. and Musoke, D. (2023) 'Digital health systems and primary care in Uganda: Current gaps and future prospects', Journal of Health Systems, 12(1), pp. 21–30.

Tumwesigye, D. and Bukenya, G., 2023. Institutional preparedness for digital transformation in Ugandan health centers. Uganda Journal of Organizational Development, 8(3), pp.55–67.

Turyakira, E., Mwesigwa, R. and Nabunya, C. (2022) 'Human resource digital literacy and healthcare delivery in Uganda', East African Journal of Health Sciences, 4(3), pp. 33–41.

Uganda Ministry of Health, 2024. Annual Health Sector Performance Report 2023/2024. Kampala: MoH.

Venkatesh, V., Brown, S.A. and Bala, H. (2013) 'Bridging the Qualitative-Quantitative Divide: Guidelines for Conducting Mixed Methods Research in Information Systems', MIS Quarterly, 37(1), pp. 21–54.

Wanyama, P. and Lubega, J., 2022. Policy enforcement and digital adoption in Uganda's health sector. Information Systems for Development Africa, 10(1), pp.25–39.

WHO AFRO (2022) Digital Health Platform (DHP) Framework: Technical Overview and Implementation Guide. Brazzaville: World Health Organization Regional Office for Africa.

World Health Organization (2021) Digital Health Guidelines: Recommendations on Digital Interventions for Health System Strengthening. Geneva: WHO.

World Health Organization (2021) Global Strategy on Digital Health 2020–2025. Geneva: WHO.

World Health Organization (2022) Global Strategy on Digital Health 2020–2025. Geneva: WHO.

World Health Organization (WHO), 2021. Global Strategy on Digital Health 2020–2025. Geneva: WHO Press.
World Health Organization (WHO), 2023. Transforming Health through Digital Innovations: Global Strategy 2020–2025 – Midterm Update. Geneva: WHO Press.

APPENDICES

Appendix I: Introductory Letter

Dear Sir/Madam,

RE: INVITATION TO PARTICIPATE IN A FRAMEWORK FOR ENHANCING DIGITAL SYSTEMS ADOPTION IN HEALTHCARE STUDY IN UGANDA.

My name is Kikashemera Pheoner, a Postgraduate student of Uganda Martyrs University. I am writing my final thesis and I am carrying out a study that is aimed at enhancing digital systems adoption in healthcare centers in Uganda. This study is part of the requirements for the award of a Master of Science Degree in Information Systems.

I am inviting you to participate in this study by completing the questionnaire below. If you choose to participate in this study, please answer all questions as honestly as possible. Participation is strictly voluntary and you may refuse to participate at any time. The data collected will provide useful information regarding the designing of a framework for enhancing digital systems adoption in healthcare centers in Uganda.

If you would like a copy of this study, please let me know as I come to pick the completed questionnaire. Completion and return of the questionnaire will indicate your willingness to participate in this study. If you require additional information or have questions, please contact me on phone number 0780253400.

Thank you for sparing time to assist me in my educational endeavours

Yours Sincerely

……..

Kikashemera Pheoner

APPENDICES

Appendix II: Questionnaire (Patients)

UGANDA MARTYRS UNIVERSITY

FACULTY OF SCIENCE

Dear Sir/madam,

I am Kikashemera Pheoner, a student of Uganda Martyrs University, Nkozi. I am carrying out a research study on **"a framework for enhancing digital systems adoption in healthcare study in Uganda: A case study of Mubende regional referral hospital, Mubende Municipality"**.

The study is being conducted in fulfilment for the award of a degree of Master of Science in Information System. This questionnaire is seeking information on the study. Therefore, the information provided in this questionnaire will be used for academic purposes only and shall be accorded utmost confidentiality. Therefore, your contribution towards filling in this questionnaire will be a great contribution to my academic endeavor.

Looking forward to your contribution,

Yours Sincerely

……..

Kikashemera Pheoner

0780253400

Section A: Bio Data: Kindly tick (√) the appropriate answers option.

1. Gender

Sex	**Tick**
Male	
Female	

2. Age of the respondents

Age	**Tick**
18 - 30 years	
31 - 45 years	
Above 45 years	

3. Years of service

Years of service	**Tick**
Less than 5 years	
5 - 10 years	
Above 10 years	

4. Highest Level of Education attained

Education level	**Tick**
Certificate	
Diploma	
Degree	
Masters	
Professional qualification	
Other	

5. Position held in the organization

Position	**Tick**
Certificate	
Diploma	
Degree and above	

Others please

Specify……

6. Role in the facility

Role in facility	**Tick**
Clinical staff	
Administrative staff	
Community health worker	
ICT/Data ICT/records personnel	

SECTION B: A Framework for enhancing digital systems adoption in healthcare

Objective (a): Technological infrastructure on digital systems adoption

Please indicate the extent to which you agree or disagree with the statement below by ticking **(√).**

Key: 1=SD-strongly disagree; 2=D-disagree; 3=NS-not sure; 4=A-agree and 5=SA-strongly agree

Table 9: A Framework for enhancing digital systems adoption in healthcare

No.	Items	SD	D	NS	A	SA
a1	Our facility has adequate computers and tablets for digital health use.	1	2	3	4	5
a2	Internet access at the facility is reliable.	1	2	3	4	5
a3	Power outages affect the use of digital systems.	1	2	3	4	5
a4	Equipment for data entry is functional and well-maintained.	1	2	3	4	5
a5	We receive technical support when systems fail.	1	2	3	4	5

Objective (b): Human digital capacity on digital systems adoption

Please indicate the extent to which you agree or disagree with the statement below by ticking **(√).**

Key: 1=SD-strongly disagree; 2=D-disagree; 3=NS-not sure; 4=A-agree and 5=SA-strongly agree

No.	Items	SD	D	NS	A	SA
b1	I am confident in using computers and mobile devices.	1	2	3	4	5
b2	I have been trained to use electronic health records.	1	2	3	4	5
b3	I find the digital systems use-friendly.	1	2	3	4	5
b4	More training is needed to effectively use these systems.	1	2	3	4	5
b5	I can troubleshoot basic digital challenges at work.	1	2	3	4	5

Object (c): Organizational readiness on digital systems adoption

Please indicate the extent to which you agree or disagree with the statement below by ticking **(√).**

Key: 1=SD-strongly disagree; 2=D-disagree; 3=NS-not sure; 4=A-agree and 5=SA-strongly agree

No.	Items	SD	D	NS	A	SA
c1	Facility leadership supports the use of digital tools.	1	2	3	4	5
c2	There is a clear strategy for implementing digital systems.	1	2	3	4	5

c3	Staff are involved in planning for ICT adoption.	1	2	3	4	5
c4	Budgets are allocated for digital systems.	1	2	3	4	5
c5	There is follow-up and supervision on the use of digital systems.	1	2	3	4	5

SECTION C: Level of digital systems adoption

Please indicate the extent to which you agree or disagree with the statement below

Key: 1=SD-strongly disagree; 2=D-disagree; 3=NS-not sure; 4=A-agree and 5=SA-strongly agree

No.	**Items**	**SD**	**D**	**NS**	**A**	**SA**
C1	Most patient data is captured using digital tools.	1	2	3	4	5
C2	The systems are used consistently by staff.	1	2	3	4	5
C3	Digital records are used in making clinical decisions.	1	2	3	4	5
C4	Digital tools have improved our workflow and service delivery.	1	2	3	4	5
C5	We rely on digital reports for health planning.	1	2	3	4	5

Appendix III:

INTERVIEW GUIDE (Facility in-charges, department heads, ICT officers, or community health leaders)

Introduction:

Hello;

I am **Kikashemera Pheoner** a student of Uganda Martyr's University (UMU) undertaking a study on **"a framework for enhancing digital systems adoption in healthcare study in Uganda: A case study of Mubende regional referral hospital, Mubende Municipality"**. You have been selected as a key stakeholder in this study and would like to request for your cooperation in this important task. Your responses will be highly confidential and only used for the academic study purposes. I highly appreciate your commitment and support towards this noble course.

Thank you!!

Name:……(***Optional***) Title……..

1. Can you describe the current digital systems used in this facility?
   ……
   …….
2. What challenges do you experience with the technological infrastructure (power, internet, equipment)?
   ……
   …….
3. How would you rate the digital skills of your staff?
   ……
   …….
4. What support is offered to staff in learning or using digital tools?
   ……
   …….
5. Does the facility have any internal strategy or roadmap for digital health adoption?
   ……
   …….
6. Are there specific leadership roles or teams assigned to oversee digital health activities?

……
…….

7. How do you assess the level of digital adoption in your daily workflows?
   ……
   …….

8. What do you think needs to be done to enhance the adoption of digital health in this facility and others like it?
   ……
   …….

9. Are there any policies or government directives that influence your digital health practices?
   ……
   …….

10. What recommendations would you give to improve digital health adoption in Uganda?
    ……
    …….

END

Thank you very much for your time and input. Your insights are highly valuable to this research.

Appendix V: Budget

CATEGORY	QUANTITY	ESTIMATED UNIT COST	ESTIMATED (UGX)
Research Fees (UMU)	1	1,195,000	1,195,000
Personnel			
Research Assistant	2	150,000	300,000
Data Collection& Analysis			
Transportation	1	300,000	300,000
Refreshments (during interviews)	8	50,000	200,000
Internet Data for participants	15	8000	120,000
Equipment and Software			
Laptop	1	1,900,000	1,900,000
Software and Licenses	1	400,000	400,000
Internet	1	100,000	100,000
Airtime	2	50,000	100,000
Training and Capacity Building			
Refreshments	5	10,000	50,000
Printing	1	20,000	20,000
Miscellaneous			
Printing & Stationary	2	50,000	100,000
Others	1	200,000	200,000

Appendix IV: Budget

Task	**Sub Tasks**	**1st-30th Oct 24**	**1st Nov-31st Jan 25**		**01st-28th Feb 25**	**01st-31st May 25**	**15th-30th May 25**	**01st - 15 June 25**	**15th-30th June 25**
Tasks	Subtask	**Oct '24**	**Nov '24**	**Dec '24**	**Jan '25**	**Feb '25**	**Mar '25**	**Apr '25**	**May '25**
Collection of Ideas	Brainstorm, conduct Literature review, develop a concept	**1st-30th Oct 24**							
Research Proposal Development	Literature Review, Proposal Development		1st Nov-31st Jan 25						
Data Collection	Identify key stakeholders, design questionnaire, conduct interviews				01st-28th Feb 25				
Data Analysis	Review Interview, transcript, reports, databases, analyse survey responses					01st-15th May 25			
Framework Development	Identify value chain requirements, design the value chain framework, review and refine the prototype						15th-30th May 25		
Documentation and Reporting	Write Research report, prepare presentation							01st-15th	

								May 25	
Final Presentation and Défense	materials								**15th-30th June 25**

Work Plan; The table below gives a summary of the activities, the duration and the days on which these activities commenced.