MULTI DIMENSIONAL MODEL FOR E-HEALTH IMPLEMENTATION IN PUBLIC HEALTH CARE FACILITIES: A CASE OF EASTERN UGANDA

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DECLARATION

This thesis is my original work and has not been presented for an academic award of a degree or diploma in any other University or Institution.

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APPROVAL

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DEDICATION

This thesis is dedicated to my daughter and the entire family whose unwavering love, sacrifices, and encouragement have been the foundation of my academic journey. Your belief in me has been my greatest source of strength and inspiration.

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This PhD journey has been an incredible and transformative experience, and I owe my deepest gratitude to many individuals who have contributed to its successful completion.

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ABSTRACT

Healthcare systems consist of mechanisms intended to provide medical care, advance public health and guarantee that everyone has access to healthcare resources. The challenges facing the public healthcare sector in developing countries are mainly associated with weak healthcare systems. Weak and poor-quality health information systems contribute to failure of information flow across integrated health systems pathways; hence there is growing need to strengthen the components of Health Information Systems. It is also agreeable that health information systems have immense benefits, yet their implementations vary greatly among different countries; hence benefits to beneficiary translational gap. It is further notable that, the adoption, diffusion, acceptance and utilization of this innovation in the healthcare context are lagging. The study addressed these concerns by examining the factors influencing eHealth in public healthcare facilities and develop a multi-dimensional model for eHealth implementation in developing countries, a case of eastern Uganda. This was achieved through a survey, encompassing both quantitative and qualitative strategies. Three healthcare facility study sites were identified through predetermined selection criteria in Eastern Uganda region. The respondents cut across the different cadres of health workers, administrator, and IT staff. The collected quantitative data was descriptively and inferentially analyzed, through different analytical techniques using STATAv17, while qualitative data was thematically analyzed. From the identified study sites, key leaders were identified to respond to interview questions for qualitative data. IT personnel were interviewed to give expert response. Further, observation protocol aided data collection which equally was analyzed qualitatively, together with documents analysis. A significance test of the model components was done from which the following results were observed social factors with p-value = 0.000, Organisational factors had a p-value = 0.012, Environmental factors with a p-value = 0.024 and Technological factors that had a p-value = 0.047. A multi-dimensional model was developed from the study's outcomes to guide and support effective eHealth implementation. The model was informed by a conceptual framework which was tested and validated using a structural equation model.

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ABBREVIATIONS AND ACRONYMS

ANT	Actor Network Theory
CFA	Confirmatory factor analysis
EFA	Exploratory Factor Analysis
HIT	Health Information Technology
ICTs	Information and communications technologies
ISO	International Organization for Standardization
ITU	Information and Telecommunications Union
NGOs	Nongovernmental organizations
NPT	Normalization Process Theory
PLOS	Patient Length of Stay
SEM	Structural Equation Modeling
SST	Strong Structuration Theory
TAT	Patient turn-around time
WHA	World Health Assembly

WHO	World Health Organization
WTC	Waiting time to doctor's consultation

OPERATIONAL DEFINITION OF KEY TERMS

Health: The World Health Organization (WHO) defines health as an integrated condition of physical, mental, and social well-being, not just the absence of illness or impairment.

Information and Communication Technology (ICT): "Information and Communication Technologies" is shortened to ICT. It refers to technology that allows people to get information using telecommunications. For example, this covers different ways to communicate such as the Internet, wireless networks, mobile devices and various others.

eHealth: EHealth describes the use of information and communication technology in healthcare. eHealth means using information and communication technologies (ICTs) to help with health tasks such as treating patients, performing research, teaching students, monitoring diseases and watching over public health.

World Health Organization (WHO): The World Health Organization (WHO) is a part of the UN that handles international health matters. The organization was set up on April 7, 1948 and Geneva in Switzerland is where its headquarters are located.

International Telecommunication Union (ITU): The International Telecommunication Union (ITU) is part of the UN and manages worldwide efforts in telecommunications.

The Actor-Network Theory (ANT): ANT belongs to the sociotechnical systems group because it studies how social and technological subsystems are related. The approach was first adopted in organizational studies by sociologists and anthropologists and was later improved by researchers Bruno Latour, Michael Callon and John Law.

Normalization Process Theory (NPT): NPT provides a way to understand how interventions are put into practice, accepted and included in healthcare settings. NPT sees that health care is best achieved when there are many interactions and support from several players. It covers human, organizational and societal factors which enables researchers to study the difficulties of implementation.

Strong Structuration Theory (SST): SST is suggested as a way to explore the sociotechnical aspects of introducing healthcare IT systems. The theory is based on Giddens' structuration theory which connects social norms, political and economic institutions with the actions and decisions people make. Stones improved Structuration

Theory and offered a simpler explanation so it could be studied through research which is now known as SST. The theory focuses on external structures, internal structures, action/active agency and results as the main aspects.

CHAPTER ONE: INTRODUCTION

1.1 Overview

The chapter centered around the implementation of eHealth, particularly in public healthcare facilities in developing countries, with a case study of Uganda. Benefits of leveraging IT in health globally was analyzed with success cases cited. The chapter also looked at benefits to beneficiaries' translational gaps hence the study problem. The chapter further articulated the study objective and the step-by-step procedures of achieving it through well-defined specific objectives. Significances and justifications of the study were equally articulated, as well as study assumptions, scoping and limitations.

1.2 Background of the Study

The World Health Organization (WHO) defines health as an integrated condition of physical, mental, and social well-being, not just the absence of illness or impairment. The enjoyment of the best possible health is a fundamental right for all people, regardless of ethnicity, religion, political beliefs, wealth or social standing. One of the most significant difficulties today confronting health systems is the effective management of both complicated chronic and acute disorders. This necessitates innovative methods of providing health care, involving integration of healthcare professionals or, at the very least, much closer management of their operations [1].

The rising number of healthcare facilities has resulted in the necessity of distinguishing one's product from another, in addition to quality service and speed. This requirement is a primary motivator for eHealth adoption [2]. Using Information Technology for data capture, processing, retrieval, and exchange of health data has become the need of the hour [3].

Developing countries encounter health concerns that eHealth deployment could address, such as a lack of healthcare facilities and issues with healthcare quality, accessibility, and price. Despite the benefits of eHealth, there have been reports of implementation difficulties independent of the eHealth technology utilized. Most of these failures might be attributed to a lack of eHealth preparation [4].

Developers of software, stakeholders, and governments should first consider the roles of every category of healthcare professionals and the ways information and communication technology might help them do their jobs or offer services [5].

Information and communication technology (ICT) is rapidly changing the way business, interactions between people, and health research are conducted around the world [2]. The application of 'e'-terminology began to evolve in the 1990s, in response to international developments in the field of Information and Communication Technology (ICT). The term "eHealth" refers to "the use of information and communication technology for health." [6].

According to the WHO and the International Telecommunication Union (ITU), an electronic health system (eHealth) is a computerized medical record used to gather, store, and share information among healthcare practitioners in an organization in order to enhance the delivery of healthcare services to patients. Data is collected from medical records, whether paper-based or electronic, and then processed for statistical analysis using the Health Management Information System (HMIS) [5].

According to the WHO, eHealth is the use of ICTs for health purposes, such as treating patients, conducting research, educating students, tracking diseases, and monitoring public health. Thus, eHealth is concerned with enhancing the flow of information via

electronic methods to aid in provision of health services and administration of health systems [7]. This definition combines two major ideas (health and technology) into a single, generally distinct notion (eHealth) [6].

In 2012, WHO and the International Telecommunications Union (ITU) reported that provision of healthcare was becoming more dependent on information and communication, as well as technologies that enable these resources, whether to deploy personnel, perform research, or encourage humanitarian efforts at any level and in all countries [8].

Low ICT budgets, unpredictable electrical supply, poor infrastructure supporting health services, and insufficient workforce capacity are all barriers to eHealth implementation in Africa, according to WHO. The setting of eHealth initiatives in poor nations is marked by significant multi-level discrepancies. As a result, initiatives to leverage and integrate eHealth processes into health systems necessitate cross-sector collaboration, strategic planning, and commitment focusing on: constructing physical infrastructure; installing applications and suitable eHealth services and; ensuring a sound legal and regulatory environment; developing a skilled health workforce; and enhancements to administration, policy, standards, plus interoperability [9].

Uganda, like the majority of developing nations, has used eHealth strategy to strengthen the delivery of healthcare and health for all. Considering significant investment in the industry at the individual, national, regional, and global levels, there is mounting evidence indicating low uptake [10]. The National eHealth Strategy emphasizes the importance of evaluating digital health interventions and tracking their outcomes and impact; nevertheless, most eHealth activities are not properly recorded and lack continuing

monitoring or measuring tools. Uganda's eHealth strategy and policy was developed to direct the country's eHealth growth and implementation. According to Ashaba and Nabukenya [11], data collection and reporting system was the most common area of eHealth application followed by data analysis software among others. The common eHealth systems deployed at health facilities in Uganda are DHIS2 -District Health Information System 2 with the highest percentage of 54.5%, mTrac (41%) and Family Connect 5 (22.7%).

Uganda is divided into 111 districts, which are distributed across four administrative regions: Northern, Eastern, Central, and Western.

In developing nations, low utilization is due to inadequate uptake by organizations and individuals, a scarcity of health professionals, exorbitant communications costs, a lack of political drive, and civil upheaval, which often ends in infrastructure destruction. In contrast, enhanced infrastructure (both Internet and cellular phone-based) may result in more economical and dependable eHealth services [12].

1.2.1 Success cases in the Implementation of eHealth

With the exponential development of Internet adoption, as well as advancements in networking and information communication technologies, the eHealth movement has been presented and regarded as a vital and crucial component of healthcare systems. The adoption of eHealth initiatives is anticipated to bring about a paradigm shift in the traditional healthcare system through decreasing medical errors, improving healthcare quality, lowering healthcare costs, and enabling clients to understand their healthcare needs to make informed healthcare decisions [13].

Despite the difficulties encountered in implementing eHealth in Ethiopia, the government remains committed to its Fourth Health Sector Development Plan and has demanded that the eHealth system known as SmartCarebe be implemented in major hospitals. To date, the technology is currently deployed in over eleven clinics and hospitals, with further expansions planned [14].

The Australian government issued the first edition of the Personally Controlled Electronic Health Record (PCEHR) system on July 1, 2012. It is commonly believed in Australia that systematic eHealth Records (EHRs) offer excellent chances to enhance safety and quality healthcare, minimize expenses, enhance reliability, safeguard lives, time, and funds, support equal access to healthcare for all Australians [13].

1.2.2 Translational Gap of Benefits to Beneficiaries

Regardless of the growth in literature on eHealth perceived benefits, there is still a well-recognized and significant translational gap between these domains.

Organizations can achieve internal operational efficiency by controlling internal resources more efficiently and effectively, as well as strategic benefits by increasing customer service, by correctly employing IT. As a result, IT quality is critical for enterprises to generate value in terms of benefits such as providing timely and reliable data, enhanced decision making, finding profitable projects, and giving potential future business avenues [15].

However, there is a translational gap between research and practice, which means that proven effective healthcare advances frequently do not reach practice or only after a large delay. Furthermore, the introduction of new interventions into healthcare is occasionally

a success. This is concerning because it may have an impact on the quality of care provided; for example, it may jeopardize the efficiency and security of healthcare [16].

1.3 Statement of the problem

Healthcare Information Technology (also referred to as eHealth), is a key factor in improving quality and reducing cost in healthcare, however its successful implementation varies greatly among healthcare systems [17]. Further, even though various authors agree that there are many benefits of Health Information Technology (eHealth); the translation of these benefits to reach the intended beneficiaries, has been difficult [18]. Overall, the usage of technology in delivering and providing healthcare is ubiquitous worldwide. In spite of the potential advantages of eHealth, implementation of these systems is frequently reported as challenging [19]. The health care system of several developing countries is so affected with numerous challenges and issues. Uganda as a developing country is still in its nascent stages of achieving meaningful use of the technology in healthcare service delivery. Therefore, the need for a critical examination of eHealth implementations in public healthcare facilities to assess the challenges in eHealth implementation process due to the varying influencing factors, their interactions and perceived benefits translational gap to the beneficiaries. The study sought to fill the gap by using a theoretical framework as a guide or a road map to explore the socio-technical, organizational and environmental interactions and their influence on eHealth implementation process.

1.4 Objective of the study

1.4.1 Main Objective

To examine the factors influencing eHealth in public healthcare facilities and develop a multi-dimensional model for eHealth implementation in developing countries, a case of eastern Uganda.

1.4.2 Specific Objectives

i. To establish by documenting eHealth services implementation status at the study site facilities.

ii. To determine, through the lens of a theoretical framework, factors that affects implementation of eHealth in public healthcare service delivery.

iii. To determine the core mechanisms in implementation of eHealth systems.

iv. To develop a multi-dimensional model for successful implementation of eHealth.

1.5 Research Questions

i. What is the eHealth adoption state, implementation and routine in healthcare services delivery at the study site facilities?

ii. What are the determinants of eHealth systems implementation process in healthcare service delivery at the study site facilities?

iii. What are the core mechanisms in implementation of eHealth systems in healthcare service delivery?

iv. Are there existing models to guide or inform e-health implementation process?

1.6 Justification of the Study

There is growing interest in eHealth adoption because of the enhanced potential to improve healthcare quality for both developed and developing countries. Although the use

of ICT to improve healthcare delivery would significantly solve quality and accessibility issues in healthcare, and also reduce healthcare costs, the adoption of eHealth has not been fully realized. [20].

This study is in line with the United Nations Sustainable Development Goals (SDGs), particularly Goal 3, which aims to ensure healthy lives and promote well-being for people of all ages [21].

The Ministry of Health (MoH) in Uganda found that there are not enough qualified healthcare workers and that the country has to deal with epidemics such as HIV/AIDS, TB and malaria, as well as limited access to health services and professionals because of bad infrastructure. To address the problems, the supply side must continuously enhance its capabilities and efficiently meet some of the increased demand for healthcare services. The implementation of eHealth is looked at as a possible solution in this case, which is in concurrence with the views of [22]. This therefore required an examination of the multi-dimensional factors that influence eHealth implementation process in public healthcare facilities in Uganda, a case of Eastern Uganda.

1.7 Significance of the Study

The study developed a multi-dimensional model for eHealth implementation in public health care facilities, which captured the various dimensional aspects that affect eHealth implementation. From the study problem, it is highlighted that there is a challenge of the benefits of eHealth reaching the beneficiaries due to implementation challenges. Therefore, by adopting this model which addressed the implementation challenges, it is believed that the implementation will be successful. Thus, making the beneficiaries reap the benefits therefrom. Notably, the policy makers, stakeholders and implementers would

find guidance on the most appropriate issues to address in their quest to leverage IT in health.

The successful implementation of eHealth services at health facilities enables the secure interchange of information among clinicians, patients, payers, government, and other important parties who can favorably impact patient care and population health. eHealth ensures effectiveness in health care through cost reduction, improved service quality, expansion of patients' understanding and accessibility to individual electronic records via the internet.

The study's purpose is to improve existing knowledge on the multiple factors that influence the deployment and use of Health Information Technology (HIT) in healthcare facilities.

1.8 Assumptions

The study assumed that eHealth is a key enabler in the delivery of services at health facilities, and that it makes health systems efficient, responsive to people's needs and expectations; that facilities have no choice but to adopt and implement in their daily routines. It also assumed cooperation and honesty from the respondents.

Equally it was assumed that the respondents would have sufficient interaction with eHealth systems, that is in case they are available, which then gave them the knowledge and understanding required to respond to the issues asked. It was assumed that the choice of study sites was representative enough to aid its focus.

1.9 Scoping and Delimitation of the study

The study's purpose was to address both the gaps of ICT implementation in health (eHealth) and the benefits to the beneficiaries, to improve healthcare service delivery outcomes in developing nations, of which Uganda is one.

While this is achievable over a long time, the study period is cross-sectional, that is, limited. The researcher, therefore, purposively picked on Eastern Uganda, a manageable scope for the cross-sectional study. Three study sites that matched the inclusion requirements, particularly public health care facilities (government-owned), differed in terms of geographical location and coverage, economic endowment, operation levels, and eHealth services standardization and domains used.

Consequently, as the study aimed at assessing the multi-dimensional factors affecting eHealth implementation in health care facilities, it focused on the Information Technologies available as the eHealth media, and investigated services that health-care providers used directly or online, and from which patients and caregivers are free to choose (these were divided into four broad domains: Clinical decision support systems, Health Management Systems, Communication Systems for Care, and Information Systems).

For any implementation to be regarded as a success, it has to be accepted by the target users.

Adoption of information systems in organizations typically occurs in two stages: primary adoption by a business, division, or department and secondary adoption by individual employees [23].

[24], [25] offered a six-stage model of information system implementation: initiation, adoption, adaptation, acceptance, routinization, and infusion. Therefore, the study explored the implementation process from formative state to the point when routine use of the innovation occurred within an organization leaving out outcome. Thus, considering [24], six-stage model only the first four phases were examined in the study. They were however collapsed to broader classification of formative and process implementation. Thus, the study was limited to formative and process implementation evaluation given the three implementation development stages of formative, process and outcome.

Additionally, to aid in the screening and evaluation of the implementation process, the study applied Actor-Network Theory (ANT), Normalization Process Theory (NPT) and Strong Structuration Theory (SST), because they are applied at the Organization level, while most other theories, models or frameworks are at the individual levels.

1.10 Limitations

The first challenge the researcher faced during the study was choosing the right theories to address the problem. The researcher solved the issue by reading widely on key topics for investigation and theories supporting the study. To solve the issue, the researcher attended seminars and solicited advice from experts in different fields. Selecting the appropriate methodology presented another difficulty for the researcher, who struggled to choose the best course of action for carrying out the research. To address this, the researcher conducted a pilot study to evaluate the data gathering instruments before to beginning the actual research and conferred with other researchers. One of the challenges the researcher faced when analyzing the data that was gathered was figuring out how to make sense of the data that had been.

Another constraint encountered throughout the research was the participants' mindset. Regarding their familiarity with eHealth systems, a few individuals were hesitant to provide information. To overcome this limitation, the researcher sought to ensure the informants that the information they provided would be kept confidential and used exclusively for the study. The research's funding was another drawback. Funding was needed for the study to collect and evaluate all of the data correctly. However, there were insufficient finances to cover the complete operation of the research because the research was solely funded by the researcher. To gather and accurately analyze data, the researcher had to work within the constraints of the funding at hand and confine the study to Eastern Uganda.

CHAPTER TWO: LITERATURE REVIEW

2.1 Overview

This chapter looks at studies and research on eHealth, as well as studies related to its goals, models, frameworks, theories, conceptual frameworks and hypotheses.

2.2. Leveraging ICT in Healthcare

The e in e-health makes us address the concern of ICT in healthcare. According to [5], The prefix "e-," which stands for "electronic," is used to convey the concept of digital data (as opposed to traditional analogue data such as paper medical records, electrocardiogram printouts, and x-ray film). Without digitization, there would be no automatic processing and no instantaneous exchange via the internet.

eHealth is concerned with health in general, which has two key components (public health and healthcare). Public health is the duty of states and is concerned with illness prevention and response in populations, whereas healthcare is concerned with individual patients and disease treatment. Thus eHealth encompasses all facets of health, not just healthcare. It is constantly changing to accommodate all skeletal structures for all purposes of health systems.

The evolution of computer technology and its convergence with improvements in telecommunications has radically provided the means through which healthcare delivery services by distance has progressed in recent times. An informed patient is an empowered one and on the other hand an informed professional is activated to be proactive. Thus, the interaction thereof between the two entities; proactive professional and empowered patient results into an improved healthcare outcome as was found out by Edward Wegner the

founder of Chronic Care Model. ICTs are now widely used in whatever form and is critical in providing better and more efficient healthcare services [26].

Every healthcare structure in any business strives to support processes and, as a result, give better outcomes to the organization and, in particular, the patient. Thus, IT acting as an enabler impacted the processes and the service delivery to the patients. IT applications in health are broadly categorized into three: -

The Administrative and financial systems: Administrative systems involve the digital management of operational and organizational functions within healthcare institutions. They enable healthcare providers to manage resources, personnel, and processes more effectively. Financial systems in eHealth focus on managing funds, payments, and economic resources within the healthcare ecosystem. These systems are critical in ensuring the sustainability and accountability of healthcare institutions.

Clinical systems: eHealth refers to the application of information and communication technologies (ICTs) in healthcare systems to improve access, efficiency, and quality of health services. Central to the effective implementation of eHealth are its administrative and financial systems, which play crucial roles in the organization, management, and sustainability of healthcare services. These systems streamline processes, ensure transparency, and optimize resource allocation. Some of the systems are Electronic Health Records (EHRs) and Electronic Medical Records (EMRs), Computerized Provider Order Entry (CPOE), Clinical Decision Support Systems (CDSS).

Infrastructure: This helps with administrative and clinical applications. (Administrative billing and financial general ledger, Cost accounting systems, Patient registration, Personnel and payroll, and so on.) Handling of electronic materials, Clinical Decision

Support Systems, image storage and communication systems for filmless imaging, results reporting of laboratory and different tests, as well as clinical decision support systems. Individuals, health care professionals, and healthcare providers can use ICT to: get information, interact with professionals, give first-line support, particularly when distance is an issue, and promote preventative medicine programs.

eHealth Domains: - The study divided eHealth into four domains as adapted from [27]:

1. Health Management Systems (Including Systems on electronic medical record)- This is a computer-based system that is used to collect, process, store, transmit, and display patient administrative or health information from numerous sources in order to support administrative or clinical tasks. They are specifically intended to support health care facilities and organizations with planning, management, and decision-making.

2. Clinical Decision Support Systems (CDSS) - (It consist of computerized systems used to support medical personnel in carrying out their jobs in accordance with clinical standards and in delivering superior evidence-based care). CDSS works as an interface for users and future activities. It is collaborative and rule-driven, with the goal of improving healthcare delivery by augmenting medical judgments with focused clinical knowledge and patient information.

3. Information systems (IS) – IS incorporates resources online or eHealth web-based applications for information extraction. They are digital systems that leverage open data from various sources in an ethical manner, using effective ICT technologies to produce strategic information for the enhancement of public health.

4. Communication Systems (CS) – Is a system that describes a communication exchange between two stations, transmitter and receiver. This encompasses both asynchronous and

synchronous information and communication systems utilized for clinical information sharing between health professionals and patients; with e-mail, telemedicine and telecare systems. Signals or information passes from source to destination through a channel. The employment of telecommunications networks as mediators between users who are separated in place and/or time is referred to as CS.

2.2.1 What eHealth entails

According to [28], while doing an evaluation for the UK National Health Service Research and Development Programme identified eHealth as having human, technological, and organizational components. The authors of the review recognized parts of the human narratives as patients, citizens, organizations, managers, academics, and policymakers, contributing to an eHealth idea.

According to [29], the technology of eHealth includes telecommunication, computing, medical equipment and infrastructures. Table 2.1 identifies and gives a brief description / example of these components.

Table 2. 1: Components of eHealth

Components of eHealth	**Description/Examples**
Telecommunication	Includes smart phones, mobile phones, , receivers, routers, cables and sensors.
Computing	consists of desktop PCs, laptops, tablets, personal digital assistants, internet and e-mail

Medical equipment	consists of ultrasound, radiological tests like digital X-rays, remote monitoring of the heart with electrocardiograms, blood pressure machines and lab tests involving microscopes
Infrastructures	For any system to be connected and work properly, it needs to have an electrical power source and a backup. The items and tools that make up interconnected systems to supply goods and services for society.
Infostructure	It is the combination of human resources, organizational and administrative systems, laws, rules and motivations that help use new ICTs and services in health care.

Source: [29].

A national eHealth programme requires the integration of three factors of technology, environment and clinical. The integration of these three themes leads to classifications of eHealth as captured in table 2.2 though not limited to these alone; the WHO [30] , gives further classification.

Table 2. 2 Broad Categorization of eHealth

Categories	**Examples**
telehealth/telecare	e.g. video consultations including service redesign, remote monitoring, equipment management, among others
electronic patient records	includes assessment and care planning, electronic nurse prescribing, scheduling of patients, online laboratory requests/results, e-pharmacy, clinical communications like discharge/ transfer letters
electronic communication	includes telephone support lines, SMS text messaging and email
information governance	covers confidentiality, data protection, system security and data quality

information management	reusing data recorded for care purposes to improve care, run clinical services, health care research, patient informed decision making and many more.
Personal health records	a reservoir of information that the individual considers to be significant to his or her health, wellness, growth, and welfare, and over whose content the individual has primary control.

Source: [30]

The World Health Assembly resolution in 2005 recognized eHealth's promise for enhanced health systems and healthcare quality, safety, and effectiveness [31]. A good, low-cost eHealth intervention can assist healthcare practitioners in achieving continual advances in health and healthcare quality while improving citizens' access to services. Healthcare professionals must participate fully in eHealth initiatives [32].

eHealth strategies attempt to optimize the interactions between costs, benefits, affordability, risks, and time to achieve sustainable net gains. eHealth in this context includes clinical information systems, local electronic patient records (EPR), public health databases for new and prevalent diseases, mHealth, telemedicine, telehealth and telecare, all of which can integrate gradually into wider, regional and national settings [33].

Benefits of eHealth

eHealth has been identified as having a number of benefits. According to [34], there is increasing evidence to show that leveraging technology in health can positively impact on quality of care, adherence to guidelines or protocols through decision support (reminders), enhanced surveillance and monitoring (adverse drug events, quality measurement, disease outbreak) and reduction in medication errors. Some of the benefits of eHealth are captured in Table 2.3

Table 2. 3 Examples of eHealth benefits

Key areas	Explanations
patient safety	Patients' demographic and clinical information is more legible, accessible, and shareable, providing medical professionals with more accurate, timely, and full data to base decisions on.
Effectiveness	clinical pathways and decision support systems can be embedded in electronic patient systems to give easy access to best practice evidence
Efficiency	more efficient work processes due to enhanced availability of clinical information, such as computerized delivery of prescriptions directly to the pharmacy.
patient centered	information about patient's preferences more easily available
Timeliness	access to up-to-date information on which to base clinical decisions
Equitable	ensuring that all people have the same level of access to services.

Source: [35]

eHealth includes a broad range of implements, such as electronic health records, information gathering software, mobile devices, e-learning tools and horizon technologies that defy human imagination.

There are more specific benefits of eHealth to diverse stakeholders, not just limited to the one captured in table 2.4. These benefits only accrue on the assumption that eHealth is

successfully implemented and the devices are available to the stakeholders; which often is not the case for most of the developing countries.

eHealth is making progress in the treatment of mental illnesses, self-health tracking, diagnosis of illness, physical activity intervention for medically impaired individuals, survivors, and a variety of other health-related circumstances [2].

Table 2. 4: Benefits of eHealth adoption (ICT & Health) that have been documented

improved clinical staff output
decrease in missing dose medication errors
Enhancing cost-efficiency for outpatient appointments by streamlining processes and minimizing delays.
drop in drug interaction errors
A rise in the number of patients seen by general practitioners as well as the volume of tests performed (increase in throughput)
decrease in misplaced images
decrease in the number of repeat imaging examinations
decrease in administrative staff time spent filing and monitoring forms
drop in number of redundant tests
decrease in cases of medicines running out where RFID is used for stock control and inventory management
rise on radiologist productivity as assessed by the amount of tests read per radiologist
decrease in medication errors due to mistaken identity
Facilitating the delivery of treatment personalized for each patient, where ICT allows for better decision-making based on evidence as well as patient-specific data;
Ensuring transparency and accountability in care processes, as well as promoting cross-border shared care
Enhancing diagnostic accuracy and treatment efficiency;

Source: [1]

2.2.2 Challenges for Healthcare

According to [36], the shifting health demands, rising public expectations, and ambitious new health goals are putting pressure on health systems to achieve better health outcomes and higher social value. People frequently receive insufficient treatment, and low-quality care is ubiquitous across conditions and countries, with the most vulnerable populations faring the poorest. Data from a variety of countries and settings reveal that the quality of care is consistently low. In LMICs, mothers and children receive less than half of the recommended clinical actions during a typical preventive or curative visit; less than half of suspected tuberculosis cases are correctly managed; and less than one in every ten people diagnosed with major depression receives barely adequate treatment.

Pneumonia, myocardial infarction, and neonatal asphyxia are all common misdiagnoses. Care can be excessively sluggish for conditions that demand immediate care, diminishing the chances of survival [36].

[37] identified three specific areas of global health system challenges namely: Changes in population demographics and social factors; balancing cost containment with access and quality; and fragmented healthcare delivery frameworks. Other researchers agree that globally, in both developing and developed countries healthcare management is faced with acute challenges of expanding areas of health needs, operationalizing health management, constrained budget allocations as well as resource limitations. Therefore, effective national operational strategies to minimize resource wastage and contain costs of health service production are critical.

A study conducted in Bangladesh found that perceived ease of use, gender, and subjective norm all boosted patient adoption of eHealth. Similarly, other studies conducted in the Netherlands demonstrated that the ease of use and benefits of eHealth systems greatly enhanced patient acceptance [38].

According to [2], eHealth can rise healthcare service efficiency while also positively influencing the quality of care. It is hampered by a number of issues, including high acquisition prices, particularly at the start, safety, confidentiality, and security concerns, and a lack of technical competence. Healthcare professionals' resistance to change, the failure of Healthcare Information Systems (HIS) to interoperate and communicate information, and the enormous variety of available eHealth standards, many of which compete, overlap, and occasionally contradict each other, have all slowed eHealth adoption.

2.2.3 Using eHealth as a solution

The World Health Assembly endorsed a resolution establishing a 'Global eHealth Strategy' within the World Health Organization. In the same year, the World Health Organization established the 'Global Observatory for eHealth (GOe)' to study, monitor, and support the application of eHealth in health services and systems around the globe [22].

Target 18 of MDGs' Goal 8, in recognition of the value of ICTs to health, among other fields, advocates for the development of a global partnership in cooperation with the private sector; to make available the benefits of new technologies especially information and communications. [39] argued that, the related literature does show a number of identified benefits of these information and communications technology (ICT) solutions in health. These included ease of access, improved quality of care, improved efficiency,

improved quality of information (including charts, records and reports), improved communication, facilitation of management, cost saving, and other benefits.

It is expected that what ICT has achieved in other sectors of economy e.g., banking, commerce, among others can appropriately be replicated in the health sector. According to [40], for a sustainable healthcare system in the coming years, it is necessary to build a collection of interconnected services that make data and processes available across various environments. Overall, it is expected to improve various aspects of healthcare service delivery in terms of quality, cost-effectiveness, efficiency, access, timeliness and overall performance.

The use of ICT changed the way people work, get health services, and provide solutions to patients and clients. Several literature reviews show a low rate of eHealth adoption and implementation notwithstanding the capability of eHealth systems to improve health outcomes.

eHealth appears to be beneficial for routine handling of chronic illnesses that necessitate substantial regular interactions with healthcare providers, in addition to symptom and diagnosis monitoring [41].

2.3 Related studies

Barriers to Implementing eHealth: A Multi-dimensional Perspective by [42], explores the challenges and obstacles encountered in the application of eHealth systems from a comprehensive, multi-dimensional perspective. The study looks at several aspects of eHealth implementation, including as technological, organizational, human, and regulatory aspects. It digs into the details and diverse nature of eHealth adoption, taking into account aspects such as healthcare organizations' readiness, technology infrastructure,

worker participation, and regulatory compliance. The authors emphasize the importance of understanding these multi-dimensional barriers so as to effectively address the challenges associated with implementing eHealth solutions. and provides valuable insights for healthcare organizations and policymakers seeking to overcome obstacles and improve the positive deployment of eHealth technologies. Therefore, this study provides a multi-dimensional examination of the obstacles to eHealth implementation, emphasizing the interplay of technological, organizational, human, and regulatory elements in shaping the adoption of eHealth.

An evaluation framework for health information systems: human, organization and technology-fit factors by [43]. The framework presents an evaluation dimension for addressing the fit of technology, people, and organizations factors.

A Review of Telehealth Service Implementation Frameworks by [44], presents a thorough evaluation of various frameworks aimed to aid in the development of telehealth services. The study's primary purpose was to assess and synthesize existing telehealth service implementation frameworks. The author conducted a systematic review of a variety of literature and research studies focusing on deployment of telehealth services. The review identifies and categorizes various frameworks used to guide the establishment and operation of telehealth initiatives. Technology integration, patient involvement, healthcare professional training, and regulatory compliance are all common components of these systems. It emphasizes the significance of these frameworks in supporting the effective deployment of telehealth services, hence enhancing healthcare access and health outcomes.

The challenge of Integrating eHealth Into Health Care: A Systematic Literature Review of the Donabedian Model of Structure, Process, and Outcome by [45], conducts a systematic review to understand how the Donabedian model influences eHealth integration into healthcare. The Donabedian model classifies healthcare quality into three components: structure, process, and outcome. It emphasizes the many challenges and opportunities involved with the adoption of eHealth technology, which altered the quality and effectiveness of healthcare provision. The model was used to measure the quality of healthcare. "Structure" refers to the physical and organizational features of healthcare, "process" refers to the methods of care delivery, and "outcome" refers to the effects on patients' health and overall well-being.

According to the article, Impact of Patient-Centered eHealth Applications on Patient Outcomes: A Review on the Mediating Influence of Human Factor Issues by [46], explores the impact of patient-centered eHealth apps on patient outcomes while keeping the role of human aspect issues into consideration.

The study undertook a comprehensive evaluation of existing research on patient-centric eHealth applications. It investigated how these applications influence patient outcomes such as improved health, satisfaction, and engagement. Furthermore, the paper looked into human aspect issues such as usability, user experience, and human-computer interface, which can either increase or decrease the impact of eHealth applications.

An evaluation of eHealth services: user's perspective criteria by [47]. The framework suggests user-focused assessment standards for eHealth services. The researchers use a sequential multi-method research strategy that states that the assessment criteria can be used as part of an eHealth evaluation framework. In an evaluation process, the framework

analyzes stakeholder(s) who have a shared perception; in this case, it is the user's perspective. Users are not mentioned; Costs (saving money and time), benefits (saving effort, quality, access), ease of learning/use, availability, compatibility, function (such as: accuracy of information, technical functionality), user satisfaction (reliability, utility, flexibility, efficiency, customization). Research approach used was a sequential multi-method.

The article "A Holistic Framework to Improve the Uptake and Impact of eHealth Technologies" by [48], provides a comprehensive outline meant towards improving adoption as well as effectiveness of eHealth innovations. This all-encompassing approach takes into account governance, infrastructure, data management, user engagement, evaluation, and compliance. The framework was designed to steer eHealth stakeholders toward more successful and effective eHealth implementations.

2.4 A Review of the Study Objectives

The review of the study objectives aims to provide a clear understanding of the specific goals that guide this research. These objectives are designed to explore the status of eHealth service implementation, identify the factors influencing its adoption, examine the core mechanisms involved in its integration, and ultimately develop a multi-dimensional model for the successful implementation of eHealth in public healthcare settings.

2.4.1 eHealth Services available, level of integration and the process of implementation

According to WHO-ITU [49], the identification of key eHealth services available, level of integration and the process of implementation in Health has enabled and advanced a joint discussion and an awareness of what is meant by "eHealth," meaningful prospects

for eHealth to assist health care, and priority areas for eHealth investments. Thus, centered on the ICT setting and eHealth-friendly atmosphere, the nationwide perspective can be defined in three distinct classes as depicted in the figure 2.1 below.

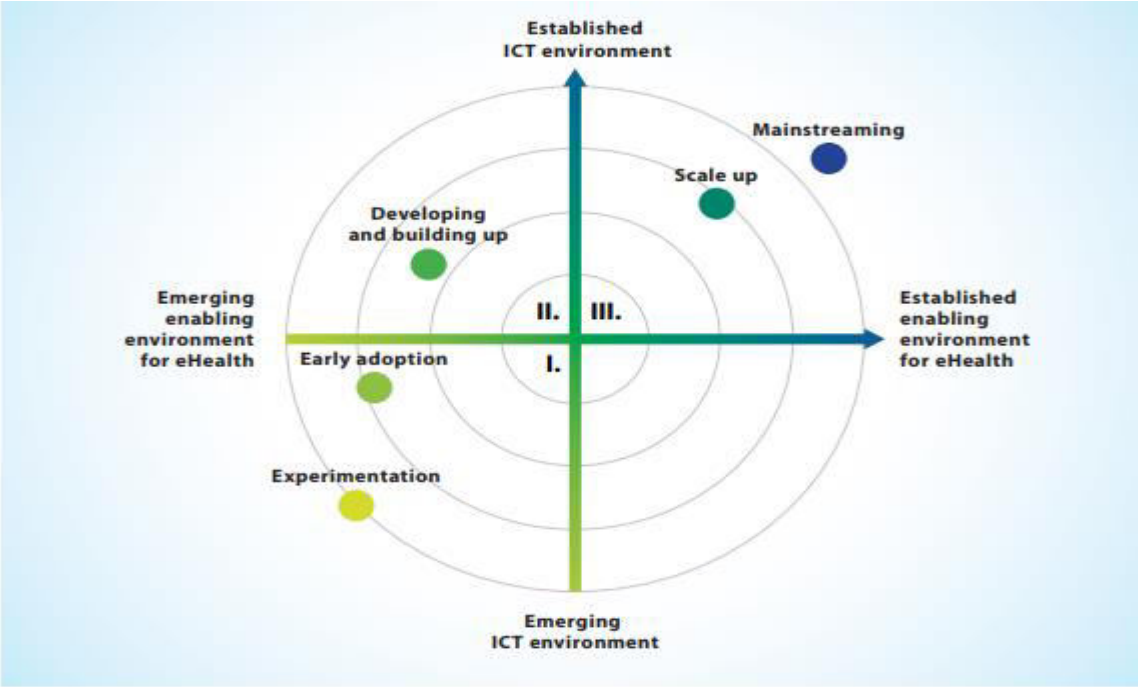

Figure 2. 1: National context for eHealth development (Source: [8])

1. **The experimentation and early adoption,** here**,** both in terms of ICT and enabling contexts are at infant stage. eHealth in this setting is project-based, with a few local efforts that are rarely linked to one another. In this configuration, the general population's use of ICT is limited to mobile phones. The government does not provide funding for eHealth or technical assistance. In this constricted setting, the government is unable to achieve its international commitments for public health reporting on a consistent basis. In this situation, the driving reasons for eHealth include increasing citizens' access to health care and enhancing the quality of that care.

In this setting, a country's national plan emphasizes on articulating eHealth, raising alertness and staff training, eHealth acceptance in key services and systems [49]. Countries would not be able to leapfrog to more sophisticated eHealth systems unless they also worked on creating an enabling environment; otherwise, ICT breakthroughs would have been isolated with limited influence on health.

Developing and building up, in this case, the ICT environment is growing quickly compared to the enabling environment. Though eHealth is project-based here, the initiatives are bigger with a broader understanding of their potential. The commercial ICT industry is growing, frequently rapidly, with a significant and apparent push towards ICT area to draw multinational suppliers [49].

Public-private collaborations are common in this setting, plus, eHealth is viewed as a component with larger push towards boosting ICT and financial growth.

[49], indicates that ICT may be an enabler of development, with a growing emphasis on private sector competitiveness and service expansion. Nonetheless, the health industry trails behind other sectors in terms of awareness and systematic implementation of ICT to satisfy health demands. Telemedicine and other eHealth applications can provide appreciated services, early achievements and implications on health results.

2. **Scaling up and mainstreaming,** during this period, the aiding atmosphere matures to facilitate wider usage of ICT.

Adoption of guidelines and standards, the integration of ICT in health care, and investment and strategies for developing a qualified workforce are all components of the supportive environment which can only be handled at the national level. In this configuration, the

eHealth context is defined by the enabling atmosphere coexisting with the ICT environment. As there is usually a policy underpinning for investment, eHealth can move to scale, safeguarding citizens and industry more significantly. Quality and cost are driving factors for eHealth in this setting.

Globally, there is a multitude of variables that impede or facilitate the deployment of eHealth. There could however be variations reliant on whether the implementation is in a developing economy or a developed economy. However, common to the two economies are cost, training and education the importance of verification and assessment; confidentiality, system safety and guidelines; system usability; professional attitudes; infrastructure and funding.

According to[7], [50], [49], [51], [38], as a result of poor or weak ICT infrastructure and services, eHealth programs are rarely sustainable where both ICT and supportive ecosystems are in their infancy. Patients and healthcare workers' rejection of change; a lack of control; a shortage of skilled ICT personnel or insufficient human skills; variations in culture and linguistic barriers; limited monetary funds; limited checking and appraisal systems; and no sound lawful frameworks.

2.4.2 Determine, through the lens of a theoretical framework, factors that affects implementation of eHealth in Public healthcare service delivery

Literature available indicates that several factors influence the implementation of an innovation. These include: environmental (external to the organization), organizational (internal environmental setting; structure, culture and processes), technological and social factors in healthcare facilities.

2.4.2.1 Environmental factors

Environmental factors, such as government funding or grants, are crucial in the acceptance and deployment of eHealth. In the health facilities, there is a government implementation body, Political backing, as well as NGO and donor assistance [52].

Economic factors are important in supporting the continuing viability of eHealth deployment. [53]. The affordability of connection, like mobile cellular taxes, broadband internet charges, and eHealth system procurement pricing, has a direct impact on economic consequences. [2], [51], [52], [54].

2.4.2.2 Social factors

Individuals and cultural elements, tasks, and organizational structure are all represented by social factors [36]. They represent eHealth's capacity to address stakeholder-related issues like cultural, ethical, behavioral, ease of use, a person's opinion of a system's value, and stakeholder necessities throughout the processes of eHealth creation, implementation, operation, and enhancement [24], [38], [53]. Limited expertise and knowledge is often seen as a hindrance to successful system installation.

Training improves the skills and knowledge of health care practitioners, leading to the adoption of eHealth systems [10].

2.4.2.3 Technological factors

Four variables are identified in the technological dimension: infrastructure, information quality, system quality and quality service. The system and quality information are seen as critical aspects influencing IS acceptability and improving corporate performance. The

level of service provided by the IS department and IT support people provide to system users is referred to as service quality [63]. The economic affordability of the healthcare organization also has an impact on the success of eHealth technology. As a result, social

2.4.2.4 Organizational factors

The operational environment settings and their ongoing interaction with technology define the successful implementation of an eHealth system. The business atmosphere, together with the organization's material, financial, and human resources, are important to the efficient implementation of eHealth [64]. Table 2.8 presents the organizational factors that affect ehealth implementation.

The adoption of eHealth systems is a transformative process that significantly enhances healthcare delivery, but it is influenced by numerous facilitators and barriers. Understanding these factors is crucial for successful implementation and sustainability. Tables 2.9 and Table 2.10 below provide a summary of the specific facilitators and barriers that were identified.

2.4.3 The core mechanisms in implementation of eHealth systems

In view of successful implementers, these are step-by-step procedures that were followed throughout their whole execution of predefined tasks or those customized to their contexts and restrictions. According to Accenture research on successful IT adoption instances in healthcare, there are a variety of mechanisms in place, including a variety of direct and indirect incentives, to boost healthcare IT adoption. Subsidies, bonuses, tax breaks, grants or loans, and co-funding mechanisms are all examples of adoption incentives. Focusing on multiple organized initiatives contribute to creation of a countrywide eHealth plan; was another mechanism identified for implementers. Which include:

I. Developing governance structures to promote visibility, coordination, and control of eHealth operations across the country's health sector.

II. Involving key health and non-health stakeholders in the creation and implementation of a national vision and strategy for eHealth.

III. Developing a grasp of the current eHealth ecosystem with regard to existing programs, projects, and eHealth components.

IV. Creating an eHealth strategic context to aid as the basis for the eHealth vision and strategy, as well as allow the state to make informed judgments about whether to pursue possibilities presented by the ICT industry and other stakeholders.

Begin a national eHealth coordination and alignment strategy, which includes the creation of national frameworks and infrastructure components that can be leveraged at various levels to deliver solutions that can be integrated and exchange data across geographic and health sector boundaries.

National action should concentrate on four main areas:

• Implementing the national 'health information highway' architecture and guidelines to enable information to be retrieved and shared effortlessly across the national health care system.

• Encourage venture in high-priority computer systems and tools that brings noticeable benefits to consumers, caregivers, and health-care managers.

• Encourage participants in the health sector to embrace and employ high priority systems and tools when they become available.

• Creating an eHealth governance framework to allow for effective coordination and oversight of national eHealth efforts.

2.4.4 Development of a multi-dimensional model for successful implementation of eHealth

A literature review indicates that a variety of implementation models and frameworks with various techniques or indexes have been offered. [68], [54] recognizes several of these, particularly the Networked willing Readness Index (NRI) framework, which contains four sub-indices: the environment for ICTs; a society's willingness to adopt ICTs; actual usage by all main stakeholders; and the impact of ICT on the economy and society. According to these authors, the first three sub-indices serve as drivers for the findings of the fourth sub-index of ICT impacts; the interaction is illustrated in figure 2.2.

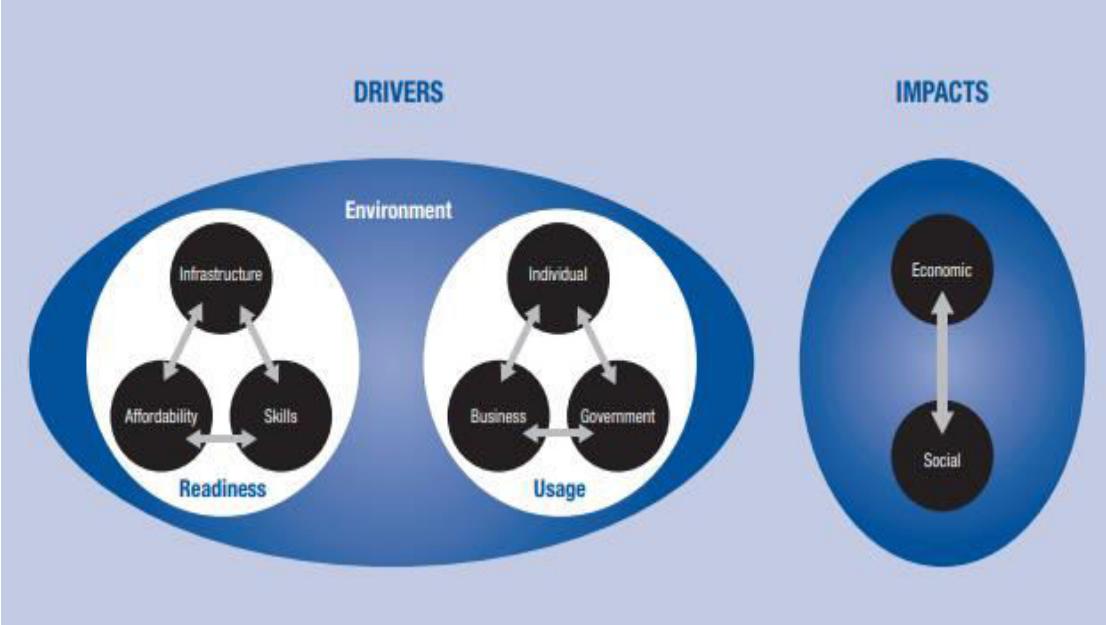

Figure 2. 2: The Networked Readiness Index framework (Source: [54])

According to Bilbao-Osorio et al. [54], Baron and Kenny [68], are of the opinion that, because eHealth is the application of ICT in health, the indicators stated in NRI have an impact on the longstanding viability of eHealth systems. Those authors define four NRI subindices, which are further subdivided into ten pillars made up of 54 distinct indicators.

Environment sub-index: The openness of the country's market and regulatory system in terms of encouraging ICT adoption.

Usage sub-index: the effort made by a society to incorporate ICT into its daily activities (individual, business, and government usage).

Readiness sub-index: A society's willingness to use affordable ICT infrastructure and digital material: (Infrastructure, Affordability, Skills, and Digital Content).

Impact sub-index: represents the evolution of the economy and society into an ICT and technology-savvy economy and society (economic and social repercussions).

[54] states that, social, environmental and economic conditions in the developing and developed nations are much different. Furthermore, they contend that most eHealth success issues are related to the environment of the system. Environmental factors like legislation, ICT infrastructure plus expertise is substantially weaker in underdeveloped nations than in the developed world. According to reports, these environmental variables are among the key hurdles in eHealth deployment.

2.5 Frameworks, Models and Theories

Frameworks, models, and theories serve as structured tools for understanding, analyzing, and addressing complex issues across various disciplines. In fields such as healthcare, technology, and social sciences, these constructs provide a systematic approach to exploring relationships, identifying challenges, and guiding the implementation of solutions.

2.5.1 Frameworks

[68] identifies four different eHealth frameworks which they categorize as: eHealth framework 1; eHealth framework 2; eHealth framework 3 and eHealth framework 4. Each is discussed herein below.

eHealth framework 1: ([44]**, A review of telehealth service implementation frameworks).**

This framework is a summary of a review done by [44], of nine published studies on different eHealth frameworks. The framework emphasizes the need for a comprehensive approach to implementing telehealth services, including technology, organizational structures, change management, economic feasibility, societal impacts, perceptions, user-friendliness, evaluation and evidence, legislation, policy, and governance.

eHealth framework 2: (A Health systems framework: Health system dimensions required for scaling up mHealth for community based health services [69]**)**

The framework is the product of the work done by [69] which identifies four primary health system aspects required for scaling up mHealth systems and the related capacity requirements for each dimension, which are:

i. Government stewardship: policy environment supportive of mHealth
ii. Organizational: culture and capacity to use information technology for management
iii. Technological: usability, integration and sustainability of the chosen technology
iv. Financial: adequacy of finance for the medium to long term use of m-Health

The framework stresses the economic and technological factors more compared to the other two factors of eHealth sustainable factors.

eHealth framework 3: (ISO/TR 14639 Health informatics — Capacity-based eHealth architecture roadmap [70]**)**

This framework is an ISO based; it describes the four components of the eHealth Architectural Maturity Model (eHAMM) based on ISO/TR 14639-1 (ISO, 2012). The framework is hinged on four main domains: that is, i. Governance and National Ownership, ii. Foundation – eHealth Infrastructure, iii. Foundation – ICT Infrastructure and iv. Health Process Domain Components.

The framework classifies the model's health process domain as eHealth Infrastructure, which relates to the technological aspect of eHealth sustainability factors, ICT infrastructure, governance, and national ownership associated with the environmental factors; whereas the model of eHealth architecture covers the environmental and technological aspects of eHealth sustainability.

However, economic factors are covered under governance and national ownership. The approach fails to address the social aspects of eHealth system installation.

eHealth framework 4: (Khoja–Durrani–Scott Evaluation Framework [71] **)**

This is a framework by Khoja-Durrani-Scott (KDS); it covers a wide range of areas influenced by eHealth interventions, these includes: Health services outcomes; Behavioral and socio-technical outcomes; Technological outcomes; Economic outcomes; Ethical outcomes; Policy outcomes; Readiness and change outcomes [71],[68]. The authors view the framework as comprehensively covering the four eHealth sustainability factors and as useful for assessing eHealth programs at the development stage, implementation stage, integration stage and sustained operation stages of the eHealth lifecycle.

A summary of the frameworks and how they address or their emphases of the key four areas for sustained eHealth are given in table 2.11 below.

Table 2. 11: Summary of eHealth evaluation frameworks

Framework (Author)	Social	Environmental	Economic	Technological
Framework 1 van Dyk [44]	Societal impact • Perceptions	• Organizational structure • Change management • Legislation • Policy and governance	• Economic Feasibility	• Technology
Framework 2 Leon [69]	• Organizational	• Government stewardship • Organizational	• Financial	• Technological
Framework 3 ISO, [70]		• ICT Infrastructure foundation • National ownership and governance	• Governance and national ownership: eHealth financing	• Foundation – eHealth Infrastructure
Framework 4 (Khoja-Durrani-Scott) [71]	Ethical • Behavioral & sociotechnical • Health service Outcomes	• Policy and readiness • Change aspects	• Economic Outcomes	• Technology Outcomes

Source: [68]

2.5.2 Theories

Research suggests that theory-informed implementation knowledge approaches can improve the translation and acceptance of eHealth into clinical treatment. Numerous

theories and models have been developed to inform and explain the implementation of eHealth [72].

Individual elements, such as attitudes, motivation, and behavior, are more typically emphasized in the research than broader social and environmental factors influencing implementation [73], [74].

Despite data demonstrating the multilevel nature of technology adoption in health care and the relevance of addressing factors at different levels [72]. [74] noted that, even when people are strongly motivated, social and environmental variables might limit their conduct. Furthermore, successful eHealth adoption has frequently been characterized from a technical rather than a health outcomes perspective, and costs have been overstated [75].

As a result, the authors suggest that individually oriented theories be supplemented by theories of social, policy, or organizational change.

A study by [72], found multiple theories characterized as relational or structural, that capture the intricacy and multilayered nature of eHealth implementation to varied degrees. ANT (actor-network theory), NPT (normalization process theory), and SST (Strong Structuration Theory) were the most often mentioned relationship theories. The findings demonstrate the prevalence of theories that emphasize human readiness to accept health innovations above the numerous chaotic social processes or systemic characteristics of implementation. From the various literature [72]–[75], this raises the question of whether the theories now employed to guide and explain eHealth deployment adequately address the many and multidimensional aspects that influence the implementation process.

2.4.2.1 Actor Network theory

The Actor-Network Theory (ANT) falls under the sociotechnical systems umbrella since it investigates the interconnected nature of social and technological subsystems. Its beginnings can be traced back to sociological and anthropological approaches to organizational studies, and it was refined by science and technology researchers Bruno Latour, Michael Callon, and John Law [76].

Human and nonhuman actors coexist in networks, and technology are thought to have agency and the ability to influence human interactions. As a result, it could be a relevant theory for investigating the implementation of eHealth innovations and their effects on human behavior [72].

When researching the implementation of information technology (IT) in healthcare settings, sociotechnical techniques are a popular choice. They are particularly adapted to investigate altering organizational and healthcare professional behaviors that follow the introduction of new technology in complicated situations. It is assumed that if any player, regardless of status, is removed or added to the network, as is the case when technology is introduced into an organization, the overall network suffers. However, networks are always evolving due to the assumption that social reality is both complicated and changeable [76].

ANT was used to gain a thorough grasp of the complexities of the heterogeneous network of numerous social and technical players, as well as the process of social change connected with the introduction of new technology [77].

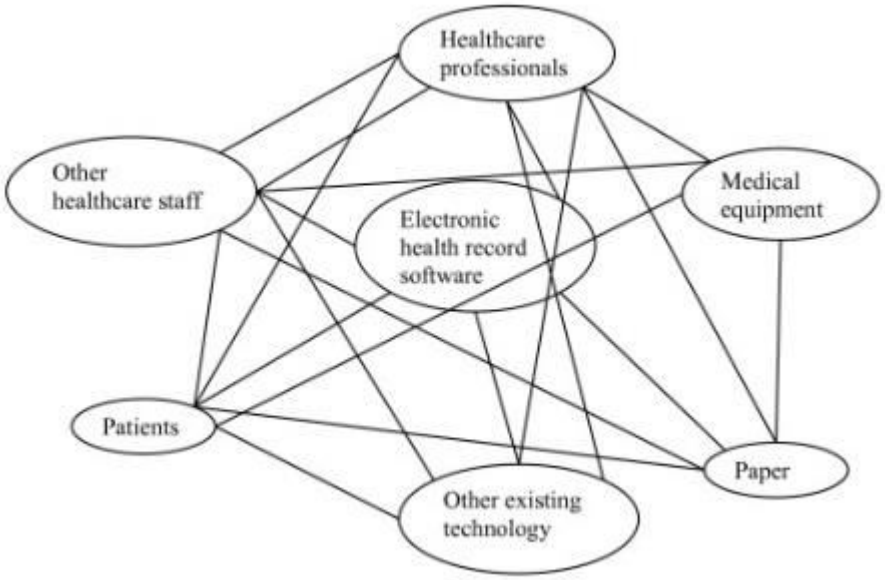

Figure 2. 3: Latour's Actor Network Theory (Source: [76])

2.4.2.2 Normalization Process Theory (NPT)

NPT delivers a paradigm for understanding how interventions are implemented, embedded, and integrated in healthcare environments [78]. NPT understands that health care is a collaborative endeavor that necessitates several interactions and buy-in from various levels of actors. It addresses human, organizational, and societal elements, allowing researchers to thoroughly investigate implementation challenges [61].

Therefore, by utilizing a multi-tiered perspective of health-care systems, NPT may be able to better solve the "know-do gap" for the deployment of eHealth and eHealth innovations [61].

NPT characterizes implementation processes as the result of four social mechanisms: coherence (what users do to make sense of new practices); cognitive participation (what users do to engage with new practices); collective action (what users do to enact a new practice); and reflexive monitoring (what users do to appraise the effects of a new

practice), facilitating an understanding of the contexts, social structure, and processes through which behavior changes [61], [62].

Coherence- When met with the difficulty of operationalizing a set of practices, attempts to determine whether the people involved in the process implementation activity, either individually or collectively, understand new innovation.

Cognitive Participation- Is the relational work that individuals do to develop and sustain a community of practice around a new technology or complex intervention; that is, is there 'buy-in' for the implementation effort from key participants?

Collective Action- is the operational work that people perform to put into action a set of practices, whether they represent a new technology or a sophisticated healthcare intervention; that is, what work must be done for implementation to take place?

Reflexive Monitoring- is the assessment work that individuals perform to assess and understand how a new set of behaviors impact them and those around them; that is, how is the implementation work reviewed by those involved?

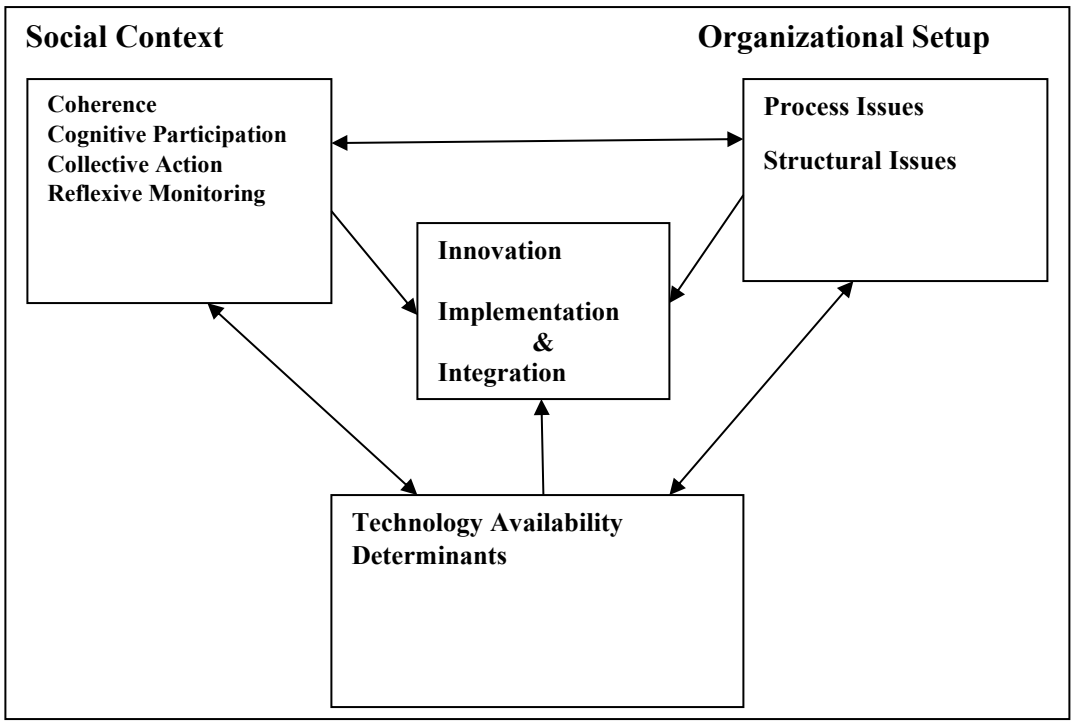

Figure 2. 4: A conceptual Visualization of the interaction and interrelationship between the NPT Context (Source: Author)

2.4.2.3 Strong Structuration Theory (SST)

SST has been offered as a method of investigating these sociotechnical elements of healthcare IT implementation. It is founded on Giddens' structuration theory, which proposed a link between structures (such as social norms and political and economic institutions) and agency (people's actions and choices) [79].

Structures as rules (procedures that keep social life going, such as social conventions and formal regulations) and resources (power sources). Agency is human action, and it requires humans to be aware of the norms or laws that govern that action. Giddens postulated a 'duality of structure': that structures are formed by and shape human agency. Thus, structures and agency are mutually reinforcing, like two sides of the same coin [80].

Stones refined Structuration Theory and provided a more concise and unambiguous explanation of the theory to facilitate empirical study, called SST. External structures, internal structures, action/active agency, and results are the four key aspects of the theory (a 'quadripartite cycle of structuration'). The elements are illustrated in figure 2.5.

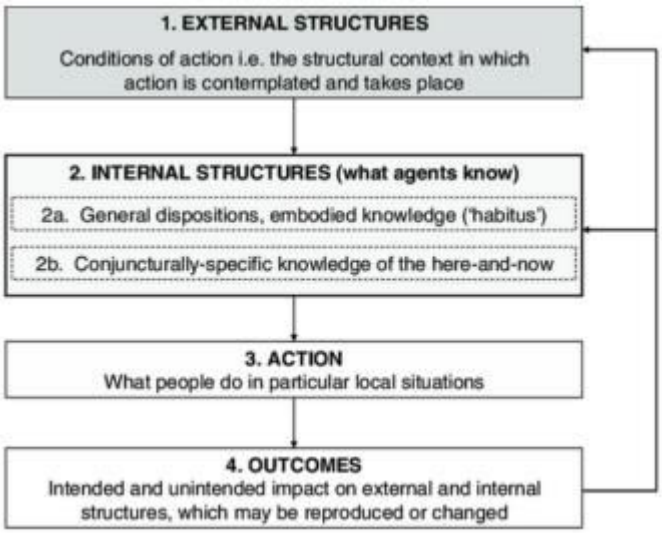

Figure 2. 5: Elements of Strong Structuration Theory (Source: [58])

Stones considers four empirically study able components of the recursive relationship between structure and agency: external social structures (conditions for action), internal social structures (what agents know or believe they know about the social world), active agency (what agents do in specific social situations), and outcomes (both short term, affecting the immediate situation, and long term, feeding into social structure continuity or change). SST's 'quadripartite' analytic lens is made up of these four components [81].

External structures - traditions, conventions, moral standards, and established ways of doing things are autonomous to individuals. Health, legal, and educational systems are examples of macro-level societal institutions [80].

Internal structures - There are two kinds: (i) generic dispositions are socially positioned persons' relatively enduring and transposable attitudes, opinions, beliefs, and embodied knowledge. (ii) conjuncturally specific internal structures are made up of situationally specific information about characteristics of the immediate terrain of activity [80].

Agency - which describes how and why agents use internal structures to operate in specific ways in given situations [79].

Outcome - this is the manner in which the agency influences external or internal structures, as well as how they are maintained or modified [79].

Summary of the theories/Models/Framework and their limitations

Theories, models, and frameworks provide essential foundations for understanding complex phenomena, particularly in socio-technical contexts. The **Actor-Network Theory (ANT)**, proposed by Bruno Latour, Michael Callon, and John Law, emphasizes the interconnectedness of social and technical entities. It highlights the heterogeneous networks of actors and the processes of social change accompanying the adoption of new technologies. Key constructs within ANT include *technology*, *organization*, and *social* dimensions. However, ANT is critiqued for its lack of consideration for the environmental context, which may limit its applicability in sustainability-focused studies.

The **Normalization Process Theory (NPT)**, developed by Carl R. May, focuses on the implementation and integration of interventions into routine practices. It identifies four main constructs: coherence, collective action, cognitive participation, and reflexive monitoring [82]. Similar to ANT, NPT does not address the environmental context, which might restrict its utility in ecological or environmental research domains.

In contrast, the **Strong Structuration Theory (SST)**, formulated by Rob Stones, expands on structuration theory by incorporating both external and internal structures, active agency, and the results or outcomes of these interactions. SST effectively captures the interplay of these constructs in a comprehensive manner. Notably, in the context of the study, SST demonstrates no discernible limitations, making it a robust framework for addressing the key dimensions under investigation.

A summary of the theory/model/framework as they interact with the firm (enterprise) at the various context levels, their presence or absence at any of these levels and the key variables or concepts addressed. Table 2.12 further presents a summary of the theories/Models/Framework and their limitations.

Table 2. 12: Summary of the theories/Models/Framework and their limitations

Theories/Models/Frameworks	Author	Constructs	Limitations
Actor-Network Theory (ANT),	Bruno Latour, Michael Callon, and John Law [76]	heterogeneous network of numerous social and technical players, as well as the process of social change connected with the introduction of new technology [77]. Technology Organisation Social	Does not address the environmental context

Normalization Process Theory (NPT)	Carl R. May [83]	Coherence Collective Action Cognitive Participation Reflexive Monitoring	Does not address the environmental context
Strong Structuration Theory (SST);	Rob Stones [68]	External structures, interior structures, action/active agency, and Results/ outcomes	In the context of the study, SST addresses the key constructs, hence, it has no limitation.

Source: Author

From the three (theory, framework, and model), the researcher, developed a model for the study as captured in figure 2.6. The model can either be viewed as an extension of ANT with an inclusion of environmental factors which was otherwise lacking or an extension of NPT with an inclusion of environmental factor. The researcher saw the inclusion of social factors as necessary so as to address the disruptive nature of innovation when not carefully introduced into a new setting.

The context diagram for the eHealth system (Figure 2.6) summarizes the system environment: organization, social, external environmental (mainly government controlled factors) and technology availability factors and shows their interaction to yield eHealth system (innovation) at the centre; whose successful implementation leads to achieving the benefits there from both measured and anticipated. It highlights the elements that should be present and how they should interact. In summary, eHealth systems sustainability

factors analyze the system and its system environment's ability to ensure the sustainability of eHealth systems implementation in resource constrained settings.

2.6 The theoretical Multi-Dimensional model; interaction and interrelationship explained

To achieve the aims of this study, a multi-dimensional model was developed that could help explain the complex interaction between the key determinants of an organization implementation of technology and the influencing factors both internal and external to the organization. This prompted a secondary review of potential theoretical frameworks and models, where the primary objective of the study was clarified in terms of its basic purpose; that is to develop a multi-dimensional model that would assist in measuring the benefits of an eHealth implementation. The researcher thus developed a multi-dimensional model, derived from three other theory/framework/models (ANT/NPT/SST). The researcher used the framework diagram shown in figure 2.6 for evaluating eHealth implementation in the three case study sites. The theoretical model shows the fundamental factors (contexts) and how they influence principal construct variables (concepts) and their interactions to give the measured and anticipated benefits.

It is formed using a mix of models, theories and literature review studies. Since technology in healthcare involves various things and methods, it cannot be studied apart from the context and the daily activities happening around it. Although they are meant to serve particular reasons (for example, to prevent mistakes in prescriptions), technological artifacts also represent different interests (such as those of doctors, technologists, managers and patients). Therefore, technology is created to help people in the organization carry out their assigned tasks. This means that technology enables

managers and other workers to adjust their tasks. It offers a lot of flexibility and several choices for managing work, communication and coordination.
The social aspect looks at people who may work alone or as a group to carry out the innovation (eHealth). The application of eHealth within the organization would influence the social life of the organization, making the workflow more unified, encouraging people to work together and boosting their mental involvement. Social factors consider how stakeholders work together to make sure the innovation (eHealth) is carried out.
Policies from the government can encourage innovation by regularly updating and changing the regulations and institutions involved in it. For this reason, changes are necessary to support innovation in many areas such as the general business climate, services, network industries, international trade, international investment, financial markets, labour markets and education.

The organization's existence is greatly affected by the external environment which is mostly controlled by the government. Therefore, it contributes to the creation of new ideas. Supporting science and basic research with public funds can contribute to the development of ICT and other general-purpose technologies which helps to promote more innovation.
It points out that public investment in science and research, along with support for innovation, should be improved by using various instruments such as tax credits, direct support, well-planned public-private partnerships, assistance for innovative clusters and strict evaluation of the public support provided.

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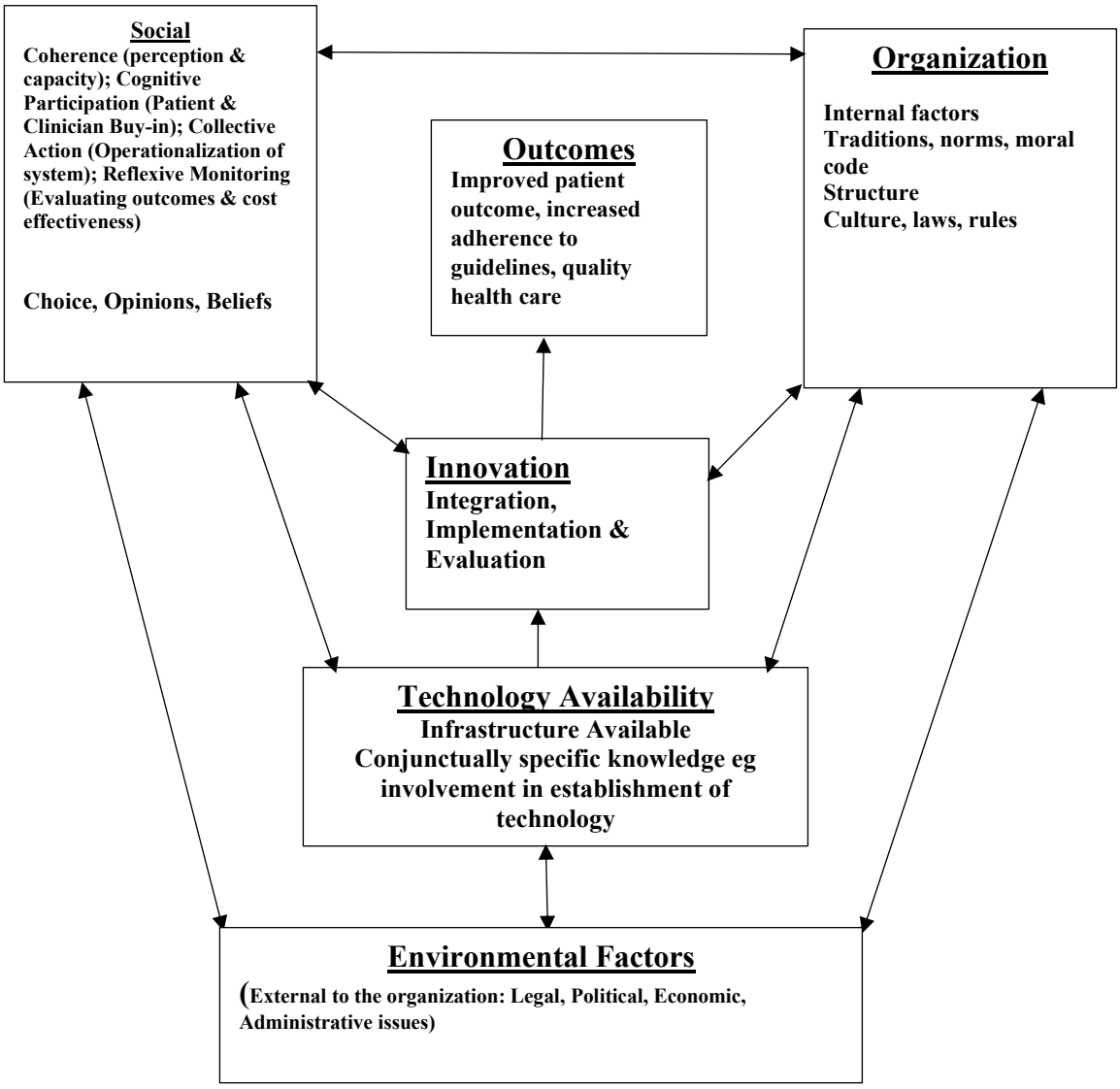

Figure 2. 6: Theoretical Multi-Dimensional Model (Source: Author)

2.7 Conceptual framework

A conceptual framework is a diagram that outlines a complicated environment or system in a way that academics believe best illustrates major evidence-based components and explains relationships between them. The idea is to simplify and make an otherwise complex situation more understandable [4]. It articulates the routes through which an intervention is expected to produce the desired results and gives the evaluator with particular aspects to evaluate. [84] defines a conceptual framework as a visual or written product that outlines the primary things to be examined, i.e. the key components, concepts, or variables, and the assumed relationships between them, either graphically or narratively. [85] adds that a study's conceptual framework, i.e., the system of concepts, assumptions, expectations, beliefs, and theories that supports and informs the research, is an important aspect of the design. It shows the interactions between the various variables ie Independent variables (X), mediating variables (M_1 and M_2) or moderating variables and Dependent variables (Y), as is captured in figure 2.7.

Given the complexity of healthcare sector, the researcher explained the complex interaction between the diverse stakeholders and issues which are key in the eHealth implementation process. These are conceptualized as per the conceptual framework diagram that illustrates the fundamental factors influencing eHealth implementation process and how the factors interact with one another. This research assumed that these factors are interacting either mutually or unidirectional to influence the implementation of an innovation which for this case is eHealth. The interaction of the constructs in the

framework is thus utilized to lead and generate hypotheses (as in section 2.5.1) for the remaining phase of the investigation. From the above literature, three models with concepts related to these factors were used to underpin the study and the researcher developed a multi-dimensional model.

[15] proposes that a conceptual framework for sustainable eHealth implementation adapts the traditional linear input-process-output-outcome-and-impact approach to sustainable program implementation, integrating sustainability pillars and feedback loops to develop an understanding of the nonlinear dynamics of eHealth system implementation conduct.

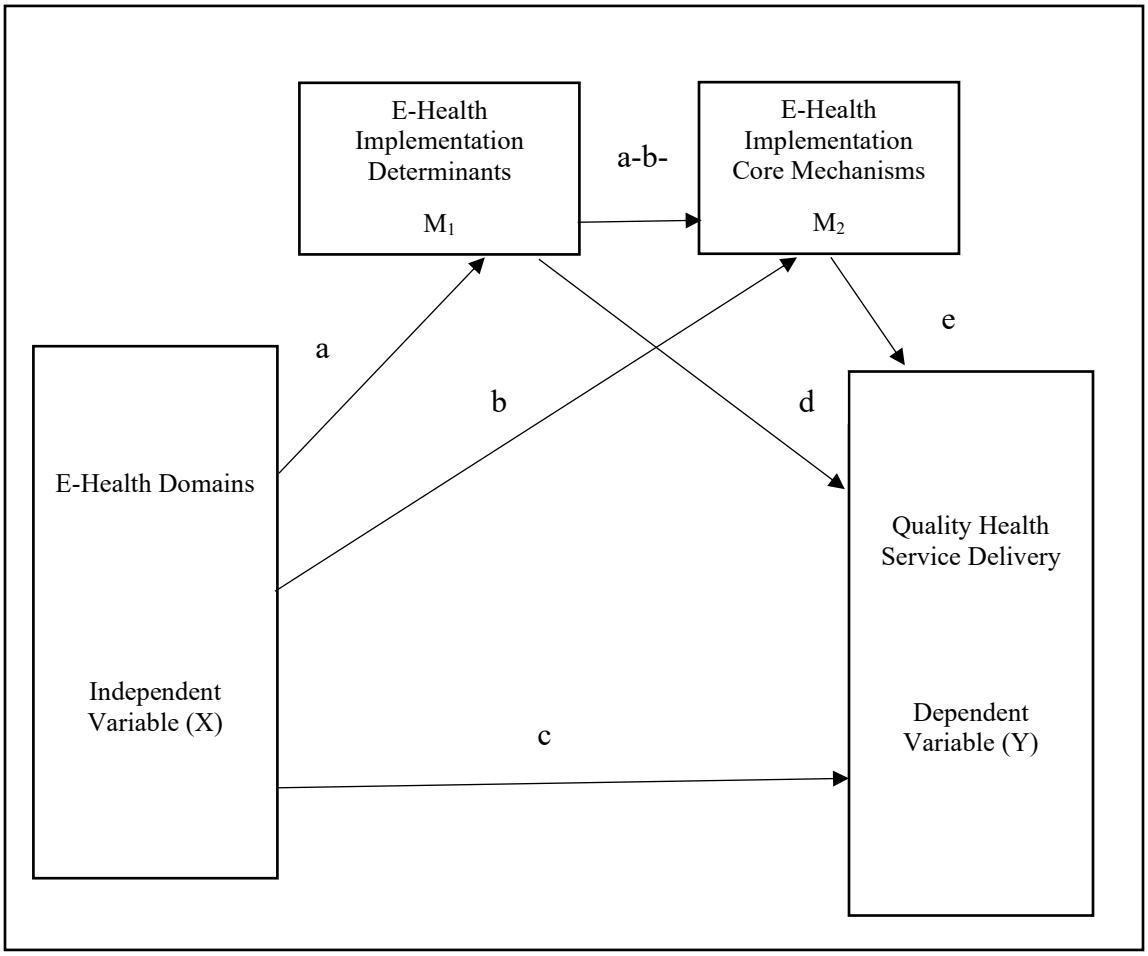

Figure 2. 7: Conceptual Framework (Source: Author)

According to Baron and Kenny [86], when a variable matches the following conditions, it is said to function as a mediator: (1) Changes in the level of the independent variables (IVs) significantly account for changes in the presumed mediator (path-a, d); (2) changes in the mediator significantly account for changes in the dependent variables (DVs) (path-b, e); and (3) when path-a and path-b are controlled, previously significant relationships between the IVs and DVs are no longer significant, with the strongest demonstration of mediator occurring when path-c is zero. Thus, from the authors definition, a mediator can be thought of as a variable in the sense that it accounts for the relationship between the independent variable and the outcome variable.

For this study, the effect(s) are healthcare and provider service delivery related issues (quality, efficiency, effectiveness, patient centeredness, safety, among others) and thus were referred to as dependent variables. The independent variables were broadly divided into four main eHealth implementation domains: Clinical decision support systems, Health Management Systems, Communication Systems for Care, and Information Systems.

The following factors such as professional attitude, the expense of deploying the system, the system's simplicity of use, Education and training, security, confidentiality and standards, infrastructure and funding, Governance, Leadership, Organizational structures/culture; Need for and impact of evaluation and validation, which were deemed as either determinants; or core mechanisms were considered as mediating variables; therefore the study sought to determine the effects of their variation impact either positively or negatively to the implementation of the identified eHealth domains in the

organizations. Mediating variables are defined as variables that explain a relation or provides a causal link between other variables as captured in Figure 2.7.

2.7.1 Hypotheses

i. Ho1: eHealth domains do not interact positively with the Quality Health service delivery

   Ha1: eHealth domains interact positively with the Quality Health service delivery.

ii. Ho2: eHealth domains do not interact positively with the eHealth determinants to influence Quality Health service delivery.

   Ha2: eHealth domains interact positively with the eHealth determinants to influence Quality Health service delivery.

iii. Ho3: eHealth domains do not interact positively with the eHealth implementation core mechanisms to influence Quality Health service delivery.

   Ha3: eHealth domains interact positively with the eHealth implementation core mechanisms to influence Quality Health service delivery.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Overview

The section provided a description of the contents, the strategies and procedures to be utilized to collect research data throughout the study, and the methodology to be used to analyze the data, as well as justifications for each. It discussed research design, research paradigm and the philosophical and methodological underpinnings of the research; which also defines the options, choices and influences, the range of approaches and strategies of inquiry, the scientific community's and researcher's worldview, and the approaches suitable to allow and facilitate the study design in answering the research questions based on six layers of the research onion as they were applied through this study [87]. The chapter further discussed the study population, sample size determination, data collection instruments, data collection procedures and data analysis strategies. It is significant to state at this stage, that the investigator, to help guide the direction of the study, consulted key experts in the field of health and informatics (practicing and/or academicians) for their advice besides literature reviews from secondary data.

3.2 Research Design

A mixed method was used for the study that is characterized by exploratory and explanatory designs (both descriptive and inferential); and their philosophical assumptions of positivism, constructivism and pragmatism.

The researcher adopted the research onion which is presented as a layered onion [88], and Creswell's Mixed Methodology encompassing exploratory and explanatory designs. A deductive approach, which is secondary, entailed an extensive literature review to determine some of the factors which successful eHealth implementers have applied. In

contrast, an inductive, empirical approach entailed a survey and case study strategies to aid in the scoping. This goes further to incorporate both quantitative and qualitative methodologies into a single study. It entails gathering and evaluating both forms of data before integrating the findings to meet the research questions more comprehensively. The design combines various phases for collecting and analyzing quantitative and qualitative data.

Saunders' Research Onion model, on the other hand, is a framework that guides researchers through the various layers of research decisions, beginning with philosophical and theoretical foundations and progressing through methodological choices, time horizons, and data collection techniques. The researcher adopted Saunders et al research onion. According to the authors, while using the research onion, each layer must be regularly considered prior to data collection and analysis, which are both essential components of the research process.

Integration of Saunders and Creswell's design

The researcher integrated both Saunders and Creswell's design as captured below;

i. Philosophical and theoretical framework (Saunders research Onion)

   Start with the research onion's outer layer, which determines the research philosophical and theoretical framework that guided the overall underpinning.

ii. Methodological Choices (Creswell's Mixed Methods)

   Creswell's mixed methods approach was used at this layer, which included both quantitative and qualitative data collection and analysis.

iii. Data Collection Techniques (Saunders research Onion):

Questionnaires, interviews, observation, and report reading was to collect quantitative and qualitative data.

iv. Data Analysis (Creswell's Mixed Methods):

Stata v17 was used for descriptive, inferential and exploratory factor analysis.

A robust and comprehensive research design that addressed multiple dimensions of the research process, from philosophical underpinnings to practical data analysis and interpretation, was achieved by combining elements from Creswell's Mixed Methods Research design and Saunders' Research Onion model.

Table 3. 1:Summary of Research Design

	Objectives	**Method**	**Data Collection Tool**	**Analytical tool**	**Analysis Technique**
1.	To establish by documenting eHealth services implementation status at the study site facilities	Literature review Survey	- Questionnaires -Key Informant Interviews (KIIs) schedule	-Stata -Thematic analysis	-Descriptive -Thematic analysis
2.	To determine, through the lens of a theoretical framework, factors that affects implementation of eHealth in public healthcare service delivery.	Literature review Survey	- Questionnaires -KII guides	-Stata -Thematic analysis	Descriptive and Inferential [Factor Analysis & Structural equation modeling]
3.	To determine the core mechanisms	Literature review	- Questionnaires	-Stata	Descriptive

	in implementation of eHealth systems	Survey	-KIIs schedule	-Thematic analysis	
4.	To develop a multi-dimensional model for successful implementation of eHealth	Literature review Survey	- Questionnaires -KIIs schedule	Stata & Thematic analysis	Descriptive and Inferential

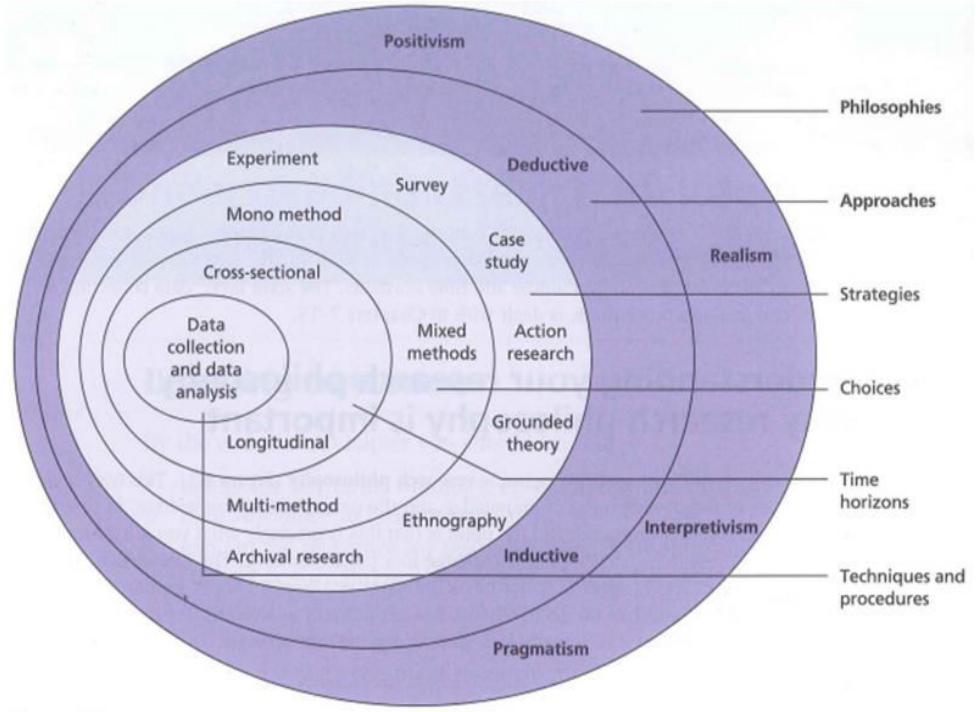

Figure 3. 1: Research Onion (Source: [87]**)**

3.3 Research Paradigm

The researcher adopted both positivist and pragmatic paradigms to address the study.

The term paradigm was employed by the researcher in this study to refer to a continuum of broad worldviews or traditions that shape research: positivism, post-positivism, realism, interpretivism, constructivism, and pragmatism [89]. Each of these paradigms can

be differentiated by their philosophical underpinnings (called methodologies, with four attendant axioms), which in turn inform the methods or techniques employed to conduct research within these paradigms [89]. The four axioms are epistemology- what counts or is worthy as knowledge and how people come to know it; ontology- what counts as nature, reality, feeling, existence or being; logic- what is acceptable as rigor and inference in the development of arguments, judgments or insights; and axiology- what counts as fundamental values and what is consciousness (moral choices, ethics, and normative judgments).

3.4 Research Philosophy

It forms the first layer of the research basis which is the most critical layer. According to [90] a research philosophy is a set of basic beliefs that guide the design and execution of a research study and different research philosophies offer different ways of understanding scientific research. The study adopted a pragmatist view. Pragmatism provides an appropriate framework for understanding both the qualitative and quantitative aspects of the study. According to [91], research philosophy is a belief or idea concerning the gathering, interpretation, and analysis of data. According to [91], this layer of the research onion reflects several ideologies related to ontology, epistemology and axiology.

Pragmatism, as a philosophical perspective, emphasizes the practical application of ideas and focuses on the outcomes and usefulness of research findings rather than adherence to any single methodological tradition. It has an impact on data interpretation and the overall research process, particularly in mixed-methods and applied research.

For a pragmatist, research begins with a problem and ends with practical solutions that influence future practice.

3.5 Research Strategy and Time Horizons

The researcher used a cross-sectional study because it is undertaken at a specific time and a descriptive survey as the best option for the study.

The survey strategy and case study was used in the study because they are typically connected with the deductive approach [92].

3.6 The Study Area

The study identified three study sites that vary in terms of geographical location and coverage, financial assets, eHealth service consumption levels, eHealth domains used, and unique provision and strategy settings.

This study sought for opinions of persons with practical knowledge of eHealth as compared to hypothetical beliefs [18]. Participants from many disciplines were sought to provide a more complete picture of the barriers and enablers to eHealth adoption for the study plan than a single-disciplinary approach could provide.

The study identified six criteria to direct the selection of study sites, aiming at enhancing the outcomes' adaptability and ability to be generalized, hence, attaining a sample with the greatest degree of variability. Below are the seven criteria:

1 Innovations in the case studies comprised of a variety of eHealth areas (like. management systems, communication systems, clinical decision support systems and information systems);

2 The study sites covered a variety of medical settings such as primary, secondary, and community care.

3 Research facilities showed a variety of implementation funders, as this is an essential variable.

4 The study locations were representative of urban, semi-urban, or rural areas with varying economic and geographical endowments.

5 The sites had a strong commitment to ethical standards and patient confidentiality, making it a suitable and ethical choice for research.

6 The sites were geographically distributed within Eastern Uganda and strategically important for the study.

The implementation timeline was not a limiting factor though it is important to know for how long the eHealth systems had been in existence.

Three healthcare facilities within Eastern Uganda region were purposively chosen based on the above set criteria to form the study sites. The sites were Mbale Regional Referral Hospital, Tororo District Referral Hospital and Nagongera Health Centre IV. A detailed characteristic of each study site was captured in the tables 1, 2 &3 of appendix C. One site is a facility within a rural setting; the second study site is a semi-urban based District public hospital facility which has implemented eHealth; the third study site is an urban based public Regional Referral hospital which has implemented eHealth services. Therefore, one healthcare facility was categorized at Regional Referral level, another is a District Hospital and one facility was categorized as level 4 (health center 4, county level).

The anonymity of participants was protected, as guaranteed in the consent forms, and therefore, it sufficed to say, that:

After setting the study site selection criteria, the researcher collected data in three stages.

a) To consult with experts in health and informatics (who were not part of the study and had no indicated interests) to create an inventory of possible eHealth initiatives as well as an inventory of persons to interview to learn more about each initiative
b) Research instrument for the collection of data were prepared, that is, questionnaire, interview protocols and observation.
c) To seek secondary data, consultation of the health facility's departments and relevant websites for information on local and national eHealth projects and strategies was done.
d) Key informants were interviewed by the researcher for their opinions on which eHealth initiatives were tested and why.
e) Researcher assistants were trained by the researcher, one technology and one health expert.
f) The researcher consulted with experts (from health and informatics) to validate the research instruments.
g) To assess reliability and validity, the researcher and her assistants conducted a trial or pilot study of the research instruments in a setting other than the stated study sites.

This research was carried out in Uganda and is hence tailored to the Ugandan setting. The main rationale for selection of Uganda as the study's environment is that the researcher lives in Uganda, making access and data collecting easier; the Ugandan context is also seen as particularly suitable. Uganda is regarded as a developing country which is also the focus of the study. Uganda as a country has key characteristics of developing nations like; shortage of healthcare professionals and where healthcare providers as a percentage of

GDP are extremely low, the majority of healthcare systems are public, health care systems are lacking the essential resources to manage with the great demand of medical services. This is especially true for rural communities, as urban areas receive the majority of resources and investment. Most healthcare systems in developing nations are controlled by the government; the services being financed through tax revenues.

3.7 Target Population

According to Martínez-Mesa [93] defines a population as a collection of people who live in a specific geographical area. (neighborhood, state, city, country, continent etc.) or certain organizations (health centres, hospitals, schools), that is, a group of people who share at least a single trait. [94] states: "a target population refers to all the members who meet the criteria specified for a research investigation".

Ideally, data should be collected from the entire population under consideration; however, this is not always possible due to the population's size and other constraints. Therefore, a representative sample of the population must be drawn. The target population comprised of Doctors and Clinicians, Pharmacist, physicians, nurses, medical record officers, office administrator storekeepers, lab technicians and IT staff from the selected healthcare facilities.

3.8 Sampling Design Strategy

The researcher purposively identified Eastern Uganda. This is informed by the fact that the researcher resides in Eastern Uganda, thus making data collection easy and hence reducing on cost. The selection of an appropriate sample strategy aided in generalizing data, especially for large populations, as it is not common for a research project to survey the entire population due to time and budget restrictions. Non-probability sampling

techniques include convenience/purposeful sampling, quota sampling, snowball sampling, and so on. Each sampling method has advantages and disadvantages; nonetheless, probability sampling is preferred since its results can be generalised [95].

The three public health care facilities were identified that met the selection criteria and this formed the sampling frame. From the sampling frame, probability sampling was done comprising stratified random sampling (stratifying the different cadre of health workers) and simple random sampling.

3.9 Quantitative Survey Sample Size

Regardless of the research methodology chosen (quantitative or qualitative) for data collection and analysis, researchers inevitably meet challenges in attempting to examine everyone, everywhere, doing everything. There are numerous methods for computing sample size, including a variety of formulas[96]. The sample size for this study was determined by Krejcie and Morgan formula [97]. According to [87], for most business and management research, researchers are comfortable to estimate a population's characteristics with 95% accuracy to within 3% to 5% of the true values. No calculations are needed (Krejcie and Morgan [97], Al Zefeiti and Mohamad [92]). The sample size for this study was indicative of the perspectives of about 300 healthcare providers. Hence, the required sample size that was entered into the table at N = 300. The sample size representative of the healthcare providers in this case was 169.

Alternatively, Sample size calculations is captured below;

Krejcie and Morgan formula for sample size calculation

Formula: S = X^2 * N * P * (1 - P) / [d^2 * (N - 1) + X^2 * P * (1 - P)]

where:

S = required sample size

X^2 = table value of chi-square for 1 degree of freedom at desired confidence level (e.g., 3.841 for 95% confidence)

N = population size

P = population proportion (assumed to be 0.5 for maximum sample size)

d = degree of accuracy (margin of error, e.g., 0.05)

Constants

N = 300 # Population size

X2 = 3.841 # Chi-square value for 95% confidence

P = 0.5 # Population proportion

d = 0.05 # Margin of error

Calculate sample size

sample size = (X2 * N * P * (1 - P)) / ((d**2 * (N - 1)) + (X2 * P * (1 - P)))

round(sample size) # Rounded to the nearest whole number

Using Krejcie and Morgan's formula, the required sample size for a population of N=300 at a 95% confidence level and a 5% margin of error is **169**.

3.10 Development of Data Collection Tools (Questionnaire)

The quantitative form shall consist of three sections; Section “A”, captured demographic data while Section “B” consisted of several Likert-scale-type questions that aimed at collecting information about eHealth systems available and the users’ understanding of these systems, implementation, use by staff and hence routinization; organizational

commitment, and work performance. Section “C” captured the questions that sought to unveil the contents of the theoretical framework as they impacted on eHealth innovation. For the purpose of questionnaire development, the researcher adopted Churchill and Iacobucci approach that comprises nine steps to develop the research questionnaire [98].

3.11 Procedures for Quantitative Data Collection

The process of obtaining information from diverse sources in order to answer research questions is known as data collection [99]. [100], [101] are of the view that there are many channels used to collect survey research data, such as post, telephone, interview, internet-based survey, email, and by-hand delivery. Research assistants were trained to deliver the questionnaires by hand, with assistance from contact people at each study site. This composition provided a representative sample of medical practitioners, as was the study's goal.

Every group included participants from different backgrounds in both the interview and the questionnaire. There were people from different age groups, nurses, assistant nurses, clerks, doctors, matrons and hospital managers among the participants. All the work processes at each study site were examined through a time motion study and a total assessment within a week. It was necessary to identify where the patient flow began and ended, as well as the different movements within the process. This meant studying how patients travel throughout the facility to find out their starting and ending points as well as other movements. The process included the usual steps in a patient’s journey (Registration, billing, triage, provider/patient consultation, diagnosis (Laboratory, Pharmacy and Radiology), staff scheduling and loading. After finishing, the results were compared to the service charter to find any differences, good or bad.

Data was gathered using a combination of observing events, filling out questionnaires and conducting interviews to give a clear picture of the situation. More information from the department was necessary to help explain the results from observations and interviews

3.11.1 Observational Study

A non-participatory observational study was carried out. The first part is a morning session that included following and observing the care process from 08:00 to 17:00. This helped to obtain insights into the process layout as well as confirmed details regarding activities and the structural layout of the facilities. The second part was a 5-day collection of timestamps from 08:00 am to 05:00 pm, when there are extremely few or not any outpatient arrivals being noted. The timestamps encompassed all time intervals applicable to the Patient Turn-Around Time (PTAT).

3.11.2 Data Collection Methods and Tools for Qualitative Technique Research design

The conceptual and theoretical frameworks were used to define the topics and questions that were investigated during the qualitative data collection process. At each case study location, at least two physicians, one clinician, and one nurse practitioner were questioned. An interview guide was used, which included questions about how external (environmental) variables, organizational characteristics, procedures (including social and technological), and clinical routines affect service delivery. Key informant interviews focused on a variety of cross-cutting broad issues in healthcare service delivery, such as governance, accountability, and performance measurement. The daily interview meetings with the respondents consisted of questions that arose before and during observations, questionnaire administration and were posed when the respondents were available.

3.11.3 Interview

Interviews were used as the primary way of obtaining data from individuals regarding their own actions, beliefs, or opinions. Qualitative research involves the collection of data through participant interviews. Interviews are the most direct and straightforward method of acquiring thorough and rich data about a certain topic. The style of interview used to collect data can be adapted to the research question, participant characteristics, and the researcher's chosen approach [101]. In qualitative descriptive research, key informant interviews are the most common method of data collection [102]. A semi-structured interview method was applied, this was chosen because semi-structured interviews gave the interviewer a certain amount of freedom and also provided the interviewee with the possibility to deviate, steering the interview in a direction that the interviewer had not considered. [103] further states that, semi-structured interviews are often used when the researcher wants to delve deeply into a topic and to understand thoroughly the answers provided.

Data was collected through oral physical meetings with participants selected from the purposive sampling framework. The conceptual and theoretical frameworks guided the interview content, which is detailed in appendix B of the interview procedure.

3.11.4 Document Analysis (Requested data)

The researcher requested for data that contained:

- The organization (Healthcare facility) service charter
- Total number of walk-in outpatients per day in the past

- Official time plan for number of staff per time per day including breaks
- Number of employees available for work per time per day for the observed days

To capture data from the expected respondents, the study engaged research assistants who initially went through a research training protocol. The research assistants were trained on the use of research instruments for data collection, ethical issues, other protocols and practical approaches of capturing data, data cleaning and validation. The research assistants used observation, timing of patient flow across the departments and exit interviews to capture the needed information. The survey questionnaires and interview guides were developed in English.

3.12 Reliability and Validity of the Survey Instrument

Reliability: The scores of an instrument are reliable if they are constant and consistent. When the instrument is administered multiple times at different times, the scores should remain consistent [104]. Internal consistency measurements were used to determine reliability. The Cronbach alpha is a well-known internal consistency metric that indicates how effectively a set of observable variable items addresses the latent variable or how they are associated [105]. It was employed in this research to analyze reliability. Cronbach's alpha, the most widely used statistic of scale reliability, is calculated from the correlations between individual scale items. This value should ideally be higher .7 [106].

Validity: Validity, on the other hand, is that an instrument's individual scores are meaningful and allow the researcher to make solid conclusions from the sample population under study [104]. There are four primary types of validity: (1) content validity, (2) construct validity, (3) criterion validity and (4) face validity. Content validity

refers to the extent to which a measure taps the various aspects or dimensions of a construct [107] or how well a tool covers a range of meanings included within a concept that is being measured; it is ensured by having experts go through and assess the items to ensure that each construct is well reflected. Content validity is used to measure how well the questions represent the possibilities of questions available [104]. For this study four experts (two academicians and two health professionals) evaluated the instruments before being administered (Table 3.2). The experts assessed whether the concepts the instrument is trying to measure and the set of items or check if lists accurately represented the concept under study. An average of the scores from the experts was then calculated and the instrument deemed to have face and content validity if the score was either .7 or above; this also covered face validity. As concerns construct validity (being able to generalize about the construct of interest or the research being able to measure what it claims to measure), it can be differentiated into convergent and discriminant validity [107].

Besides the four different types of validity, internal and external validity are other areas of concern for a researcher. Internal validity is established when research indicates a causal relationship between two variables, the independent and dependent variables. The external validity of a study is concerned with whether the research findings may be applied to other relevant scenarios or people.; the sampling is done from the bigger population (i.e. the representativeness).

Table 3. 2: Expert (Inter-rater) Evaluation of the research instrument

Expert	**Face Validity X/10**	**Content Validity X/10**	**Average X/10**	**Verdict**

1st	.70	.80	.75	Accept
2nd	.75	.85	.80	Accept
3rd	.75	.70	.725	Accept
4th	.85	.75	.80	Accept
Average	**.763**	**.775**	**.769**	**Accept**

Source- Author

To confirm the validity and reliability of the questionnaire, a pilot test was done on a group of health Centre (not participating in the study) staffs who had the relevant knowledge. From the organization, ten participants were randomly picked and asked to complete the questionnaire. They were expected to express their views on the questions about systems, their knowledge of e-health, its use and implementation, their organization's commitment and how they perform their jobs. The participants were told to bring up any confusing or awkward language in the questions to understand how long it would take them to complete the questionnaire and improve the design based on their comments.

Overall, the researcher tried to address the various factors that posed risks to validity as well as reliability of the findings. This was done through planning and implementing tactics or strategies to avoid or counter these risks (like errors and biases from diverse sources; namely the researcher whose presence could affect the validity of the information provided by respondents due to reactive effects, the respondents contributing to the project). Further, the researcher and her research assistants were taken through a training and an awareness process to encourage them to have an objective view of the phenomena under study.

The social context under which the data was collected is a significant element in determining data validity and dependability. Individuals may behave differently in different social contexts; for example, when alone with the researcher, they may disclose different information than when in a group. The researcher therefore ensured privacy by interviewing the respondents individually in a serene friendly environment away from the office, save for cases where individuals had independent closed offices.

3.13 Study Variables, Model specifications and Implementation

The study developed and used a multi-dimensional model together with a conceptual framework to identify the dimensions of eHealth implementation and its effect on healthcare service quality domains. This was then used to address and to help select the tools for the evaluation process. The study developed a conceptual framework (chapter 2) that identified key areas to measure. The conceptual framework basically addressed the observed variables also referred to as indicators, which was captured in the questionnaire instrument as questions to the respondents. The theoretical framework on the other hand addressed the latent variables or factors, which were the underlying themes of the study. The conceptual framework adopted program logic model that provides a detailed visualization of the link between the variables, independent, mediating and dependent (figure 2.7). These were further focused on the underlying themes of the study; namely, organizational attributes with environment (internal and external), social issues i.e. activities and performance as they related to technological innovation. As discussed in section 2.5 the study's independent variable (X), was taken as eHealth domains implementation. There were two mediating variables (M_1 & M_2), M_1 being determinants of eHealth implementation (barriers and facilitators) and M_2 being core mechanisms

applied by implementers towards eHealth implementation. The dependent variables (Y), represented domains of Quality healthcare service delivery (Safety, effectiveness, patient-centeredness, timely, equitable and efficient). Section 2.4, details the steps taken to develop the multi-dimensional model which is then used as a lens to underpin the study. The theoretical model is made of five factors which also were the underlying or latent variables of the study. The questionnaire broadly captures all the components of both the conceptual and theoretical frameworks.

3.13.1 Addressing Study Objectives

For each group, either a detailed questionnaire or an interview schedule was drafted (details of these survey instruments are included in Appendix A and Appendix B respectively). Healthcare providers, administrators and other IT staff provided information on all research questions, responses to generally yielded data on perceived benefits of eHealth, facilitators and barriers to the implementations of ICT in their areas of location. To aid the other research tools (i.e., questionnaire and interview schedule), an observation protocol was used to unveil the fine details of the organizational setup as they affect the daily workflow and their interactions with the patients.

Objective I: To document and establish eHealth services available in the selected public healthcare facilities;

The purpose of this objective was to establish the number and type of ICTs that were available and could support eHealth solutions in each of the healthcare facilities; besides describing the process of implementation. This was achieved by administering questionnaires to the sampled respondents so that they could identify eHealth initiatives within the care facility. Further interviews were used to clarify the issues of integration

and issues which arose or were not clear from questionnaire as observed by the researcher. In order to determine the effects factors, the following issues were tracked through observation, questionnaire interviews and time stamps:

i. To identify factors that determine implementation of e-health in service delivery

ii. Patient Turn-Around Time: if efficiency of service is important; patients want to receive good care in the most efficient manner. Patient turn-around time (PTAT) or Patient Length of Stay (PLOS) is tracked; TAT acts as a surrogate of the length of time a patient spends at care facility. It is calculated by obtaining the time difference from time of entry to time of exit. The research assistants observed and took timestamps for sampled patients as they entered the facility through the patients' flow process to exit.

iii. Waiting time to doctor's consultation (WTC). A major component contributing to the long TAT is waiting for the doctor's consultation. WTC is defined as the time difference between the appointment times given to the patient; to the actual time the patient is called into the doctor's consult room. This was done as (iv)

iv. Diagnostic or screening time. This entailed the time taken for a patient's specimen to be taken processed and results released to the doctor (or clinician) for decision making.

v. Registration and Billing Time: This captured the time a patient takes with the registration clerk and the cashier at the point of entry to the facility.

vi. Waiting time at the Pharmacy. Often after prescription of drugs by the doctors, the patients are expected to collect the drugs from the pharmacy technician; the study

observed the time taken by each patient when released by the doctor for drugs dispensing to exit.

vii. Working schedule and working procedure was keenly observed and timed.

Objective II

To determine, through the lens of a theoretical framework, factors that affects implementation of eHealth in healthcare service delivery

Initially, in the literature review these factors were identified so it was to verify their applicability or to ascertain whether the same or different determinants affected implementation either as facilitators or barriers at the study sites. This was achieved by incorporating these factors in the questionnaire and in the interview schedule. The respondents were asked whether they agreed or disagreed in the questionnaire; while the interviewees were urged to identify the factors, they thought were the main determinants of eHealth implementation.

Objective III

In order to describe the core mechanisms in eHealth systems implementation, a literature review was done to unearth the core mechanisms used in global success stories; besides, the leadership of the study sites were also interviewed on their vision, key approaches and the mechanisms they are applying towards achieving implementation of eHealth at their facilities.

Objective IV.

A critical survey of secondary data was conducted to identify existing eHealth implementation evaluation frameworks and their gaps in order to develop a model for successful eHealth implementation.

3.14 Data Analysis Strategy

Central to any scientific investigation is a question that the research is trying to address, scientific literature converts this question into a hypothesis that is tested by the study. Stata V17 was used to analyze the data and research hypotheses.

Furthermore, Stata 17 was used to improve the analytical properties, particularly the mediation effect that the Independent Variable has on the Dependent Variable, thereby testing the theoretical model. To verify and confirm the theoretical model's latent variables, structural equation modeling (SEM) was implemented using Stata 17 software.

3.14.1 Descriptive and Inferential Analysis (achieved with Stata)

Descriptive statistics (deals with the presentation of numerical data or facts in either tables or graphs form; also involve relationships between variables). It involves techniques like regression, principle components, factor analysis, Logistic Regression, Probit Analysis and inferential statistics. For this study, correlation, regression and factor analyses were used to investigate the relationship between the independent variable and dependent variable.

3.14.2 Establishing Mediation and Cause-Effect (Stata on Conceptual Framework)

According to [108], these questions about how things work bring up the idea of mediation. Even though the study included both core mechanisms and eHealth implementation determinants as processes, as shown in the conceptual framework figure 2.7, it was

important to add mediation and causal-effect studies and analyses to help answer the concerns raised. Even though there are various ways to calculate routes in these models, the study centered on using ordinary least squares (OLS) regression.

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3.14.3 Factor Analysis (Stata on Theoretical Framework- Exploratory)

Factor analysis was applied to check the reliability and validity of the measurement scales, following [109]. It was used to find the main reasons behind the way different observed variables are related to each other. Factor analysis is commonly used to summarize a lot of data by finding a few important factors that explain the greatest part of the variance in many variables. Factor analysis can be done in two ways, depending on if the researcher wants to explore patterns or test specific hypotheses. EFA which is used to explore patterns in data, does not place any major restrictions on the data. It is thought that each common factor affects every observed variable and all the common factors are either correlated or uncorrelated. Unlike exploratory factor analysis (EFA), confirmatory factor analysis (CFA) is based on a specific theory. With CFA, you can set the effect of a latent variable to zero on a part of the observed variables. This research used exploratory factor analysis.

It was assumed in factor analysis that the sample size was large enough to provide enough data for the analyses. Various publications suggest that the sample size should be at least 100 or 5-10 times the number of variables in the principle component analysis (PCA). For the purposes of this study, 178 people were included.

The following assumptions were made to carry out a factor analysis:

1. It was assumed that variables were continuous and had a normal distribution.

2. It was thought that the questionnaire data included ordinal, continuous and other types.

3. The assumption was that the sample size (number of respondents) was 50 or more and that the survey included enough questions about the factors.

The beginning step was to use descriptive statistics and see if the variable had enough responses to be considered for analysis. Variables that do not vary were not included; [114] believes that uniform responses do not help factor analysis and should be removed. The KMO was used to assess if the data was suitable for Exploratory Factor Analysis. The KMO is always a number between 0 and 1. Values that are considered acceptable are between 0.5 and 1.

Bartlett's Test of Sphericity: This test was used to check how much the variables were related. The null hypothesis is tested which claims that the correlation matrix is equal to the identity matrix. If the significance level is less than 0.05, the null hypothesis is rejected. In other words, the correlation matrix is not an identity matrix; it instead shows how different variables are related to each other.

A correlation matrix: is a straightforward table that shows the correlation coefficients between a single variable and all other variables in the study. The correlation coefficient of a variable with itself is always 1, so the main diagonal of the correlation matrix shows 1s [111]. The correlation coefficients on the principal diagonal and those below it are all the same. All the values on the left and right side of the main diagonal were very small which could make the model work well.

Reducing the Data and Extracting Components: **Principal component analysis** was used to break down the data and get components that explain the most variance in the measured items. **Exploratory factor analysis** was performed to reveal the hidden structure of the

extracted components and to find links between the different variables that make up each. The purpose of rotation is to reduce the amount of factors that have a strong effect on the variables being studied. The results are not changed by rotation, but it does improve how the analysis is understood. A positive loading means the variable and the factor are positively related and a negative loading means they are inversely related. If the absolute value of a factor loading is ≥ 0.4, whether it is positive or negative, it is considered to add enough to the overall variability explained by the factor. Factor loadings that were greater than 0.6 were considered extremely high, those between 0.4 and 0.6 were high and those less than 0.4 were considered insignificant and therefore suppressed. **Eigenvalue:** The total of the squared loadings for a factor. It shows, in concept, the portion of variance that is explained by the principle components..

3.14.4 Structural Equation Modeling (Stata 17- Factor Loading and CFA)

As stated in [112], Structural Equation Modeling is a way to test hypotheses about how observed and latent variables are related. These variables are sometimes called latent, unobserved or underlying factors; as they cannot be measured directly, they have to be explained using observed variables. SEM is a way to test a theory about some phenomenon by confirming or disproving a hypothesis. [113] points out that SEM is different from other multivariate techniques in four main ways.
SEM confirms the relationships among variables by specifying them in the analysis. Other multivariate techniques such as exploratory factor analysis, are mainly used for description, so hypothesis testing is not easy with them.
SEM gives direct estimates for the error variance parameters. Other multivariate techniques cannot assess or correct for problems with measurement error. As an

illustration, regression analysis does not consider the possibility of errors in the independent variables and this may lead to incorrect conclusions because of misleading regression estimates.

SEM includes both unseen (latent) and seen (observed) variables in its procedures. Some multivariate techniques depend solely on measured data.

(4) SEM can model how different variables are related and estimate the direct and indirect effects of those variables.

The study used SEM which is a CFA tool, to confirm the factor structure after the EFA. The study made use of Stata 17 for both EFA and SEM-CFA.

3.14.5 Thematic Analysis

Thematic analysis is a popular way to study qualitative data by searching for, examining and interpreting patterns (themes) in the data. Data codes were put into different categories and these categories were grouped by the themes that appeared. The theoretical framework was used to deduce the main ideas and meanings behind these themes [114]. The framework was used to sort the categories. The interview technique (IT) data was analyzed using thematic analysis. Even though some argue that qualitative data analysis lacks a standard procedure [87]; the transcribed data were coded according to the main topics and issues found in the literature review and the provider survey. Responses were studied for common themes and these were then organized into categories. The results of the interviews were analyzed qualitatively using comments and descriptions to provide basic research evidence to go with the quantitative data from the first methodology.

3.15 Ethical considerations

All regulatory and administrative clearances for this research were obtained from the ethical review boards of the partnering institutions.

For the purposes of this study, all relevant clearances were obtained from the School of Computing and Informatics (SCI), in collaboration with the Graduate School (see Appendix E). Additionally, Busitema University Research and Ethical Committee/ Institution Review Board granted permission for the research to conduct the research (see Appendix F). Informed consent, privacy and confidentiality was observed throughout the study. To ensure confidentiality, respondents did not write their names or provide any other form of personal identification on the questionnaire. The completed questionnaires were kept under key and lock. The participants were also assured that all the data collected in this study was to remain confidential.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Overview

This chapter presents results from both the quantitative and qualitative information alongside each other according to the objectives. It presents data collected from the study on factors influencing the successful implementation of eHealth in public healthcare facilities are discussed in the chapter. The development of a multi-dimensional model for successful eHealth implementation is discussed using theories as a foundation. It is also discussed how to understand and evaluate potential strategies that might enhance the implementation. The objectives, which are discussed in detail, set the model for how the study's findings are explained. These goals included learning more about the state of eHealth Implementation in Uganda, identifying crucial elements that influence the successful eHealth implementation of eHealth and creating a model for long-term eHealth implementation in Uganda.

4.2 Findings from observations

It was observed that most of the processes within the study sites are predominantly manual save for the HIV clinic i.e. from patients' point of entry for registration through the patients flow process to exit save for billing section. People are required to pay for their own medical records and prescription books. After the files are handled, they are kept in the records office. But when they come for their next visit, patients wait in long lines to get their files before they are helped. For some patients, their books are given to them so they can continue their reading at home. At times during the process, some patients end up losing their books.

It was found that certain patients could not be treated because they had to buy a book for their prescription recordings, even though they had money or not. Furthermore, administrators were in charge of creating the duty schedule for healthcare providers (such as nurses and clinicians) and their copies were usually visible on the walls. It was noticed at the facilities that some days were set aside for patients with certain illnesses such as HIV, TB, as well as for mothers to have their children vaccinated, weighed and checked by doctors. This helps the hospital share its resources because the records office has a small workforce and can only assist a limited number of patients and the number of doctors is low as well.

It was evident that the hospitals do not have enough technologies in place. The ICT infrastructure is poor if not wholly lacking; for example, site3 is not connected to the NBI, does not have fixed telephone lines in place; so most of the staff use personal mobile phones for internal communication for convenience. The computer ratio is also very low in all the study sites; i.e. there were few for clinical operations except for administrative

functions. In site1 and site 2, the communications systems in place often experienced very frequent break downs thus forcing members of staff to move from point to point to pass information leading to time wastages.

4.3 Findings from Quantitative Data (Descriptive Statistics)

This section presents the findings derived from the analysis of quantitative data using descriptive statistics. The results provide an overview of the key variables, including measures of variability and distribution patterns. These statistics offer valuable insights into the characteristics of the study population and the trends observed, laying the groundwork for further interpretation and discussion of the data.

Demographic information of the Respondents

This section presents the background information of respondents with respect to the period of working experience, age groups, gender and ICT use. The first output from the analysis is a pie chart of descriptive statistics for some of the variables under investigation. Analyzed broadly in terms of male and female participation or their frequency, one can conclude that there were more female staff 101 compared to male at 77 as shown in Figure 4.1.

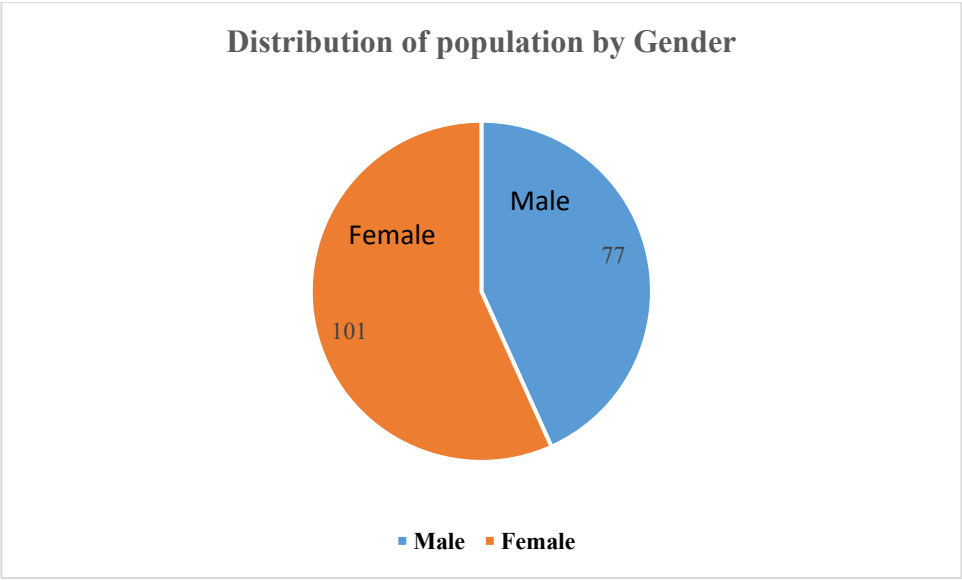

Figure 4. 1 Distribution of population by Gender (Source: respondents scores 2024)

Distribution of population by Age Range

Table 4.1 shows the total respondents, the age group range of 35-44 are the majority with a percentage of 40.45% followed by the age range of 25-34 at 26.40%; while the age range of 45-54 at 17.42%. 10.11% were 24 years and below while 5.62% were 55 years and above.

Table 4. 1: Distribution of population by Age Range

Age Range	Freq.	Percent	Cum.
<24	18	10.11	10.11
25-34	47	26.40	36.52
35-44	72	40.45	76.97
45-54	31	17.42	94.38
>55	10	5.62	100.00
Total	178	100.00	

Source: respondents scores 2024

Working Role General Practitioner

Considering the working role of the respondents, Nurses constituted the majority with 36.52%,

then Laboratory Technicians at 11.80%, general administrative staff at 11.24%, while the other cadre of staffs fell within unit levels with Doctors at 5.06%, Pharmacists at 9.55%, Clinicians at 10.11%, Radiologists at 5.06%, network/system administrators at 5.62% and stores at 5.06% as shown in table 4.2.

Table 4. 2: Working Role General Practitioner

Working Role	Freq.	Percent	Cum.
Clinician	18	10.11	10.11
Nurse	65	36.52	46.63
Pharmacist	17	9.55	56.18
Laboratory Technician	21	11.80	67.98
Radiologist	9	5.06	73.03
Doctor	9	5.06	78.09
Administrator	20	11.24	89.33
IT Officer / Network/Systems Administrator	10	5.62	94.94
Stores	9	5.06	100.00
Total	178	100.00	

Source: respondents scores 2024

Relationship between gender and use of computer- based technology

From table 4.3, 6.74% of respondents were fairly anxious, 26.97% were anxious 39.89% were fairly at ease, and 25.84% were completely at ease when using computer-based technologies. Furthermore, male employees were more comfortable utilizing computer technology than female employees.

Table 4. 3: Relationship between gender and use of computer- based technology (Cross tabulation)

Sex	Extremely Anxious	Fairly Anxious	Anxious	Fairly at ease	Completely at ease	Total
Male	0	3	18	32	24	77
	0.00	3.90	23.38	41.56	31.17	100.00

Female	1	9	30	39	22	101
	0.99	8.91	29.70	38.61	21.78	100.00
Total	1	12	48	71	46	178
	0.56	6.74	26.97	39.89	25.84	100.00

First row has *frequencies* and second row has *row percentages*

Source: respondents scores 2024

Relationship between Age Range and use of computer- based technology

Considering age range against comfort with the use of computer-based technology, table 4.4 showed that there were fewer respondents of age range of 55 and above at 60.00% being fairly anxious with the use of computer based technology, while 20.00% of the same age range were anxious, 0.00% were fairly at ease and 10.00% being completely at ease. Respondents of age range of 25-34 were at 2.13% fairly anxious, 19.15% being anxious with the use of computer based technology, while 34.04% of the same age range were at ease and 44.68% being completely at ease; implying that the youthful age easily adopt computer based technology; though the same age range also had the highest completely at ease; this reflects the discomfort in adopting and learning or embracing new technology by old age group. On the other hand, while the age ranges of 35-44 were the majority, a greater percentage were fairly at ease at 45.83% and 19.44% being completely at ease. As for the age range of 45-54, 41.94% were anxious, 32.26% were fairly at ease 22.58% completely at ease. Respondents of age 24 and below were 16.67 anxious, 66.67% fairly at ease and 16.67% completely at ease.

Table 4. 4: Relationship between Age Range and use of computer- based technology (Cross tabulation)

Age Range	Extremely	Fairly	Anxious	Fairly at	Completely	Total

	Anxious	Anxious		ease	at ease	
<24	0	0	3	12	3	18
	0.00	0.00	16.67	66.67	16.67	100.00
25-34	0	1	9	16	21	47
	0.00	2.13	19.15	34.04	44.68	100.00
35-44	0	4	21	33	14	72
	0.00	5.56	29.17	45.83	19.44	100.00
45-54	0	1	13	10	7	31
	0.00	3.23	41.94	32.26	22.58	100.00
>55	1	6	2	0	1	10
	10.00	60.00	20.00	0.00	10.00	100.00
Total	1	12	48	71	46	178
	0.56	6.74	26.97	39.89	25.84	100.00

First row has *frequencies* and second row has *row percentages*

Source: respondents scores 2024

The facility information

Considering the facility information, 75 respondents were from site 1, 67 respondents were from site 2 and 36 respondents were from site 3 as shown in figure 4.2

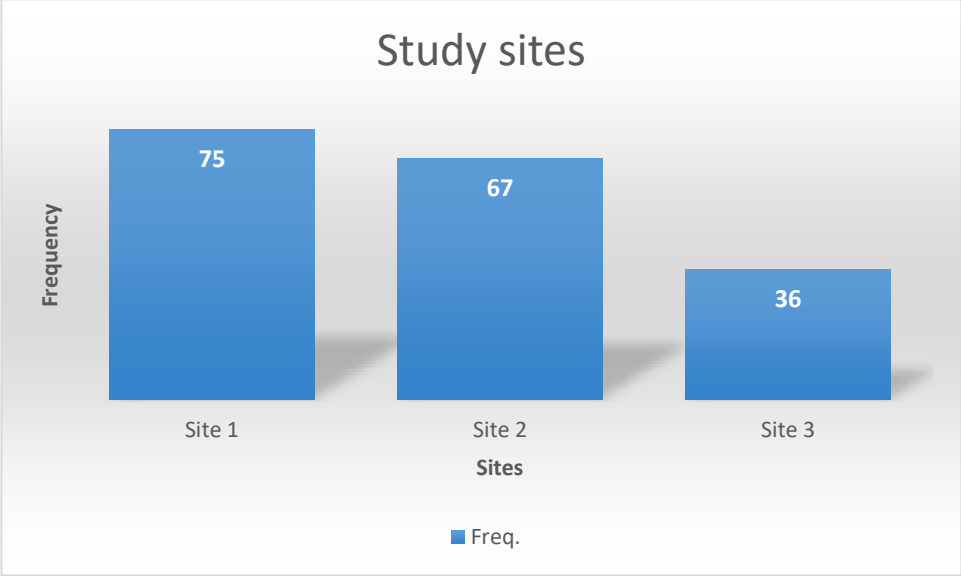

Figure 4. 2: The facility information (Source: respondents scores 2024)

Need for Government policies, regulations and legal frameworks environment supportive of eHealth

The research sought to establish whether there was need for an environment supportive of eHealth in the form of government policies, regulations and legal frameworks. Table 4.5 shows that, of the respondents reached, 2.25% were not sure on this while 44.38% agreed that there is need for it and 53.37% strongly supported.

Table 4. 5: Need for Government policies, regulations and legal frameworks environment supportive of eHealth

How important are the following factors affecting (positively or negatively) the	Freq.	Percent	Cum.
Not sure	4	2.25	2.25
Agree	79	44.38	46.63
Strongly agree	95	53.37	100.00
Total	178	100.00	

Source: respondents scores 2024

The commitment of individual to making the system work

For collective action and coherence to exist, there is a need to have a shared understanding of the system's purpose and how it will be used. Collective action is a fabric that keeps the system together, hence it is crucial to understand people' commitment to make the system operate, which can be viewed as a strand of the larger set: According to table 4.6, 1.69% of respondents disagreed and 1.69% were not sure about individuals' commitment to making the system work, whereas 51.12% agreed and 45.51% strongly disagreed. It can be seen from this results that there is some exposure of the respondents on the working of eHealth systems thus they could confidently state the need for collective action.

Table 4. 6: The commitment of individual to making the system work

The commitment of individuals to making the system work	Freq.	Percent	Cum.
Disagree	3	1.69	1.69
Not sure	3	1.69	3.37
Agree	91	51.12	54.49
Strongly agree	81	45.51	100.00
Total	178	100.00	

Source: respondents scores 2024

Mechanisms of monitoring and evaluating how the system is used

Monitoring and evaluation (M&E), often acts as a control mechanism in any project; therefore, it was important to establish its existence in the facility's setup. From table 4.7: 1.69% strongly disagreed, 1.12% Disagree, 2.81% of the respondents were not sure, while 44.94% were of the opinion that, there should be M&E and 49.44% strongly supported. Thus, from the response, the results strongly support reflexive monitoring.

Table 4. 7: The existence of ongoing mechanisms of monitoring and evaluating how the system is used

The existence of ongoing mechanisms of monitoring and evaluating how the system	Freq.	Percent	Cum.
Strongly disagree	3	1.69	1.69
Disagree	2	1.12	2.81
Not sure	5	2.81	5.62
Agree	80	44.94	50.56
Strongly agree	88	49.44	100.00
Total	178	100.00	

Source: respondents scores 2024

Access to ICT equipment and facilities; electronic communication infrastructure; ICT processing and storage services

As touching technological factors, the study sought to establish either existence or need for ICT equipment at facilities. From table 4.8, of the total respondents polled, 36.52% agreed while 63.48% strongly agreed. The response thus shows the importance of this factor in the implementation process (100% gave approval). This shows the importance attached to availability of infrastructure, access to ICT equipment, storage services and facilities in the implementation process.

Table 4. 8: Access to ICT equipment and facilities; electronic communication infrastructure; ICT processing and storage services

Access to ICT equipment and facilities; electronic communication infrastructure;	Freq.	Percent	Cum.
Agree	65	36.52	36.52
Strongly agree	113	63.48	100.00
Total	178	100.00	

Source: respondents scores 2024

Availability of technical support in using the system

It was also imperative to establish the availability of or need for technical support in using the system under technological factor: From table 4.9, 46.63% agreed while 53.37% strongly agreed on the need for technical support staff. This implies that 100% gave approval for the need of or availability of technical support; it can be interpreted that this could be due to the fact that all sites had eHealth systems implemented and the respondents could really state the need for technical support.

Table 4. 9: Availability of technical support in using the system

Availability of technical support in using the system	Freq.	Percent	Cum.
Agree	83	46.63	46.63

Strongly agree	95	53.37	100.00
Total	178	100.00	

Source: respondents scores 2024

4.3.1 Determination of adequacy of sample size

The dataset's appropriateness for EFA was established by assessing the KMO for sampling adequacy (Table 4.10; cutoff above .50). The KMO measure is 0.667, which is above 0.5 and therefore was accepted.

Table 4. 10: KMO and Bartlett's Test

Bartlett test of sphericity
Chi-square = 4166.887
Degrees of freedom = 1770
p-value = 0.000
H0: variables are not intercorrelated
Kaiser-Meyer-Olkin Measure of Sampling Adequacy
KMO = 0.667

Source: respondents scores 2024

The researcher employed Bartlett's Test of Sphericity (Table 4.10; significant level of p <.05) to confirm patterned correlations between variables and analyze their strength. This tests the null hypothesis, which states that the correlation matrix is an identity matrix. An identity matrix in this context means that the variables are uncorrelated, which implies that factor analysis would not be appropriate. The null hypothesis is rejected when significance value is less than 0.05. From the same table, the Bartlett's Test of Sphericity is significant (0.000), this result is highly significant, generally reported as $p<0.001$. That is, significance is less than 0.05 and is small enough to reject the null hypothesis. This means that the correlation matrix is not an identity matrix. For this study, the tests showed

that there were patterned relationships amongst the variables ($p < .0001$), this indicates that the correlations among variables are significant and factor analysis can be justified. Despite the KMO value = 0.667, the significant Bartlett's test suggests that there is enough correlation among the variables to proceed with factor analysis.

4.3.2 Distribution of factors into Independent, Mediating and Dependent variables

Table 4. 11: Indicators (observable variables) as they are distributed across IV, MV and DV

Independent Variables- IV (X)	Mediating Variables- MV (M_1)	Mediating Variables- MV (M_2)	Dependent Variables- DV (Y)	Covariates
eHealth Domains (CDSS,IS, HMS, CSC)	eHealth Implementation Determinants (Technological, Environmental, Social and Organizational) factors	eHealth Implementation Core Mechanisms (National frameworks, Policies, Loans, Grants, subsidies, tax holidays etc)	Quality Health service delivery (Safety, Timely effectiveness and efficiency service, patient	Covariates

			centeredness, Equity)	
Q_{11}, Q_{12}, Q_{13}, Q_{14}, Q_{15}, Q_{16}, Q_{17}, Q_{18}, Q_{19}, Q_{20}, Q_{21}, Q_{22}, Q_{23}, Q_{24}, Q_{25}	Q_{29}, Q_{32}, Q_{33}, Q_{34}, Q_{35}, Q_{36}, Q_{38}, Q_{39}, Q_{41}, Q_{42}, Q_{44}, Q_{46}, Q_{47}, Q_{48}, Q_{49}, Q_{51}, Q_{52}	Q_{9}, Q_{10}, Q_{26}, Q_{27}, Q_{28}, Q_{30}, Q_{31}, Q_{50},	Q_{37}, Q_{40}, Q_{43}, Q_{45}	Q_{1}, Q_{2}, Q_{3}

Source: Author

Table 4. 12: Summary statistics

	N	Mean	SD	p25	Median	p75	Min	Max
Quality health Service delivery	178	17.854	1.353	17	18	19	10	20
eHealth Domains	178	14.433	12.687	12	14	15	3	11
eHealth implementation Determinants	178	73.045	4.573	71	74	76	58	84
Ehealth implementation core mechanisms	178	36.596	2.122	36	37	38	28	40

Source: Respondents scores 2024

Composite variables were created as per the Independent Variables, Mediating Variable MV1, Mediating Variable MV2 and the Dependent Variable.

Quality Health Service Delivery (QHSD) which is the Dependent Variable (DV) had four (4) variables measured in a scale of 1-5. If a respondent strongly disagreed to all the four variables, the minimum possible score is 4, and if a respondent strongly agreed to all the variables, the maximum possible score is 20. From table 4.17, 4.12 the minimum score is 10 and the maximum score is 20 showing that there were mixed responses as per the scale. The mean score is 17.854 which means most of the respondents were at scale 4 (Agree). This means that the respondents are affirmative that there is Quality Health Service Delivery. The mean and median values are very close, meaning that there is a

close approximation to a normal distribution. Therefore, this variable QHSD can qualify for a linear regression. Regression relies on the mean value of the dependent variable QHSD.

eHealth Domains which is the Independent Variable (IV) had 15 variables. Majority of the variables had responses of Yes/ No. Two variables which had responses to the scale of 1-5 were re-categorized so that they could be interpreted in the basis of Yes/No. The possible minimum score is 0 and the possible maximum score is 15. For this research data collection, the minimum score was 3 and the maximum score was 11.

eHealth Implementation Determinants which is Mediating Variable- MV (M_1) had 17 variables measured in a scale of 1- 5. If a respondent strongly disagreed to all the 17 variables the minimum possible score is 17, and if a respondent strongly agreed to all the variables, the maximum possible score is 85. For this research data collection, the minimum score was 58 and the maximum score was 84.

eHealth Implementation Core Mechanisms which is Mediating Variable- MV (M_2) had 8 variables measured in a scale of 1- 5. If a respondent strongly disagreed to all the 8 variables, the minimum possible score is 8, and if a respondent strongly agreed (5) to all the variables, the maximum possible score is 40. For this research data collection, the minimum score was 28 and the maximum score was 40.

Table 4. 13: Matrix of correlations

Variables	(1)	(2)	(3)	(4)
(1) Quality Health Service Delivery	1.000			
(2) eHealth Domains	-0.054	1.000		
(3) eHealth Implementation Determinants	0.551	-0.052	1.000	
(4) eHealth Implementation Core	0.365	-0.069	0.490	1.000

Mechanisms

Source: Respondents scores 2024

This matrix shows the association of the Depend Variable - Quality Health Service Delivery with the other variables.

eHealth Domains- there is a negative correlation of -0.054 between the Quality Health Service Delivery and eHealth Domains. There is almost no direct relationship between the two domains.

eHealth Implementation Determinants- there is a positive correlation of 0.551 between the Quality Health Service Delivery and eHealth Implementation Determinants. When you improve the services of the eHealth Implementation Determinants, this improves on the health service delivery by 55%.

eHealth Implementation Core Mechanisms- there is a positive correlation of 0.365 between the Quality Health Service Delivery and eHealth Implementation Core Mechanisms. When you provide or increase on the services of the eHealth Implementation Core Mechanisms, this improves on the health service delivery by 36.5%.

Table 4. 14: Linear regression

Quality Health Service Delivery	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Sex : base Male	0	.	.	.	.	.	
Female	-.087	.185	-0.47	.64	-.453	.279	
Age Range : base <24	0	.	.	.	.	.	
25-34	.275	.309	0.89	.375	-.334	.884	
35-44	.334	.285	1.17	.243	-.229	.898	
45-54	.519	.341	1.52	.13	-.154	1.192	
>55	-.19	.307	-0.62	.536	-.796	.416	
RECODE of q3_RoleG~l	0	.	.	.	.	.	
Clinician	-.009	.208	-0.04	.966	-.42	.402	
Lab	-.073	.265	-0.28	.783	-.596	.45	

Technician/Pharm							
eHealth Domains	-.001	.007	-0.22	.825	-.015	.012	
eHealth implementation	.149	.028	5.22	0	.092	.205	***
Determinants							
eHealth implementation	.081	.041	1.99	.049	.001	.161	**
core Mechanisms							
Constant	3.843	2.556	1.50	.135	-1.204	8.89	
Mean dependent var		17.854	SD dependent var			1.353	
R-squared		0.334	Number of obs			178	
F-test		7.403	Prob > F			0.000	
Akaike crit. (AIC)		561.595	Bayesian crit. (BIC)			596.595	

*** *p<.01, ** p<.05, * p<.1*

Source: Respondents scores 2024

Regression is based on the conceptual framework.

Sex- Male was used as a reference category. In the regression, we give it a base of 0, women rated the QHSD to be worse compared to the males by -0.087. The females are less satisfied with the Health Service Delivery. The t-test shows the level of significance. The p-value of 0.64 is the difference in the mean for Male and Female.

Age range- the age range of <24 was used as a reference category. Respondents in the age range of 25-34 scored more by 0.275. For example, if the average mean value for the age range of <24 is 15, then the mean for the age range 25-34 would be 15.275. The age group of >55 had a rating of -0.91, they score below the respondents of <24 but the difference is quite small.

Roles- had many categories and this were broken down to 3 categories, that is, i) Non clinicians (Administrators, Records Officers, Stores and IT/ Network Admins), ii) Clinicians (Doctors, Clinicians, Nurses), and iii) Technician/ Pharmacy (Laboratory

Technicians, Pharmacists, Radiology). This was because some categories had few respondents.

eHealth Domains- An increase by one (1) unit of the Independent variable causes an increase of on the Dependent Variable. In this case, there is a decrease by -0.001, in line with QHSD. The p-value of 0.825 is not significant.

eHealth Implementation Determinants – An increase by one score on the MV -M_1 improves the rating of the QHSD by 0.149. According to the data collected, this is the most significant variable with p value = 0.000 (***), so it is highly significant. So the indicators fall under eHealth Implementation Determinants have the biggest influence on Quality Health Service Delivery. From the policy point of view, these are the indicators to target improvement on because they have the strongest effect on the outcome.

eHealth Implementation Core Mechanisms - An increase by one score on the MV –M_2 improves the rating of the QHSD by 0.081, which is not so big with a p value of 0.049 (**).

*** $p<0.01$, ** $p<0.05$, * $p<0.1$ The lower the percentage, the stronger the significance. Therefore, more focus is needed on the variables MV -M_1 or eHealth Implementation Determinants, because those are the variables we need to address to change the respondents rating or understanding of Quality Health Service Delivery. For the MV –M_2 or eHealth Implementation Core Mechanisms, the respondents have less control over them, they have more control over the eHealth Implementation Determinants.

Dependent variable: Quality Health Service Delivery – The Mean Dependent Variable of 17.854 and the R-square of 0.334 or 33.4% shows that the variables can explain 33.4% of the variation in the Dependent Variable.

The AIC (Akaike Information Criteria) and the Bayesian Information Criteria are additional tests to confirm that the model is stable.

Table 4. 15: Reliability test of the domains

	eHealth Domain	eHealth Implementation Determinants	eHealth Implementation Core Mechanisms	Quality Health Service Delivery
Average interitem covariance:	0.0301539	0.0537106	0.031027	0.0403997
Number of items in the scale:	15	17	8	4
Scale reliability coefficient:	0.8433	0.7422	0.6911	0.6791

Source: Respondents scores 2024

The data highlights the varying degrees of reliability and item correlation across different domains related to eHealth and quality of health services. The eHealth domain, eHealth implementation determinants. eHealth implementation core mechanisms and Quality Health Service Delivery shows reliability, suggesting that the items in these scales are consistent in measuring the intended constructs.

In the eHealth domain, the average interitem covariance is 0.0301539, indicating a low but consistent level of correlation among the items in the scale. With 15 items in the scale, this domain appears to be well-covered, addressing various aspects of eHealth. The scale reliability coefficient of 0.8433 suggests that the items are reliable, with good internal consistency. This indicates that the items within this domain consistently measure the concept of eHealth, making the results trustworthy and dependable.

For eHealth implementation determinants, the average interitem covariance is 0.0537106, slightly higher than in the eHealth domain, suggesting a moderate correlation among the items. With 17 items in the scale, this domain seems to cover a broad range of detailed aspects of eHealth implementation. The scale reliability coefficient of 0.7422 indicates a moderate level of reliability, suggesting that the items are fairly consistent in measuring the implementation details of eHealth.

The eHealth implementation core domain has an average interitem covariance of 0.031027, indicating a moderate correlation among the items. With only 8 items in the scale, this domain is concise, focusing on the core elements of eHealth implementation. The scale reliability coefficient of 0.6911 is moderate, to measure the core aspects of eHealth implementation. This is most likely since the questions presented were policy-related, and the respondents had minimal awareness of policy concerns.

In the quality of health services domain, the average interitem covariance is 0.0403997, suggesting a moderate correlation among the items. The scale reliability coefficient for the outcome variable is 0.6791, indicating moderate internal consistency.

4.3.3 Exploratory Factor Analysis (EFA)

Independent variable

The researcher performed a factor analysis on a dataset comprising 178 observations. The primary aim was to identify underlying factors that explain the patterns of correlations among the variables. Using the principal factors method, four (4) factors were retained for further analysis. The factor analysis revealed four primary factors that explain the majority of the variance in the dataset. These factors have strong associations with certain groups of variables, providing insights into underlying constructs. This analysis can guide further research and interventions by focusing on the most significant factors and their associated variables. The first factor (Factor1) has the highest eigenvalue of 4.88244, explaining approximately 32.55% of the total variance. The second factor (Factor2) has an eigenvalue of 2.40378, explaining 16.03% of the variance. The cumulative variance explained by the first four factors is 62.43%. This indicates that these four factors are significant in explaining the variance in the dataset.

Table 4. 16: Independent Variables

(obs=178)

Factor analysis/correlation Number of obs = 178

Method: principal-component factors Retained factors = 4

Rotation: (unrotated) Number of params = 54

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	4.88244	2.47867	0.3255	0.3255
Factor2	2.40378	1.35551	0.1603	0.4857

Factor3	1.04827	0.01837	0.0699	0.5556
Factor4	1.02990	0.05706	0.0687	0.6243
Factor5	0.97284	0.10675	0.0649	0.6891
Factor6	0.86609	0.19250	0.0577	0.7469
Factor7	0.67359	0.05513	0.0449	0.7918
Factor8	0.61846	0.08114	0.0412	0.8330
Factor9	0.53731	0.07594	0.0358	0.8688
Factor10	0.46137	0.03898	0.0308	0.8996
Factor11	0.42240	0.08720	0.0282	0.9278
Factor12	0.33520	0.01992	0.0223	0.9501
Factor13	0.31529	0.08271	0.0210	0.9711
Factor14	0.23258	0.03210	0.0155	0.9866
Factor15	0.20048	.	0.0134	1.0000

Variables with high loadings on Factor1 include q22_MedRec~n (0.7375), q23_Online~g (0.7182), q24_Online~t (0.6942), and q25_Online~l (0.6554). These variables are measuring a similar underlying construct. Factor2 has significant loadings from q11_Patien~s (0.7703), q12_Encoun~s (0.5667) and q20_Comput~s (0.4567). Factor 3 has significant loading at q15_Ordere~s (0.6951), Factor 4 has significant loading at q17_CPOE_F~n (0.7004) indicating these variables are related to another distinct construct. The uniqueness value indicates the proportion of each variable's variance that is not explained by the factors. For instance, q20_Comput~s has a high uniqueness of 0.5734, suggesting that this variable is not well explained by the common factors. Conversely, q15_Ordere~s has a low uniqueness of 0.1464, implying that the factors explain a significant portion of its variance. The cumulative variance explained by the first four factors is (62.43%), indicating that most of the variability in the data can be captured by these four factors. Factors 5 to 15 have eigenvalues less than 1, so were not considered for factor loading.

LR test: independent vs. saturated: chi2(105) = 1046.26 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Factor4	Uniqueness
q11_Patien~s	0.3345	0.7703	-0.0613	-0.0023	0.2910
q12_Encoun~s	0.5007	0.5667	0.3082	-0.0969	0.3238
q13_Patien~s	0.5036	0.4410	0.1061	0.0457	0.5386
q14_Patien~s	0.6006	0.2776	-0.0874	-0.0685	0.5499
q15_Ordere~s	0.3303	-0.0751	0.6951	0.5055	0.1464
q16_Claims~n	0.6322	0.0965	-0.4058	-0.1288	0.4098
q17_CPOE_F~n	0.3253	-0.0858	-0.3229	0.7004	0.2920
q18_CPOE_P~n	0.5632	-0.0074	-0.3404	0.3323	0.4564
q19_Clinic~t	0.6473	0.2784	-0.0969	0.0932	0.4854
q20_Comput~s	0.4366	0.4567	0.0393	-0.1610	0.5734
q21_Clinic~y	0.6269	0.0351	0.1587	-0.1680	0.5524
q22_MedRec~n	0.7375	-0.4815	0.1201	-0.0905	0.2017
q23_Online~g	0.7182	-0.4739	0.0880	-0.0062	0.2519
q24_Online~t	0.6942	-0.4604	0.0307	-0.1515	0.2822
q25_Online~l	0.6554	-0.4896	-0.0580	-0.2160	0.2807

Moderating Variable MV1

The researcher performed a factor analysis on a dataset comprising 178 observations. The primary aim was to identify underlying factors that explain the patterns of correlations among the variables. Using the principal factors method, six (6) factors were retained for further analysis. The factor analysis has revealed six primary factors that explain the majority of the variance in the dataset. These factors have strong associations with certain groups of variables, providing insights into underlying constructs. This analysis can guide further research and interventions by focusing on the most significant factors and their associated variables. The first factor (Factor1) has the highest eigenvalue of 3.51265, explaining approximately 20.66% of the total variance. The second factor (Factor2) has

an eigenvalue of 1.64821, explaining 9.7% of the variance. The cumulative variance explained by the first six factors is 59.43%. This indicates that these six factors are significant in explaining the variance in the dataset.

Table 4. 17: Mediating Variable MV1

(obs=178)

Factor analysis/correlation Number of obs = 178

Method: principal-component factors Retained factors = 6

Rotation: (unrotated) Number of params = 87

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	3.51265	1.86444	0.2066	0.2066
Factor2	1.64821	0.13795	0.0970	0.3036
Factor3	1.51026	0.30889	0.0888	0.3924
Factor4	1.20137	0.05146	0.0707	0.4631
Factor5	1.14991	0.06887	0.0676	0.5307
Factor6	1.08104	0.12659	0.0636	0.5943
Factor7	0.95445	0.12677	0.0561	0.6505
Factor8	0.82768	0.02331	0.0487	0.6992
Factor9	0.80437	0.06158	0.0473	0.7465
Factor10	0.74278	0.05330	0.0437	0.7902
Factor11	0.68948	0.05486	0.0406	0.8307
Factor12	0.63462	0.06860	0.0373	0.8680
Factor13	0.56603	0.05896	0.0333	0.9013
Factor14	0.50706	0.02883	0.0298	0.9312
Factor15	0.47823	0.11023	0.0281	0.9593
Factor16	0.36800	0.04413	0.0216	0.9809
Factor17	0.32387	.	0.0191	1.0000

Source: Respondents scores 2024

Variables with high loadings on Factor1 include q49_SysUse~e (0.6479), q48_SysMon~l (0.6479) and q46_SysEas~e (0.5485). These variables are measuring a similar underlying construct. Factor2 has significant loadings from q34_Servic~y (0.4496), Factor 3 has significant loading at q52_SysTec~t (0.7135) and q51_ICTAcc~e (0.7116), Factor 4 has

significant loading at q39_SysAdd~d (0.7740), indicating these variables are related to another distinct construct. The uniqueness value indicates the proportion of each variable's variance that is not explained by the factors. For instance, q47_SysCom~t has a high uniqueness of 0.6356, suggesting that this variable is not well explained by the common factors. Conversely, q51_ICTAcc~e has a low uniqueness of 0.2233, implying that the factors explain a significant portion of its variance. The cumulative variance explained by the first six factors is (59.43). Factors 7 to 17 have eigenvalues less than 1, so were not considered for factor loading.

LR test: independent vs. saturated: chi2(136) = 535.24 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Uniqueness
q29_InfraA~y	0.1204	0.3750	0.4285	0.1624	0.3166	0.4012	0.3737
q32_Change~e	0.4854	0.4370	-0.2445	0.0032	-0.3467	0.1361	0.3749
q33_StaffI~v	0.3314	0.3203	-0.1679	0.0116	-0.6874	-0.1960	0.2484
q34_Servic~y	0.4096	0.4496	-0.0470	0.3026	-0.1242	0.0634	0.5169
q35_MgmtSu~t	0.4114	0.2313	0.0362	-0.5138	0.1905	-0.0825	0.4689
q36_LearnS~t	0.4671	0.4156	-0.2463	-0.2172	0.3133	-0.0297	0.4021
q38_CoopSy~e	0.4226	0.2323	0.0957	0.0416	0.3283	-0.4287	0.4649
q39_SysAdd~d	0.1430	0.2051	0.1220	0.7740	0.1427	0.0443	0.3012
q41_SysSki~t	0.4328	-0.0837	0.0794	0.0571	0.0834	-0.5870	0.4445
q42_SysLea~y	0.4328	-0.4883	-0.1616	0.0464	-0.1536	0.2214	0.4733
q44_SysEff~n	0.5102	-0.4289	-0.1313	0.0968	0.0163	0.1868	0.4940
q46_SysEas~e	0.5485	0.0016	-0.1992	-0.2078	0.2039	0.3827	0.4283
q47_SysCom~t	0.5324	0.0395	-0.1562	-0.0748	-0.0221	0.2210	0.6356
q48_SysMon~l	0.6417	-0.3598	-0.1408	0.1602	0.1191	-0.1948	0.3612
q49_SysUse~e	0.6479	-0.3395	-0.0377	0.1664	0.0638	-0.0349	0.4306
q51_ICTAcc~e	0.4242	-0.0956	0.7116	-0.2291	-0.1658	0.0344	0.2233
q52_SysTec~t	0.4094	-0.0696	0.7135	-0.0442	-0.2456	0.0380	0.2548

The likelihood ratio (LR) test for model fit yields a chi-square value of 535.24 with 136 degrees of freedom (chi2(136) = 535.24) and a p-value of 0.0000. This result is highly significant, suggesting that the factor model provides a better fit than the null model of independent variables.

Moderating Variable MV2

The researcher performed a factor analysis on a dataset comprising 178 observations. Using the principal factors method, three (3) factors were retained for further analysis. The factor analysis has revealed one primary factor that explains the majority of the variance in the dataset. This factor has a strong association with certain groups of variables, providing insights into underlying constructs. The first factor (Factor1) has the eigenvalue of 1.93986, explaining approximately 24.25% of the total variance. Factor 2 has an eigenvalue of 1.30630 and Factor 3 has an eigenvalue of 1.00837. The variance explained by the 3 factors is 53.18%. This indicates that these factors are significant in explaining the variance in the dataset. When the eigenvalue is less than 1.0 the factor explains less information than a single item would have explained. The information gained from such a factor would not be considered sufficient to justify keeping that factor. Therefore, all the remaining factors are not significant.

Table 4. 18: Moderating Variable MV2

(obs=178)

Factor analysis/correlation Number of obs = 178
Method: principal-component factors Retained factors = 3
Rotation: (unrotated) Number of params = 21

Factor	Eigenvalue	Difference	Proportion	Cumulative

Factor1	1.93986	0.63356	0.2425	0.2425
Factor2	1.30630	0.29793	0.1633	0.4058
Factor3	1.00837	0.03732	0.1260	0.5318
Factor4	0.97105	0.07508	0.1214	0.6532
Factor5	0.89597	0.21120	0.1120	0.7652
Factor6	0.68477	0.03797	0.0856	0.8508
Factor7	0.64680	0.09992	0.0808	0.9316
Factor8	0.54688	.	0.0684	1.0000

Source: Respondents scores 2024

Variables with high loadings on Factor1 include q27_GovtEc~n (0.7600) and q26_eHealt~v (0.7408). These variables are measuring a similar underlying construct. The uniqueness value indicates the proportion of each variable's variance that is not explained by the factors. For instance, q50_Stakeh~b has a high uniqueness of 0.6695, suggesting that this variable is not well explained by the common factors. Conversely, q31_PolSup~h has a low uniqueness of 0.3213, implying that the factors explain a significant portion of its variance. The cumulative variance explained by the first 3 factors is (53.18%), indicating that the variability in the data can be captured by these factors. Factors 4 to 8 have eigenvalues less than 1, so were not considered for factor loading.

LR test: independent vs. saturated: chi2(28) = 108.01 Prob>chi2 = 0.0000

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Factor3	Uniqueness
q9_Workflo~s	0.4111	-0.3177	-0.3200	0.6277
q10_MOH_R~on	-0.3957	0.3155	0.5840	0.4029
q26_eHealt~v	0.7408	0.0805	0.0493	0.4423
q27_GovtEc~n	0.7600	0.0852	0.1199	0.4008
q28_Transp~v	0.3979	-0.3414	0.5157	0.4593
q30_CoordB~s	0.4738	0.5370	-0.2558	0.4218
q31_PolSup~h	0.0774	0.8133	0.1058	0.3213
q50_Stakeh~b	0.3150	-0.1603	0.4534	0.6695

Dependent variable

The researcher ran a factor analysis on a set of data made up of 178 observations. A useful factor is often defined by an eigenvalue (a measure of explained variance) greater than 1.0. An eigenvalue that is smaller than 1.0 means the factor does not explain as much information as a single variable could have. The knowledge obtained from this factor would not be enough to support keeping it in the model. So, if the algorithm did not specify otherwise, the computer would have explored the best factor solution by rotating the factors.

Using the principal factors method, two (2) factors were retained for further analysis. The factor analysis did not reveal factors that explain the variance in the dataset. The first factor (Factor1) has the eigenvalue of 1.36697, explaining approximately 34.17% of the total variance. Factor 2 has an eigenvalue of 1.07250 with approximately 26.81% of the total variance. The cumulative variance explained by the first two factors is 60,99%. This indicates that these two factors are significant in explaining the variance in the dataset.

Table 4. 19: Dependent variable

(obs=178)

Factor analysis/correlation Number of obs = 178

Method: principal-component factors Retained factors = 2

Rotation: (unrotated) Number of params = 6

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	1.36697	0.29447	0.3417	0.3417
Factor2	1.07250	0.26988	0.2681	0.6099
Factor3	0.80261	0.04469	0.2007	0.8105
Factor4	0.75792	.	0.1895	1.0000

Source: Respondents scores 2024

The variable with high loading on Factor1 is q43_SysPat~e (0.6551), q37_SysImp~y (0.6065). The uniqueness value indicates the proportion of each variable's variance that is not explained by the factors. For instance, q37_SysImp~y has a high uniqueness of 0.4420, suggesting that this variable is not well explained by the common factors. Conversely, q45_SysRes~t has a low uniqueness of 0.3486, implying that the factors explain a significant portion of its variance. The cumulative variance explained by the 2 factors is (60.99%), indicating that more of the variability in the data can be captured by these factors. Factors 3 and 4 have eigenvalues less than 1, so were not considered for factor loading.

LR test: independent vs. saturated: chi2(6) = 20.13 Prob>chi2 = 0.0026

Factor loadings (pattern matrix) and unique variances

Variable	Factor1	Factor2	Uniqueness
q37_SysImp~y	0.6065	0.4361	0.4420
q40_SysWor~n	0.4944	0.6374	0.3493
q43_SysPat~e	0.6551	-0.3875	0.4206
q45_SysRes~t	0.5706	-0.5709	0.3486

Among the tables 4.4.16 to Table 4.19, there are five factors with eigenvalues (measure for explained variance) greater than 1.0 which is considered a common requirement for a factor to be useful. An eigenvalue less than one means the factor is less productive at explaining information than a single item. The information you get does not justify keeping that factor. So, if no other settings were given, the computer would have tried to find the best solution by rotating the factors. The purpose of this analysis and interpretation was to use only Extracted Sums of Squared Loadings. The purpose of rotation is to cut down the number of factors that have strong influence on

the variables we study. Rotating the data does not affect the conclusions, but it helps with the analysis. Because of rotation, different items are connected to different underlying factors and each factor helps to explain more than one item.

4.3.4 Interpretation and naming of new factors

To interpret the factors, the researcher looked at which collection of variables loaded most highly on a factor, and then identified what that set of items have in common. For this case, the items were questionnaire statements also referred to as observed variables or indicators; it could then be seen that what the statements are asking are common thus interpreted the factors accordingly. This helped the researcher to decide what each new factor represented. A positive loading (eg: above 0.4) indicates a positive relationship with the factor, whereas one with a negative sign suggests an inverse relationship. As a 'rule of thumb', regardless of whether they are positive or negative, the researcher considered loadings above 0.6 to be very high, above 0.4 to be high, and less than 0.4 to be irrelevant and thus suppressed. Having decided what each new factor might represent, the researcher then assigned suitable names or labels to them respectively as indicated below: The factors represented Environment, Social, Organization, Technology Availability and Benefits of eHealth implementation.

4.3.5 Findings from Quantitative Analysis (SEM using stata)

A confirmatory factor Analysis was done on the four factors observed variables (Environment, Social, Organization, Technology Availability) and the outcome variable.

Table 4. 20: Generalized structural equation model

Number of obs = 178

Response: Quality Health Service Delivery

Log likelihood = -270.79287

	Coefficient	Std. err.	Z	P>z	[95% conf.	interval]
Quality Health Service						
Technological factor	0.0037185	0.0683277	0.05	0.047	-0.1302012	0.137638
Environmental factor	0.1494938	0.0664615	2.25	0.024	0.0192317	0.279756
Social factor	0.2044166	0.042317	4.83	0.000	0.1214769	0.287356
Organisational factor	0.1411727	0.056155	2.51	0.012	0.0311109	0.251234
cons	4.909066	1.588369	3.09	0.002	1.795919	8.022213
Var(e.quality_health_service)	1.227205	0.1300835			0.9969882	1.510582

Source: Respondents scores 2024

An increase in by one (1) unit in the Technological factors causes a 0.0037change or improvement in Quality Health Service Delivery. An increase in by one (1) unit in the environmental factors causes a 0.15 change or improvement in Quality Health Service Delivery. An increase in by one (1) unit in the social factors causes a 0.2 change or improvement in Quality Health Service Delivery. An increase in by one (1) unit in the Organisational factors causes a 0.14 change or improvement in Quality Health Service Delivery.

Therefore, the results from the significance test of the model components showed the social factors with p-value = 0.000, Organisational factors had a p-value = 0.012, Environmental factors with a p-value = 0.024 and Technological factors that had a p-value = 0.047.

Model Incorporating the variables

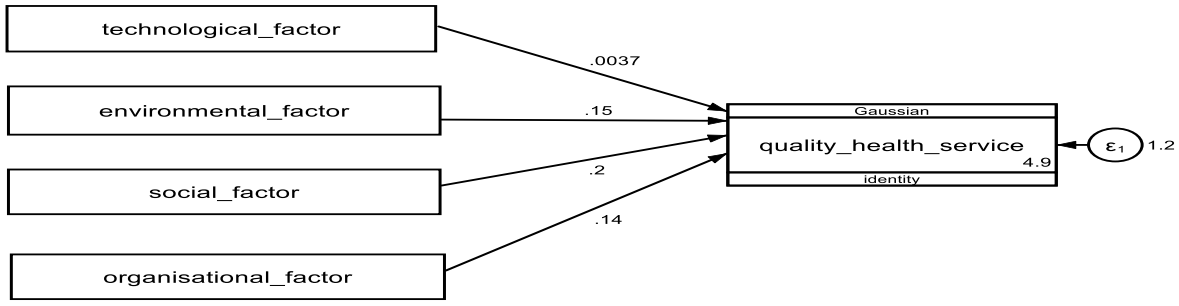

Figure 4. 3: A Structural Equation Model showing the relationship between the variables

SEM results for the Domains

eHealth Implementation determinants (MV- M1)

The variables with positive loadings greater than 0.4 were used for Structural Equation Modeling.

Measurement: q32_ChangeCulture q35_MgmtSupport q36_LearnSupport q38_CoopSysUsage q41_SysSkillCompat q42_SysLearnAbility q44_SysEfficiencyPerception q46_SysEaseOfUse q47_SysCommitment q48_SysMonitoringEval q49_SysUserOrgBalance q29_InfraAvailability q51_ICTAccessInfrastructure q52_SysTechSupport

Exogenous variables

Latent: Factor1 Factor3

Fitting target model:

Iteration 0: log likelihood = -2079.1846

Iteration 1: log likelihood = -2064.2024 (not concave)

Iteration 2: log likelihood = -2053.7239 (not concave)

Iteration 3: log likelihood = -2052.3352

Iteration 4: log likelihood = -2050.4591

Iteration 5: log likelihood = -2049.0606

Iteration 6: log likelihood = -2048.63

Iteration 7: log likelihood = -2048.5918

Iteration 8: log likelihood = -2048.584

Iteration 9: log likelihood = -2048.5832

Iteration 10: log likelihood = -2048.5832

Structural equation model Number of obs = 178

Estimation method: ml

Log likelihood = -2048.5832

(1) [q32_ChangeCulture]Factor1 = 1

(2) [q29_InfraAvailability]Factor3 = 1

OIM					
Coefficient	std. err.	Z	P>z	[95% conf.	interval]
Measurement					
q32_ChangeCulture					
Factor1	1	(constrained)			
_cons	4.477528	.04144	108.05	0.000	4.396307	4.558749
q35_MgmtSupport					
Factor1	.8051731	.2939548	2.74	0.006	.2290322	1.381314
_cons	4.61236	.0365181	126.30	0.000	4.540785	4.683934
q36_LearnSupport					
Factor1	1.093254	.3605985	3.03	0.002	.3864937	1.800014
_cons	4.466292	.0428949	104.12	0.000	4.38222	4.550365
q38_CoopSysUsage					
Factor1	.8723829	.3141243	2.78	0.005	.2567106	1.488055
_cons	4.303371	.0379444	113.41	0.000	4.229001	4.37774
q41_SysSkillCompat					

Factor1 1.401256	.4651329	3.01	0.003	.4896119	2.312899
_cons 4.331461	.0507001 85.43		0.000	4.23209	4.430831
q42_SysLearnAbility					
Factor1 1.442512	.4536632	3.18	0.001	.5533485	2.331676
_cons 4.477528	.0450876 99.31		0.000	4.389158	4.565898
q44_SysEfficiencyPerception					
Factor1 1.744102	.5182408	3.37	0.001	.728369	2.759836
_cons 4.376404	.0475975 91.95		0.000	4.283115	4.469694
q46_SysEaseOfUse					
Factor1 2.115802	.6113377	3.46	0.001	.9176025	3.314002
_cons 4.359551	.0586504 74.33		0.000	4.244598	4.474503
q47_SysCommitment					
Factor1 1.504175	.4489218	3.35	0.001	.6243041	2.384045
_cons 4.404494	.0459427 95.87		0.000	4.314448	4.49454
q48_SysMonitoringEval					
Factor1 2.879346	.7964262	3.62	0.000	1.318379	4.440313
_cons 4.393258	.0563122 78.02		0.000	4.282889	4.503628
q49_SysUserOrgBalance					
Factor1 2.733277	.7573381	3.61	0.000	1.248922	4.217633
_cons 4.297753	.0542416 79.23		0.000	4.191441	4.404064
q29_InfraAvailability					
Factor3 1	(constrained)				
_cons 4.679775	.0349704 133.82		0.000	4.611235	4.748316
q51_ICTAccessInfrastructure					
Factor3 4.140503	1.810845	2.29	0.022	.5913124	7.689694
_cons 4.634831	.0360882 128.43		0.000	4.5641	4.705563
q52_SysTechSupport					
Factor3 3.772799	1.69895	2.22	0.026	.4429174	7.10268

_cons 4.533708	.0373913	121.25	0.000	4.460422	4.606993
var(e.q32_ChangeCulture) .2731817	.0300929		.2201333	.339014	
var(e.q35_MgmtSupport) .21631	.0236863		.1745294	.2680923	
var(e.q36_LearnSupport) .2886796	.0321394		.2320864	.3590728	
var(e.q38_CoopSysUsage) .2315519	.0253556		.1868268	.2869838	
var(e.q41_SysSkillCompat) .3937489	.0438149		.3165926	.4897087	
var(e.q42_SysLearnAbility) .2942417	.0335262		.2353517	.3678672	
var(e.q44_SysEfficiencyPerception) .3044231	.0357435		.2418437	.3831955	
var(e.q46_SysEaseOfUse) .4668374	.0547043		.3710406	.5873675	
var(e.q47_SysCommitment) .3021933	.0346466		.241376	.3783341	
var(e.q48_SysMonitoringEval) .295061	.0435021		.2210119	.3939199	
var(e.q49_SysUserOrgBalance) .2809535	.0402856		.2121201	.3721237	
var(e.q29_InfraAvailability) .2087844	.0224426		.1691223	.2577479	
var(e.q51_ICTAccessInfrastructure) .0792991	.0396795		.0297404	.2114416	
var(e.q52_SysTechSupport) .1222294	.0348387		.0699134	.2136934	
var(Factor1) .0324931	.0166853		.0118767	.0888969	
var(Factor3) .0088965	.0075163		.0016986	.0465977	
cov(Factor1,Factor3) .0059624	.0033612	1.77	0.076	-.0006254	.0125502

LR test of model vs. saturated: chi2(76) = 123.92 Prob > chi2 = 0.0004

Goodness of fit test

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(76)	123.919	model vs. saturated
p > chi2	0.000	
chi2_bs(91)	451.318	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.060	Root mean squared error of approximation
90% CI, lower bound	0.040	
upper bound	0.078	

Pclose	0.195	Probability RMSEA <= 0.05
Information criteria		
AIC	4183.166	Akaike's information criterion
BIC	4319.983	Bayesian information criterion
Baseline comparison		
CFI	0.867	Comparative fit index
TLI	0.841	Tucker–Lewis index
Size of residuals		
SRMR	0.068	Standardized root mean squared residual
CD	0.940	Coefficient of determination

Interpretation of the SEM output for eHealth Implementation determinants (MV-M_1)

The SEM command was run for the Moderating Variables that had Technological, Environmental, Social and Organizational factors and Convergence was reached with a RMSEA (Root Mean Squared Error of Approximation) of 0.060.

RMSEA is a measure of how well a model fits the population covariance matrix. It adjusts for model complexity, with lower values indicating better fit.

Thresholds:

- RMSEA < 0.05: Indicates a close fit.
- RMSEA = 0.05 to 0.08: Indicates a reasonable fit.
- RMSEA > 0.10: Indicates a poor fit.

For this study, the RMSEA was 0.060 that suggests the model has a reasonable fit

90% CI (Confidence Interval) for RMSEA

Lower Bound = 0.040

Upper Bound = 0.078

The confidence interval gives a range of values that are plausible for the RMSEA. Since the lower bound is 0.040 (indicating a close fit) and the upper bound is 0.078 (indicating a reasonable fit), this reinforces that the model is likely a reasonable fit to the data.

The model seems to fit the data reasonably well based on the RMSEA and its confidence interval.

4.4 Findings from Qualitative Data (Thematic Analysis)

The qualitative study consisted of 22 respondents from the three study sites who were interviewed on various issues concerning eHealth implementation and factors influencing its successful implementation, integration, and embedding, as detailed in the interview schedule (Appendix B).

The main issues emerging from the qualitative study were thematically analyzed as presented here below; a summary of the themes is presented in table 4.21.

The respondents were asked on how they perceived eHealth in terms of benefits, implementation process and its impact on their work. As touching benefits, a number of respondents talked of eHealth being beneficial in terms of efficiency in documentation processing (storage and retrieval): i.e faster input increases staff time with patients; reduced time to file, copy papers, retrieve, and ease of manipulation of data and decreased redundancy as compared to paper systems; thus, leading to improved patients flow rate, length of stay or turnaround time.

The interviewees also perceived the use of eHealth to improve quality of documentation as leading to: reduced errors and omissions in documentation; improved legibility of documentation and confidentiality; improved medication administration accuracy and documentation. They also cited easier access to charts and medical information

processing: i.e access to past medical history; easier access for physicians to sign orders, ease of analysis and reporting, hence improved surveillance.

Other common themes which emerged from the interviews were Cost for hardware and infrastructure: vendors or suppliers often exaggerate or inflate prices when they know they are dealing with a government sponsored organization. Besides, the quality of the devices they supplied often times were sub-standard (this may be due to lack of standardization). Staff training, training costs, and training program quality were all cited as key impediments to the deployment process because few employees are trained on eHealth modules and services. This was also supported by human issues, such as staff apathy to change due to unfamiliarity with or fear of computers, as well as a lack of training at colleges or universities.

Maintenance issues covering both maintenance costs and procuring of spare parts due to lack of funds or procurement procedures were also cited by the respondents as factors slowing down the implementation process. Besides government procurement regulations and policies, which often led to bureaucracy, hence long procedures in having things done and lack of tax incentives were cited.

eHealth is a new idea hence it is not structured or factored in the facilities development plan. The strategic health development plans for the cities or districts do not have an explicit programme for eHealth development both in terms of process and structural plan; and budgetary allocations.

The Key Informants were also interviewed on the four factors of the theoretical framework (environment, organization, social and technology), as they perceived them affecting the implementation of eHealth in their facilities. The respondents had the following to say:

Environment factors- this was seen mainly as the role of the government at the city, district level or the central government in political issues, economic, legal, policies etc of which the following issues emerged.

Some of the interviewees cited lack of political awareness or goodwill as contributing greatly to the slow pace of technology implementation (in this case eHealth); political interference and competing interests whenever there are opportunities for tendering, the political class often had vested interests in every opportunity that came by. For example, an interviewee cited that "sometimes there is a conflict of interest as some politicians or councilors, prefer to have their relatives or friends take up certain positions at the expense of the most qualified candidates as a campaign tool in their areas of jurisdictions; or take tenders to supply goods even though they may not be qualified".

Explaining political influence and interference, another respondent had this to say "political factors are a major consideration for managers on formulating and implementing strategy; they define the legal and regulatory parameters within which cities, districts and sub counties must operate. Therefore, abrupt changes in the political leadership such as members like councilors, Members of Parliament executive committee in health affect the smooth operations within the city, districts and the affiliated facilities". Further, absence of accountability mechanisms for committees / Boards; has ripple effects in an organizations way of governance and implementation process.

As much as the cities and districts have their strategic and investment plans, mainly aligned to the national strategic and investment plan, very little emphasis was given to ICT thus it has been poorly resourced and is not able to expand or play its important role.

Interviewed on factors facilitating Implementation; some of the interviewees had the following suggestions to give:

1. Well-written and good implementation planning, gain staff buy-in early in the process; early efforts to increase comfort level with computers; Vendor support with training and implementation plans. This was evidently missing from the strategic plan both at the city or district and at the facility levels.
2. Assistance from government entities to cover cost: incentives, rate increase or other mechanisms to assist facilities with technology related costs; temporary rate increase or one-time payment for infrastructure development and hardware purchases; Grants to help cover implementation costs.
3. Raise awareness among care providers about benefits: quality of care outcomes; financial outcomes and learn from facilities that have implemented eHealth. There is lack of awareness among healthcare providers about eHealth and its benefits.

The respondents were further interviewed on other wide ranging general issues of eHealth as they perceived them; these are captured herein below.

Regarding whether e-health can help lessen disparities in inequality around the world; a respondent had this to say: *"Technology as a major driving force of civilization, can be seen as an enabler; thus, whether through medicines to heal the sick, or through information and communication technology to fuel economic and social growth, it can be part of human development. For example, today the technology most accessible to the poor is the mobile phone; its availability and accessibility to the underserved can be exploited with interventions from health and other sectors of the economy to bridge the social gap".*

They were further asked how governments and international entities can advocate for the benefits of eHealth; A response from one of the respondents reads as follows: "*Governments decide the guidelines and international agencies have a big impact on everyone involved. Strategies and policies that strongly address reducing inequalities can make eHealth technology more popular and help more people benefit from it. To support eHealth, governments develop national strategies and ensure proper regulations, while also training all health workers – these are some of the actions they can take with help from international agencies".*

Another respondent emphasized governments role in providing budgetary allocations and the necessary finances to the healthcare facilities for implementation and sustainability of such a kind of project; emulating the international agencies who have often provided financial aid for start-up or pilot projects as evidenced in a number of public healthcare facilities in the country.

Asked as to whether eHealth technologies can help improve health systems' performance, the respondents agreed that in an environment faced with a lot of ailments and healthcare service delivery shortcomings (e.g shortages of healthcare staff), information and communication technologies plays an important.

There are many difficulties that get in the way of successfully implementing eHealth programmes, like technical, staff, financial and political problems. Scaling up is also a major problem; when projects are expanded, they end up being costly and inefficient because many separate systems are introduced. For example, site3 only had three sections of the facility using the health information system, as it was managed and funded differently, so it was more of a pilot project for a specific disease. In order to succeed in

the future, all the main stakeholders must cooperate and work together much more. There are also major challenges to using eHealth; for example, there are not enough skilled workers to help with implementation. Many eHealth systems do not work like the paper systems they are designed to replace and they are rarely able to communicate with other systems in different disease and programme areas. Another issue to consider is the cost involved".

Some of the respondents mentioned that the health-care systems should be gradually improved by the facilities, instead of choosing major changes. Using a phone or a tablet to enter patient data in a rural clinic, then electronically transferring it and finding the necessary information is much faster than using paper records. Most importantly, eHealth technologies have the power to transform how health care is given and supervised. Now, front-line workers have the tools they need to make decisions close at hand and telemedicine gives them access to expert support. Therefore, fresh roles can be set up and patients can be supported with knowledge and a way to participate in monitoring.

Asked on need for evidence of the impact of eHealth technologies, for sound policy-making and investment decisions; the respondents had this to say: *"It is difficult to make policies and invest in eHealth because evidence of their impact in the public sector is lacking, while the private sector has some information on this. Even so, it is believed that when eHealth systems are designed well, they can greatly change the field. However, before this assumption can be fully backed and help form evidence-based policy, a thorough evaluation of e-health systems must take place."*

Another respondent's view is however that; "*Many times, these technologies sound logical to people, so they often do not require proof before using them. Having strong evidence of how well they work, how quickly and for how much money is necessary for governments and donors to support them. Because of the fast pace of innovation, choosing wisely requires using creative and flexible evaluation".*

Table 4. 21: A Summary of the Themes in the Qualitative Interview

Key Themes	Responses
Benefits, of eHealth and its impact on the providers' work	eHealth benefits: efficiency in documentation processing (storage and retrieval): i.e faster input increases staff time with patients; reduced time to file, copy papers, retrieve, and ease of manipulation of data and decreased redundancy, compared to paper systems; thus, leading to improved patients flow rate, length of stay or turnaround time.
Effects of eHealth on social inequality across the community	"Technology as a major driving force of civilization, can be seen as an enabler; thus, whether through medicine to treat the sick, or through information and communication technology to fuel economic and social growth, it can be part of human development. For example, today the technology most accessible to the poor is the mobile phone; its availability and accessibility to the underserved can be exploited with interventions from health and other sectors of the economy to bridge the social gap".
Impact of eHealth technologies on health systems' performance	- eHealth technologies improve patient care by providing remote monitoring, information dissemination, health advice,

	remote consultations, telemedicine, and faster access to emergency services. eHealth technology improves illness surveillance, data collection, and patient record administration, leading to greater openness, accountability, and surveillance.
Challenges to the successful implementation of eHealth programmes	"There are several barriers, ranging from technical, staffing, financing to political issues. Another big challenge is scalability; i.e. while pilot projects have generally been successful in some cases, when taken to scale, they result in costly and inefficient programmes due to the proliferation of discrete and independent systems. A case in point is site3 where only a section of the whole care facility has implemented health information system; under different management and funding, hence more of a pilot geared to a specific disease. Success in the future therefore depends on achieving much more interoperability and cooperation between all the major stakeholders"
	"……. not enough skilled eHealth practitioners to drive the implementation process. Many e-health systems fail to replicate the paper systems they mirror and these systems are often not interoperable across specific disease and programme domains. And there is also the issue of cost as well".
	- Often the healthcare providers, specifically doctors; feel that they should drive every component of the healthcare system though in this case they have limited knowledge to do so.
Evidence of the impact of eHealth technologies, for sound policy-making and investment decisions	"Policy-making and investment decisions are limited because there is insufficient evidence of the impact of eHealth tools in the public sector though there are packets of what it can do, in the private sector. However, the assumption is that eHealth

	systems – when appropriately designed – are transformative. But before that assumption can be fully supported and used to drive evidence-based policy, a rigorous approach to the assessment of implemented eHealth systems is needed".
E-Health Implementation Process	-there should be incremental improvement of the existing health-care systems by the facilities.
Governments and international agencies role to promote eHealth adoption and implementation.	"Governments set the rules of the game and international agencies have great influence on all players. The right policies and strategies for development of eHealth, with proper emphasis on reducing inequalities can play a big role in promoting adoption of eHealth technologies and thereby extend their benefits. Governments develop national policies and strategies which create an accommodating regulatory environment for eHealth, equally they can build capacity through training programmes and on-the-job training for all health workers – these are some of the mechanisms through which governments and international agencies can help provide an enabling environment for the growth of eHealth". -Also emphasized was governments role in providing budgetary allocations and the necessary finances to the healthcare facilities for implementation and sustainability of such a kind of project; emulating the international agencies who have often provided financial aid for start-up or pilot projects as evidenced in a number of public healthcare facilities in the country.
Political influence	"political factors are a major consideration for managers on formulating and implementing strategy; they define the legal and regulatory parameters within which cities or districts must operate. Therefore, abrupt changes in the political leadership

such as members of cities or districts executive committee affect the smooth operations within the county and the affiliated facilities".

4.5 Results Per Objective

Objective 1: eHealth services available and the level of integration and use of the services. This was to help determine where each study site stands or their level of implementation and possible integration and routinization of eHealth processes in their daily or routine workflow and in the healthcare service delivery to the diverse stakeholders.

From the data gathered, the three sites thus can be categorized along the three levels as follows:

Site 3: The use of ICT in the general population in this setup is limited to not much more than mobile phones. The commercial ICT market is fragmented, with little local expertise available. The government has no role in funding and providing technical support for eHealth. This comes instead from aid agencies, donors, nongovernmental organizations (NGOs) and consultants.

Evidence: Based on observations, Site 3 lacks telephones and has weak ICT infrastructure; the bulk of staff communicate via personal cell phones. The health facility has only a few computers in the records, stores, and HIV clinic; the remaining computers are for administrative purposes and are located in the Medical Officer in Charge's and Clinicians' offices, which are similarly fragmented (not networked). staff. This site included eHealth implementation projects in specific portions of the facility. In this site, there were eHealth implementation projects in some given sections of the facilities.

Sites 1 and 2 could both be mapped to category I of figure 2.1. The setup is primarily defined by strengthening infrastructure and making the case for eHealth.

Evidence: According to the observation data, the majority of the procedures and activities at site2 are manual, with the exception of the HIV/AIDS clinic, stores, and laboratory, which have adopted eHealth components through government-donor collaborative financing. Other computer locations include the Medical Superintendent's office, finance, and the data center (Records office), which are primarily used for administrative rather than clinical duties.

Furthermore, the implementation is mainly donor-funded for specific diseases, with some government engagement in the eHealth project. The majority of the facility's functions lack eHealth adoption; as a result, its operations are reliant on old traditional methods of clinical medicine processing, which are primarily manual and paper-based for patient records.

Site1 has a networked environment; eHealth presence begins with billing, where computers are used to gather patient information and print receipts, triage, pharmacy, laboratory, finance, and administrative offices; however, they are in silo or fragmented in nature. This site had ICT personnel deployed to support the systems in place and provide technical assistance to the staff. The administrative tasks are networked, but the other functions (clinical) remain siloed.

However, due to financing constraints, the institution is battling to ensure the system's sustainability. The government's primary duty is to pay the salaries of employees working in the eHealth project.

Objective ii: To determine factors that affects implementation of eHealth in service delivery.

A number of determinants either as facilitators or as barriers were elicited both from literature review (chapter 2, section 2.3.2) and from empirical data. It is worthy noting, from the literature, to state that there were differences depending on whether the implementing healthcare facility is coming from a developed economy or from a developing economy. Further, variations were noted in the local implementation process (empirical data) depending on the economic environment of the healthcare facility. This can be explained from different key fundamental issues as is pointed out herein below.

It was noted that key determinants of eHealth implementation and diverse strategies should be put in place to help guide implementation process; these can broadly be categorized into four distinct factors, namely: environmental, organizational, social and Technological. Environmental factors mainly provide an enabling platform for the organization wellbeing with the government as the main actor; it sets the pace for organization's growth and stability. Bad governance, corrupt leadership and lack of clear vision, structures and legal frameworks besides lack of financial empowerment often impacts organizational setup and growth.

Organizational factors mainly focus on the organization structure, culture and management process - which almost remains the same for the public healthcare facilities though each could be having different priorities depending on their age, economic and political stability- more so given the county government type of administration; thus, one county may be more stable and organized than the others therefore setting a governance structure which favors organizational development. That is to say wrangling,

mismanagement and any form of political instability in the District Local Government impacts the healthcare facility's development plans which are mainly influenced by external environmental factors. It is important to also state at this point that the public healthcare facilities often lack a business focus; more often the business focus is inculcated in their systems when development partners who could either be non-government organization or international partners are involved. It can thus be argued that there is need for change management with a focus on business orientation type of leadership.

Technology availability factors focus on availability of equipment (involves acquisition, procurement procedures, maintenance, software development- in-house built or proprietary based, phase based implementation plan of the different domains and legal framework for each approach); infrastructure and expertise- these factors also are further influenced by the government's role in providing an enabling environment for their existence.

Social factor focuses on human interaction with technology within an organizational setup and the impacts thereof. At the initial stage of adoption or implementation, technologies often tend to have disruptive effects on the organization's workflow. The length of disruption was determined by the management and leadership of the organization. It is however important to state that the focus should be for a coherent system, where there is collective action, cognitive participation and reflexive monitoring. Social factors also address the involvement of diverse stakeholders in the implementation process.

Objective iii: To determine the core mechanisms in implementation of eHealth systems.

Considering successful implementers, these are stepwise procedures which they have undertaken in form of set activities during their entire implementation process. While there are tangible evidences from literature reviewed (chapter 2, section 2.3.3) on core mechanisms in the implementation of eHealth systems, there was little evidence from the empirical data gathered from the study sites. According to the literature review, governments play an important role in offering adoption incentives such as subsidies, bonuses, tax breaks, grants or loans, and co-funding mechanisms, however these were not included in the empirical data.

Though Uganda as a nation has developed an eHealth strategy, critical analysis of the document shows that it is lacking in depth compared to others which have been used by successful implementers. From other successful implementers, the following five structured activities were identified in their strategic plans which however were glaringly missing from the Uganda national eHealth strategy and from care facilities implementation process: i- Engaging the important health and non-health partners; ii- Establishing governance mechanisms to provide improved visibility, coordination and control of eHealth activities, iii- Establishing the strategic context for eHealth to provide the foundation for the eHealth vision and plan, iv- Forming an understanding of the current eHealth environment and v- Identifying the short-, medium- and long-term goals, identified earlier in literature review [8].

The under-financing of the health sector has thus reduced its ability to ensure an adequate level of service provision to the population and more specifically to eHealth

implementation. Worse still is the high level of corruption and self interest shown by those on whom responsibility to guide the health sector is vested.

In addition to the above mechanisms, other implementers have categorized governance of eHealth programme at different levels to oversee its implementation, which are however missing in the Uganda context and at the facilities and districts under study. Four broad categories are identified, that is:

- The eHealth Strategy Board is the governance body that provides overall strategy guidance and investment approval for the Programme. In the Ugandan context, as much as there is eHealth strategy, there is no specific board or body commissioned to oversee its implementation; thus, it just remains more of a policy paper.
- The eHealth Programme Board is in charge of the overall management and implementation of the project. This is more of a technocrat team upon whom the management and implementation programme is bestowed; it could be a sub-committee of the eHealth strategy board. Once again this was lacking in the Ugandan context.
- The Clinical Change Leadership Group (CCLG) was established to ensure clinical input into the Programme and plays an important role in presenting and advising on the Programme with relevant clinical groups. As noted in other section of this study, clinicians often insist on leading every component of clinical medicine, technology included though they may not have the perquisite training required for its implementation. However, since they understand the complexities of medicine and the need for less variation in its implementation, there is need for them to lead the process. This team therefore needs to include both clinical experts and

technology experts so that the two processes (clinical and technology), can pull together.

- The eHealth Leads Group serves as a liaison between Boards and the eHealth Programme at the management level, and it is critical to the successful execution of Board projects. With budgets held by Boards for nationally used systems, a key delivery mechanism would ensure a Group continues to act collectively.

  From the above governance boards recommended, are strategies that have been used elsewhere by successful implementers to provide synergies between the different levels of government stakeholders.

4.6 Development of A Multi-Dimensional Model for Successful Implementation of eHealth

This section outlines the process which the study undertook to achieve objective four which was to develop a multi-dimensional model for successful implementation of eHealth. The section concludes by presenting and explaining the developed model.

4.6.1 Development of A Multi-Dimensional Model for the Implementation of eHealth

To develop the model, a critical analysis of objectives i, ii & iii was done. This made the researcher identify (i) the status of each study site, their levels of adoption, implementation and integration of eHealth in their daily workflow; (ii) the determinants of eHealth implementation process (both facilitators and barriers) and also (iii) core mechanism in the eHealth implementation process. The researcher also assessed other frameworks and

models which are currently used and eHealth strategies which have been used in successful implementation.

The development process of the multi-dimensional model was equally informed or underpinned by three other theoretical frameworks and models. The researcher looked at the gaps of each theory or model as they related to this study. Thus, a critical analysis of each of the theoretical frameworks/model gave the insight which led to the development of a modified model which the researcher deemed was holistic to guide the study. The theoretical frameworks and model studied were Actor-Network Theory (ANT), Normalization Process Theory (NPT) and Strong Structuration Theory (SST); each of which had a gap/limitation in view of this study as captured in literature review (table 2.8). NPT has been used in other studies to address technology adoption, implementation and embedding, thus analyzed in view of this study contexts, it has three contexts or factors; Social context (with emphasis on coherence, collective action, cognitive participation and reflexive monitoring), technological context (infrastructure- emphasizes availability of equipment and technical skills) and organizational context (focuses on processes, structures, Management support, management strategies either Top-Down or Bottom-Up, Leadership and cultural concepts). Thus, it can be seen as missing out on environmental context (Government Vision, political and economic stabilities, Policies, Taxes, regulations, Legislations; budgetary allocation and physical infrastructure, devoid of corruption and crime etc. i.e factors necessary for an enabling environment) which is external to the organizational context. ANT on the other hand was also missing on environmental context, while SST key constructs helped ground the other two theories. Thus, the theoretical multi-dimensional model developed from the other theoretical

frameworks and model has four contexts interacting to give out an innovation whose output yields benefits (impacts); measured and anticipated. This was then used to underpin the development of the Multi-dimensional model for successful implementation of eHealth.

To develop a model for successful implementation of eHealth in a developing economy, the researcher took an analogy of a good architectural design, which must have a strong foundation to hold the key pillars which equally provides firm support for the rest of the architectural design (Figure 4.4). The architectural design here is envisioned as a five-layered structure comprising of the environment (foundation), organization which holds the key pillars, social and technical availability which either interacts or enables the implementation process of an innovation. The implementation of an innovation leads to either anticipated or measured benefits (impacts or results). The first three layers are strategic to successful implementation of eHealth; while the fourth layer being the benefits which accrue due to successful implementation of eHealth. Each of the layers has added components which make them provide the functionality they are intended for.

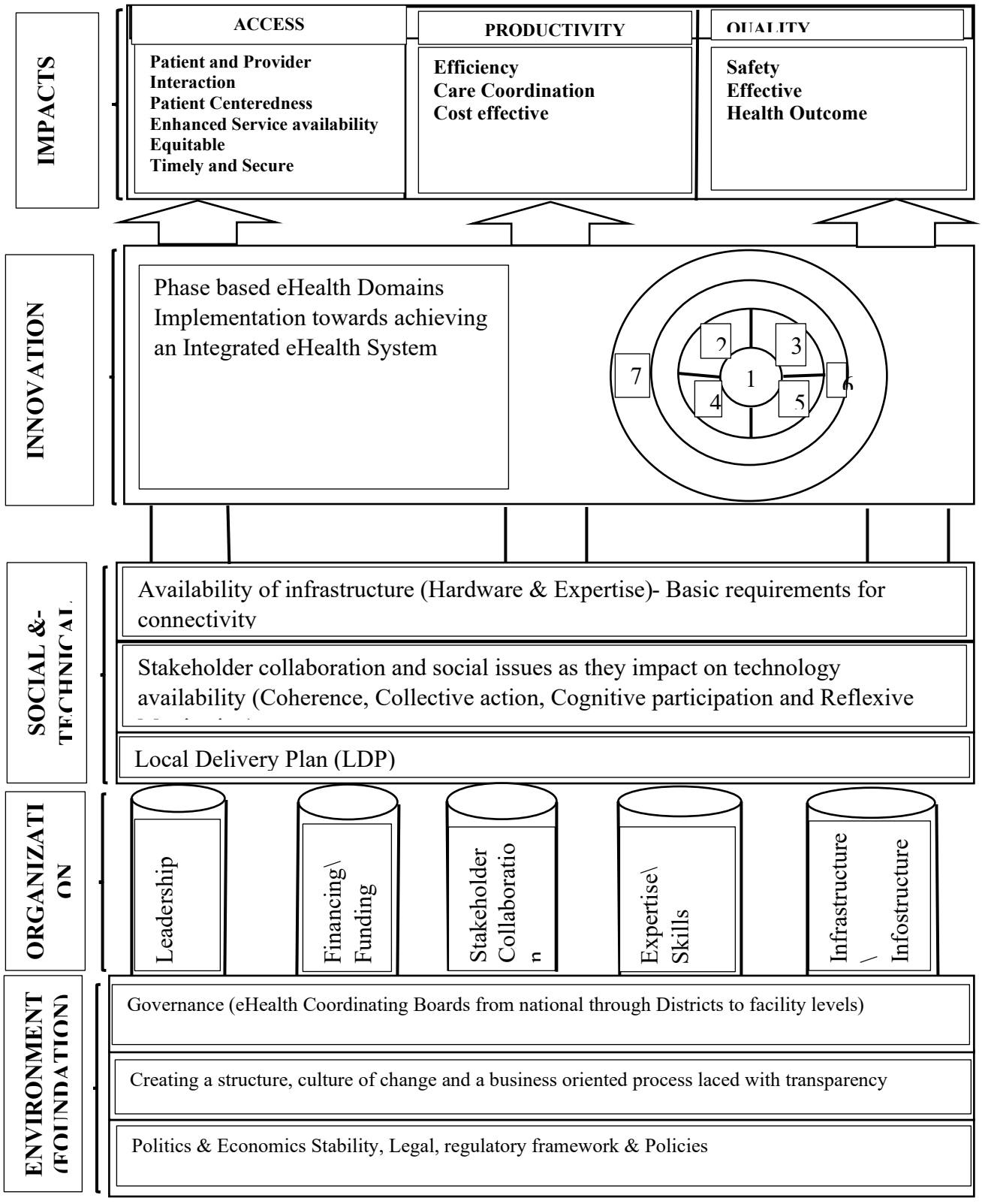

Figure 4. 4: Proposed Multi-Dimensional Model for E-Health Implementation

Legend: 1- Patient Centric; 2- Clinical Decision Support Systems (CDSS); 3- Health Management Systems; 4- Communication Systems; 5- Information Systems; 6- Health Care Systems; 7- M&E

Building from the theoretical multi-dimensional model figure 2.6 and conceptual framework figure 2.7, the key contexts are social, organization, technology, Environment, innovation and benefits. The environmental factor formed the foundation of this model, which is basically government enabled thus, provides an external enabling environment for the organizational activities to thrive. The foundation is structured in a layered pattern; given the diverse arms and roles of the government with different functions:

Layer i. Government vision, political and economic stability; policies, regulations, strategies; availability of budgetary allocations for the implementation process which are fundamental for an enabling environment for an organization to thrive well.

Layer ii. The government must strive for a change driven approach, creating a culture of change and a business oriented process laced with transparency and devoid of corruption; different from a culture of complacency filled with corruption;

Layer iii. The government must create a governance structure and a legal framework for the existence of eHealth i.e. providing useful tools, guidance and advocating for an organizational culture that is transparent and accountable. Create a coordinating body at the national level (National eHealth Board) responsible for implementing the government vision and advising on strategies and policies which would lead to successful implementation of eHealth. Given the decentralized government, the coordinating body would oversee all the implementations at the district facilities levels and at the national hospital facilities. At the local facilities, implementation process was done by local

delivery plan committee whose composition should accommodate key stakeholders from the national, district and the local facility. In their implementation strategies,

they should incorporate the national strategies into their local delivery plan which again must be developed in consultation with the stakeholders.

The strategies developed both at the national level and at the facility levels should be a performance contract between the government and the boards or the implementing bodies. The strategies should define what needs to be done and when it should be done (in the short, medium and long term). The LDPs eHealth strategy needs to be consistent with the national eHealth strategies. They are reviewed each year by the Board and share details about progress towards the strategic aims, budgets, local priorities, activities and how the Board collaborates. The Government should make an annual report to Parliament on how well the strategic aims are being met and on promoting best practices.

The main methods for bringing the government's eHealth vision to life are to set up strong leadership, promote collaboration, use existing financial resources and ensure the right infrastructure is in place. The eHealth strategy is a major initiative that brings together many different partners. So, its success really depends on having strong leadership, teamwork and proper implementation.

The coordinating board should offer guidance and lead any eHealth projects that are aimed at a local community and/or involve several stakeholders from the local or national levels.On top of the Environment- (foundation) layer is the organization which encompasses the pillars; these must be grounded or embedded firmly on the foundation layer to provide support to the remainder of the architectural structure. The pillars are one of the ways of delivering the e-strategies, they are meant to facilitate the achievement of

real eHealth implementation targets that would benefit the intended beneficiaries (patients, care providers, businesses and other stakeholders). Five pillars were derived from a situational analysis. Included herein are: i. Leadership, ii. Financing/ Funding, iii. Stakeholders Collaboration, iv. Expertise and Training, v. Infrastructure and/ Infostructure. The lack or absence of any single pillar led to a weak link to the implementation process hence a likelihood of failure. The roles of each pillar have been discussed earlier in the literature review, corroborated by the empirical data.

The third layer is a social and technical availability setting whose interaction and availability determines the implementation process of eHealth. The layer is basically made up of three other layers; i- the Local Delivery Plan (LDP) layer which sets the agenda and strategies for the implementation plan at the facility level, ii) the social layer which determines what people do either individually or collectively to ensure the implementation process of eHealth, and iii) technology availability, takes into consideration the availability of infrastructure-hardware, software and the mandatory expertise or skills. Assuming the right environment in terms of technical availability and social factors being addressed, this layer then yields the next layer of Innovation implementation, in this case eHealth domains.

The layer, with a focus on the patient are planned to be implemented in a phase-based pattern towards achieving an integrated system. In the process of implementation, monitoring and evaluation (M&E) is a continuous process. This layer is found at the hospital (local healthcare) facilities. At this level, the facilities shall have a local delivery plan (LDP) which should have an incremental implementation plan for the eHealth domains i.e. prioritize the implementation plans depending on their abilities but as would

be guided by the national eHealth strategies and the district strategies which must be in place. This would be the first layer within the implementation layer.

Assuming that the indicated structures are put in place, then it is envisaged that there would be a successful implementation of eHealth systems, therefore the outcome would be beneficial to diverse stakeholders in different ways; thus, bridging the beneficiary benefits gap. Key areas of benefits would be in terms of access (patients and providers; patient centered, timeliness and enhanced service availability); productivity (efficiency, care coordination and cost effective) and quality (safety, effective and health outcome).

Table 4. 22: Roles and Responsibilities of Key Actors and their relationship with conceptual Context

Conceptual Context	**Actors**	**Roles and Responsibilities**	
Environment	(Foundation) Government enabled	Legal, regulatory framework and Policies	-Enabling the legal and regulatory framework Enactment of an eHealth Legislation -Enactment of a data protection legislation and the establishment of a regulatory framework for data protection • Enactment of a freedom of information legislation
		Governance (eHealth Coordinating Boards)	-Provide oversight of flagship of eHealth projects -Provide Monitoring & Evaluation team of eHealth projects. -Provide synergies between Board, Ministry, Counties,

			Agencies and Local Delivery Plan teams. -Report to parliament the status of projects & Performance Contracting (PC)
		Political & Economic Stability	-Change driven (cultural & business process, transparency & accountability) -Provide an enabling environment (liberalized market) -Provide or source for funding for the eHealth strategic plan
Organization	Pillars	Leadership	Leadership is crucial in promoting business process reengineering, creating and implementing change management, and other implementation interventions.
		Financing/ Funding	Achieving the vision of eHealth implementation Plan requires the mobilization of significant financial funding. Government to fund foundational pillars through the Government budgetary allocations and human resources
		Stakeholder/Collaboration	Partnership Collaboration with commercial sector, academic institutions, District Local Governments, and foreign partners is

			essential for executing eHealth strategies.
		Expertise/Training	The development of quality skills and competence is a prerequisite for the creation of viable eHealth. It guarantees that eHealth deployment and exploitation are an ongoing and sustainable part of development. A curriculum focused on health informatics and capacity building for healthcare providers at their training institutions.
	Culture		To be fully effective, the eHealth implementation process must focus on a culture of efficiency, transformation, and business processes in the way health services are delivered across institutions, including workflow re-engineering, as well as a patient-centered culture.
	Structure		Organizations and ISs are mutually distinct entities. A new information system has an impact on an organization, while an information system is influenced by an organization's structure.

		Local Delivery Plan team (at the healthcare facility)	-Provide eHealth Incremental Implementation plan & prioritize plan Organizational and internal staff buy-in requires strong leadership, good management style and proper communication. Actively engage key stakeholders in the design and delivery of eHealth solutions.
Social	Stakeholders Collaboration		For successful implementation, coordinated roles of the stakeholders should be emphasized (collaboration) eHealth vision should be expressed in terms of what it might mean for each of the key stakeholders It should also be looked at in terms of its impact on the social fabric of the organization (coherence, collective action, cognitive participation, & reflexive monitoring)
	Coherence		When faced with the difficulty of operationalizing a set of practices, persons participating in the process implementation work individually or collaboratively to determine whether the

			new innovation makes sense.
	Collective Action		-is the operational work that people do to enact a set of practices, whether these represent a new technology or complex healthcare intervention; i.e. what is the work that needs to happen for implementation to occur?
	Cognitive Participation		Is the relational work that people do to build and sustain a community of practice around a new technology or complex intervention; i.e. is there 'buy-in' from key stakeholders for the implementation work?
	Reflexive Monitoring		is the appraisal work that people do to assess and understand the ways that a new set of practices affect them and others around them. Have a monitoring and evaluation mechanism that enhances the effectiveness of the eHealth strategy by establishing clear metrics to measure the performance of the e-health initiatives in delivering services to its stakeholders.
Technology Availability		ICT infrastructure	The basic prerequisites for system

			connectivity and operation are the availability of an electrical power source and backup. Affordable and high-quality broadband infrastructure for underdeveloped areas, such as (NBI) National Backbone Infrastructure Extension.
Innovation	Implementation	eHealth Domains	Phase based on eHealth domains aiming at Integrated eHealth (Management systems, Communication Systems, Computerized decision support systems, and Information systems, etc.).
Benefits (Impacts)	Measured and Anticipated	Access	-Patient and provider interaction -Patient centeredness -Enhanced service availability -Equitable -Timely -Secure
		Productivity	-Efficiency -Care coordination -Cost effective
		Quality	-Safety -Effective -Health outcome

The process of putting eHealth into action should: (i) Encourage both cultural and workflow changes in health services across all facilities; (ii) Join forces with the medical

community and stakeholders to improve how care is delivered and information is accessed; and (iii) Establish a long-term, unified approach to collecting, analyzing, using and sharing health information.

4.7 Discussions

The progress in the evolving field of eHealth varied significantly across the study sites, with each facility at a different stage in its journey and creating varying levels of value. To assess eHealth implementation progress at each of the facilities levels, extensive primary research on the program was done. Nonetheless, it was found out that its adoption and implementation, lagged or cannot be comparable to the success cases of the developed world due to underestimating or omission of implementation factors. The discussion that follows captures the interactions of some of the factors and their influences. There are still some issues, both in health care and outside it, that need to be handled, regardless of how fast eHealth is introduced. While these issues are sometimes discussed as eHealth-related, they actually appear in many different industries:

• **Complexity**, Handling how infrastructure, applications, information, integration and clinical administration are dependent on each other; due to the complexity of human life.

• **Governance**, for example, making sure that initiatives, processes, the organization as a whole and outcomes are all aligned

• **Local conditions**, such as finding the right balance between central and local drive, priorities and funding.

• **Stakeholder engagement**, e.g. involving and accepting the opinions of managers, clinicians and IT staff.

• **Vendor engagement**, such as making contracts that have clear roles and responsibilities.

• **Adapting to change**, such as communicating updates, training the team and making sure projects are driven by clinicians rather than IT specialists.

• **Measurement**, such as defining the starting point and the agreed results to be achieved; this is the basis for monitoring and evaluation.

It is important to add that from anecdote information available, in African political setup, government regimes often have a lot of influence on the economic being of an environment. Regimes can always skew things to favor a given region and deprive another region thus leading to skewed empowerment and hence growth; which trickle down to the organization. [115] adds a voice to the debate by stating that poverty is a major factor to be considered in using ICT on health service delivery in developing countries. They argue that low level of economy may be a great challenge in adopting a fully developed European/western based solutions for African developing countries where information systems are not fully established. An argument which gives credence to the variations evidenced at the three different study sites. Therefore, an information system support for health in rural areas of developing countries should consider the macro and micro economy (which are components of broad environmental factors) level of the community where it is to be implemented. It should consider the form of health service support that the community is getting compared to the urban settings. Issues like availability of funds, accessibility to health care, availability of energy and infrastructure, affordability and

adaptability of new technology to the communities should be taken into consideration [116], [117].

[118] argues that there are ways in which environmental health and economic prosperity go together. They point out that natural environment affects the economy, both by being used directly in production and by giving many other useful services. The creation of goods and services depends on environmental resources. This was vividly evident from the three case study sites with varying natural environments and hence economic endowment. Site 3 is more of a rural facility situated within an upcoming urban Centre (which owes its growth to the presence of a national educational institution in the area, otherwise the region largely relies on agriculture for its economic being), thus it has low economic income or index compared to the other two study sites. Further the region has not been favored by different political regimes and has a poor road network (marram). Site 2 is in a semi urban environment (one of the biggest districts in Eastern Uganda close to Malaba boarder) thus is exposed to a number of economic opportunities and other situational advantages. Site 1 on the other hand is situated in an urban environment (Mbale City located in Eastern Uganda) endowed with naturally good climatic conditions for agriculture which therefore forms the environments' economic base, besides the region can also be argued to have had favors with different political regimes thus driving their economic growth. Further the rich economic base has made the urban Centre to grow rapidly from the revenue generated from the diverse economic activities emanating from agriculture. It can thus be argued that a sound economic environment is necessary for the growth of an organization. Because of financial difficulties at both the national and health sector levels, many hospitals and medical schools cannot meet their computerization

needs. As a result, using external resources or donor money to introduce eHealth is now more common than not.

Other factors besides economics do play a role in the development of an organization hence the adoption and implementation of an innovation as has been discussed in other sections of this study (e.g political regimes, stability, leadership, legal framework, vision, policies, etc). An enabling environment must be created by providing firm foundation both at the political arena and at the government levels. The government must provide legislation and policies which need to be implemented that are conducive to promoting eHealth practices. The government must equally create a new culture of transparency and accountability. Further on, administrative and clinical leaders, preferably at the highest levels of organization, are essential to implementation. This is corroborated from the findings of the study which found out that leadership is one of the key pillars of the model which determines the success of eHealth implementation in an organization. They need to embody skills and expertise (another of the pillars of proposed model) that would enable them understand the complexities that exists between the interaction of technology, social, organizational and environmental factors. Though this is the case, the leaders both administrators and clinicians are not adequately prepared for these roles. More often than not, the clinicians focus more on clinical issues wherein they are trained hence they exhibit the skills and expertise thereof and on the other hand miss on technological skills and expertise; which therefore makes them shy off from leading technological innovations. The administrators also on one hand are only experts in their field of study hence they

often lack the clinical and technological expert knowledge necessary for guiding the implementation process of eHealth innovation considering the complex environment where it exists. Thus leadership, skills and expertise are two key pillars which are internal to the organization that makes the innovation implementation plan move smoothly. It can be argued then that in the absence of good leadership and appropriate skills and expertise knowledge to drive eHealth implementation, it is hard achieving its successful implementation. Leadership however also links the organization and the external environment, seeking for funds, ensuring the availability of the right infrastructure in collaboration with right government ministries and other stakeholders, articulating the policies and legislations towards the implementation process. Further leadership must ensure coherence and less disruption in the workflow due to introduction of new innovation at the workplace by providing the right communication, change management, incentives and motivation to the staff through training; an approach which would easily enhance staff buy-in. It can then be also argued that leadership is the thread that holds the other four pillars in place, linking all the factors of implementation (technological, social, organizational and environmental). A leader who has "Vision" and "Innovative Approach" as well as other similar characteristics can manage organizational change more effectively. Successful organizational change can lead to new ideas and innovation which helps an organization survive and succeed for the long term.
Upon implementing policies and new regulations, the foundation for eHealth care would be set and the benefits discussed in chapter one would be experienced: Access and equity (focusing on the patient, better interaction with doctors, more available doctors); productivity (becoming more efficient, better coordination of care and cost savings); and

Quality (increasing safety, effectiveness and the positive health outcomes for patients). Various standard methods and best practices are used in healthcare and other sectors, yet because of the size and importance of healthcare organizations, any significant changes must be carefully planned and carried out in stages.

The vision for Uganda 2040 is to have a health system that gives all citizens high-quality, affordable and accessible healthcare which helps achieve the goal of transforming Uganda into a successful and developed nation. The current health system in Uganda is not affordable, does not work well and does not address the health needs of all kinds of people. To overcome these issues, the health delivery system should move from being mainly public to involving both public and private sectors. A major approach was to put in place universal health insurance. Health care services should be enhanced by government, the private sector and other nations by specialization.

Given the complexity of the health organization setting and the interaction it has with the key factors which determine the adoption, implementation and routinization process of eHealth, the study proposed and tested a few hypotheses on the interactions. The findings of the tests are discussed below.

i. Ho1: eHealth domains do not interact positively with the Quality Health service delivery

   Ha1: eHealth domains interact positively with the Quality Health service delivery

From the test results the null hypothesis was accepted given that p = 0.825 was insignificant, that is, p>0.05. Thus, it can be noted that eHealth domains do not interact positively with the Quality Health service delivery.

ii. Ho2: eHealth domains do not interact positively with the eHealth determinants to influence Quality Health service delivery

Ha2: eHealth domains interact positively with the eHealth determinants to influence Quality Health service delivery

The test gave a highly significant outcome of p = 0.000 (often reported as p < 0.001); thus, the null hypothesis was rejected and the alternative hypothesis being accepted.

iii. Ho3: eHealth domains do not interact positively with the eHealth implementation core mechanisms to influence Quality Health service delivery

Ha3: eHealth domains interact positively with the eHealth implementation core mechanisms to influence Quality Health service delivery

The findings of the tests showed that p was significant at p = 0.049, thus, the null hypothesis was rejected and the alternative accepted.

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Overview

This chapter outlined actionable steps based on the study's findings. It provided practical guidance for stakeholders, such as policymakers, practitioners, or future researchers, to address identified gaps or leverage the study's contributions. This section also included suggestions for further research to explore unresolved issues or extend the study's scope in related areas. This chapter presented a summary of the findings in section 5.1,

conclusions in section 5.2 and recommendations from the study and for future research in section 5.3 and 5.4 respectively.

5.2 Summary of findings

The study aimed at evaluation of the process of eHealth implementation in public healthcare facilities, and the interactions between implementation and the complex organizational setting in which it is to be used with a view to unveiling and addressing the challenges causing benefits to beneficiaries' translational gap and also assess integration and routinization of eHealth among healthcare providers' daily work. The findings were used to inform policy formulation on eHealth implementation. Four research objectives were formulated to guide the study. Research objective one sought to establish through documentation, eHealth services available and the level of integration and use of the services in the facilities under study. Research objective two sought to establish determinant factors (facilitators and barriers) that affect implementation of eHealth in healthcare service delivery, while objective three sought to determine core mechanisms in the implementation of eHealth systems. The fourth objective was to develop a multi-dimensional model for successful implementation of eHealth.

5.3 Conclusion

From the forgone discussions, empirical findings, literature studies, and anecdotal data all point to the study's objectives being met. Through the generalizability of the findings from the three case studies, the study emphasized the progress that has been accomplished as well as the gaps that still exist in Uganda's health system in terms of eHealth implementation as a nation.

The deployment of eHealth allows for substantial progress toward greater continuity and coordination of quality health services. Though still in the early phases of implementation, it is possible to argue that there is a strong desire to see eHealth implemented successfully.

The study discovered that more work needs to be done for successful implementation in public healthcare institutions, which served as the foundation for the suggested Multi-Dimensional Model for eHealth implementation (figure 4.4).

According to this study, the proposed model will ensure the successful and long-term adoption of eHealth. Chapter 4 has a detailed description of the model. The model is the outcome of extensive research of existing theories, models, and frameworks, as well as their limitations and gaps; effective implementers' basic mechanisms and methods for eHealth implementation.

Furthermore, the model is based on a comprehensive conceptual and theoretical framework comprised of five components that interact either mutually or unidirectionally to produce eHealth innovation, which benefits or has an impact on the beneficiaries. The conceptual and theoretical multi-dimensional model were analyzed, and the component relationships were quantitatively validated and their components interactions proved statistically by use of mediation tests; CFA through use of SEM..

The survey findings revealed that there are still challenges to incorporating ICT into healthcare organizations and clinical activities. Outpatient clinics continue to have limited access to information and communication technology. Another finding from this study is the low maturity of information systems for clinical decision making.

Various clinical data for individual patients were only available in paper file format at each location. Though eHealth is proposed to reduce the costs of providing quality health care, there are significant implementation costs, such as infrastructure, equipment, training programs, and the change management required to integrate the accompanying new business practices.

Adoption and implementation of eHealth solutions are frequently delayed when fundamental issues are not addressed; there appears to be no unified healthcare approach, let alone a system that can be legitimately used as a proven blueprint for transformation enabled by technology. However, the recognized benefits of reform and automation go hand-in-hand.

An analysis of the successful adoption, implementation and integration of eHealth into health service delivery programs from different countries, highlights the following critical issues: (a) acceptance and change management, (b) demonstration of benefits and funding, (c) project management, (d) health-policy-related goals and implementation strategy, (e) basic legal requirements, particularly in the field of data protection. These are however lacking in the local scenario, or where they are evidenced, they are passive not having the luster or the emphasis they deserve. The results of the study showed that there is need for the implementers to critically considered the social, environmental interactions together with organizational and technical relationship.

Overall, the results of the research study are two-fold in terms of contribution, one, contribution to academic theory and two, a contribution to the body of practice. To the academic theory, the study contributed through the creation of a theoretical multi-dimensional model for successful implementation of eHealth and sustainability in

developing countries (figure 2.6), by extending and modifying ANT, NTP and SST theories. This was therefore used as a lens to guide the study.

To the body of practice, the study developed a Multi-Dimensional Model for the Implementation of eHealth. Primarily, eHealth in Uganda is still in its formative implementation stages; thus, it is mainly characterized by pilot projects. The study however sought to transform this to a full-scale implementation at the public healthcare facilities by providing a Multi-Dimensional Model that provided an understanding and a guide to the stakeholders on the key determinants and core mechanism that would impact on eHealth implementation. The model developed from the study can be relied on to provide guidance on the pitfalls to avoid and also on fundamental items that must be addressed for successful implementation of eHealth, basing the whole process on the multi-dimensional model as a lens. The theoretical model can be applied in like and unlike studies.

5.4 Recommendations from the study

i. The study recommends that ICT infrastructure throughout the country be improved in order to support and not only transfer information across the country, but also to be used for successful eHealth solutions; a number of healthcare facilities have little or no access to ICT infrastructure and technological resources, which is a significant barrier to implementing solutions. Infrastructures, guidelines, and protocols must be established before eHealth services, procedures, and solutions can be effectively implemented.

ii. The study recommends that health sector (specifically policy makers) address issues such as absence of a legislative framework to support decentralization and

an accountable governance devoid of competing interests and corruption; lack of prioritized and costed strategic plans; limited consultations amongst care facilities management and other key stakeholders involved in the provision of health care services; lack of institutional coordination and ownership of the strategic plan leading to inadequate monitoring of activities; weak management systems; inadequate funding and low level of resource accountability.

iii. Establish governance structures, tools, and processes to offer effective leadership and oversight of the national eHealth agenda at the district level. Activities that motivate, promote, and excite concerned users or stakeholders to use eHealth solutions and meet the requirements.

iv. Develop and implement policies that support eHealth implementation and address issues such as data privacy, security, and resource allocation.

v. Establish and enforce data quality standards to ensure the accuracy and reliability of data collected through eHealth systems.

vi. Investigate the development and adoption of standardized data exchange protocols to facilitate interoperability between eHealth systems.

5.5 Recommendations for Future Studies

i. There is need for further research encompassing design, implementation and adoption considerations in relation to eHealth innovations.

ii. The study was limited to outpatient setting thus the inpatient setting was assumed, however healthcare setting is often complex, sometimes starting from the outpatient and ending at the inpatient for admission and finally back to the

outpatient for discharge. Therefore, it is important that further research be done which combines both setups and their interaction with information technology.

iii. The respondents or the sampling frame was limited to the public healthcare facilities study sites, the study thus recommends further studies including other informants from different domains (policy makers from line ministry and associated ministries, District Local Government, political class, international partners, NGOs and other diverse stakeholders).

iv. Patients were not actively involved in the survey save for observations for time stamping on TAT, patient wait time and patient/provider consultation time, therefore the study recommends for further study a research to assess patients' satisfaction with the service delivery with respect to eHealth implementation.

v. The empirical evidence-base for approaches to strategize implementation and adoption is at present very limited; this reflects amongst other things, the lack of rigorously conducted prospective studies that allow assessment of effectiveness and processes through which these effects are mediated.

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APPENDICES:

Appendix : Approval of Proposal

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

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P.O Box 190
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Kenya

Directorate of Postgraduate Studies

Ref: MMU/COR: 509099

24th October r 2023

Grace Adong
SIT/H/01-70057/2022
MMUST
P.O. Box 190-50100,
KAKAMEGA.

Dear Ms. Adong

RE: APPROVAL OF PROPOSAL

I am pleased to inform you that the Directorate of Postgraduate Studies has considered and approved your PhD proposal entitled: ***"A Multi Dimensional Model For E-Health Implementation in Public Health Care Facilities: A Case of Eastern Uganda"*** and appointed the following as supervisors:

1. Dr. Jasper M. Ondulo - SCI
2. Dr. Collins Odoyo - SCI

You are required to submit through your supervisor(s) progress reports every three months to the Director Postgraduate Studies. Such reports should be copied to the following: Chairman, School of Computing and Informatics Graduate Studies Committee and Chairman, Department of Information Technology. Kindly adhere to research ethics consideration in conducting research.

It is the policy and regulations of the University that you observe a deadline of three years from the date of registration to complete your PhD thesis. Do not hesitate to consult this office in case of any problem encountered in the course of your work.

We wish you the best in your research and hope the study will make original contribution to knowledge.

Yours Sincerely,

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY DIRECTORATE OF POSTGRADUATE STUDIES P.O. Box 190 - 50100, KAKAMEGA (K)
Date:..... Sign:.....

Prof. Stephen Odebero, PhD, FIEEP
DIRECTOR, DIRECTORATE OF POSTGRADUATE STUDIES

Appendix F: Research Permit

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Pursuing Excellence

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FACULTY OF HEALTH SCIENCES' REC

26/01/2024

To: Grace Adong

Masinde Muliro University of Science and Technology, Kakamega, Kenya
+256782557366

Type: Initial Review

Re: BUFHS-2023-130: A Multi Dimensional Model For E-Health Implementation In Public Health Care Facilities: A Case Of Eastern Uganda

I am pleased to inform you that the Busitema University Faculty of Health Sciences REC, through expedited review held on **17/01/2024** approved the above referenced study.
Approval of the research is for the period of **26/01/2024** to **26/01/2025.**

As Principal Investigator of the research, you are responsible for fulfilling the following requirements of approval:

1. All co-investigators must be kept informed of the status of the research.
2. Changes, amendments, and addenda to the protocol or the consent form must be submitted to the REC for re-review and approval **prior** to the activation of the changes.
3. Reports of unanticipated problems involving risks to participants or any new information which could change the risk benefit: ratio must be submitted to the REC.
4. Only approved consent forms are to be used in the enrollment of participants. All consent forms signed by participants and/or witnesses should be retained on file. The REC may conduct audits of all study records, and consent documentation may be part of such audits.
5. Continuing review application must be submitted to the REC **eight weeks** prior to the expiration date of **26/01/2025** in order to continue the study beyond the approved period. Failure to submit a continuing review application in a timely fashion may result in suspension or termination of the study.
6. The REC application number assigned to the research should be cited in any correspondence with the REC of record.
7. You are required to register the research protocol with the Uganda National Council for Science and Technology (UNCST) for final clearance to undertake the study in Uganda.

The following is the list of all documents approved in this application by Busitema University Faculty of Health Sciences REC:

No.	Document Title	Language	Version Number	Version Date
1	Protocol	English	Version 3	2024-01-02
2	Informed Consent forms	English	version 1	2023-11-27
3	Data collection tools	English	version 1	2023-11-27

Yours Sincerely

Dr.Edith Mbabazi
For: Busitema University Faculty of Health Sciences REC