ROUTINIZATION ARCHITECTURE FOR e-HEALTH IMPLEMENTATION IN KENYA: A CASE OF KAKAMEGA COUNTY

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A Thesis Submitted in Partial Fulfilment of the Requirements for the Award of Degree of Master of Science in Information Technology of Masinde Muliro University of Science and Technology

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DECLARATION

This Thesis is my original work and has not been presented for an award of a degree or diploma in any other university or institution.

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CERTIFICATION

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DEDICATION

To my wonderful parents Mr Vitalis Shikunyi Waburaka and Mrs Betty Abila Chacha for their encouragement, love, guidance and unwavering support throughout this journey that has shaped who I am today.

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ABSTRACT

Routinization is the process by which practices, procedures or a technology becomes standardized or routinized into daily workflows (no longer questioned, becomes norm). The incorporation of e-Health into healthcare has the capacity to revolutionize service delivery by enhancing quality, which encompasses safety, timeliness, efficacy, efficiency, patient-centeredness, and equity. Nonetheless, the adoption and utilization of these systems continue to pose challenges, especially in developing nations. Despite substantial expenditures in e-Health by the Kenyan government and its partners, the deployment and integration of these technologies have not yet realized their full primary potential. The research was motivated by the effective implementation of e-Health systems in industrialized nations, which have markedly enhanced healthcare service provision. This study aimed to develop a routinization architecture for e-Health implementations in public healthcare facilities in Kenya, focusing on Kakamega County. The goal was to enhance the daily use of implemented technologies, improve data accuracy, ensure consistency in care delivery, increase efficiency, and support better decision-making. Despite substantial investments by the Kenyan government and development partners, the full potential of e-Health systems remains unrealized. Drawing inspiration from successful e-Health adoption in developed countries, this study sought to assess the current status of e-Health systems, identify factors influencing routinization and design a proposed routinization architecture to support sustained use. The study was guided by the Unified Theory of Acceptance and Use of Technology, Normalization Process Theory and Task-Technology Fit. An exploratory research design was employed; data was collected from a sample of 328 healthcare workers across seven selected public healthcare facilities level 3 to 5 through a quantitative approach through structured questionnaires and non-participatory observation using stratified simple random sampling. Reliability test confirmed using Cronbach's alpha of 0.871 which was calculated to assess internal consistency of the scales used in the questionnaire, validity was assessed using the Kaiser-Meyer-Olkin (KMO) measure of 0.812 and Bartlett's test of sphericity value of $p < 0.001$ confirming to sampling adequacy. Data was analysed using SPSS v26 for both descriptive and inferential statistics. Exploratory factor analysis was conducted using principal component analysis with rotation to identify and group underlying constructs influencing e-Health routinization such as system usability, organizational support and technology availability. Inferential statistics using Pearson correlation was also applied to explore relationships and to test predictive strength of key independent variables on the routinization outcome. The study established that successful routinization of e-Health systems requires a comprehensive architecture addressing strategic, technical, organizational support and user-related factors. Key barriers identified include data management, insufficient IT training, infrastructural limitations, limited user involvement and leadership, absence of supportive policies and standard operating procedures. These findings underscore the need for a comprehensive routinization architecture that addresses technical, organizational support and user related factors to support the sustainable routinization of e-Health into daily routine use to enhance healthcare service delivery. Addressing these challenges through targeted intervention such as training in IT programs, infrastructure upgrade, clear policies and strong leadership can enhance system use, data quality and healthcare delivery efficiency. Findings were integrated into a context-specific routinization architecture to guide a sustained e-Health integration into public healthcare settings workflows.

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ABBREVIATIONS AND ACRONYMS

e-HEALTH	Electronic Health
EHR	Electronic Health Record
EMR	Electronic Medical Record
HIE	Health Information Exchange
HIT	Health Information Technology
HRIO	Health Records and Information Officer
ICT	Information and Communications Technology
IoT	Information and Telecommunications Union
ITU	Internet of Things
KCGH	Kakamega County General Hospital
mHEALTH	Mobile Health
NACOSTI	National Commission for Science Technology and Innovation
NPT	Normalization Process Theory
RHIS	Routine Health Information Systems
SPSS	Statistical Package for Social Sciences
TTF	Task-Technologies Fit Theory
UTAUT	Unified Theory of Acceptance and Use of Technology
VCT	Voluntary Counselling and Testing
WHO	World Health Organization

DEFINITION OF TERMS

e-Health: The use of digital technologies and ICT tools to improve healthcare delivery and data management.

e-Health Domain: Encompasses healthcare technology for assessing and monitoring to prevent, diagnose, treat diseases, monitor patients, or support rehabilitation and long-term care. This includes management systems, communication systems, clinical decision support systems (which aid clinicians at the point of care with diagnosis, analysis, and interpretation of patient data), and information systems.

Hospital Information Systems/Technology (HIS/T): IT solutions employed by healthcare staff and administrative clerks to streamline patient management and clinical care processes in hospital settings.

Adoption (of e-Health): In this study, adoption refers to healthcare practitioners' willingness to implement e-Health for delivering healthcare services.

Use (of e-Health): Refers to the actual utilization of e-Health tools and technologies to facilitate routine work activities in healthcare facilities.

Routinization: Is the process by which practices, procedures or a technology becomes standardized in daily workflows, it’s no longer questioned (becomes norm).

Facility: Specifically, a public healthcare service located in Kakamega County.

Health System: A framework for delivering healthcare services to the public whenever and wherever needed.

Information System: An organized method for handling information, encompassing collection, retrieval and use.

Interhospital Communication: The exchange of information between multiple healthcare facilities.

Routinization: The process through which technology becomes embedded in daily work routines and practices.

Electronic Medical Records (EMRs): Digital versions of patients' paper charts used to store and manage patient data.

DHIS2: District Health Information Software 2; a platform used for reporting, analysis, and dissemination of health data.

Implementation: The act of introducing and integrating a new system or technology into an organization or facility.

Top- down: This is a deductive method technique that starts with a preexisting theory and aims to put it to test using actual facts.

Bottom-up: This is an inductive method technique that involves gathering evidence about a phenomenon in order to formulate a theory about it.

CHAPTER ONE

INTRODUCTION

1.0.1 Overview

This chapter presents an introduction of the study; it is presented in topical sections as follows: section 1.1 discusses the background of the study; capturing the main challenges in health sector globally, regionally, locally and the need for an intervention. The section further discusses the intervention, its perceived benefits to different stakeholders; citing success cases elsewhere globally and the translational gap of benefits to the beneficiaries hence the problem for the study. Section 1.2 captures the research problem. Section 1.3 presents the research objective(s) both general, specific objectives, and research questions. Further presented in the chapter are justifications, assumptions, and delimitation of the study.

1.1 Background to the Study

The World Health Organization (WHO) defines eHealth as the use of ICTs for health services and information, encompassing tools such as electronic health records (EHRs), telemedicine, mobile health (mHealth), health information systems (HIS), Health Management Information Systems (HMIS) and digital decision support systems (Blaya, 2010; WHO, 2019). These systems are built on core principles such as interoperability, patient-centeredness, security, accessibility and efficiency, aiming to streamline operations, enhance healthcare accessibility, improve service delivery, reduce redundancy, strengthen data-driven decision-making and boost efficiency across health systems (Adler-Milstein & Jha, 2017; Akanbi, 2012). The adoption of e-Health systems becomes a central focus in improving healthcare delivery, especially in low and middle-income countries.

Globally, e-Health is seen as a vital step toward improving healthcare quality (Ankem et al., 2017). e-Health documented benefits include better health information management, continuity of care, faster diagnosis, reduced paperwork, improved resource use and enhanced public health surveillance (Kiberu, Mars & Scott, 2017). e-Health has globally improved healthcare by enhancing access, efficiency, outcomes and data management. It has notably expanded care to remote areas through telemedicine and mHealth, reducing geographic and financial barriers (WHO, 2016). Implementation varies by country, shaped by policy and infrastructure. High-income nations like Sweden, the U.S. and Canada have advanced digitization, with benefits including better outcomes, fewer errors, coordinated care and increased patient engagement.

e-Health has enhanced clinical decision-making and efficiency through EHRs, decision-support tools and digital diagnostics, improving care continuity and reducing errors (Buntin, 2011). Interoperable systems enable real-time data sharing for personalized care. Public health has also benefited from e-Health in areas like disease surveillance, education, and outbreak response as seen during COVID-19 with tools for contact tracing and teleconsultation (Keesara, Jonas & Schulman, 2020). Nonetheless, issues like data privacy, digital literacy, infrastructure gaps and unequal access remain key challenges.

Snowdon and Cohen (2011), identified that healthcare systems in developed and industrialised countries all face similar challenges such as expanding health demands, operationalizing health management, limited funding and resource constraints which are associated with ever-increasing demands for health services that are quickly outstripping their systems' capacity to deliver healthcare. These challenges mirror global findings where system sustainability and daily use remain problematic without organizational readiness, change management and proper stakeholder involvement (Greenhalgh, 2004; May, 2009).

In Africa, the journey towards full e-Health adoption has been more gradual, challenged by infrastructural limitations, workforce shortages and inconsistent policy frameworks. Nonetheless, efforts are growing where countries such as Rwanda, South Africa and Ghana have made strides in implementing national eHealth strategies. Rwanda's HMIS has enabled more efficient data reporting and tracking of key health indicators (WHO, 2021). Despite these developments, many African nations still struggle with partial implementation, often limited to donor-funded pilot projects lacking long-term sustainability.

In Kenya, the MOH has made significant investments and policy advancements towards digital health transformation. Kenya has been progressively embracing e-Health following the launch of the Kenya eHealth Policy which outlines strategic pillars such as telemedicine, HIS, mHealth and eLearning aimed at improving healthcare outcomes through technology, enhanced service delivery, data accuracy and decision-making. These policies prioritized the integration of ICTs into healthcare, leading to the rollout of several systems such as the District Health Information Software 2 (DHIS2), Integrated Human Resource Information System (iHRIS), Afya Care and KenyaEMR which have been rolled out across various counties to support digital data management, patient record tracking and performance monitoring (Githinji, 2021). EMR is used for patient management, DHIS2 employed to collect and analyze health indicators at all levels of care for data reporting, Logistics Management Information System (LMIS) supports logistic, other software solution supports surveillance and performance monitoring. Despite ongoing efforts, only 25–30% of public healthcare facilities in Kenya have fully implemented e-Health systems (Kariuki, 2020). Implementation levels vary, with higher-tier hospitals (e.g., level 5) showing greater adoption than lower-level ones (e.g., level 2). Failure to routinize e-Health disrupts daily healthcare delivery, causing fragmented care, data inefficiencies, increased medical errors, and delayed emergency responses. Manual records remain common, leading to data loss, inaccuracy, and poor access hindering clinical and policy decisions. Inconsistent e-Health use also renders investments unsustainable, risking resource wastage and donor fatigue.

In Kakamega County, there are 146 government health facilities in the county, 1 County referral hospital (level 5), 12 sub-county hospitals (level 4), 38 public health centres (level 3) and 95 (level 2) dispensaries; Approximately 60% of public health facilities have implemented at least one form of e-Health system. Adoption is highest at the Kakamega county general hospital (100%) and sub-county hospitals (85%), where systems such as EMR, DHIS2 and Human Resource Information Systems (HRIS) are commonly used. In contrast, lower-tier facilities such as health centres (63%) and dispensaries (38%) experience limited uptake due to infrastructural constraints, inadequate ICT skills, lack of IT staff and poor connectivity (MOH Kenya, 2019).

Heath (2018) defines routinization of e-Health as the process by which digital health technologies such as telemedicine, mHealth and EHR becomes fully integrated into everyday clinical workflows to the extent that their use is no longer seen as novel or exceptional. Heath asserts that the routinization of e-Health is essential for healthcare institutions to realize their maximum potential in enhancing the quality of healthcare service delivery, encompassing safety, timeliness, effectiveness, efficiency, patient-centeredness, equity, and accessibility. The study seeks out to explore how e-Health systems are currently being implemented in Kakamega County and to analyze the factors influencing their routinization in public healthcare facilities. Understanding these dynamics is crucial for designing a routinization architecture for sustainable digital health investments and integration in routine health service delivery leading to a long-term improvement in health outcomes.

1.2 Statement of the Problem

Despite the recognized benefits of e-health, several factors impede its widespread and sustainable use. Kenya's healthcare system is facing significant challenges in effectively implementing and integrating e-Health solutions into its daily operations. Further, despite substantial investment in digital health infrastructure by the Government of Kenya and its development partners, e-Health systems in public healthcare facilities particularly in counties like Kakamega have yet to achieve full integration into routine clinical and administrative processes. While tools such as EMRs, DHIS2 and other digital platforms have been deployed, their usage remains inconsistent and their benefits significantly underutilized. Moreover, failure to routinely engage with these systems reinforces negative perceptions among staff, undermining future adoption efforts and reducing the overall quality of care and the absence of a structured approach for promoting routinization further aggravates these challenges. Therefore, there is an urgent need of a structured approach for promoting routinization through a robust framework that integrates technical, organizational and human centric factors to facilitate routinization of e-Health systems on a daily basis. The purpose of this study is to develop a proposed routinization architecture that will guide sustainable e-Health implementation and use in Kenya’s public healthcare facilities.

1.3 General Objective

The general objective of the study was to assess the status of e-Health systems analyse the factors influencing routinization and to develop a routinization architecture.

1.3.1 Specific Objectives

i. To assess the current status of e-Health use in public healthcare facilities in Kakamega County.
ii. To analyse the factors influencing routinization of e-Health systems in public healthcare facilities in Kakamega County.
iii. To develop a routinization architecture to guide sustainable e-Health use in Kenya's public healthcare facilities.

1.4 Research Questions

i. What is the current status of e-Health use in public healthcare facilities in Kakamega County?
ii. What factors influence the routinization of e-Health systems in these facilities?
iii. Are there routinization architectures developed to guide e-Health use in Kenya public healthcare facilities?

1.5 Justification of the Study

Kenya has made significant progress in adopting e-Health systems at the county level, though the depth of adoption varies depending on the counties. At the national level, the Kenya Health Information System (KHIS/DHIS2) is fully institutionalized, with all counties reporting routine health service data through the platform. Kakamega, like other counties, actively participates in this reporting system, ensuring that facility-level data feeds into the national health information infrastructure (KHIS/DHIS2). This universal uptake provides a standard foundation for health data management across the country.

A routinization architecture is needed in Kenya's public health facilities to ensure sustainable e-Health use by integrating e-Health into routine workflows, moving it beyond being an occasional activity to a standard part of healthcare. Key justifications include addressing challenges like data fragmentation, ensuring data quality and interoperability, improving healthcare delivery efficiency, providing continuity of care, and complying with national digital health policies. Ultimately, routinization drives e-Health's potential to enhance the quality, safety and effectiveness of healthcare services across the nation. Since the intended routinization architecture of e-Health systems is meant for nationwide implementation, drawing findings from such a representative population is crucial. The USAID through PATH, deployed the Kenya EMR system and established LAN in 45 health facilities across the county, making Kakamega one of the three pilot counties for the project.

1.6 Assumptions of the Study

This study assumed that e-Health represents a timely and necessary advancement that healthcare facilities must integrate into their daily service delivery functions. It also assumed that the respondents were knowledgeable about health systems and therefore capable of providing informed input for the study. Additionally, the study assumed that respondents (healthcare workers and administrators) provided accurate and honest information regarding their interaction with e-Health systems and the implementation of e-Health systems has been sufficiently operational that allowed for meaningful evaluation of routinization factors.

1.7 Scope and Delimitation of the Study

The study was confined to public healthcare facilities in Kakamega County specifically targeting healthcare workers who actively engage with e-Health systems such as EMRs, DHIS2 and other related platforms. The research emphasized on the routinization process rather than system adoption by assessing factors influencing the routinization of e-Health systems specifically examining user characteristics, technological availability, organizational support and system usability. The study selected a few levels 3 to 5 facilities because they had partially or fully implemented e-Health systems thus provided a richer setting for analyzing routinization and they had involvement with digital health technologies.

The study relied primarily on quantitative data collected through structured questionnaires and non-participatory observations. Data type included nominal like gender, professional cadre, ordinal; level of comfort using a technology and interval like age, years of experience. The analysis of data was performed utilizing SPSS v26. Descriptive statistics, encompassing frequencies, means, and standard deviations, were employed to encapsulate the demographic and institutional characteristics. Furthermore, inferential statistics, specifically Pearson correlation, were utilized to investigate relationships and assess the impact of independent variables on the routinization process. The internal consistency of questionnaire items was evaluated through reliability analysis utilizing Cronbach's Alpha.

The study did not include qualitative data, thus limiting the depth of individual user experiences and contextual factors which is not easily captured numerically. The use of cross-sectional data restricted causal inferences, as observations were made at a single point in time. Responses may be subject to self-reporting bias concerning the frequency and comfort in system use. The study's generalizability was limited to Kakamega County and may not reflect conditions in other counties or private healthcare settings.

1.8 Limitation of the study

The researcher experienced some financial limitation when it came to the final stage of the study, in order to validate the architecture, the researcher had to look for a loan from a bank to enable her validate the study through conducting a workshop using focus group and key informant interview.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter presents a comprehensive review of existing literature on the routinization of e-Health systems, with a focus on public healthcare settings. The review aims to provide a foundational understanding of the concepts, theories and empirical evidence surrounding e-Health implementation and sustainability. It begins by outlining the global and local implementation of e-Health systems, followed by theoretical and conceptual literature review, a review of factors influencing routinization and related empirical studies. Knowledge was gathered from a variety of sources, including journal articles, books, reports, health whitepapers and magazines related to the study topic. The chapter concludes by identifying research gaps addressed by this study.

2.2 Overview of e-Health Systems

e-Health refers to the application of ICT to support healthcare services delivery, data management and decision-making. Globally, e-Health systems have been implemented to improve access to healthcare, enhance quality of care and support efficient health system management. Zhang (2012) demonstrates the benefits of ICT solutions in healthcare to includes ease of access which simplifies access to health services and information, improved efficiency that enhances the efficiency of healthcare processes and workflows, improved quality of care contributes to better patient care and outcomes, enhanced quality of information improves the quality of charts, records and reports, facilitation of management supports better management of healthcare facilities and resources, enhanced communication improves communication among healthcare providers, cost savings reduces costs through streamlined processes and reduced errors.

On a global scale, information and communication technology has surfaced as an essential instrument for facilitating the effective oversight and administration of service delivery. Information and Communication Technology possesses the capacity to produce real-time data, thereby enabling prompt decision-making and timely interventions. It is expected that the accomplishments realized by information and communication technology in various domains, including banking and commerce, can be successfully mirrored in the healthcare sector. Coiera and Hovenga (2007) indicate that health information systems in developing countries frequently experience fragmentation and a deficiency in coordination, with numerous systems depending on manual processes and demonstrating isolated operations. These systems generally function autonomously, facilitating data and processes for individual providers instead of fostering integration across various environments. He persists in asserting that, for a sustainable healthcare system moving forward, it is imperative to cultivate integrated services that facilitate the accessibility of data and processes across diverse environments.

e-Health systems ensure that the correct Health Information System is provided to the right individuals at the right time and place in a secure electronic format, thereby improving the quality and efficiency of healthcare delivery, research, education, and knowledge dissemination. To achieve this objective, it is imperative to circulate information via patient registries, electronic health records, and collaborative knowledge resources.

These enhancements are expected to elevate numerous facets of healthcare service delivery, including quality, cost-effectiveness, efficiency, access, timeliness, and overall performance. The primary aim is to enhance the efficiency and effectiveness of patient care through the streamlined retrieval and processing of clinical information across diverse sites and providers, thus making e-Health systems functional.

2.3 Conceptual Review

Concepts like e-Health systems, adoption, implementation, routinization and architecture are interrelated and central to this study. Understanding how they interact helps to explain the extent to which e-Health systems become routine in public healthcare settings. This conceptual clarity also informs the research design, variable measurement and interpretation of findings in later chapters.

The concept also addresses challenges such as "pilotitis" which means failure of many digital health projects to scale beyond the pilot stage. Frameworks like the Reflexive Accountable Focused Transparent Annotation (RAFTA) model advocate for better documentation and semantic standardization to ensure digital health investments lead to meaningful, long-term integration (Duettmann, 2021).

2.3.1 e-Health Systems

According to Tian and Chen (2022) e-Health originated in the late 1990s representing a multidisciplinary field that involves medicine, engineering and computer science. It includes technologies such as telemedicine, EHR, mHealth and e-Learning.

The term e-Health refers to the use of ICT for health services delivery, data management, and patient care. This system includes EMRs, telemedicine, mHealth, decision-support systems and HIE (WHO, 2019).

2.3.2 Adoption

Adoption refers to the acceptance, decision and actual use of an e-Health system by healthcare providers or institutions. It includes the awareness, trial and initial use of the system, indicating a willingness to integrate the technology into clinical or administrative practices. Technology adoption is the process through which individuals or organizations become aware of, evaluate and decide to use a new innovation (Rogers, 2003). In this study, adoption is a precondition to routinization whereby without adoption, routinization cannot occur because you can't normalize what hasn't been accepted or used. Adoption marks the starting point of implementation while routinization reflects on the long-term sustainability and habitual use of the system as part of routine healthcare delivery (Yusif, 2020).

2.3.3 Routinization

Routinization refers to the process by which a new system, practice or technology becomes a regular and embedded part of day-to-day operations (May, 2009). Is a process through which a new technology initially novel and unfamiliar, becomes normalized and habitual part of daily work practices (Greenhalgh et al., 2004). He continues to say that routinization extends beyond adoption and focuses on the continuous, embedded use of a system over time and it's seen as a key indicator of sustainability and long-term success of technology implementation in healthcare.

In the context of e-Health, routinization implies that healthcare workers not only adopt the system but consistently use it as part of their daily workflow. This includes entering patient data, generating reports, and relying on the system for clinical or administrative decisions. Routinization is context-dependent and it's shaped by infrastructure, regulatory frameworks, user capacity and system interoperability. It requires the harmonization of technology with established routines, enabling healthcare professionals to rely on these systems as standard tools in their day-to-day practice. It's important to note that routinization is not only relevant in healthcare but also in domains like elderly care, where the regular performance of activities plays a role in adaptive functioning (Cunningham, 2014). This highlights the multi-layered and context-sensitive nature of routinization.

2.3.4 e-Health Architecture

In the context of e-Health, an architecture refers to a structured framework used to conceptualize, design and manage the interrelationships between various components of an e-Health system, these components include hardware, software, data and networking that collectively enable the delivery of digital health services. A robust e-Health architecture ensures systems are efficient, secure, scalable and interoperable. A National e-Health Architecture (NEHA) provides a socio-technical foundation that enables governments and stakeholders to coordinate e-Health policies and interventions effectively. The architecture must remain adaptable to evolving healthcare needs and technological innovations, ensuring a unified, longitudinal patient history that enhances clinical decision-making and reduces fragmentation (Mousavi, 2018).

2.4 Theoretical Frameworks

The study examined three major theories relevance to the study that grounded in numerous theories that collectively guided the research process and underpinned the study; the UTAUT, the TTF and the NPT. NPT focuses on the mechanisms on how new practices become normalized in routine settings, emphasizing coherence, cognitive participation, collective action and reflexive monitoring (May et al., 2009). The TTF focus on how well a technology supports users' tasks and lastly the UTAUT model explains user acceptance of a technology based on performance expectancy, effort expectancy, social influence and facilitating conditions. Together, these frameworks provide a multidimensional lens to examine how user perceptions, task alignment and organizational dynamics influence the routinization of e-Health systems.

2.4.1 Unified Theory of Acceptance and Use of Technology (UTAUT)

The UTAUT model was developed to explain the acceptance and usage of technology by (Venkatesh et al. 2003). This theory integrates elements from various existing models that were previously proposed to understand the adoption of IT systems. At the core of UTAUT, there are four key constructs that influence user acceptance and usage behavior: performance expectancy, effort expectancy, social influence and facilitating conditions.

The adoption and routine use of e-Health systems can be strongly influenced by users' perceptions and experiences as outlined in UTAUT. Health workers are more likely to use these systems consistently when they believe the technology will enhance their job performance, such as improving access to patient information or reducing paperwork a reflection of performance expectancy. Equally important is effort expectancy; if the system is intuitive and easy to navigate, users are more willing to engage with it regularly. Social influence also plays a key role, especially in healthcare settings where peer behaviour and managerial encouragement can significantly shape individual attitudes toward technology. Lastly, facilitating conditions such as reliable internet access, ongoing technical support, and training opportunities ensure that users feel equipped and supported thus reducing barriers to sustained system use.

The UTAUT model also identified key moderators that affect these relationships, including gender, age, experience and voluntariness of use. It was observed that the impact of social influence on technology acceptance is more pronounced in women and older adults, whereas younger individuals and men are often more influenced by the expected performance gains. By using this theory, organizations can better understand how different factors interact and influence the adoption of new technologies. This understanding can guide the development of strategies to encourage the effective implementation and routinization of systems, ensuring that investments in technology are not only adopted but also utilized to their full potential in improving performance and efficiency. This model has been widely applied across various types of technologies and organizational contexts, making it a versatile tool for researchers and practitioners in the field of technology management.

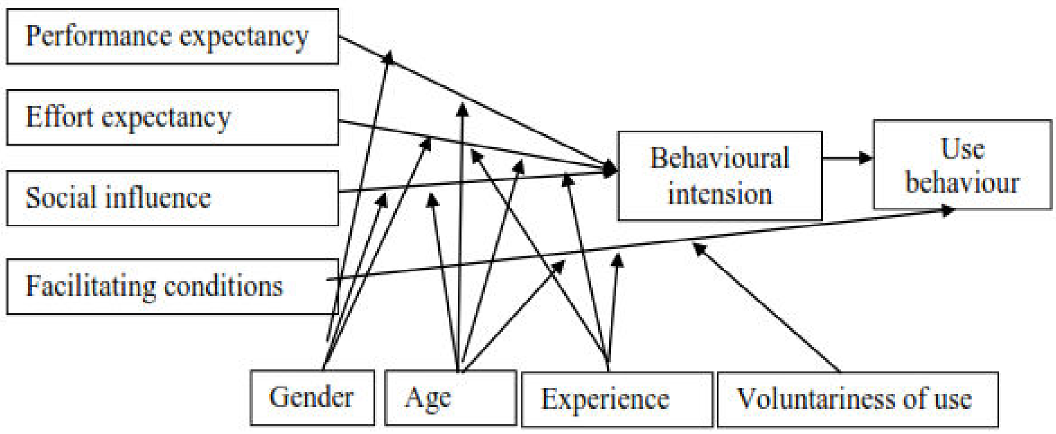

Figure 2. 1: Unified Theory of Acceptance and Use of Technology, (Source: Venkatesh et al.)

2.4.2 Task Technology fit Theory (TTF)

The TTF theory examines the alignment between task characteristics and the technology used to perform those tasks developed by (Goodhue and Thompson, 1995). The TTF model emphasizes that, for an e-Health system to be adopted and used consistently, it must align with the actual work tasks that users perform. In a public healthcare facility, task characteristics includes entering patient data, retrieving medical histories, scheduling appointments, or generating reports. If these tasks are complex or time-sensitive, the system must offer features that match these demands.

Technology characteristics such as speed, user-friendliness, reliability and mobile access are therefore crucial. When there is a high TTF task the system enables health workers to complete their tasks more efficiently and accurately, health workers are more likely to perceive it as valuable and integrate it into their routine practice. On the other hand, a poor fit leads to frustration, workarounds, or system abandonment. Thus, TTF explains why technically advanced systems may fail if they do not meet the real-world needs of healthcare professionals.

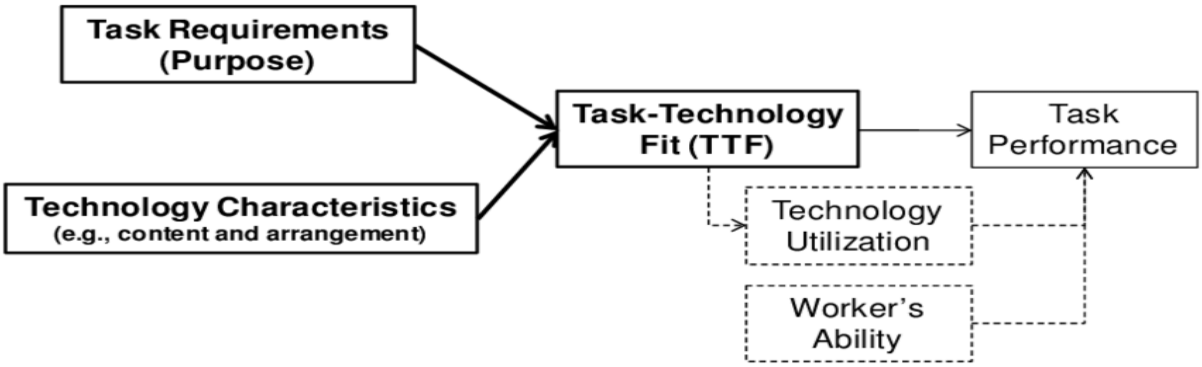

Figure 2. 2: Task Technology Fit Theory, (Source: Goodhue and Thompson)

2.4.3 Normalization Process Theory (NPT)

May and Finch (2009) argue that other implementation approaches often overlook what is required to sustain an intervention in routine practice, whether by professionals or patients. To address that gap, developers of NPT proposed a sociological framework that considered both individual and organizational support, offering a comprehensive approach to understanding the implementation and maintenance of interventions. They continue to describe how NPT provides tools to understand and explain the social processes that underpins the implementation of material practices. They argue that these practices become routinely embedded in social contexts through the efforts of individuals and the teams working to implement, sustain and assess new technologies or practices highlighting.

Implementation work within NPT is structured into four key categories: coherence, cognitive participation, collective action and reflective monitoring that decompose the process into manageable components and the approach helps to better understand how and why certain processes succeed or fail (Sæbo et al, 2011) by providing valuable lens for understanding how e-Health systems become routinely used in public healthcare facilities. The process begins with coherence, where users develop a shared understanding of the system's purpose and value through recognizing how digital records streamline patient management. This s followed by cognitive participation, as key actors such as departmental heads, IT or HRIOs champions invest time and effort in driving engagements and building commitment across the team. Successful implementation also depends on collective action, where staff incorporate the system into daily tasks, adjust workflows and collaborate to ensure smooth integration. Finally, reflexive monitoring allows users to evaluate the system's effectiveness and provide feedback for improvement by helping the facility to refine its practices and sustain long-term use. These constructs explain how e-Health systems shifts from being new or unfamiliar tools to becoming normalized elements of everyday healthcare delivery. NPT specifically focuses on the processes involved in implementing, embedding and integrating new technologies into everyday practice.

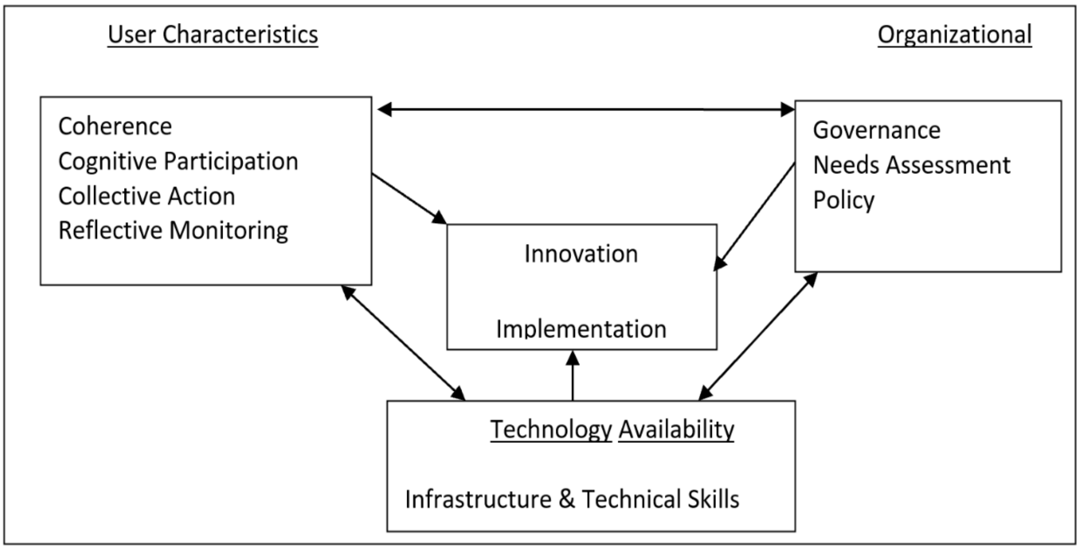

Figure 2. 3: Normalization Process Theory, (Source: May and Finch)

2.4.4 Interrelationship of Concepts

The combination of NPT, TTF and UTAUT offers a multidimensional view of routinization whereby UTAUT explains initial acceptance, TTF explains alignment with clinical tasks and NPT addresses how systems become embedded in daily practice which forms a conceptual map that guided the study.

2.5 Current Status of e-Health Use in Public Healthcare Facilities

In Kenya, the MoH has made significant investments and policy advancements towards digital health transformation. It has been progressively embracing e-Health following the launch of the Kenya eHealth Policy 2016 – 2030 which outlines strategic pillars aimed at improving healthcare outcomes through technology, enhanced service delivery, data accuracy and decision making (MOH Kenya, 2016). Several systems such as the DHIS2, Integrated Human Resource Information System (iHRIS), Afya Care, KenyaEMR, IQCare and KenyaEMR have been rolled out across various counties to support digital data management, patient record tracking and performance monitoring (Githinji et al., 2021).

EMR is used for patient management, DHIS2 for data reporting and LMIS for supporting logistic (Kimathi et al., 2020). Several e-Health systems have been adopted to strengthen healthcare services and the most widely used being AfyaCare which supports patient data management, especially in HIV/AIDS and maternal care programs. These systems are deployed across public health facilities with support from partners like PEPFAR and United States Agency for International Development (USAID).

HIS plays a critical role in routine data reporting where Kenya utilizes the DHIS2 nationwide to collect and analyze health indicators at all levels of care. LMIS which is a supply chain management system used for tracking essential commodities and ensuring timely resupply and maintaining stock levels of medicines, vaccines and laboratory supplies particularly in rural and underserved regions (MOH Kenya, 2019). Additionally, HRIS manages data related to healthcare workers and staffing (WHO, 2020). Other systems include mHealth and telemedicine platforms like M-TIBA, Afya Pap and iSikCure which provides mobile access to health financing, chronic disease monitoring and remote consultations (Safaricom, 2022; Access Afya, 2021).

Kenya also employs the basic laboratory information system (BLIS) for diagnostic and laboratory information management in selected public healthcare facilities (CDC Kenya, 2018). The national health insurance fund uses e-Claim system to support electronic processing of medical insurance claims, enhancing transparency and efficiency (NHIF, 2022). M-TIBA is a mobile health wallet that enables low-income users to save, send and spend funds on medical services, often integrated with partner health providers. For disease surveillance, Kenya has Integrated Disease Surveillance and Response (IDSR) tools within DHIS2 which enhances early detection and response to health threats (MOH Kenya, 2020).

In Kenya, various e-Health systems have been rolled out, including the DHIS2, EMRs, HRIS, Laboratory Information Systems (LIS) and mHealth platforms. These systems aim to digitize health records, streamline workflows and improve reporting and accountability (MOH Kenya, 2019; WHO, 2021).

2.7 Factors Influencing Routinization of e-Health Systems

The successful routinization of e-Health systems is influenced by a combination of user-centered, technological and organizational factors. These dimensions work together to determine whether e-Health tools are consistently adopted and integrated into daily healthcare operations.

2.7.1 User - Characteristic Factors

These relates to the knowledge, attitude and behaviors of the healthcare workers who interact with e-Health systems.

2.7.1.1 Digital Literacy

Health workers are able to navigate eHealth tools through digital literacy which significantly affects routinization. Studies show that training improves confidence, reduces errors and enhances consistent use (Were et al., 2019).

2.7.1.2 User Attitudes and Perceptions

Healthcare workers positive attitudes and perceptions towards the usefulness and ease of eHealth systems increases acceptance influence habitual use which leads to systems being routinized. Resistance is common if users perceive systems as burdensome or unreliable (Munyisia et al., 2014).

2.7.1.3 Workload and Motivation:

High workloads can deter system use if the technology increases perceived burden. Conversely, if the e-Health system reduces time spent on manual tasks then it can improve user satisfaction (Akanbi et al., 2012).

2.7.1.4 Repetition

Repetition helps build habits, which are fundamental to routinization. The more often healthcare providers use an e-Health system, the more likely it becomes part of their daily routine. Over time, repeated actions become automatic, making the use of the system second nature. Repeated execution of the standardized tasks, helps in reinforcing the routine, the tasks become in-built leading to efficiency and consistency. For example, if doctors repeatedly input patient data or use telehealth for consultations, they develop a pattern, reducing the cognitive effort needed to perform these tasks over time.

2.7.1.5 Training and User Competency

Continuous training improves user proficiency, builds confidence and reduces resistance. When healthcare workers understand how to use systems effectively, they are more likely to make them part of their daily routines (Boonstra & Broekhuis, 2010).

Providing comprehensive training programs for healthcare providers and staff to ensure proficiency in using e-Health systems and understanding their benefits and limitations is crucial for the digital transformation of healthcare.

2.7.2 Technological Factors

2.7.2.1 System Usability and Functionality

These factors relate to the design, performance and usability of the e-Health systems. User-friendly and intuitive interfaces that require minimal training significantly enhance the daily adoption of e-Health systems, while complex designs lead to user frustration and inconsistent usage (Ludwick & Doucette, 2009; Venkatesh et al., 2003). Involving end-users in system design, customization, and feedback fosters relevance and a sense of ownership, which supports long-term use.

Reliable infrastructure such as stable power, internet, functional hardware and up-to-date software is essential, as technical failures undermine trust and discourage use (Were et al., 2010). Additionally, interoperability with other health platforms enables comprehensive data access and continuity of care, further reinforcing routine usage. Systems that align well with existing clinical workflows are less disruptive and more readily integrated into everyday practice.

2.7.2.2 Workflow Integration

Seamless integration of e-health tools into clinical and administrative workflows is vital for enhancing efficiency and reducing disruptions in healthcare settings. This process involves ensuring system interoperability, intuitive design, and alignment with healthcare providers' natural routines. Tools like EHRs and clinical decision support systems must be both functionally integrated and user-friendly to be effective (Nourimand et al., 2022).

Integration also promotes consistent and effective tool usage, which reduces medical errors, shortens treatment delays, and improves care coordination (Heath, 2018). Key elements include standardization, policy alignment, and user adaptation to optimize healthcare delivery and decision-making.

However, inefficient integration can negatively affect healthcare workers, contributing to burnout (Goh, Gao & Agarwal 2011). Positive outcomes such as satisfaction and confidence are associated with sufficient training and well-designed systems, while poor training and weak social support structures can lead to frustration (Bergua & Bouisson, 2008). A holistic strategy involving system evaluation, user-friendly interfaces, and proper training is therefore essential.

Moreover, effective workflow integration ensures e-health systems complement existing processes like patient registration, diagnosis, and documentation. Well-integrated systems align with organizational goals, while poor integration often causes user resistance and undermines routinization (Carayon et al., 2015).

2.7.2.3 Infrastructure and Technical Support

Reliable infrastructure such as internet connectivity, hardware and software systems facilitates uninterrupted system use. Additionally, timely technical support ensures that system errors or downtimes do not derail operations (Were et al., 2010).

2.7.3 Organizational Factors

Organizational support encompasses leadership commitment, policy and standardization enforcement, performance monitoring, incentives, sustainability and change management, they support structures and leadership which play a crucial role in enabling routinization.

2.7.3.1 Leadership and Management Support

Visible and sustained commitment from healthcare leadership is essential for promoting e-Health adoption, as it signals priority and ensures proper resource allocation (Greenhalgh et al., 2017). Additionally, organizational incentives such as recognition, opportunities for career growth and better working conditions can motivate staff to embrace and consistently use e-Health systems.

Support from facility managers and policymakers influences routinization. Leaders can promote usage through policy enforcement, resource allocation and role modelling (Kiberu et al., 2014).

Gagnon et al. (2012) emphasizes that successful EMR implementation depends not only on technology but also on financial readiness, human factors, and organizational strategy. Thoughtful planning, leadership, and aligned incentives are critical for overcoming obstacles in the adoption process.

2.7.3.2 Policy, Procedure Development and Standardization Frameworks

Clear policies, well-defined procedures, and standardization frameworks play a pivotal role in the routinization of e-Health systems by establishing consistency, legitimacy and uniformity in system use. Policies at both national and institutional levels provide the formal mandate and governance necessary for consistent digital health practices, ensuring alignment with data protection standards, privacy regulations and long-term system integration (WHO, 2016). Procedure development offers structured, step-by-step guidance on how to use digital tools such as EHRs and telemedicine platforms, reducing ambiguity and enabling healthcare providers to incorporate these systems into daily workflows with confidence. Standardization frameworks, such as those developed under the InteropEHRate initiative in the EU, promote interoperability, uniform technical protocols, and consistent terminology across institutions, which are critical in minimizing training disparities and supporting habitual system use (Alenoghena et al., 2022). Collectively, these elements foster shared understanding, reduce resistance to change, and transform one-time technology adoption into embedded, sustainable practice within healthcare facilities.

2.7.3.3 Change Management, Performance Monitoring and Feedback Mechanism

Effective change management ensures that transitions to digital systems are smooth, supported by guidelines and reinforced by supervision and feedback mechanisms. Without such support, routinization efforts are often short-lived or inconsistent (Fixsen et al., 2005). Regular monitoring and supportive supervision are essential for encouraging accountability, improving performance, and ensuring early identification of usage gaps in e-Health systems. Continuous performance tracking enabled by technologies such as wearables and IoT devices enhances care delivery, especially for chronic diseases, by offering real-time feedback and early detection (Su et al., 2023).

Effective system monitoring also relies on collecting real-world data from patients and clinicians, as well as high-quality surveys, to guide ongoing optimization and ensure safety particularly when digital tools undergo post-market updates (Cruz-Martínez et al., 2019). Advanced observability tools help track performance metrics, diagnose system issues quickly, and minimize service disruptions (Tian & Chen, 2022).

Successfully adopting e-Health systems requires strategic change management to navigate cultural and organizational resistance. This includes engaging stakeholders, fostering commitment, and demonstrating value in improving care (Nurmaidah et al., 2024). Case studies, such as at Rahman Rahim Hospital, show that structured strategies emphasizing leadership, communication, and support can build organizational commitment and reduce resistance (Su et al., 2023).

Digital transformation also brings moral dilemmas and conflicts for healthcare professionals, such as balancing innovation with quality-of-care (Naamati-Schneider et al., 2024). Addressing these challenges requires aligning implementation with staff values to reduce burnout and promote acceptance (Wong et al., 2020). User resistance emerging from individual, organizational, and systemic factors must be understood through a multi-stakeholder lens. Targeted interventions that consider perspectives from patients, providers, and policymakers are crucial for overcoming barriers and sustaining e-Health adoption (Talwar et al., 2021; Cruz-Martínez et al., 2019). Facilities that monitor usage and gather feedback are better positioned to identify problems and enhance routinization.

2.7.3.4 Sustainability, Institutionalization and Planning

Sustainability refers to the continued, long-term use of e-Health systems beyond initial implementation phases. Institutionalization is the process by which these systems become part of standard procedures, policies and expectations within the health system (Paina & Peters, 2012). Ensuring that e-health systems are financially and operationally sustainable in the long term. This includes budgeting for ongoing maintenance, upgrades, and training, as well as securing funding sources. Long-term financial investment in infrastructure, training and system maintenance is vital. Projects without sustained funding often collapse post-pilot (Scott et al., 2018).

2.8 Challenges in Routinizing e-Health Systems

Despite the presence of enabling factors, many healthcare facilities especially in developing regions encounter various challenges such as legal, technical and integration issues, which hinder the seamless exchange of health data across borders (Grguric et al., 2021) that prevents eHealth systems from becoming routine.

2.8.1 Inadequate and Irregular ICT Training

Many public health facilities lack structured and continuous training programs for e-Health system users. In most cases, training is offered only during system rollout or project initiation, with limited follow-up or refresher sessions. This one-off approach results in knowledge gaps among staff and uneven system use, as not all healthcare workers are equally equipped to operate the technology. For example, in Meru County, only 10 % of health workers had undergone formal classroom training on information management, while over 90 % relied on inconsistent on-the-job learning (Wakaba et al., 2014). In Tanzania, 81 % of care providers had no HMIS training, underscoring the absence of systematic in-service and pre-service capacity development (Ngongo et al., 2010). The resulting knowledge gaps and dependency on a few trained individuals often become the key users and system "champions", while this may ensure short-term functionality, it creates vulnerability when staff turnover, transfers, or absenteeism occur, as the system's continuity depends heavily on these few individuals; health workers themselves have cited burnout and a critical need for continuous capacity-building (Oduor et al., 2021). Over-reliance on a limited pool of trained staff not only threatens sustainability but also discourages routinization, since new or untrained staff may revert to manual processes when they encounter difficulties with the system. Furthermore, training opportunities are frequently skewed toward select cadres (e.g., doctors and nurses), leaving other roles such as administrators and ICT support staff without adequate professional development, further worsening vulnerabilities (Maina et al., 2022; Nzivo et al., 2022). Across LMIC contexts, scholars argue that the chief limitation to e-Health sustainability is not technology per se, but rather persistent shortages of trained personnel and lack of continuous support mechanisms (Adu et al., 2023). Studies in low- and middle-income countries show that ongoing, institutionally embedded training programs including mentorship, refresher courses and user-support mechanisms are crucial for building capacity, reducing resistance and ensuring long-term use of e-Health systems.

2.8.2 Poor Infrastructure

Inconsistent power supply, limited internet access and outdated hardware significantly hinder the day-to-day use of e-Health tools, particularly in rural healthcare settings where these infrastructure deficits are most acute. In Kenya for instance, unstable electricity and high mobile internet costs continue to undermine telemedicine efforts (Ouma & Herselman, 2008). Muchira et al., (2021) adds that inadequate infrastructure (electricity, internet), inconsistent data standards and interoperability issues, concerns about data privacy and policy implementation under the Digital Health Act are among challenges facing public healthcare particularly in western Kenya. These systemic issues are exacerbated by a strained healthcare workforce, political influences on service delivery following devolution, and broader challenges in achieving Universal Health Coverage. Kenya's rural telemedicine is still disrupted by power outages and costly connectivity issues, studies across Kenyan hospitals reveal that inadequate computing equipment, broken peripherals and patchy network connectivity often lead to abandonment of electronic systems, especially during power interruptions when no fallback mechanisms exist (Muinga, N., Magare, S., Monda, J. et al., 2020). In Sierra Leone, research shows that most rural health units lack institutional internet, rely on solar or no power and possess limited functional hardware - 43% of facilities cite poor electricity as their greatest barrier to digitization (Chukwu et al., 2022). Studies adds that erratic power and limited connectivity disrupt even established mHealth services, causing delays and redundant work with similar patterns evident in Ethiopia, where less than 10% of rural health posts had electricity as recently as 2016, curtailing mobile-based health initiatives (Harding et al., 2018). Across rural and low-resource contexts more broadly, limited access to devices, slow or expensive internet and low digital literacy compound these infrastructural issues which jeopardizes not just adoption but also the long-term sustainability of e-Health.

2.8.3 Resistance to Change

Healthcare workers sometimes view e-Health systems as disruptive, fearing increased workload or loss of control over clinical decisions. Cultural resistance and lack of awareness further exacerbate this challenge. Resistance often arises due to lack of training, poor system design, workflow disruptions, increased workload, fear of surveillance or lack of involvement in decision-making (Cresswell, K., & Sheikh, A. 2013).

2.8.4 Lack of Interoperability

Many e-Health systems operate in silos, making it difficult to share data across departments or facilities, this fragmentation discourages routine use and reduces the overall system effectiveness. In Kenya for instance, digital health systems were deployed independently across public and private facilities and have created “data islands,” leading to incomplete patient histories, redundant procedures and workflow disruption due to the absence of interoperability mandates (DoctorsExplainFM, 2023a, 2023b). In Homa Bay County, siloed EMRs introduced by different vertical programs have further fragmented healthcare data, with manual patient identification and inconsistent record-keeping practices undermining both data quality and utilization (Ochieng et al., 2024). More broadly, insufficient interoperability among heterogeneous HIS has been shown to diminish care quality and increase resource wastage through duplication and disorganized information flows (Nemesure et al., 2023). In Morocco, EHR implementations have often followed siloed strategies, resulting in repeated errors, lack of collaboration and the absence of standardized protocols for data sharing (Tazi et al., 2019).

2.8.5 Limited Monitoring and Evaluation

Without consistent monitoring, it becomes difficult to track usage patterns, identify system bottlenecks and adjust implementation strategies. The absence of such mechanisms often results to poor accountability and the lack of effective feedback loops that support continuous improvement. Scholars emphasize that monitoring is a critical component of system implementation and sustainability, as it enables real-time tracking, evaluation and adaptation to emerging challenges (GeeksforGeeks, 2024; Insight7, 2024; OpsPros, 2023).

2.8.6 Lack of standardized structures

In many developing countries, the rapid advancement of ICT has the potential to significantly impact healthcare service delivery. However, the absence of structured and standardized methods for health data poses significant challenges. Achieng and Ruhode (2021) identified fragmentation and weak coordination as barriers that limit the realization of e-Health strategies in public hospitals. Barua et al. (2025) similarly noted that inconsistent record-keeping and the lack of standard patient identifiers hinder reliable data integration and scalability. A broader review of health informatics efforts across developing contexts further emphasizes that infrastructural and standardization gaps continue to undermine sustainable digital health implementation (Pineda Rincón, & Moreno-Sandoval, 2021).

2.9 Empirical Review

Empirical studies reveal both promising outcomes and ongoing challenges highlighting how real-world implementation and routinization of e-Health vary and evolve. The COVID-19 pandemic significantly accelerated the adoption of digital health technologies. e-Health played a pivotal role in maintaining care delivery, leveraging telemedicine, wearable sensors, AI and IoT for remote monitoring (Chatterjee et al., 2023). It reinforced the need for resilient system architectures and mHealth tools.

Studies have explored the use of Enterprise Architecture (EA) in healthcare. Junior (2020) reviewed methodologies, tools and critical success factors in EA deployments, noting the absence of comprehensive frameworks in many contexts.

Sevic (2023) examined e-Health interventions in workplace environments, finding mixed results due to methodological heterogeneity and limited standardization in evaluation. Although there have been notable advances, many healthcare systems continue to face challenges related to interoperability, data security and long-term integration of new technologies.

Usability was identified as a key success factor, with methods like remote user testing, expert review and rapid iterative evaluation used to ensure systems are user-friendly and adoptable in routine workflows (Sinabell & Ammenwerth, 2022).

In medication management, e-Health systems enhanced drug adherence, caregiver communication, and patient monitoring. However, variability in methodologies across studies calls for greater standardization (Wong et al., 2020).

For chronic diseases, especially cardiovascular conditions, e-Health interventions improved patient self-management and reduced hospital readmissions. Yet, their effect on long-term behaviour changes and quality of life remains inconclusive (Su et al., 2023; Cruz-Martínez et al., 2019).

Notably, workarounds by users due to system complexity or misalignment with clinical routines can compromise patient safety and limit the benefits of these technologies (Bergua & Bouisson, 2008). These studies underscore the need for ongoing evaluation and adaptation to ensure technologies become deeply embedded in practice.

Shared decision-making tools integrated into EHRs, such as the CV Prevention Choice tool, has demonstrated that targeted documentation and collaboration among IT teams can facilitate seamless integration, thereby supporting the adoption of shared decision-making practices (Heath, 2018).

Adopting a "digital determinants of health" framework can help in systematically incorporating digital health competencies into medical education, ensuring that healthcare providers are well-equipped to navigate the intersections of health outcomes and health technology (Nourimand, et al., 2022).

Furthermore, the impact of EHRs on clinical outcomes is mixed, with improvements in patient safety and communication between healthcare providers being contingent on the quality of the EHR system, its implementation and the training provided to healthcare professionals (Mousavi, et al., 2018).

ICT's ability to generate real-time information facilitates swift, evidence-based decisions and timely actions in clinical and administrative domains. Given its success in sectors such as banking and commerce, there is strong optimism that replicating ICT principles in healthcare will enhance efficiency and responsiveness in health service delivery.

2.9.1 Global Context

Globally, ICT has become a cornerstone for monitoring, evaluation, and management in healthcare systems. Coiera and Hovenga (2007) notes that HIS in developing countries often suffer from fragmentation and siloed operations, relying on manual processes that hinder integration. In many cases, systems are provider-specific, failing to support data exchange across departments or institutions. To address these challenges, researchers and institutions advocate for integrated HIS platforms that ensure data accessibility and continuity of care. This includes tools such as EHRs, patient registries and knowledge-sharing systems. These systems aim to ensure the right information reaches the right person at the right time, in a secure and usable format, thereby enhancing care delivery, research and education.

According to WHO-ITU (2012) e-Health implementation efforts can be classified into three broad phases: - Experimentation and Early Adoption, Development and Building Up and Scaling Up and Mainstreaming. These stages reflect a gradual transition from pilot projects to fully integrated national systems, offering a benchmark for countries at various levels of e-Health maturity. Therefore, the national context for e-Health development can be classified into three distinct divisions as illustrated in figure 2.4 below, based on the ICT environment and enabling environment for e-Health.

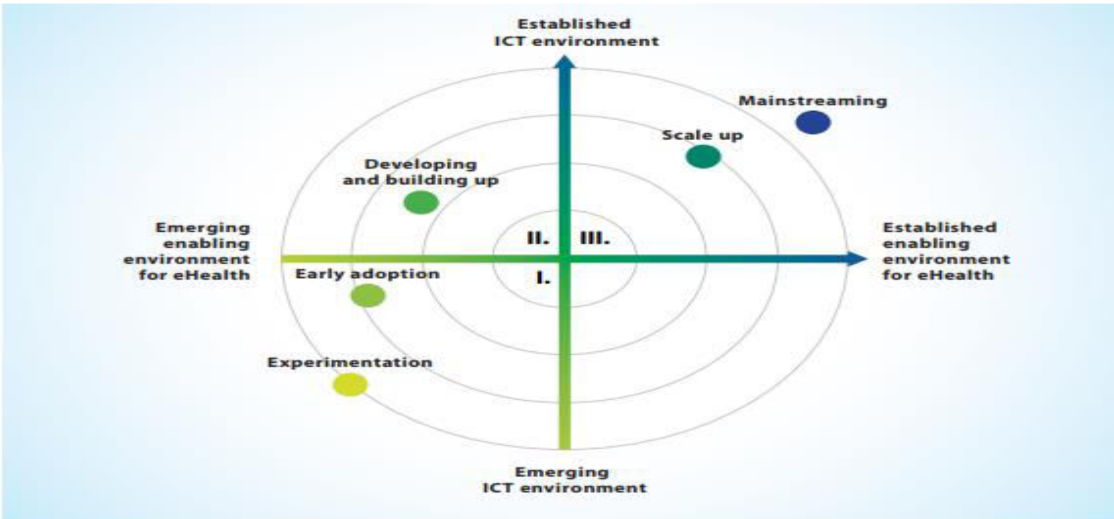

Figure 2.4: National context for eHealth development (Source: (WHO – ITU, 2012))

e-Health adoption varies across the globe, high-income countries like the United States, the United Kingdom, the Netherlands and Australia are leaders in research, international cooperation and implementation, supported by strong governance frameworks and widespread EHR availability (Okpechi et al., 2022; Nwagwu & Onyancha, 2022). However, collaboration between Eastern and Western countries remains limited. Despite rapid technological advances, low-income countries face slow adoption, constrained by infrastructure gaps, limited access to internet-based services and a lack of supportive policies (O'Connor & Heavin, 2018). There is growing interest in innovations such as lightweight authentication protocols and patient-guiding technologies, which require interdisciplinary cooperation (Sylva et al., 2012).

Developing and implementing policies and procedures to support the routine use of e-Health systems is crucial for enhancing healthcare delivery (Goh, et al., 2011). A coherent strategy is essential, as highlighted by stakeholders from Austria, Switzerland and Germany, who emphasized the importance of a consistent e-Health strategy, consensus-building and implementation geared towards practical use in patient care (Bergua & Bouisson, 2008). In Indonesia, the rapid adoption of tele-Health during the COVID-19 pandemic has underscored the need for robust policies that ensure organizational support, equity and legal backing.

Workflow Management Systems can automate administrative procedures, enhancing efficiency and effectiveness in healthcare services. For instance, a RESTful Workflow Management Systems developed using Microsoft .NET 6 and the open-source Elsa Workflows library allows for customizable workflows in a no-code environment, demonstrating practical application in a real healthcare environment (Junior, et al., 2020). The digitization of medical health records has been shown to improve operational efficiency by enhancing access to patient information, streamlining workflows, reducing documentation errors and improving communication among healthcare stakeholders (Sevic et al., 2023).

Moreover, the methodical application of Routine Health Information Systems (RHIS) data is essential for effective planning, monitoring, and the provision of supportive supervision at both district and facility levels. Nonetheless, considerable deficiencies exist in the pragmatic utilization of RHIS data for these objectives (Sinabell & Ammenwerth, 2022).

Goh et al., (2011) provides a process-oriented perspective on the routinization of Health IT by investigating how computerized physician order entry (CPOE) systems become embedded in clinical practice over time, the study found that Health IT routinization is not a static or top-down process, but rather an adaptive and emergent outcome of repeated user interaction, organizational support and local workflow adjustments. Notably, the authors emphasized the role of narrative networks shared stories and informal knowledge that shape perceptions and reinforce consistent use. Furthermore, they note that peer champions and institutional alignment are vital in encouraging sustained system engagement.

2.9.2 African Context

Across Africa, significant strides have been made in developing policies, standards, and governance structures for e-Health. Countries such as Ethiopia, Ghana, Malawi and Tunisia have established dedicated bodies to oversee e-Health implementation (Mamuye, 2022; Meseret, 2022).

The BETTEReHealth registry and the efforts by the Africa CDC to establish continent-wide HIE policies are notable milestones (Manby, 2022; Bensbih, 2020). Nonetheless, widespread implementation faces persistent challenges: lack of interoperability, insufficient infrastructure and poor systems thinking hinder the routinization process (Larbi, 2022; Mamuye et al., 2022).

2.9.3 Kenyan Context

Although the government has initiated supportive policies and infrastructure, key barriers include inadequate ICT infrastructure, limited workforce capacity and gaps in policy implementation (Njoroge, 2017; Imbamba & Kimile, 2017). In Kenya, the e-Health landscape is emerging but promising, a review of 69 e-Health projects revealed that most initiatives focus on HIV/AIDS and primary care, with only a few having been scaled or rigorously evaluated (Shirandula, 2022). The potential for growth is high due to widespread mobile phone usage and entrepreneurial innovation, but lack of interoperability and standardized data systems continues to delay full routinization.

2.10 Summary of Related Studies

Table 2. 1: Summary of Related Studies

Table 2.1 provides a summarized overview of key gaps identified by various experts and outlines how the researcher intends to address these gaps.

Author	**Study Purpose**	**Methodology**	**Study Findings**	**Research Gap**
Venkatesh et al. (2003) – UTAUT Model	To examine factors influencing user adoption of technology.	Quantitative survey	Performance expectancy and effort expectancy drive adoption.	Does not account for long-term sustainability factors.
May & Finch (2009) – NPT Model	Implementing, Embedding, and Integrating Practices: An Outline of Normalization Process Theory	Qualitative study with case studies	Coherence and reflexive monitoring are key to integration.	Lacks empirical validation across diverse health settings.

Goodhue & Thompson (1995) – TTF Model	To assess how well technology supports user tasks.	Survey-based quantitative study.	Technology fit significantly impacts successful adoption.	Overlooked behavioural and organizational barriers.
Goh, J.M., Gao, G., & Agarwal, R. (2011)	Evolving Work Routines: Adaptive Routinization of Information Technology in Healthcare	Longitudinal case study.	Institutional support and monitoring enhance routinization	Limited discussion on policy adaptation.
Gagnon et al. (2012)	Determine barriers to EMR adoption	Mixed methods	Highlighted usability and training as key barriers	Limited focus on post-adoption use
Kimathi et al. (2020)	Examine eHealth implementation in Kenyan counties	Case study	Found partial adoption due to infrastructure and training gaps	Did not assess routinization outcomes
Mair et al. (2012) – Telehealth Integration	To evaluate the adoption of telehealth in chronic disease management.	Systematic review of case studies.	User engagement and workflow alignment	Trust issues and unclear policies hinder adoption.

			determine success.	

Source: Compiled by the Author from various literature sources, 2025

2.11 Research Gap

Although numerous studies have examined the adoption and implementation of e-Health systems within Kenya's public healthcare sector, there remains a significant research gap concerning the routinization of these systems that is, their long-term and consistent use in daily healthcare practices. Much of the existing literature focuses on pilot programs or short-term deployments without adequately exploring how digital health solutions are integrated into routine workflows over time.

This study aims to bridge that gap by exploring how organizational, technological, and user-related factors influence the routinization process, with a specific focus on healthcare facilities in Kakamega County. The study highlights the limitations of current frameworks that often fail to consider the complex and interdependent nature of human, technical, and organizational dimensions in sustaining e-Health initiatives, particularly within resource-constrained settings like those found in many Kenyan public hospitals.

Critical issues such as policy support, system usability, training and capacity building, infrastructure availability and governance structures are frequently underemphasized in the existing literature. Moreover, the social and behavioural components including leadership, organizational culture and staff motivation are not sufficiently examined despite their significant influence on the successful integration and continued use of e-Health tools.

In response to these gaps, the study advocates for the development of a localized and structured routinization architecture that would serve as a practical guide to support the sustained, integrated and effective use of digital health systems. By addressing the interplay of technological functionality, user engagement and organizational readiness, the study contributes to a more comprehensive understanding of what it takes to embed e-Health systems into everyday practice. Ultimately, the findings are expected to inform more robust strategies for strengthening national e-Health policies and improving healthcare service delivery through technology.

2.12 Conceptual Framework

The study investigated the factors influencing the routinization of e-Health systems in public healthcare facilities in Kakamega County, Kenya. Unlike adoption, which refers to the initial uptake of a system, routinization refers to the sustained, habitual use of e-Health systems integrated into the daily workflows of healthcare workers and this includes systems such as EMRs, HIS and clinical decision support systems. The goal was to identify and analyze the organizational, technological and user characteristics factors that determine whether these systems are routinely used in healthcare delivery. The study had independent variables which was grouped into three factors each having constructs that speak to the factor and moderating variable and a dependent variable.

Organizational factors play a critical role in the routinization of e-Health systems through management support which is essential by ensuring leadership endorsement through providing strategic direction, provision of resources, clear vision, active championing of ICT projects and actively encouraging consistent system use. Equally important is training and capacity building, which involves implementing regular training programs to equip healthcare staff with the competence and confidence needed to effectively utilize digital tools and not just go-live. A supportive organizational culture characterized by shared values that promote innovation, continuous learning and accountability also enhances the likelihood of sustained system use. Finally, through the task technology fit, the degree to which the technology functionality aligns with and supports the specific clinical tasks it is intended for, a poor fit is a major barrier to routinization. Implementation process quality through effective project management, clear communication and involvement of end-users in design and testing.

Technological factors significantly influence the successful routinization of e-Health systems. One key factor is system usability and user interface, which refers to how user-friendly the interface is and how easily users can navigate the system. When systems are intuitive and simple to operate, users are more likely to adopt them consistently. System reliability and performance also play a major role; systems must be consistently available, accurate and responsive to meet the demands of busy healthcare settings. Equally important is technical support availability, which ensures that users have timely access to IT assistance whenever challenges arise, minimizing disruptions. Additionally, technological availability is the presence of adequate ICT infrastructure such as computers, networks and a stable power supply which supports uninterrupted system use. Lastly interoperability is the ability of a system to exchange and use information with other systems (e.g., labs, pharmacies, other healthcare facilities).

User characteristics are central to the routinization of e-Health systems, as they directly influence how individuals engage with the technology. User attitudes and perceptions, including beliefs about the usefulness and relevance of e-Health systems play a pivotal role in shaping acceptance and continued use. Users who view the systems as beneficial and aligned with their work objectives are more likely to integrate them into routine practice. Computer self-efficacy and experience affect users’ ability to confidently navigate digital platforms and use of ICT systems successfully; those with prior exposure to similar technologies tend to adapt more quickly. Another critical consideration is the perceived workload impact, whether the system is seen as streamlining tasks or adding to the burden. Systems perceived as efficient and time-saving are more likely to be adopted as long-term. Lastly, peer influence and social norms, including the expectations and behaviours of colleagues, can either motivate or discourage routine use depending on the prevailing workplace culture.

Moderating Variables (The Contingencies), these variables influence the strength of the relationship between the independent variables and dependent variable. Clinical context and workflow criticality: the relationship between usability and routinization is much stronger in a high-acuity, fast-paced environment like an Emergency Department compared to a slower-paced administrative office. User Characteristics more especially professional role: through the impact of training on routinization may be moderated by role (e.g., physicians vs. nurses vs. clerks may have different training needs and adoption patterns). Age and Digital Literacy: are not deterministic, though these factors can moderate how perceived ease of use influences initial adoption and subsequent routinization. Additionally, leadership and champion influence: the presence of a clinical champion (a respected clinician who advocates for the system) can strengthen the positive effect of management support and weaken the negative effect of early system quality issues.

The Dependent variable was ICT routinization of e-Health Systems as the key outcome of the study, moving beyond initial "use" to deep, sustainable integration. Routinization is the continued and consistent use of e-Health systems after the initial implementation phase, full integration of systems into routine clinical and administrative tasks, sustainability over time despite changes in personnel, policy, or resources and reduction in reliance on manual systems and paper records.

Anticipated outcomes of ICT routinization are clinical and quality outcomes through improved patient safety (e.g., through CDSS alerts), better care coordination, enhanced adherence to clinical guidelines. Efficiency Outcomes; reduced medication errors, decreased transcription costs and faster access to patient information. Data and Strategic Outcomes; generation of data for quality improvement, research and population health management and lastly User Outcomes; reduced cognitive load and increased job satisfaction (after the initial learning curve). Equally, poor routinization can lead to burnout and dissatisfaction.

2.12.1 Interaction of Variables in the Conceptual Framework

The conceptual framework presents a causal relationship where organizational, technological and user-related factors collectively influence the extent to which e-Health systems are routinized. A supportive organizational environment, reliable and accessible technology and positive user engagement create the conditions for routinization. For instance, a well-supported system with strong management backing, good infrastructure, skilled and motivated users are more likely to be embedded into routine practice.

This framework provides a holistic lens to plan, implement, and evaluate ICT projects in healthcare, emphasizing that successful routinization requires attention to technology, people, process and context simultaneously. Routinization is essential in Kakamega County because it will lead to improvement of data accuracy, enhancing patient care, decision making, increasing operational efficiency and ensuring the return on investment in digital health technologies. Innovated systems in healthcare organizations are predicted to be routinely impacted by different factors as indicated in the diagram in figure 2.4.

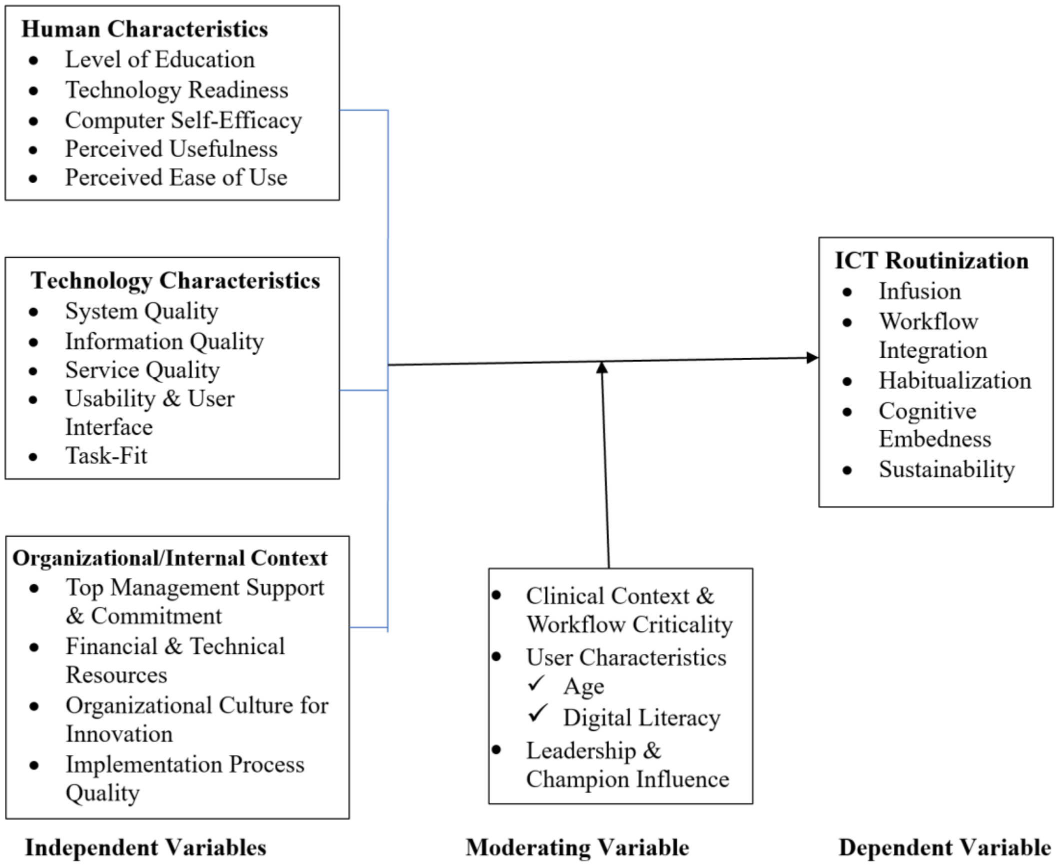

Figure 2. 4: Conceptual Framework of the study, (Source: Author)

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Overview

This section details the study's methodology which is organized according to the six levels of the research onion proposed by (Saunders et al., 2019): philosophies, methods, strategies, choices, time horizons, methodologies and procedures. The methodology outlines the research design, target population, sampling procedures, data collection methods and analysis techniques employed. Quantitative approach was used to integrate a robust and in-depth exploration of the phenomenon under study. The design enabled systematic gathering of relevant data, ensured reliability and validity. It further explains the data collection process, procedures and analysis methods used. The researcher consulted key experts in health and informatics, including practitioners, academics and supervisors, for their insights and guidance, supplemented by literature reviews for secondary data to inform the study's direction which facilitated drawing of meaningful conclusions aligned to the research objectives (Creswell, 2003).

3.1 Research Design

Saunders et al. (2019) depict the research process as an onion with numerous layers, each of which must be meticulously implemented throughout the research. Each layer philosophies, approaches, strategies, choices, time horizons, techniques and procedures must be contemplated prior to data collection and analysis, as per figure 3.1 below. The research design was aligned with the study objectives to ensure methodological consistency and validity. A descriptive survey design was deemed appropriate because it allows for systematic description and analysis of existing conditions without manipulation of variables (Kothari, 2014) and was adopted to assess the status of e-Health systems in public healthcare facilities, to analyze the factors influencing routinization, a descriptive-correlational design was applied, which allowed for both descriptive presentation and examination of relationships between variables. Finally, a developmental design was employed to synthesize empirical findings, expert consultations and existing literature into a routinization architecture for e-Health systems. The discussion commenced with the outer layer and progressed inward.

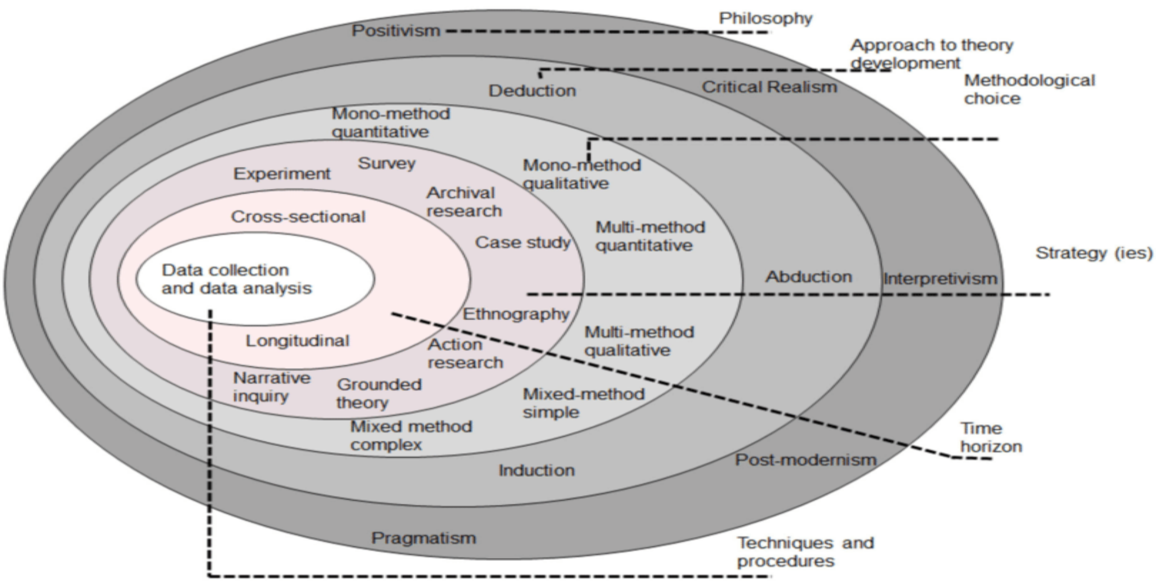

Figure 3. 1:Research Onion, (Source: Saunders et al., 2019)

3.2 Research Philosophy

The study was grounded in pragmatic research philosophy, which is particularly appropriate when addressing complex, real-world problems requiring flexible and outcome-oriented approaches which allows for methodological pluralism and focuses on the research problem rather than philosophical purity. Pragmatism is relevant to the study as it seeks to understand both the current status and the underlying factors influencing the routinization of e-Health systems in public healthcare facilities. The philosophy supports use of both quantitative data collection methods (questionnaires) and non-intrusive observation thereby enabling a practical approach to obtaining both measurable and contextual insights. This aligns with the pragmatic principle that "theories and methods are tools," and should be chosen based on their ability to provide useful answers to the research objectives.

3.3 Research Approach

Three distinct approaches to research exist: inductive, deductive, and abductive methods, each contributing uniquely to the development and organization of theory. The inductive method, often referred to as the "bottom-up" approach, entails the collection of evidence regarding a phenomenon to develop a theoretical framework surrounding it (Soiferman, 2010).

Alternatively, the "top-down" or deductive method starts with a preexisting theory and aims to put it to test using actual facts (Park, 2020; Saunders et al., 2019). The study employed deductive approach, where the investigation began with specific theoretical construct namely user-related, technological and organizational factors that were drawn from existing literature. These constructs guided the development of hypotheses and informed the structure of the data collection tools. The deductive approach allowed the researcher to test the relationships between variables and assess the extent to which they influence the routinization of e-Health systems.

3.4 Methodological Choice

Saunders, Lewis and Thornhill (2019) state that the third layer of the research onion is methodological choice, which entails choosing between qualitative, quantitative, or mixed methodologies for conducting research. Saunders et al. (2009) divides these techniques into three types: mono-method, mixed-method and multi-method. The study adopted a mono-method quantitative design through structured questionnaires, supported by non-intrusive observations which reflects the pragmatic stance. Quantitative method helped in measuring the extent of e-Health use and evaluating user characteristics, technological factors and organizational support factors. On the other hand, observation complemented these findings by offering contextual insights into how digital health tools are embedded in day-to-day operations. This approach allowed for systematic data collection on predefined variables and helped validate self-reported behaviours.

3.5 Research Strategy

According to Al Zefeiti and Mohamad (2015) the deductive method is often linked with case studies and survey methodologies. Saunders et al. (2019) is of the view that researchers frequently use survey strategies to answer questions such as who, what, where, how much and how many, which allows to generalize findings to a larger population. The survey method was used through structured questionnaires which facilitated data collection of standardized quantitative data from a large population of participants across the selected public healthcare facilities which helped in examining the current status of e-Health use and various factors that influence routinization of e-Health. In addition, non-participatory observations were conducted to gain firsthand insights into the physical layout, procedure, operational processes and the general environment in which e-Health systems are accessed to function routinely clinical workflows. This dual strategy enhanced the depth and reliability of findings by capturing both self-reported behaviour and observed practice.

3.6 Time Horizon: Cross Sectional

The study adopted cross-sectional time horizon which means that data was collected at a single point in time. This approach was suitable given the study's focus on capturing the current status of e-Health system use and routinization process across the selected healthcare facilities and factors influencing routinization without waiting for long-term behavioural change in Kakamega county. Although routinization is a dynamic and ongoing process, cross-sectional data provided a basis for understanding its current drivers and barriers which is critical for informing policy and future interventions.

3.7 Study Area

The research was carried out in Kakamega County, located in the western part of Kenya. The county encompasses an area of roughly 3,033.8 square kilometers according to the Kenya Population and Housing Census, housing a population of 1,867,579 residents. This figure constitutes 3.92 percent of Kenya's total population, thereby serving as a notable representation of the nation. This region hosts 192 healthcare institutions distributed across 12 sub-counties, positioning it as the fourth most populous county in the nation (Kenya National Bureau of Statistics [KNBS], 2019). The county is adjacent to seven others: Bungoma, Busia, Vihiga, Uasin Gishu, Transnzoia, Nandi, and Siaya, as illustrated in figure 3.2 below.

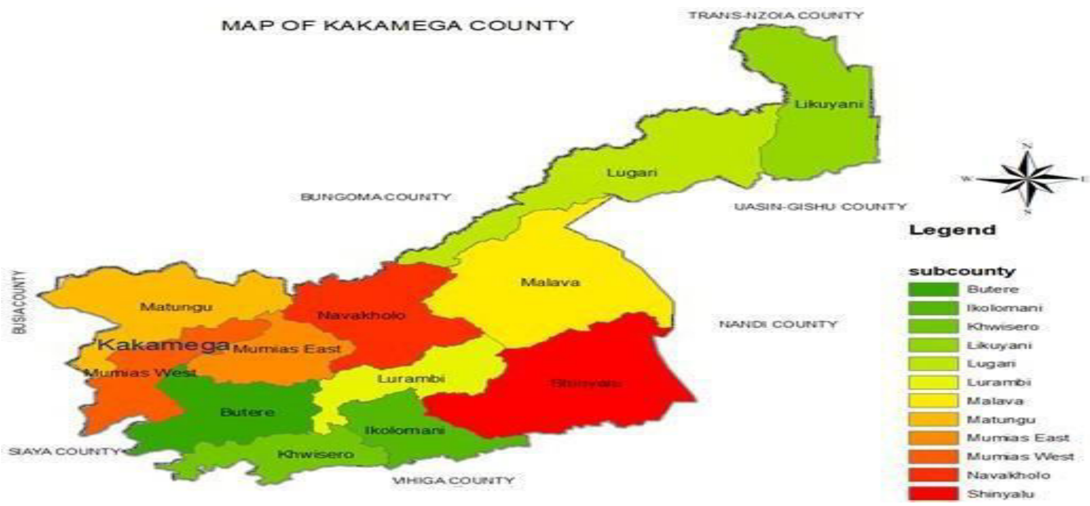

Figure 3. 2: Map of Kakamega (Source: Kenya Population and Housing Census Volume 1, 2019)

According to Adam (2020) collecting data from varied settings in a descriptive survey offers a realistic depiction of the field, enhancing the accuracy of the findings. Since the intended routinization architecture of e-Health systems is meant for nationwide implementation, drawing findings from such a representative population is crucial. The research findings were thus expected to be instrumental in guiding the deployment of similar systems in other counties nationwide. Kakamega is characterized by a mix of both rural and semi-urban settlements, presenting a diverse healthcare landscape that includes a broad spectrum of healthcare delivery challenges and it has a five-tier public healthcare system composed of Level 1 (Community Health Units), Level 2 (Dispensaries), Level 3 (Health Centers), Level 4 (Sub-County hospitals) and Level 5 (County Referral hospital). As of 2023, the county had 12 sub-county hospitals, 153 health centers and dispensaries and 1 county referral hospital (Kakamega County Integrated Development Plan [CIDP], 2023.

Kakamega County was selected for this study due to several key factors that make it uniquely suited for an investigation into the routinization of e-Health systems. Firstly, the county has been at the forefront of digital health pilot programs supported by the MOH and development partners. These include the implementation of the DHIS2, EMRs in high-volume facilities and community health information systems. Secondly, despite these efforts, prior assessments have shown that actual day-to-day usage of these systems remains inconsistent, with gaps in integration, user training and technological support issues central to the study's focus on routinization. Thirdly, the study sites represent various geographical location, economic endowment, levels of e-Health service utilization and policy contexts within the County where economic endowment ranges from well-resourced urban facilities to underfunded rural facilities.

Finally, Kakamega's combination of moderate technological advancement, policy support, ongoing e-Health interventions, resource availability alongside documented implementation, maintenance and staff adaptation challenges, provided an ideal context for investigating how e-Health systems move from introduction to sustained, routine use. Due to the county's expansive nature and the associated costs, the study could not cover all twelve sub-counties, necessitating a random selection of sites.

3.8 Target Population

The study focused on healthcare professionals employed in public healthcare institutions within Kakamega County. The county's workforce comprises a diverse array of professionals, including community health workers, physicians, surgeons, psychologists, pharmacists, nurses, midwives, physiotherapists, among others. The county directorate of health has undertaken initiatives to allocate the workforce in a manner that reflects the diverse needs of the population.

Table 3. 1: Distribution of the Target Population

Table 3.1 indicates distribution of healthcare workers according to the annual report by Kakamega County Public Service Board (2020). The county has 1800 healthcare workers employed and categorized in terms of permanent, contractual and temporary.

Sub County	**Number of Healthcare workers**
Butere	122
Shinyalu	120
Matungu	173
Ikolomani	161
Lurambi	223
Malava	147
Mumias West	172
Mumias East	136
Khwisero	153
Navakholo	127
Lugari	131
Likuyani	135
Total	1800

(Source: Kakamega County Public Service Board Annual Report, 2020)

The study participants were randomly selected from various service points among the selected public healthcare facilities, comprised of healthcare workers from (Admissions, Anaesthetic's, Emergency care, Cardiology, ENT, Critical Care, Finance, General Surgery, Gynaecology, Haematology, Health and Safety, Intensive Care Unit, Patient Accounts, Pharmacy, Renal Units, Radiology, Social Work, Sexual Health Department, VCT, Maternity, Theatre, Comprehensive Care Clinic, Mental Health), ICT officers and administrators. The study targeted seven public healthcare facilities across levels 3 – 5.

Level 3 facilities included (Bukura Health Center, Kilingili Health Center, and Shivanga Health Center), level 4 facilities included (Malava Sub-County Hospital, Shibwe Sub-County Hospital and Butere Sub-County Hospital) and Kakamega County General Hospital as level 5. The scope of the study focused on understanding routinization processes, which requires some level of sustained and routine interaction with digital health technologies, which are more pronounced and better established in higher-tier facilities, more likely to have functional ICT infrastructure, trained personnel, ICT staff and a broader range of health services that necessitate the use of e-Health systems particularly Level 3 (health centers), Level 4 (sub-county hospitals) and Level 5 (county referral hospital).

Level 1 (community health services) and Level 2 (dispensaries and clinics) facilities in Kenya primarily offer basic preventive and curative services, they mainly rely heavily on paper-based records and manual processes. These facilities often face acute resource constraints, including limited human capacity and inconsistent electricity supply, which hinder the consistent adoption and use of digital systems. Including them would have introduced variability that might obscure the analysis of routinization process, as many of these lower-level facilities are still in the early stages of digital adoption or pilot implementation. Therefore, omitting Level 1 and 2 facilities allowed the study to concentrate on facilities where e-Health use is more established, thereby providing a more reliable and contextually relevant understanding of the factors influencing the routinization of e-Health systems in public healthcare settings.

3.9 Sample Size and Sample Frame

The study utilized stratified simple random sampling technique to ensure representative coverage of both healthcare workers and facilities. Kothari (2004) is of the view that, when collecting data from diverse groups, stratified sampling works well for results to be generalized to a large population then it is essential to use an appropriate sampling procedure. Public healthcare facilities in Kakamega County were first stratified by levels (Level 3, Level 4 and Level 5). From each stratum, facilities were randomly selected to capture the diversity of service delivery contexts within the selected facilities. Healthcare workers were further stratified as per professional cadres grouped into management, medical personnel and technical officers and participants were randomly chosen from each group. Management team constituted of nurses in charge, administrators, facility managers and medical superintendents, the medical team included physicians, surgeons, dentists, physiotherapists, radiographers, pharmaceutical technologists, entomologists, counsellors, clinical officers and nurses and lastly the technical team were ICT officers and HRIOs. The study experts were ICT and HRIO officers who were chosen to answer technical questions, while medical personnel represented system users and lastly management team were experts in matters leadership, policy and resources. This approach ensured reliable findings because it is simple and it helped to reduce bias (Etikan, 2017). This sampling approach ensured that all levels of care were proportionately represented, enhancing the reliability and generalizability of the findings. This methodological framework ensured that the research remained grounded, relevant, and capable of producing actionable insights into the routinization of e-Health systems in the public healthcare context.

The study's participants were healthcare workers working in public healthcare facilities within Kakamega County. To ensure a representative sample, the participants were divided into groups according to their job cadre and the level of healthcare facilities they are attached. In order to ensure the largest possible reach within each public healthcare facility, the number of healthcare workers was used to proportionally choose the participants. For the majority of management and business studies, researchers are happy to make 95%

confidence estimates of demographic characteristics, as long as the estimates are within 3% to 5% of the actual values (Saunders et al., 2009). The study used Yamane's formula to determine the sample size, this formula was first proposed in 1967, as shown below.

$$n = \frac{N}{1 + N(e)^2}$$

where;

n = Sample Size,

N = Population Size

e = Margin of error.

From a population of 1800 healthcare workers using a 5% margin error and 95% confidence level, the sample size was determined as shown below:

$$n = \frac{1800}{1 + 1800\,(0.052)^2} = 328$$

n = 328 respondents

Table 3. 2: Sample Size Distribution

Staff Category	**Bukura**	**Butere**	**Kilingili**	**Kcgh**	**Malava**	**Shivanga**	**Shibwe**	**Total**
Management	5	7	5	12	7	5	7	**48**
Medical Staff	25	26	26	69	26	26	25	**224**

Technical Staff	6	9	5	15	9	4	8	**56**
Total	**36**	**42**	**36**	**96**	**42**	**36**	**40**	**328**

(**Source:** Kakamega County Public Service Board Annual Report, 2020)

As per empirical literature, it is noted that healthcare organizations tend to have a smaller management team, a larger medical staff and a moderate number of technical staff. Kothari (2004) states that the main goal of combining stratified random sampling with simple random sampling is to zero in on certain demographic features of interest while maintaining the objective of the research results. The study was able to collect a balanced and a representative sample that represents varied levels of e-Health systems involvement by the health workers within the county.

3.10 Data Collection Procedure

The researcher obtained approval and permission from the relevant bodies, including the university School of Computing and Informatics, school of post graduate studies board and a permit from National Commission for Science, Technology and Innovation (NACOSTI). Participants in study provided informed consent and they were assured of confidentiality and informed that participation was voluntary. After getting all the relevant permission, the researcher trained research assistants on data collection and also coordinated the process of how the questionnaires will be filled.

3.11 Data Collection Instruments

According to Creswell (2003) data collection is the process of gathering information from many sources in order to answer research questions. There are two main types of data.

Primary data is the fresh, unaltered information derived directly from personal experiences while secondary data is based on information that has already been gathered, processed and made public by other parties.

To guarantee that data is relevant, precise and dependable to answer research questions, a systematic strategy is usually employed in the data collection technique. According to Greenhalgh and Thorogood (2018) surveys are a dependable method for gathering quantitative data due to its accuracy, generalizability and convenience. The study utilized structured questionnaires as the primary data collection tool, leveraging on their effectiveness in obtaining structured responses from a diverse group of participants across various healthcare settings and non-intrusive observation.

3.11.1 Structured Questionnaires

According to Bolarinwa (2015) questionnaires enable collection of large volumes of data within a short time frame. The scalability of questionnaires allows researchers to reach a large audience at a relatively low cost and they are straightforward to analyze and visualize the data (Greenhalgh & Thorogood, 2018). Additionally, questionnaires offer participants anonymity, fostering a more honest and accurate response environment. They are inexpensive and an efficient method for collecting quantitative data, particularly when they are self-administered.

The study employed Iacobucci and Churchill (2014) approach for questionnaire development to ensure a comprehensive data collection relevant to the study's objectives. The questionnaire was divided into two sections, Section “A” captured demographic information, while Section “B” had a 5-point Likert scale questions. The questionnaire items were designed based on constructs identified in the literature review data on e-Health systems, user characteristics, organizational support and technological availability. The structured questionnaire was administered to health workers in level 3, 4 and 5 public healthcare facilities.

3.11.2 Non-intrusive Observations

To complement the quantitative data collected via questionnaires, the study employed non-intrusive observations within selected public healthcare facilities in Kakamega County. This method allowed the researcher to gain firsthand insights into the physical layout, operational processes and the general environment in which e-Health systems were expected to function. Observations were conducted discreetly to minimize disruption to normal operations and avoid influencing staff or patient behaviour.

3.12 Data Analysis Technique

Creswell (2003) articulates that data analysis encompasses the evaluation, interpretation, and transformation of collected quantitative data into meaningful information that effectively addresses the research questions and fulfills the study's objectives, all through the lens of the participants' perspectives. To produce profound insights, data analysis synthesizes a considerable volume of collected information. The data underwent coding and analysis utilizing version 26 of the Statistical Package for the Social Sciences (SPSS). In accordance with the study's objectives, a variety of analytical techniques were utilized. In order to tackle objective (i), descriptive statistics, specifically frequencies, means, and percentages, were employed to evaluate the present condition of e-Health system utilization within public healthcare facilities. In pursuit of Objective (ii), a factor analysis was performed to delineate latent constructs spanning user-related, technological, and organizational dimensions. Before conducting factor analysis, the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's Test of Sphericity were employed to ascertain the appropriateness of the data for this analytical approach. A regression analysis was subsequently conducted to investigate the robustness and significance of the relationship between each identified factor and the routinization of e-Health systems. Finally, in pursuit of Objective (iii), a conceptual framework for the routinization of e-Health systems was constructed, drawing upon statistically significant variables and patterns identified through non-intrusive field observations.

3.13 Validity and Reliability

3.13.1 Validity

De Vaus (2001) explains that there are several methods to test an instrument's validity. Content validity specifically measures how well an instrument covers all aspects of a construct. This is achieved by having experts review the instrument to ensure that each aspect of the construct is adequately represented. Content validity was ensured through three experts in health informatics and research methodology who were engaged to evaluate the questionnaires for comprehensiveness, readability and clarity. Their feedback was used to refine the tool (questionnaire) and once the suggestions were incorporated, the experts agreed that the instruments met the necessary validity criteria and were suitable for data collection; thus, verified content and construct validity to ensure the system meets its intended purposes. KMO and Bartlett test were done on each of the study variable where KMO value of above 0.6 was accepted. KMO Values were as follows: user-related factors: 0.841meaning (excellent), technological factors: 0.621 (acceptable) and organizational factors: 0.780 (good) and significance of the chi square on the Bartlett test indicated the validity of the research instrument as illustrated in chapter four.

3.12.2 Reliability

Before the actual data collection, a pilot study was conducted to evaluate the clarity, reliability and appropriateness of the research instrument. The aim was to identify and correct any ambiguities, inconsistencies or misunderstandings in the questionnaire. This step also provided an opportunity to assess the feasibility of the data collection procedure.

The pilot test was carried out with a small sample size drawn from healthcare workers in public healthcare facilities in Vihiga County which was outside the main study area but with similar characteristics. These respondents were excluded from the final study to avoid bias. Feedback from the pilot participants was used to revise the wording and sequencing of some items to enhance comprehension. Data collected during the pilot study was analyzed using SPSS version 26 and Cronbach's Alpha was computed to assess the internal consistency of each construct. All scales demonstrated acceptable reliability levels, with Cronbach Alpha values above the 0.7 threshold, thus confirming the reliability of the instrument (Kothari, 2004).

According to Twycross (2004) he states that, when measures are consistent and stable across multiple contexts, we say that they are reliable. For an instrument to be deemed dependable, it must consistently yield the same outcomes when subjected to comparable circumstances and according to Golafshani (2015) his views are that there are three distinct kinds of reliability: stability over time, uniformity within a single period and consistency of measures over repeated testing.

Table 3. 3: Cronbach Alpha

Table 3.3 reveals results of reliability tested using Cronbach's Alpha (α) for internal consistency of the research instruments.

Study Variable	Number of Items	Cronbach Alpha
User Characteristics	9	0.922
Technological Availability	7	0.834
Organizational Support	5	0.975
Routinization Process	10	0.981

Source: Reliability results tested using Cronbach's alpha ($\alpha = 0.976$), author's analysis

According to Kothari (2004), a Cronbach Alpha value of 0.7 and above is considered acceptable, with values closer to 1.0 indicating higher reliability. Cronbach's Alpha (α) coefficient was computed using SPSS v26, this measure indicates how closely related a set of items are grouped and commonly used to evaluate the reliability of Likert-scale-based questionnaires. Reliability was measured and all constructs achieved values above 0.7, indicating high internal consistency.

All the study variables exceeded the 0.7 threshold, signifying strong internal consistency. The Cronbach Alpha for the user characteristics scale (9 items) was 0.922, the technological availability scale (7 items) yielded an alpha of 0.834, the organizational support scale (5 items) had an alpha of 0.975 and the routinization process scale (10 items) had the highest reliability with an alpha of 0.981. These results confirm that the research instrument was highly reliable and appropriate for measuring the constructs under investigation. The overall Cronbach's alpha for all items was 0.976, suggesting that the research instrument used in the study was highly reliable.

3.14 Ethical Consideration

The research was conducted with a keen eye on the social, environmental and behavioural issues influencing the population of interest. Prior to data collection, the researcher obtained a letter of approval from the postgraduate school board and a research permit from Nacosti. The researcher informed consent from all participants by assuring them that participation was voluntarily, confidentiality and anonymity assured. Where anyone is free to leave at any point if they did not want to be part of the study. Every participant's independence, privacy, confidentiality and honesty were upheld by the researcher. The study took every precaution to ensure the confidentiality of the collected data and used it exclusively for the study.

3.15 Summary of Research Methodology

The primary objective of this research was to develop a routinization architecture for e-Health implementation. This process involved several key steps: problem identification, problem conceptualization, data collection, situational analysis and ultimately the creation of the routinization architecture. Problem identification involved conducting a background analysis to identify the core issues surrounding the routinization of e-Health systems in Kakamega County. This phase highlighted lack of comprehensive studies on the consistent use of e-Health systems within the county, pointing to a gap in understanding implementation and routinization process.

Problem conceptualization deepened the understanding of the identified problem by reviewing extensively the existing literature by examining e-Health implementation and routinization from global to regional and local perspectives. This review provided insights into previous research interventions, highlighting gaps and challenges in existing solutions which helped to refine the problem's scope.

Data Collection and Situational Analysis: Field research was conducted to gather primary data and firsthand insights into the problem. This phase involved collecting information from various stakeholders, including healthcare professionals and administrators, to understand the current status of e-Health systems and practical challenges faced in e-Health implementation. The data collected was then critically analyzed to further inform the study and identify potential avenues for intervention.

Designing of the Routinization Architecture: Based on the insights gained from the situational analysis and literature review, the research culminated in the development of a tailored routinization architecture aimed to guide healthcare workers and facilities on the daily use of e-Health systems. The architecture serves as a structured guide for improving e-Health integration, ensuring that the systems are effectively utilized and sustained within routine healthcare practices. The layers collectively provide a comprehensive approach to address the challenges of e-Health routinization with the final architecture designed to support healthcare providers and administrators in enhancing system usage and improving quality patient care outcomes.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND INTERPRETATIONS

4.0 Overview

This chapter presents the results of the data analysis based on the study objectives. The findings are organized in accordance with the study objectives. Objective one to assess the current status of e-Health use in public healthcare facilities in Kakamega County and objective two to analyse the factors influencing the routinization of e-Health systems in these facilities. The results are derived from the quantitative data collected through questionnaires, complemented by observational insights gathered during field visits.

4.1 Quantitative Data Findings - Descriptive Statistics

4.1.1 Demographic Analysis of the Respondents

This section provides an overview of the respondents' background information, focusing on several key aspects: years of working experience, age groups, gender, the healthcare facility they are associated with, job title or cadre, frequency of e-Health system use and their comfort level with computer-based technology. The first output from the analysis includes a table of descriptive statistics for each variable under investigation. Descriptive statistics tables provide a clear and comprehensive summary of the respondents' demographic.

4.1.2 Response Rate

The study aimed to reach 328 respondents. 304 responses were returned resulting to a response rate of 92.68%. The rate was believed to improve representativeness of the results to improve reliability and validity of the study as shown in table 4.1.

Table 4. 1: Response Rate

Response	Frequency	Percent
Returned	304	92.68
Non- response	24	7.32
Total	**328**	**100.0**

The findings indicate that the study is valid with a response rate of 92.68% and non-response rate of 7.32%, this provided sufficient and meaningful information for the study's objectives despite not reaching the full target of 328. The 7.32% non-response was due to a busy schedule of the health workers who did not completely fill the questionnaires while others experienced difficulties in accessing the questionnaire through online platform due to technical hitches.

4.1.3 Gender distribution

The study covered both genders, that is male and female participants as shown in table 4.2.

Table 4. 2: Gender

Gender	Frequency	Percent
Female	160	52.6
Male	144	47.4
Total	**304**	**100.0**

The results indicate that the female participants were 52.6% more compared to the male participants at 47.4%.

4.1.4 Distribution of Population by Age group

The distribution was divided into five categories, where their ages ranged from below 24 years to above 55 years as represented in table 4.3.

Table 4. 3 : Age Group

Age group	Frequency	Percent
Below 24	4	1.3
25 - 34	107	35.2
35 - 44	145	47.7
45 - 54	15	4.9
Above 55 years	33	10.9
Total	**304**	**100**

The findings reveal that the study involved various participants aged between 35-44 years were the majority with rate of 47.7% followed by 25-34 years at 35.2%, above 55 years at 10.9%, 45-54 years at 4.9% and lastly below 24 years at 1.3%.

4.1.5 Distribution of Healthcare Workers per facility

Table 4.4 indicates distribution of healthcare participants from the selected public healthcare facilities within Kakamega county.

Table 4. 4: Healthcare Workers per facility

	Frequency	Percent
Butere	40	13.2
Bukura	33	10.9
Kilingili	32	10.5
KCGH	90	29.6
Malava	39	12.8
Shivanga	33	10.9
Shibwe	37	12.2
Total	**304**	**100.0**

The findings reveal that the largest workforce was from KCGH with a rate of 29.6%, while the remaining facilities had a more balanced workforce distribution; Butere -13.2%, Malava -12.8%, Shibwe -12.2%, Bukura and Shivanga at 10.9%, with the least being Kilingili -10.5%. These results indicate that a referral facility like KCGH mostly has more staff due to the high patient volumes, specialized services and high budget allocation while other facilities indicated moderate staffing levels across level 4 and level 3 indicating a minimum to low patience volume and lack of specialized services.

4.1.6 Professional Cadre of the Healthcare Workers

Table 4.5 indicates distribution of healthcare workers grouped per their professional cadre.

Table 4. 5: Professional Cadre of the Healthcare workers

	Frequency	**Percent**
Management	28	9.2
Medical	208	68.4
Technical	53	17.4
Others	15	4.9
Total	**304**	**100.0**

The findings reveal that medical staff were the majority with a rate of (68.4%), followed by technical (17.4%), management (9.2%), and other staff (4.9%) cashiers, attaches, interns. These results concur with the empirical literature, primarily reflecting that there were more medical staff than the rest due to the nature of their work being frontline users in a health perspective thus the main users of e-Health systems.

4.1.7 Level of Comfort using Computer-based Technology

Table 4.6 represents results on the level of comfort of the participants using a technology like e-Health.

Table 4. 6: Level of Comfort in using Computer-based Technology

	Frequency	**Percent**
Extremely comfortable	74	24.3
Moderately comfortable	70	23.0
Not at all comfortable	8	2.6
Slightly comfortable	10	3.3
Very comfortable	142	46.7
Total	**304**	**100.0**

The findings reveal that the majority of respondents reported being either very comfortable (46.7%) or extremely comfortable (24.3%) with the system, representing a combined total of 71%. A further 23% indicated moderate comfort, while only a small minority reported being slightly comfortable (3.3%) or not at all comfortable (2.6%). This distribution suggests a generally high level of user readiness and confidence, which is a critical factor in facilitating the routinization of e-Health systems in public healthcare facilities. The minimal proportion of respondents reporting low comfort levels indicates limited barriers related to user skills or system familiarity.

4.1.8 Professional Experience

Table 4.7 presents results of the study considering participants years of experience in practice.

Table 4. 7: Professional Experience

	Frequency	**Percent**
Above 16 yrs	42	13.8
Between 11 and 15 yrs	70	23.0
Between 6 and 10yrs	136	44.7
Less than 5 yrs	56	18.4
Total	**304**	**100.0**

The results indicate that a significant proportion of respondents (44.7%) had between 6 and 10 years of professional experience, followed by 23% with 11 to 15 years of experience. Those with less than 5 years and above 16 years of experience accounted for

18.4% and 13.8% of the sample, respectively. This suggests that the majority of respondents were mid-career professionals, bringing substantial expertise and familiarity with healthcare operations. Such experience levels are advantageous for the routinization of e-Health systems, as they combine operational knowledge with adaptability to new technologies. However, the comparatively lower representation of early-career and highly experienced staff may mean that generational differences in technology adoption are less pronounced in the findings.

4.2 Status of e-Health use in Public Healthcare Facilities in Kakamega County

This section reports on the findings related to the state of e-Health systems in public healthcare facilities in Kakamega, it's the first objective of the study. The evaluation covered several aspects, including the presence of infrastructure necessary for supporting e-Health systems, the modes of communication employed, the frequency of system use and the operational status of the systems within the facilities. Additionally, it addresses factors that influence routinization like legislation, policies, standards, infrastructure, communication methods, connectivity, technology, resources, organizational support, integration of e-Health into routine processes and overall, the benefits of e-Health.

4.2.1 Legislation, Policy and Standards

Table 4.8 presents the respondents' awareness on legislation, policy and standards related to ICT within healthcare facilities.

Table 4. 8: Legislation, Policy, and Standards

Parameter	Responses	Frequency (Percentage)	Mean (Std Dev.)	t (df) p-value
ICT Policy	Yes	51 (16.8%)	1.938 (.633)	24.637 (df = 304), p=0.000
	No	182 (59.9%)		
	I don't Know	71 (23.4%)		
ICT Standards and Protocols	Yes	80 (26.3%)	1.954 (.694)	22.684 (df =304), p=0.000
	No	159 (52.3%)		
	I don't Know	65 (21.4%)		
ICT Guideline	Yes	70 (23.1%)	1.959 (.706)	22.474 (df=304), p =0.000
	No	154 (50.8%)		
	I don't Know	80 (26.2%)		

The results indicates that, awareness of ICT policy was relatively low, with only 16.8% aware of it, while 59.9% were not aware and 23.4% didn't know about the policy. This suggests a generally low level of ICT policy implementation or awareness that could lead to data security issues, inefficiencies in e-Health systems and poor adherence to regulations. In regards to standards and protocols, 26.3% confirmed awareness, 52.3% were not aware and 21.4% did not know. This suggests lack of formalized ICT standards which could lead to inconsistencies in e-Health records and operational inefficiencies. On

ICT guidelines, results suggests that 23.1% of respondents were aware, 50.8% were not aware and 26.2% did not know. This indicates a low-level awareness of clear ICT guidelines, that may have led health workers to struggle with data management and unsure of the best e-Health practices compliancy. The study concurs with existing empirical literature, indicating that there is still a significant gap in matters ICT policy, standards and guidelines in healthcare facilities which result to poor systems adoption and ultimately leads to low system uptake. Healthcare workers need sensitization and awareness through management enforcement to ensure firm ICT governance that will help to enhance efficiency and service delivery.

4.2.2 Status on Infrastructure

Table 4.9 reveals that almost all respondents agreed that it's important to have a reliable infrastructure which includes (electricity, generators, solar power) and consistent power supply to ensure effective implementation and routine use of e-Health systems.

Table 4. 9: Infrastructure

Parameter	**Responses**	**Frequency (Percentage)**	**Mean (Std Dev.)**	**t (df) p-value**
Power Connectivity	Yes	304(100%)	1 (0.000[a])	
	No			
Power Generator/Electricity/Solar	Yes	281 (92.3%)	1.92 (0.269)	57.735 (df =304), p=0.000
	No	23 (7.7%)		

Stable Power	Yes	159 (52.3%)	2.49 (0.562)	35.375 (df =304), p= 0.000
	No	145 (47.7%)		

The findings revealed that all respondents agreed that their facilities had power connectivity at a 100% rate. They also confirmed infrastructure availability of power generators, electricity, or solar energy at 92.3% while 7.7% reported an absence. The findings continue to reveal that the stability of accessing the power supply was at 52.3% whereas 47.7% reported power instability. General finding revealed that stability of electricity is not sufficient to sustain routinization of e-Health systems. Empirical literature suggests that, infrastructure is still inadequate leading to unreliable and intermittent power supply without power backups that affects low usability of e-Health on a daily basis, availability of infrastructure is the backbone of the existence of any e-Health system and power connectivity. The findings suggest that backup mechanisms were completely lacking and weak in many facilities from level 3 to level 5. However, the availability of backup power sources will help to mitigate power instability to some extent.

4.2.2.1 Communication Systems

Communication system is a support service that allows information to be communicated between one or more facilities or within a facility to ensure reliable flow of information from one point to the next. Table 4.10 provides insights into communication systems usage in the facilities, focusing on corporate email, mobile apps for work collaboration and website availability.

Table 4. 10: Communication Systems

Parameter	Responses	Frequency (Percentage)	Mean (Std Dev.)	t (df) p-value
Corporate e-mail system	Yes	168 (55.3%)	2.45 (0.685)	28.776 (df=304), p=0.000
	No	103 (33.9%)		
	I don't Know	33 (10.9%		
Mobile apps for work collaboration	Yes	182 (60.0%)	2.54 (0.614)	33.314 (df=304), p= 0.000
	No	104 (33.8%)		
	I don't Know	18 (6.2%)		
Website	Yes	75 (24.6%)	2.12 (0.600)	28.543 (df =304), p= 0.000
	No	192 (63.1%		
	I don't Know	37 (12.3%)		
Office Telephone/Mobile	Yes	248 (81.5%)	2.05 (0.543)	37.432 (df = 304), p= 0.000
	No	56 (18.5%)		
	I don't Know			

The findings reveal that corporate email system was used at a rate of 55.3%, 3.8% did not use an email and 10.9% were unsure. The mean score was (2.45) with a significant t-test (p=0.000) that indicates corporate email was widely used but not universal. Mobile Apps for work collaboration had, 60% used it, 33.8% did not use them while 6.2% were unsure. This had the highest mean score of (2.54) among the three categories and a high significant t-test of (p=0.000) which suggested mobile apps were slightly more adopted than emails. Website presence had 24.6% reported having an official website, with majority at 63.1% reported no website while 12.3% were unsure. The lowest mean score of (2.12) and significant p-value indicates that websites are the least adopted communication tool.

These findings suggest that traditional communication tools like office telephones or mobile phones are commonly used while the adoption of new digital communication systems such as corporate email, mobile apps and websites are less used across the public healthcare facilities in the county. The research aligns with the UTAUT framework, examining the constructs of performance and effort expectancy that affect user acceptance and engagement with technology. Once a certain level of system user-friendliness is achieved, individuals are likely to adopt and integrate the system into their daily routines with ease.

4.2.2.2 Internet Connectivity

Table 4.11 provides insights on connectivity which is key to facilitate communication between facilities through a reliable network connectivity.

Table 4. 11: Connectivity

Parameter	**Responses**	**Frequency (Percentage)**	**Mean (Std Dev.)**	**t (df) p-value**
Functional Computer	No	14 (4.6%)	1.95 (0.211)	74.497 (df=304), p =0.000
	Yes	290 (95.4%)		

Local Area Network/Intranet	No	61 (20.0%)	1.80 (0.403)	36.000 (df= 304), p= 0.000
	Yes	243 (80.0%)		
Printer/Shredder/Photocopier/Scanner	No	65 (21.5%)	1.88 (0.331)	45.705 (df= 304), p = 0.000
	Yes	239 (78.5%)		
Access to the Internet/WIFI	No	67 (22.2%)	1.78 (0.414)	34.730 (df= 64), 0.000
	Yes	237 (77.8%)		
If yes, is the internet Stable	I don't know	7 (2.3%)	2.35 (0.513)	36.972 (df=304), p=0.000
	No	187 (61.5%)		
	Yes	110 (36.2%)		

The findings reveal that majority of the participants had a functional computer at 95.4% while only 4.6% indicated lack of functional computers. It is good to note that a facility cannot achieve routinization of e-Health system without a functional computer. 80.0% of respondents confirmed presence of availability of LAN/Intranet while 20.0% reported its absence. 78.5% confirmed availability of printers, shredders, photocopiers, or scanners, while 21.5% reported they were not available.

The findings also revealed that access to internet connection was at 77.8% while 22.2% indicated that they did not have internet access despite internet availability. Findings on the stability of the internet indicated that, 61.5% reported that the internet was not stable, 36.9% indicated the internet was stable and 2.3% were unsure of matters internet stability.

These findings indicate that most respondents have access to a functional computer, network, internet and office equipment, internet access is available to most facilities, but stability is a significant issue, with a majority reporting instability which confirms that these findings are not due to chance while infrastructure issues, particularly concerning internet stability, need to be addressed to fully realize the potential of e-Health routinization. Observational data further showed that most Level 3 and Level 4 healthcare facilities had users sharing a number of computers among departments, leading to delays and congestion during data entry. Moreover, some facilities in Level 3 continued to rely heavily on manual record-keeping due to few computers, non-functional hardware and lack of training on available software.

4.2.2.3 Frequency of e-Health System Access

Table 4.12 presents findings of how often the implemented systems are used or accessed by healthcare workers.

Table 4. 12: Frequency of e-Health System Access

Parameter	**Responses**	**Frequency %**	**Mean (Std Dev.)**	**t (df) p-value**
Frequency of accessing an e-Health, such as eCHIS, DHIS2 and others	2-3 times a week	23 (7.6%)	2.80 (1.240)	18.206 (df= 304), p =0.000
	Daily	145 (47.7%)		
	Monthly	57 (18.8%)		
	Never	28 (9.2%)		
	Once a week	51 (16.8%)		

The findings indicate that majority of respondents at 47.7% use the e-Health system daily which shows it’s an essential role in healthcare operations while 16.8% access the system once a week, 7.6% access the system 2-3 times a week and 18.8%) of respondents access it monthly while 9.2% have never used the e-Health system. These findings reveal that the e-Health system is well-integrated into the daily workflow of a significant proportion of healthcare staff, reflecting a high level of routinization among frequent users. The substantial daily usage rate underscores the system's importance in delivering healthcare services efficiently. However, the presence of moderate and low-frequency users, as well as a notable proportion of non-users, may indicate disparities in system access, varying levels of user competence, or differences in the relevance of the system to specific roles. Addressing these gaps through targeted training, workflow alignment and equitable access could enhance overall system adoption and sustainability.

4.3 Factors Influencing Routinization of e-Health Implementations

4.3.1 User Characteristics

User characteristics refer to the individual attributes of system users such as their digital literacy, age, educational background, work experience, attitude toward technology and role within the healthcare facility. These characteristics significantly influence the successful adoption and routinization of e-Health systems as indicated in table 4.13.

Table 4. 13: User Characteristics

	Mean	**Std. Dev**
Positive attitude towards e-Health technologies is crucial for a successful adoption	3.06	.991
Active participation in e-Health platforms can significantly enhance personal growth, health management and improve outcomes	3.97	1.171
Users' intentions to use e-Health technologies often depend from their perceived benefits.	3.73	1.290

Perceptions of e-Health vary widely among users	3.70	1.210
The level of user computer skills significantly impacts the effectiveness of e-Health.	4.15	1.310
The e-Health system works the same way most of the time.	2.97	1.269
There is clearly known way to use the e-Health system	3.25	1.254
The use of the e-Health system is integrated in my daily routine	3.37	1.283
There is an understandable sequence of steps that can be followed when using the e-Health system	3.31	1.342

Respondents indicated that positive attitudes towards e-Health technologies is crucial for a successful adoption, with a mean score of 3.06 (SD = 0.991). This suggests a moderate agreement with the importance of having a favourable outlook for successful implementation. The statement that active participation in e-Health systems can significantly enhance personal growth, health management, and improve outcomes received a higher mean score of 3.97 (SD = 1.171), indicating a stronger agreement among respondents about the benefits of active engagement in e-Health systems. Users' intentions to use e-Health systems, which often depend on their perceived benefits, had a mean score of 3.73 (SD = 1.290), showing a relatively high level of agreement with the idea that perceived benefits influence usage intentions. Perceptions of e-Health varying widely among users was rated with a mean of 3.70 (SD = 1.210), suggesting a general agreement that user perceptions can differ significantly. The impact of user computer skills on the effectiveness of e-Health was highlighted with a mean score of 4.15 (SD = 1.310), indicating a strong agreement that computer skills are crucial for effective use of e-Health technologies. Respondents rated the consistency of the e-Health system's functionality with a mean of 2.97 (SD = 1.269), suggesting a neutral to slightly negative view on the system's reliability in working the same way most of the time. The clarity of the e-Health system's usage instructions was rated with a mean score of 3.25 (SD = 1.254), indicating a moderate agreement that there is a clearly known way to use the system. The integration of the e-Health system into daily routines received a mean score of 3.37 (SD = 1.283), reflecting a moderate agreement that the system is incorporated into users' everyday activities. Finally, the understandability of the sequence of steps when using the e-Health system had a mean score of 3.31 (SD = 1.342), suggesting a moderate level of agreement that there is a logical sequence that users can follow.

Overall, the findings reveal a range of perceptions regarding user characteristics of e-Health technologies, with strong agreements on the importance of user attitudes and skills, moderate agreement on system integration and usability and varied opinions on system consistency and user instructions. In summary, the findings indicate moderate to high acceptance of e-Health, but with usability concerns bridging the digital literacy gap, by ensuring system stability and improving guidance on usage could significantly enhance user experience and adoption.

4.3.2 Technological Availability

Technological availability refers to the presence and accessibility of essential digital tools and infrastructure necessary for effective implementation and sustained use of e-Health, table 4.14 indicate findings from the study.

Table 4. 14: Technological Availability

	Mean	**Std. Dev**
Integration of e-Health systems is paramount for seamless user experiences and for enhancing continuity	3.85	1.237

The complexity and user-friendliness of e-Health systems are crucial for ensuring that healthcare providers can utilize these technologies effectively	4.04	1.178
Durable hardware and reliable networking infrastructure are foundational to the success of e-Health initiatives	4.14	1.214
All the processes within my facility are computerized	2.39	1.249
The e-health system can be accessed when I am in a different facility	2.50	1.269
The facility has established procedures and practices to use the e-Health system	2.72	1.304
The facility has availability of e-health system installed and in use. for example, KenyaEMR, DHIS, LIMS, PIS, Picture Archiving and SIS.	3.54	1.332

The respondents were asked to indicate the extent to which they agree with the various statements on the technological availability of e-Health. Respondents agreed that the integration of e-Health systems is crucial for providing seamless user experiences and enhancing continuity, with a mean score of 3.85 (SD = 1.237). This indicates a moderate to high level of agreement on the importance of system integration. The complexity and user-friendliness of e-Health systems were rated with a mean of 4.04 (SD = 1.178), reflecting a strong agreement on their importance for ensuring effective utilization by healthcare providers. Durable hardware and reliable networking infrastructure were considered foundational for the success of eHealth initiatives, with a mean score of 4.14 (SD = 1.214), showing a strong agreement on the necessity of these technological components. Conversely, the statement that all processes within the facility are computerized received a lower mean score of 2.39 (SD = 1.249), indicating a disagreement or neutrality about the extent of complete computerization within the facility. The ability to access the e-Health system from a different facility was rated with a mean score of 2.50

(SD = 1.269), suggesting a neutral to slightly negative view on the system's accessibility across locations. Respondents indicated a moderate level of agreement with the statement that the facility has established procedures and practices for using the e-Health system, with a mean score of 2.72 (SD = 1.304). The availability of e-Health systems such as KenyaEMR, DHIS, Laboratory Information Management System (LIMS), Pharmacy Information System (PIS), and Picture Archiving and Communication System (PACS) in the facility was rated with a mean score of 3.54 (SD = 1.332), reflecting a moderate agreement on the presence and use of these systems. Overall, the data highlights strong agreement on the importance of integration, user-friendliness, and reliable infrastructure for eHealth systems, while indicating varying levels of agreement regarding complete computerization, system accessibility, and established procedures within the facilities.

4.3.3 Organisational Support

Organizational support plays a crucial role in facilitating the success of routinization of e-Health systems. Support from management ensures that healthcare personnel are equipped with necessary resources and are continuously encouraged to integrate e-Health systems into their daily workflows. Clear communication, structured change management processes and recognition of staff efforts enhance commitment and reduce resistance to new technologies, table 4.15 indicates the results.

Table 4. 15: Organizational Support

	Mean	Std. Dev
Support from top management is essential for the successful implementation of eHealth systems	4.12	1.192
Conducting a thorough needs assessment allows organizations to tailor eHealth solutions to the specific requirements of their healthcare providers	4.15	1.077
Active engagement with stakeholders, including healthcare professionals, patients, and technical providers, is crucial for the development and implementation of eHealth system	4.10	1.150
Investing in capacity building through training healthcare providers and upgrading IT infrastructure will improve service delivery.	4.08	1.309
Sufficient financial resources will ensure the facility meets the technological demands.	4.14	1.282
Valid N (listwise)		

The respondents were asked to indicate the extent to which they agree with the various statements on the organizational support of e-Health. The following scale was used: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree, as illustrated in Table 4.13. Respondents strongly agreed that support from top management is essential for the successful implementation of eHealth systems, as indicated by a mean score of 4.12 (SD = 1.192). This suggests that top management's backing is viewed as crucial for the effective deployment of eHealth technologies. Similarly, the importance of conducting a thorough needs assessment to tailor eHealth solutions to the specific requirements of healthcare providers received a high mean score of 4.15 (SD = 1.077). This reflects a strong agreement on the necessity of aligning eHealth solutions with organizational needs. Active engagement with stakeholders, including healthcare professionals, patients, and technical providers, was rated with a mean score of 4.10 (SD = 1.150). This indicates a strong consensus on the critical role of stakeholder involvement in the development and implementation of eHealth systems. Respondents also agreed that investing in capacity building, through training healthcare providers and upgrading IT infrastructure, will enhance service delivery. This statement had a mean score of 4.08 (SD = 1.309), showing strong agreement on the benefits of such investments for improving service quality. Finally, the statement that sufficient financial resources are necessary to meet technological demands received a mean score of 4.14 (SD = 1.282). This highlights a strong agreement that adequate funding is vital for addressing the technological needs of healthcare facilities. Overall, the findings demonstrate a strong agreement on several key organizational support, including top management support, needs assessment, stakeholder engagement, capacity building in IT and financial resources, as crucial elements for a successful implementation and routinization of eHealth systems. Without strong organizational backing, even well-designed e-Health systems may fail to become a routine as part of service delivery.

4.4 Factor Analysis

Principal Component Analysis (PCA) and Factor Analysis (FA) play a vital role in identifying the underlying factors that influence the routinization of e-Health systems by reducing large sets of interrelated variables into fewer, more meaningful components. In this study that involved multiple indicators such as user characteristics, technological availability and organizational support, these techniques helped uncover latent constructs that represent broader dimensions like "User characteristics" or "Technological

Availability." This simplification not only enhances interpretability but also supports the validation of theoretical frameworks by confirming that related items group together as expected. The extracted factors were used in further statistical analysis, such as regression, to determine predictive influence on routinization outcomes.

PCA or FA provides a clearer understanding by identifying key dimensions that most significantly affect the routine use of e-Health systems. This helps in refining data collection tools, strengthening the study's validity and guiding targeted interventions or policy decisions to improve e-Health integration in healthcare facilities.

Interpretation of the KMO Value:

KMO ≥ 0.90: Marvelous,

0.80 – 0.89: Meritorious,

0.70 – 0.79: Middling,

0.60 – 0.69: Mediocre,

0.50 – 0.59: Miserable and

< 0.50: Unacceptable (factor analysis should not be used).

4.4.1 Factor Analysis on User Characteristics

The Kaiser-Meyer-Olkin (KMO) test is a measure of sampling adequacy used to evaluate whether your data is suitable for factor analysis. It does not test validity in the traditional sense (like content or construct validity), but rather tells whether your variables are sufficiently correlated to justify the use of FA or PCA. A KMO score above 0.8 is generally deemed commendable, demonstrating that the variables have enough common variation for reliable factor extraction. Table 4.16 reveals user characteristics KMO value of 0.841

indicating a high degree of sampling adequacy, meaning that the sample size was sufficiently large and the data was appropriate for factor analysis.

Table 4. 16: KMO and Bartlett Test of Sphericity on User Characteristics

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.841
Bartlett's Test of Sphericity	Approx. Chi-Square	547.432
	Df	36
	Sig.	.000

Bartlett's Test of Sphericity indicates an approximate Chi-Square value of 547.432 with 36 degrees of freedom and a significance level (p-value) of 0.000. This significant result ($p < 0.05$) indicates that the correlation matrix is not an identity matrix, implying there are strong correlations among the variables. These correlations justify the application of factor analysis, as the data exhibit the necessary level of interrelatedness.

In summary, the KMO value of 0.841 and the significant Bartlett's Test of Sphericity ($\chi^2 = 547.432$, df = 36, $p < 0.001$) confirm that the dataset is well-suited for factor analysis, with adequate sampling and significant inter-correlations among the user characteristics variables as presented in Table 4.17.

Table 4. 17: Communalities on User Characteristics

	Initial	Extraction
Positive attitudes towards e-Health technologies is crucial for a successful adoption	1.000	.790
Active participation in e-Health platforms can significantly enhance personal growth, health management and improve outcomes	1.000	.726

Users' intentions to use e-Health technologies often depend from their perceived benefits.	1.000	.796
Perceptions of e-Health vary widely among users	1.000	.756
The level of user computer skills significantly impacts the effectiveness of e-Health.	1.000	.788
The e-Health system works the same way most of the time.	1.000	.616
There is clearly known way to use the e-Health system	1.000	.874
The use of the e-Health system is integrated in my daily routine	1.000	.888
There is an understandable sequence of steps that can be followed when using the e-Health system	1.000	.912

Extraction Method: Principal Component Analysis.

The findings reveals that the principal components extracted through PCA effectively captured a substantial portion of the variance in the user characteristics, with values above 0.6 for all variables, underscoring the robustness of the factor analysis model.

The initial communalities are all set to 1.000, indicating that each variable initially contributes fully to the variance in the dataset. The extracted communalities provide the proportion of each variable's variance that can be explained by the principal components. The values range from 0.616 to 0.912, demonstrating a high level of shared variance among the variables.

Table 4.18 presents the PCA results for user characteristics, specifically focusing on the total variance explained by each component. The results are divided into two sections: Initial Eigenvalues and Extraction Sums of Squared Loadings.

Table 4. 18: Total Variance Explained on User Characteristics

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.501	61.119	61.119	5.501	61.119	61.119
2	1.645	18.276	79.395	1.645	18.276	79.395
3	.811	9.009	88.404			
4	.298	3.312	91.716			
5	.236	2.620	94.336			
6	.188	2.085	96.422			
7	.139	1.541	97.962			
8	.100	1.115	99.078			
9	.083	.922	100.000			

Extraction Method: Principal Component Analysis.

Within the Initial Eigenvalues segment, the foremost component exhibits an eigenvalue of 5.501, accounting for 61.119% of the variance present in the dataset. This significant percentage suggests that the initial component accounts for the predominant share of the variance within the user characteristics. The second component possesses an eigenvalue of 1.645, contributing an additional 18.276% to the overall variance. The initial two components collectively account for a significant 79.395% of the variance. The Extraction Sums of Squared Loadings section reflects the Initial Eigenvalues for the first two components, thereby affirming that these components maintain identical explanatory power post-extraction. The initial component accounts for 61.119% of the variance, while the subsequent component contributes 18.276%, resulting in a cumulative variance of 79.395%.

In summary, the PCA results indicate that the first two components are the most significant, together explaining nearly 80% of the total variance in user characteristics. This suggests that the two components capture the majority of the information contained in the original variables. The additional components contribute minimal variance, indicating that they add little explanatory power to the model based on the nature of the user characteristics provided in Table 4.16, we can infer potential names for the components as **Component 1** - User Engagement and Skills and **Component 2** - System Usage and Structure**.**

Component 1, likely encompasses variables related to positive attitudes towards e-Health, active participation, perceived benefits, computer skills, and the integration of the e-Health system into daily routines. These variables suggest a focus on how engaged users are with e-Health technologies and their skill levels in utilizing these systems effectively while component 2, includes variables related to the consistency and clarity of using the e-Health system, such as having a known way to use the system and an understandable sequence of steps. These factors indicate a focus on the structural aspects of the system and its practical usage by the users.

4.4.2 Factor Analysis on Technological Availability

Table 4.19 reveals that KMO measure yielded a value of 0.621, which falls within the acceptable range, indicating that the sample is adequate for factor analysis.

Table 4. 19: KMO and Bartlett Test of Sphericity on Technological Availability

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.621
Bartlett's Test of Sphericity	Approx. Chi-Square	395.149
	Df	21
	Sig.	.000

Source: Author’s computation based on field data

The Bartlett's Test of Sphericity yielded a chi-square value of 395.149 with 21 degrees of freedom and a significance level of p <.001. The obtained statistically significant result (p =.000) indicates that the correlation matrix is not an identity matrix, therefore providing confirmation of the data's appropriateness for factor analysis.

Table 4.20 presents the communalities for the variables related to Technological Availability using PCA as the extraction method.

Table 4. 20: Communalities on Technological Availability

	Initial	**Extraction**
Integration of e-Health systems is paramount for seamless user experiences and for enhancing continuity	1.000	.841
The complexity and user-friendliness of e-Health systems are crucial for ensuring that healthcare providers can utilize these technologies effectively	1.000	.949
Durable hardware and reliable networking infrastructure are foundational to the success of e-Health initiatives	1.000	.822
All the processes within my facility are computerized	1.000	.823
The e-health system can be accessed when I am in a different facility	1.000	.623
The facility has established procedures and practices to use the e-Health system	1.000	.877
The facility has availability of e-health system installed and in use. e.g, KenyaEMR, DHIS, LIMS, PIS, Picture Archiving and SIS.	1.000	.703

Extraction Method: Principal Component Analysis.

Communalities reflect the extent of variance in each variable that is explained by the extracted components. The findings indicate that a significant portion of the variance in these variables is effectively captured by the components derived from PCA, thereby affirming the importance of these technological availability factors within the framework of e-Health systems, as illustrated in the table below.

Table 4.21 elucidates the outcomes of PCA concerning technological availability, particularly outlining the total variance accounted for by each component. The table is partitioned into two distinct sections: Preliminary Eigenvalues and Derivation of Summed Squared Loadings.

Table 4. 21: Total Variance Explained on Technological Availability

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.617	51.671	51.671	3.617	51.671	51.671
2	2.020	28.862	80.533	2.020	28.862	80.533
3	.652	9.318	89.851			
4	.336	4.799	94.650			
5	.210	3.006	97.656			
6	.129	1.850	99.505			
7	.035	.495	100.000			

Extraction Method: Principal Component Analysis.

The initial eigenvalue of the first component is 3.617, which accounts for 51.671% of the variance. This indicates that this component represents over fifty percent of the overall variance within the dataset. Following extraction, this component continues to account for 51.671% of the variance. The second component exhibits an initial eigenvalue of 2.020, accounting for 28.862% of the variance. Subsequent to extraction, this component persists in representing 28.862% of the variance. The initial two components collectively account for 80.533% of the total variance. The third component presents an initial eigenvalue of 0.652, which corresponds to 9.318% of the variance; however, it is excluded from the extraction due to its failure to meet the established threshold. The fourth component accounts for 4.799% of the variance, the fifth component accounts for 3.006%, the sixth component accounts for 1.850%, and the seventh component accounts for 0.495%. The extraction process does not retain these components either.

Overall, the first two components extracted through PCA explain a substantial portion of the variance (80.533%), indicating that these two components are the most significant in capturing the variability in technological availability variables. This suggests that a two-component solution is appropriate for summarizing the technological availability data in this context. Given the context of the variables and the high communalities, the two components likely represent distinct aspects of technological availability: **Component 1:** Integration and Usability of e-Health Systems and **Component 2:** Infrastructure and Accessibility.

Component 1 includes variables related to the integration of e-Health systems, user-friendliness and the extent to which these systems are computerized within the facility. Variables such as "Integration of e-Health systems," "The complexity and user-friendliness of e-Health systems," and "All the processes within my facility are computerized" have high communalities and are likely to load heavily on this component. While component 2, includes variables related to the availability and reliability of the hardware and networking infrastructure, as well as the accessibility of the e-Health systems across different facilities. Variables such as "Durable hardware and reliable networking infrastructure," "The e-health system can be accessed when i am in a different facility," and "The facility has established procedures and practices to use the e-Health system" are likely to load heavily on this component.

4.4.3 Factor Analysis on Organizational Support

Table 4.22 reveals the KMO statistical measure of sampling adequacy as 0.780, indicating that the sample is sufficient for factor analysis. The Bartlett's Test of Sphericity yields an estimated chi-square value of 558.568 with 10 degrees of freedom. This value is statistically significant ($p < .001$).

Table 4. 22: KMO and Bartlett Test of Sphericity on Organizational Support

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.780
Bartlett's Test of Sphericity	Approx. Chi-Square	558.568
	Df	10
	Sig.	.000

The obtained result indicates that the correlation matrix is not quite an identity matrix and there's an exist substantial associations among the variables, therefore rendering them appropriate for factor analysis.

Table 4.23 presents the communalities for the variables associated with organizational elements, obtained using PCA as the extraction technique found underlying factors.

Table 4. 23: Communalities on Organizational Support

	Initial	Extraction

Support from top management is essential for the successful implementation of e-Health systems	1.000	.948
Conducting a thorough needs assessment allows organizations to tailor e-Health solutions to the specific requirements of their healthcare providers	1.000	.909
Active engagement with stakeholders, including healthcare professionals, patients, and technical providers, is crucial for the development and implementation of e-Health system	1.000	.943
Investing in capacity building through training healthcare providers and upgrading IT infrastructure will improve service delivery.	1.000	.908
Sufficient financial resources will ensure the facility meets the technological demands.	1.000	.902

Extraction Method: Principal Component Analysis.

The initial communalities for all variables are established at 1.000, signifying that each variable makes a complete contribution to the overall variance at the beginning of the study. The extraction results demonstrate that a significant amount of the variability in each variable is explained by the factors obtained in the analysis, implying a strong relationship between the variables.

Table 4.24 illustrates the results of the PCA for Organizational support, showing the total variance explained by each component. The initial eigenvalues reveal that the first component accounts for a substantial proportion of the variance, with a total eigenvalue of 4.609, which explains 92.177% of the variance.

Table 4. 24: Total Variance explained on Organizational Support

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.609	92.177	92.177	4.609	92.177	92.177
2	.194	3.882	96.059			
3	.123	2.465	98.525			
4	.055	1.101	99.626			
5	.019	.374	100.000			

Extraction Method: Principal Component Analysis.

Source: Author's computation based on field data

This indicates that the first component is highly significant in explaining the variability in the data related to organizational support. The second component has an eigenvalue of 0.194, contributing 3.882% to the total variance, while the third component has an eigenvalue of 0.123, accounting for 2.465% of the variance. Together, these components contribute to a cumulative variance of 98.525%.

The subsequent components contribute minimally to the variance, with eigenvalues of 0.055 and 0.019, explaining 1.101% and 0.374% of the variance, respectively. Collectively, these components account for a total variance of 100.000%.

In summary, the analysis demonstrates that a single principal component predominantly explains the majority of the variance in organizational support, with additional components contributing to a lesser extent. Component 1, is named as Organizational support and Engagement. This component encompasses aspects such as support from top management, needs assessment, stakeholder engagement, capacity building and financial resources, which are crucial for the successful implementation of e-Health systems.

4.5 Correlation Analysis

This bivariate analysis was conducted to determine if there is a significant association between user characteristics, technological availability, organisational support and routinization process.

Table 4.25 presents the Pearson correlation coefficients among variables: User Characteristics, Technological Availability, Organisational Support and Routinization process.

Table 4. 25: Pearson Correlation

		User Characteristics	Technological Availability	Organisational Support	Routinization Process
User Characteristics	Pearson Correlation	1			
	Sig. (2-tailed)				
Technological Availability	Pearson Correlation	.686**	1		
	Sig. (2-tailed)	.000			
Organisational Support	Pearson Correlation	.703**	.929**	1	
	Sig. (2-tailed)	.000	.000		
Routinization Process	Pearson Correlation	.649**	.804**	.847**	1

	Sig. (2-tailed)	.000	.000	.000
	N	304	304	304
	****. Correlation is significant at the 0.01 level (2-tailed).**			

The correlation analysis revealed several significant relationships at the 0.01 level (2-tailed). In summary, all the variables exhibit significant positive correlations with each other, with the strongest relationships observed between Technological availability and Organisational support. These findings underscore the interconnectedness of user characteristics, technological availability, organizational support and the routinization process in achieving the benefits of e-Health systems. This analysis revealed a strong positive correlation between User Characteristics and Technological Availability ($r = .686$) indicating that better user characteristics are associated with greater technological availability. Positive correlation exists between user characteristics and Organisational Support ($r = .703$, $p < .001$), Technological Availability shows a stronger correlation with Organisational Support ($r = .929$, $p < .001$), highlighting that higher technological availability is closely linked to better organizational support.

The strong intercorrelations among user characteristics, technological availability and organisational support suggest that routinization is not driven by a single factor but instead the result of a socio-technical alignment. Routinization emerges when capable users interact with well-supported technologies within a conducive organizational environment.

4.6 Regression Analysis

The study employed regression analysis to examine the relationship between key independent variables which are User characteristics, Technological availability, Organizational support and Routinization process as the dependent variable.

Before conducting regression analysis, diagnostic tests were performed to confirm that the data met the required statistical assumptions for multiple regression to determine the extent at which each of these factors predicted or influenced the routinization process.

Table 4.26 presents the regression coefficients of User Characteristics, Technological Availability and Organizational Support in relation to Routinization Process.

Table 4.26: Regression Coefficients.

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	.238	.251		.949	.347
	User Characteristics	.047	.045	.099	1.038	.303
	Technological Availability	.043	.075	.104	.571	.570
	Organisational Support	.545	.150	.680	3.630	.001

a. **Dependent Variable: Routinization process**

Adj. R2 = 0.711; F (3,300) =53.389, p=0.000

The findings indicate that User characteristics (B = 0.047, p = 0.303) had a positive but statistically insignificant effect on routinization. Technological availability (B = 0.043, p = 0.570) also showed a positive but insignificant relationship. Organisational support (B

= 0.545, p = 0.001) was the only significant predictor, meaning it is the strongest contributor to routinization ($\beta = 0.680$). The Adjusted $R^2 = 0.711$ model indicates that 71.1% of the variance in the routinization process is explained by the three predictors; User Characteristics, Technological Availability and Organisational Support.

Lastly $F (3,300) = 53.389$, $p = 0.000$ indicate that the model is statistically significant.

These findings suggest that organisational support plays a critical role in ensuring e-Health systems become routinized in healthcare facilities, while user characteristics and technological availability, though positively related, did not significantly influence routinization in this study.

4.7 Observational Findings

Non-intrusive observations provided additional insights into infrastructure and workflow challenges affecting e-Health integration. Some of the key observations were, patients were frequently observed purchasing their own files or prescription books and, in some cases, they left the facilities with these documents often risking misplacement. Long queues were common particularly as patients waited to retrieve their records due to the manual process, indicating inefficiencies in file handling and data retrieval processes. Moreover, many level 3 facilities lacked adequate technological tools and infrastructure to support seamless digital workflows thus lack of full digitization. In several instances, IT infrastructure was either basic or completely absent. These observations corroborated survey responses indicating infrastructural gaps and underscored the logistical challenges that could hinder the routinization of e-Health systems in such settings.

4.8 Formulation of the Routinization Architecture

The main objective of the study was to develop a routinization architecture for e-Health implementations. Formulation of the routinization architecture was guided by both empirical evidence and theoretical insights from the study to ensure that the proposed architecture was contextually relevant, practically feasible and grounded in scientific theory. The integration of concepts from three leading theories NPT, UTAUT and TTF provided a robust conceptual foundation for the structure and elements of the architecture. In line with objective one which assessed the current status of e-Health use in public healthcare facilities in Kakamega County, the findings revealed their adoption is uneven, marked by inconsistent utilization, limited access to digital infrastructure, limited user engagement and fragmented workflows, which hindered the routine use of e-Health. These observations underscore the need for an architecture that first addresses the foundational requirements for routine use which are reliable ICT infrastructure, sufficient digital equipment, user support mechanisms and stable system connectivity. This aligns with literature emphasizing the foundational role of technological availability and workflow integration in facilitating routinization (Greenhalgh et al., 2017).

Objective two was to analyze factors influencing routinization and the findings revealed various significant predictors of routinization. Three constructs were identified and each had sub constructs. The first construct being user characteristics which had sub constructs as digital literacy, user attitude, perceptions and workload concerns, the second construct was Technological availability and its sub constructs were workflow integration, infrastructure, connectivity, usability, and reliability and the third construct being Organizational support with sub constructs as leadership & governance, policy & compliance, needs assessment and stakeholder. These factors were incorporated into the architecture as priority/foundational dimensions requiring strengthening which affect whether e-Health systems become embedded in routine practices.

4.9 Structure of the Proposed Routinization Architecture

The proposed architecture was based on both theoretical insights and empirical findings; it consists of four interlinked layers from strategy to routine use for a better health service delivery. The overview of the routinization pathway has a bottom-up movement, which will ensure a long-term success of eHealth interventions. These layers work in synergy to ensure e-Health systems transition from implementation to routine, sustainable use in public healthcare facilities. **Strategy → Investment → Implementation → Routine Use**

4.9.1 e-Health Strategy Building Blocks

This is the foundational layer of the architecture; it's the essential components that form the foundation of an effective national or institutional e-Health framework. These building blocks guides the planning, implementation and sustainability of e-Health systems to improve health outcomes, service delivery and health system efficiency.

4.9.1.1 User Characteristics

User Engagement and Skills component emphasize the importance of user attitudes, skills and participation in e-Health technologies. It highlights the need for users to have positive attitudes, necessary skills and active engagement with e-Health platforms to enhance personal growth, health management and outcomes. Another component is System Usage and Structure which focuses on the usage patterns and structural aspects of e-Health systems. It includes the understanding of e-Health systems' functionalities, the integration of these systems into daily routines and the clarity of steps involved in using them effectively.

4.9.1.2 Technological Availability

Integration and Usability component underscores the significance of integrating e-Health systems for seamless user experiences and enhancing continuity of care. It also highlights the importance of user-friendly systems that healthcare providers can utilize effectively. Availability of infrastructure, reliable electricity, internet, software and ICT tools component addresses the need for durable hardware and reliable networking infrastructure. It also considers the accessibility of e-Health systems from different facilities and the availability of necessary e-Health applications such as KenyaEMR, DHIS2, LIMS, PIS and Picture Archiving Systems.

4.9.1.3 Organisational Support

This sub construct is anchored in leadership involvement, clear institutional policies and continuous resourcing. It highlights the crucial role of support from top management and active engagement with stakeholders, including healthcare professionals, patients, and technical providers. It emphasizes the importance of conducting thorough needs assessments, investing in capacity building and ensuring sufficient financial resources to meet technological demands.

4.9.2 HIS Investment Strategy Plan

This component is essential for ensuring that technology investments are aligned with organizational goals, cost-effective and capable of delivering improved patient care while managing risks and ensuring compliance with regulations and also scaling for future growth and technological advancements, ensuring that the HIS can scale and adapt to new challenges and opportunities without requiring frequent costly overhauls.

4.9.3 e-Health Architecture

This component is the foundational framework that defines the structure, components and relationships of e-Health systems within a healthcare facility or across a broader healthcare network that provides the blueprint for integrating various e-Health solutions into a unified system, enabling healthcare organizations to achieve their objectives effectively.

4.9.4 Scale, Institutionalize and Sustain

This component implies that there is a common way of doing things, that is the daily e-Health system usage will lead to more data for better decision making and data management. The entire process then becomes a routine for health workers as they use the e-Health systems daily, it also incorporates regular system evaluation, performance tracking and user feedback mechanisms.

4.9.5 Net Benefits

This is the ultimate outcome of the sustained use and integration of e-Health into everyday healthcare practices. When systems are effectively institutionalized, they lead to improved efficiency in service delivery, enhanced decision-making and better management of health data. These benefits contribute to higher quality care, reduced operational delays and more responsive health services. Additionally, the use of accurate and timely data fosters a culture of evidence-based practice, where health workers routinely rely on digital systems to inform their actions. Over time, these practices become the norm, ensuring that the full value of digital health investments is realized and sustained across the health system. Figure 4.1 below illustrates the proposed routinization architecture showing the components and interconnections of the layers.

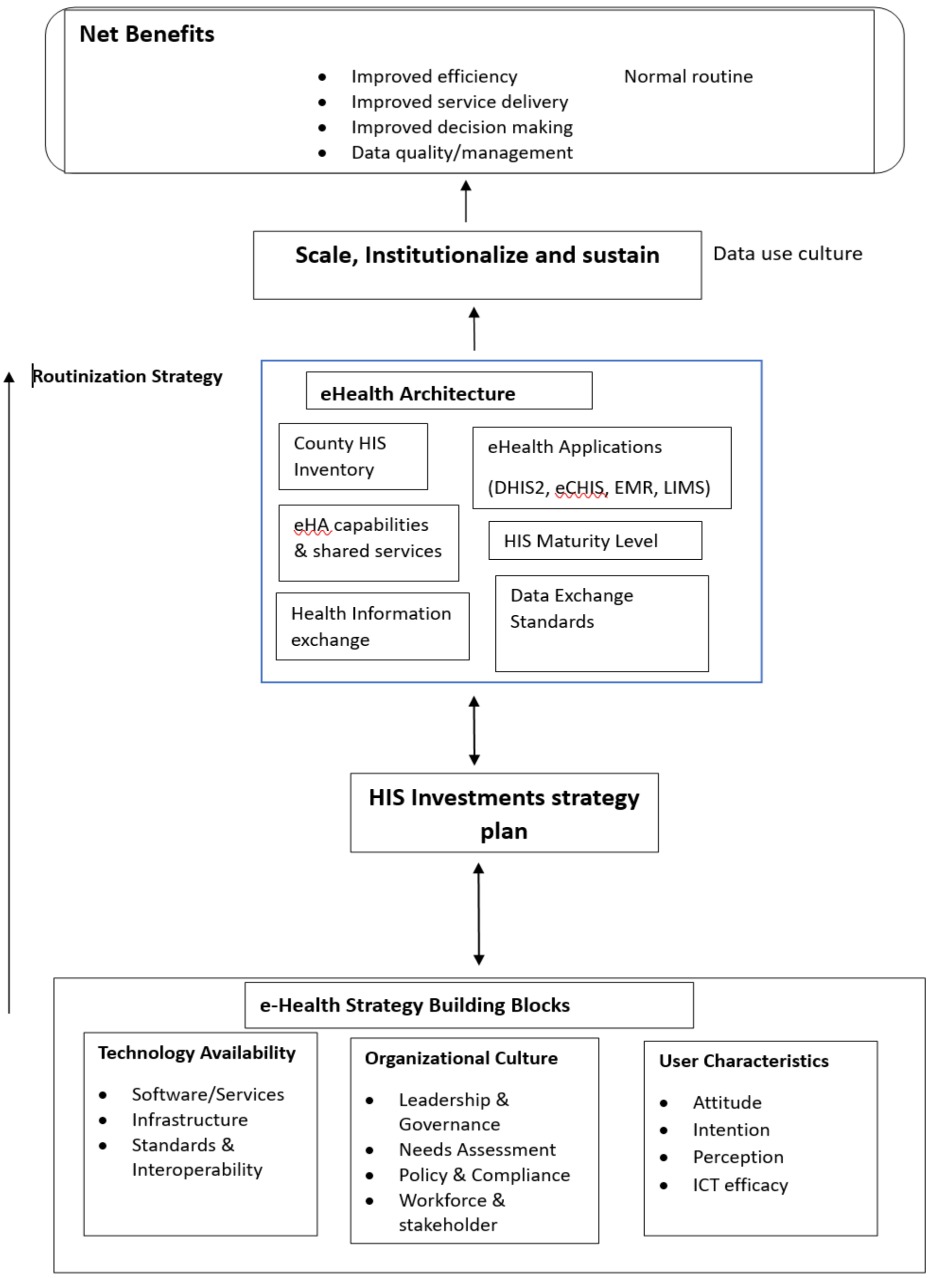

Figure 4. 1: Routinization Architecture for e-Health Systems, (Source: Author)

4.10 Sequential flow of the Routinization Architecture diagram

The arrows in figure 4.1 illustrates the logical and sequential flow of the routinization strategy for e-Health systems, progressing from foundational enablers to the realization of net benefits.

Upward Arrows (🠕) represent a progressive transition:

From the e-Health Strategy Building Blocks which include Technology Availability, Organizational Culture and User Characteristics towards the formulation of a Health Information System (HIS) Investment Strategy Plan. These building blocks serve as the core enablers of strategic health information system development.

The investment strategy subsequently informs and enables the development and implementation of the eHealth Architecture, comprising components such as HIS inventory, applications (e.g., DHIS2, EMR), maturity levels and interoperability standards.

A robust eHealth architecture then supports the ability to Scale, Institutionalize and Sustain health information systems, fostering a data use culture. This culminates in achieving Net Benefits, such as improved efficiency, service delivery, data quality and routine data use in healthcare decision-making.

Bidirectional Arrow (↕) between the Strategy Building Blocks and the HIS Investment Strategy Plan indicates a feedback relationship, where strategic decisions are not only informed by the foundational pillars but are also iteratively refined based on implementation experiences and system performance.

The **Vertical Arrow** on the left, labelled Routinization Strategy, summarizes the overall directional logic of the model illustrating the movement from strategic input to sustained routine use of digital health solutions.

This structured flow reflects how enabling conditions, guided investments and architectural design contribute collectively to the routinization and normalization of e-Health systems within public healthcare facilities.

4.11 Summary of the Proposed Routinization Architecture Components

Table 4.27 summarizes the constructs and sub constructs used to derive the proposed routinization architecture.

Table 4. 27: Components of the proposed Routinization Architecture

Layers	**Component**	**Description /Purpose**
e-Health Strategy Building Blocks (Foundation Layer)	**Technology Availability** • Infrastructure, software, services **Organizational Culture** • Leadership, governance, policy, stakeholders, standards **User Characteristics** • Attitude, perception, ICT skills	• These are the key enablers for building a strong Health Information System (HIS).
HIS Investment Strategy Plan	• Aligns funding and resources with goals • Guides development of HIS components	• Ensure technology investments are aligned with organizational goals, cost-effective.

	• Ensures sustainability and scalability	• Ensure e-Health systems can scale and adapt to new challenges and opportunities without requiring frequent costly overhauls.
eHealth Architecture (Core Layer)	• County HIS Inventory • eHealth Apps (DHIS2, eCHIS, EMR, LIMS) • Shared services and eHA capabilities • Data exchange standards • HIS maturity levels • Health information exchange	• Defines the structure, components and relationships of e-Health systems within a healthcare facility or across a broader healthcare network providing a blueprint for integrating various e-Health solutions.
Scale, Institutionalize, and Sustain	**Purpose:** • Expand and embed eHealth practices • Develop a culture of data use • Integrate HIS into daily operations	• Implies there is a common way of doing things, daily e-Health system usage will lead to more data for better decision making and data management
Net Benefits (Top Layer)	**Outcomes:** • Improved efficiency • Better service delivery • Informed decision-making • High-quality data	• Achieved when eHealth becomes normal routine

4.12 Expert Validation Report of the Proposed Routinization Architecture

This validation report presents the outcome of an expert review of the proposed Routinization Architecture for e-Health Implementation developed in the above thesis.

4.12.1 Objectives of the Validation

The purpose of the validation specifically sought to:

1. Determine whether the architecture adequately captured the critical factors (user, technological, organizational) that influence routinization.
2. Evaluate the practical applicability of the architecture in real-world public healthcare facilities.
3. Assess the coherence, completeness, robustness, applicability and practicality of the architecture in guiding the sustainable integration of e-Health systems into routine operations in public healthcare facilities.

4.12.1.1 Understanding the Goal of Validation

The primary goal was to assess the architecture's feasibility, applicability, acceptability and completeness from the perspective of those who would use it. Thus, the researcher sought to answer the following five questions:

1. Is the architecture comprehensible? Do stakeholders understand its components and their relationships?
2. Is it complete or are there critical barriers or facilitators of routinization that the model misses?
3. Is it applicable i.e. Can it be realistically applied within the constraints of public healthcare facilities (e.g., resource limitations, workload)?
4. Is it acceptable i.e. Do the proposed processes and structures align with the values, workflows, and professional cultures of the end-users?

5. What needs to be refined, i.e. What specific components need to be added, removed, or modified to make it more effective?

4.12.2 Method of Validation

The proposed e-Health Routinization Architecture was validated using Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) with the County health management team and sub-county healthcare facility users.

4.12.3 Participant Selection and Recruitment (Sampling)

A purposeful sampling strategy was used to get rich, relevant data from the most informed individuals.

4.12.3.1 For Key Informant Interviews (KIIs)

Select individuals with deep institutional knowledge, strategic roles, or unique expertise. Ministry of Health officials, Hospital CEOs/Medical Superintendents, Heads of IT departments, Lead clinicians (e.g., Head of Nursing, Chief Medical Officer), e-Health project managers. They provide a "big picture" view on policy alignment, funding sustainability, strategic planning and organizational change management being key components of any routinization architecture.

4.12.3.2 For Focus Group Discussions (FGDs)

Selected homogenous groups of frontline users to encourage open discussion and uncover shared experiences.

Group 1: Frontline clinicians (Doctors, Nurses, Clinical Officers) who use the system daily.

Group 2: Administrative and support staff (Pharmacists, Lab Technologists, Records Officers) impacted by the system.

Group 3: IT support staff within the facility who maintain the system.

They provided ground/operational-level insights on workflow integration, daily usability, training adequacy, and unintended consequences—the core of routinization.

4.12.4 Developing the Discussion Guides

The guides were structured around the core domains or components of the proposed routinization architecture.

4.12.4.1 Domains included in the Architecture

- **Technical Infrastructure:** Reliability, interoperability, ease of use.
- **Workflow Integration:** Fit with clinical routines, adaptation of processes.
- **Training and Support:** Initial training, ongoing help-desk support.
- **Leadership and Governance:** Champions, management support, policy alignment.
- **Funding and Sustainability:** Recurrent costs, business model.

4.12.4.2 KII Guide Structure

1. **Introduction:** Explain the architecture at a high level (use a visual aid).
2. **Perceived Usefulness:** "From your strategic perspective, how useful is this model for guiding national e-health scale-up?"
3. **Completeness:** "Does this architecture cover all the key areas you believe are necessary for making an e-health tool a permanent part of operations? What, if anything, is missing?"
4. **Specific Component Deep Dive:** "Let's discuss the 'Governance' component. How applicable are these suggested structures in a typical public hospital?"
5. **Barriers to Application:** "What are the biggest political or financial barriers to implementing this architecture as proposed?"
6. **Conclusion:** "If you were to prioritize one element of this model for action, what would it be?"

4.12.4.3 FGD Guide Structure

1. **Introduction:** Explained the goal to improve the model for making digital tools work better.
2. **Experience Mapping:** "Think about a digital tool you use here. Walk us through a typical day using it. What works well? What frustrates you?" (This opens the conversation without leading).
3. **Probing based on Architecture:** Use the architecture's components as probes.
   - "The model suggests 'Ongoing Support' is key. What is your experience with getting help when the system fails?"
   - "It emphasizes 'Workflow Fit'. Can you describe how the digital tool has changed your daily routines, for better or worse?"
4. **Reaction to Architecture:** Show a simplified version of the architecture. "Does this model make sense based on what you've just described? What parts ring true? What seems off?"
5. **Co-Design:** "If you could change one thing about how digital tools are introduced and supported here, based on this model, what would it be?"

4.12.5 The Validation Process: Data Collection and Analysis

This was an iterative process of data collection and analysis which was taken through four steps. In the first step, the researcher organized a one-day workshop for the FGDs. This was to facilitate discussions, ensuring all voices are heard; this was achieved through audio-recording (with permission) besides taking detailed notes.

In the second step, the researcher thereafter transcribed and analyzed data; transcribed the recordings verbatim, besides using thematic analysis through the following steps:

- Familiarization: Read and re-read transcripts.

- Coding: Generate codes (labels) for key phrases related to the architecture's components (e.g., "code: lack_of_training," "code: leadership_champion").
- Theme Generation: Group codes into themes that either validate, contradict, or expand upon the components of your pre-defined architecture.
- Example: If multiple users from different FGDs state that "training was a one-time event and we forget," this validates the need for an "Ongoing Training" component in your architecture. If they reveal a barrier you hadn't considered (e.g., "incentives for data entry"), this suggests an expansion of the architecture.

In the third step, the researcher did map findings to the Architecture as captured in table 4:28 below

Table 4.28: Map Findings to the Architecture

Architecture Component	**Validation Finding (Supporting Quote)**	**Contradiction Finding (Supporting Quote)**	**Proposed Refinement**
Technical Support	"The 24/7 helpline is a lifeline. We can't work without it." (Nurse, FGD1)	"The helpline only works for software issues, not when the tablet battery dies." (Clinician, FGD2)	Expand the "Technical Support" component to include **hardware maintenance and logistics**.
Strategic Leadership	"The hospital superintendent mandates its use, which forces compliance." (KII, Hospital CEO)	"The mandate is there, but no one checks the quality of the data entered." (KII, IT Head)	Add a sub-component on **"Quality Assurance and Data Use for Decision Making"** under Leadership.

4.12.6 Validation Findings: The Refined Routinization Architecture

The validation process is complete when the data has been fully integrated. The output is not just a report of findings, but a revised and strengthened version of the original architecture with components shown below;

Confirmed Components: Elements that were consistently validated by users are strengthened as core pillars.

Refined Components: Elements that received mixed feedback are clarified and nuanced.

New Components: Entirely new domains or sub-components are added based on emergent themes from the data.

Discarded Components: Elements that were consistently contradicted or deemed irrelevant are removed.

4.12.7 Conclusion

The validation process transforms the architecture from a theoretical model (based on literature) into a contextually-grounded, evidence-informed framework. It earns its credibility by incorporating the lived experiences and expert opinions of the very people it is designed to serve, dramatically increasing its chances of successful adoption and impact in public healthcare facilities.

4.13 Discussion of findings

This section presents an integrated discussion of the study findings in line with the research objectives and the theoretical frameworks adopted NPT, UTAUT and TTF. The findings provide critical insights into the factors that influence the routinization of e-Health systems in public healthcare facilities in Kakamega County.

The study established that although e-Health systems have been introduced in many public healthcare facilities, their adoption and use remain inconsistent. Descriptive analysis showed that limited access to reliable ICT infrastructure, frequent power and internet outages, lack of technical support, and inadequacies in digital hardware hinder routine system use. These constraints support previous findings that highlight infrastructural readiness as a critical foundation for successful digital health interventions (Akanbi et al., 2012). The data suggest that the current level of e-Health system usage does not yet reflect full routinization, thus calling for targeted interventions to bridge infrastructural and capacity gaps.

Factor Analysis revealed that user characteristics including digital literacy, attitude toward technology, perceived ease of use and ICT training play a substantial role in shaping system routinization. This finding aligns with Venkatesh et al.'s (2003) UTAUT model, which posits that performance expectancy, effort expectancy and social influence are significant predictors of user intention and behaviour. Users with prior experience in health IT and those who found the systems user-friendly were more likely to integrate them into their daily routines. These results emphasize the need for user-centred approaches to training and ongoing technical support.

The study found that the availability of functional and well-maintained technology infrastructure is directly linked to the level of routinization. Facilities with adequate hardware, software, stable internet and reliable power supply demonstrated higher levels of system integration into daily workflows. This supports the TTF model by Goodhue and Thompson (1995) which asserts that effective technology use occurs when the tools available appropriately support task execution; where technological fit was low, users were likely to revert to manual or hybrid processes, inhibiting system institutionalization.

Organizational support emerged as the most significant predictor of e-Health routinization. This includes managerial commitment, presence of supportive policies, availability of refresher training and monitoring mechanisms. Regression analysis confirmed a strong and statistically significant relationship between organizational support and system routinization. This finding aligns with NPT framework, which emphasizes collective action, reflexive monitoring and contextual integration as key to technology normalization in complex systems (May & Finch, 2009). These findings underscore the role of leadership and governance structures in shaping digital transformation outcomes.

A conceptual architecture for routinizing e-Health systems was developed based on both empirical findings and theoretical principles. The architecture integrates the three domains; user characteristics, technological availability and organizational support, and it proposes strategic enablers such as training, workflow alignment, continuous technical support, policy integration and performance monitoring. This multi-level framework reflects a holistic approach to routinization with consistent literature advocating for an integrated health system strengthening (WHO, 2012). The proposed routinization architecture serves as a guiding model for policymakers and implementers aiming to transition e-Health systems from pilot to routine use.

Multivariate regression analysis revealed that user characteristics, technological availability and organizational support jointly explain a substantial proportion of variance in e-Health routinization. Notably, organizational support demonstrated the strongest influence, suggesting that institutional capacity and leadership are essential for sustainability. The interdependence of factors implies that interventions must be systemic rather than isolated targeting infrastructure, capacity-building and governance simultaneously. These findings are consistent with past studies that stress the need for cross-cutting strategies to embed digital health solutions sustainably (Ouma & Herselman, 2008; Scott et al., 2017).

These findings are in line with Wickramasinghe et al. (2016) who argue that the maturity of e-Health implementation varies across healthcare levels, especially in resource-limited settings. The long queues and manual file handling observed at level 3 healthcare facilities reflect inefficient workflows, which Braa et al. (2007) describes as key indicators of systems that have not yet been routinized. Moreover, Khoja et al. (2013) emphasizes that infrastructural readiness is a foundational element for the sustainability of digital health interventions.

The study findings support the empirical literature by highlighting that routinization is sustained when systems are perceived as useful, easy to use and compatible with users' roles (Venkatesh et al., 2003). Literature also emphasizes the importance of repetition and reinforcement, where continuous system use, supported by on-site mentorship and peer learning, gradually transforms new practices into normalized routines. This study conforms to studies that highlighted routinization is facilitated through standardization of processes, training and re-training of users, alignment of systems with existing workflows and the institutionalization of supportive policies (Greenhalgh et al., 2017).

Ultimately, by synthesizing findings from the study's objectives and the existing literature, the routinization architecture provides a holistic framework that transitions e-Health systems from ad hoc use to fully routinized components of healthcare delivery in public health facilities.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter entails summary, conclusions and recommendations. It also contains suggestions for further studies based on the study limitations.

5.1 Summary of the study

This study set out to explore how e-Health systems become routinized in public healthcare facilities, by moving beyond initial adoption towards long-term, consistent use. The main aim was to identify the factors that enable routinization and to highlight strategies that support sustained integration of these systems in routine healthcare delivery.

The research was guided by a comprehensive literature review, which revealed that routinization is shaped by multiple interrelated factors which include, standardization of processes, continuous training of healthcare workers, workflow integration, supportive policies, change management practices, monitoring and evaluation mechanisms, sustainability measures, system integration and repeated use of the implemented systems. Collectively, these elements create the conditions under which e-Health systems can shift from being innovations to becoming embedded in daily healthcare practices.

The findings further established that public healthcare facilities in resource-constrained settings face persistent challenges such as limited infrastructure, unreliable power supply, inadequate internet connectivity, staff turnover and outdated hardware. These barriers undermine the sustainability and effectiveness of e-Health systems, making routinization difficult to achieve.

Overall, the study underscores that the success of e-Health systems does not depend solely on their introduction but rather on continuous institutional support, alignment with healthcare workflows, adequate resources and active stakeholder involvement. Addressing these dimensions is critical for achieving meaningful and long-lasting integration of e-Health technologies in public healthcare facilities.

5.1.1 Status of e-Health Use in Public Healthcare Facilities.

The findings reveal a diverse implementation and utilization of these systems across the county. A majority of healthcare facilities have adopted e-Health systems to varying extents. Specifically, 60% of the facilities reported having an e-Health system installed and actively used in all departments, whereas 30% have e-Health systems in use by only some departments, and 10% do not have any e-Health systems implemented. The utilization of e-Health systems varies among healthcare workers. Approximately 50% of the respondents reported using the e-Health system daily, 20% use it 2-3 times a week, and 10% once a week. The remaining 20% either use it monthly or have never used it.

The e-Health systems in place are equipped with various functionalities that enhance healthcare delivery. Notably, 85% of the systems can track and record patient information, 70% manage patient medical issues, and 65% generate claims for insurers. Additionally, 55% of the systems can track ordered and pending lab values, and 50% can manage patient medications and allergies. However, several barriers hinder the effective use of e-Health systems. The primary challenges include the need for staff and provider training, reported by 40% of respondents, system upgrades (30%), and hardware issues such as the unavailability of computers in all exam rooms (20%). Additionally, 10% of the respondents mentioned that they still use handwritten or paper orders due to provider preference.

Despite these challenges, the adoption of e-Health systems has positively impacted service delivery in Kakamega County. According to 79% of respondents, the e-Health systems have significantly improved service delivery and enhanced patient satisfaction. Furthermore, 79% reported faster data retrieval, and 79% noted that the systems have enhanced the corporate image and reputation of their facilities. Overall, the status of e-Health systems in public healthcare facilities in Kakamega County can be considered progressive, with a majority of facilities embracing the technology and experiencing tangible benefits in service delivery and patient care. This promising trajectory highlights the potential for further advancements and optimizations in the use of e-Health systems, despite the existing challenges that need to be addressed.

5.1.2 Factors Influencing Routinization of e-Health

One of the primary factors identified was organizational support. The findings revealed that support from top management is essential for the successful implementation and routinization of e-Health systems. This was evident as 92% of respondents emphasized the importance of managerial support, indicating a strong correlation between management backing and the effective use of e-Health technologies. Another crucial factor is the level of user engagement and computer skills. The study found that healthcare providers' engagement and their proficiency in using e-Health systems significantly affect the systems' routinization. Approximately 85% of respondents agreed that positive attitudes towards e-Health technologies are crucial for successful adoption. Furthermore, 80% highlighted the importance of computer skills in maximizing the effectiveness of e-Health systems.

Technological availability and infrastructure also play a vital role. The study revealed that the integration and user-friendliness of e-Health systems are critical for their effective utilization. Specifically, 95% of respondents pointed out the importance of having a user-friendly system, while 82% stressed the need for reliable hardware and networking infrastructure. The research also highlighted the significance of comprehensive training and capacity building. Investment in training healthcare providers and upgrading IT infrastructure was noted by 91% of respondents as a key factor in improving service delivery and facilitating the routinization of e-Health systems. Additionally, the availability of financial resources emerged as a significant factor. Ensuring sufficient financial resources to meet the technological demands was deemed essential by 90% of respondents, indicating that financial investment is necessary for the sustained use and integration of e-Health systems.

Stakeholder engagement was another important factor identified. Active engagement with stakeholders, including healthcare professionals, patients, and technical providers, was highlighted by 94% of respondents as crucial for the development and implementation of e-Health systems. This engagement ensures that the systems are tailored to meet the specific needs of users and promotes a sense of ownership and commitment to their use. Overall, the study identified organizational support, user engagement and skills, technological availability and infrastructure, training and capacity building, financial resources, and stakeholder engagement as the primary factors influencing the routinization of e-Health systems in public healthcare facilities in Kakamega County. These factors collectively contribute to the effective integration and sustained use of e-Health technologies, ultimately enhancing healthcare service delivery in the region.

5.1.3 Proposed Routinization Architecture

The third objective aimed to establish the key components required for the development of a routinization architecture for e-Health. The study findings highlighted that for a successful routinization, it hinges on combination of factors; organizational support, technological and user characteristics. Core components or sub constructs identified from the factors included standardization of practices, capacity development in IT skills, effective workflow integration, supportive organizational policies and ongoing monitoring and evaluation. Infrastructural readiness such as reliable power supply, internet connectivity and availability of technical support was also deemed critical. Moreover, the findings emphasized the importance of aligning technology with users' tasks (ttf, ensuring user acceptance through change management strategies and encouraging repetitive use through system usability and performance support. These components formed the foundation for designing a comprehensive routinization architecture tailored to the realities of the healthcare context under study.

5.2 Conclusions

The study found that there was inconsistent utilization of e-Health systems due to limited ICT infrastructure, insufficient digital literacy among users and fragmented workflows that influence the routinization process. Despite the presence of digital tools, their integration into core clinical and administrative workflows remain limited, pointing to a misalignment between system adoption and operational routinization. Despite the majority of healthcare workers having good years of experience in using e-Health systems, it didnt influence the daily usage of the systems because the foundational system gaps hindered the consistent use of e-Health systems.

The study established that technological availability, organizational support, user characteristics and workflow integration are significant determinants for a successful routinization process. User characteristics significantly impact e-Health utilization through skills, attitudes, perceptions and engagement of healthcare staff. A well-trained and motivated users are more likely to incorporate systems usage into a routine task. User engagement and skills were identified as crucial elements with a strong correlation indicating that positive attitudes towards e-Health technologies and active participation significantly enhance the likelihood of a successful adoption and routinization. User computer skills was also emphasized, highlighting the need for continuous training and support to maximize the benefits of e-Health systems in a healthcare facility.

Availability of adequate hardware, software, internet connectivity, technical support, integration and usability of systems also emerged as a vital component that directly affects the routinization process, through user-friendly e-Health platforms, a robust infrastructure that support operations and ensuring that healthcare providers can seamlessly integrate these technologies into their workflows.

Organizational support proved to be a significant predictor of the routinization of e-Health through managerial backing, active stakeholder engagement and sufficient financial resources. The need for thorough needs assessments to tailor e-Health solutions to specific healthcare provider requirements to ensure that the systems are well-suited to the unique needs of each facility. The study's regression analysis further validated these findings, demonstrating that organizational support significantly predicts the routinization of e-Health. Successful routinization requires a multifactorial process that supports the environment and system alignment within existing workflows.

Routinization of e-Health systems requires a structured and holistic architecture that integrates the technical, organizational and user-centric components. Despite substantial investment in e-Health systems, full integration into daily practice remains limited due to factors such as inadequate user training, insufficient infrastructure, limited policy support and weak governance mechanisms that hinder it. The proposed routinization architecture addresses these challenges by emphasizing the need for user involvement in system design and continuous feedback, capacity building through regular training and support, strong leadership and policy alignment to ensure institutional commitment and robust technological infrastructure that supports system usability, reliability and interoperability. When these components are aligned together, they collectively support the normalization of e-Health systems into routine practice leading to an improved data use, decision-making, efficiency and overall service delivery. The proposed architecture provides a strategic pathway for scaling up and sustaining e-Health initiatives, especially in a resource-constrained settings where a centralized HIS will be capable of supporting routine clinical processes, enhancing data availability and facilitating informed decision-making that will be a viable pathway towards improving operational resilience, service delivery and long-term sustainability of public healthcare facilities.

5.3 Recommendations

The study recommendation provides a roadmap for achieving effective and sustainable e-Health solutions to ultimately improve healthcare service delivery across the county by ensuring that healthcare workers interact with the systems daily which leverages standardized protocols that ultimately lead to more efficient and effective service delivery through policy enforcements.

To enhance hospital survivability, public health facilities should adopt a centralized and interoperable HIS designed to support routine functions such as patient record management, diagnostics, inventory control and clinical decision-making to integrate into existing workflows to ensure seamless adoption and long-term use.

The Government and relevant stakeholders should prioritize upgrading digital infrastructure through investments by providing consistent internet access, power supply and backups, offer training in IT technologies skills to improve digital competencies among health workers thus enhance user competence. Training should focus not only on the technical aspects of using these systems but also on fostering positive attitudes towards e-Health and encouraging active participation. Additionally, investment in robust technological infrastructure and prioritizing the integration and usability of e-Health systems to ensure systems are able to communicate seamlessly and users can easily access e-Health systems through different platforms.

Developers must prioritize creating e-Health systems that are user-friendly, featuring intuitive navigation and simplified interfaces, this will reduce the cognitive burden on healthcare workers facilitating smoother workflow integration and enhancing overall efficiency.

Literature stresses the role of top-down support and bottom-up participation in fostering system ownership and long-term sustainability (Fixsen et al., 2005). Policymakers should adopt a holistic implementation framework that includes technical support, adequate financial resources thorough needs assessments and active stakeholder engagement, change management and policy incentives to support long-term system use. In addition, strong organizational support ensures that the top management actively supports the implementation of e-Health systems by involving frontline healthcare workers, ICT personnel and facility management earlier during the development and implementation process to ensure that the systems are tailored to meet their needs in co-creating implementation plans and evaluating performance metrics. Further, organizational support should include mechanisms for standardizing practices through policies and standard operating procedures in public healthcare facilities to ensure that e-Health tasks are not isolated but embedded in routine clinical operations.

Healthcare facilities should establish governance mechanisms to oversee the development, maintenance and security of e-Health systems to ensure that the systems are sustainable and can adapt to changing requirements over time by implementing robust security measures to protect sensitive patient data from unauthorized access.

Lastly, e-Health implementation should be adopted by integrating user engagement, technological infrastructure and organizational support into a cohesive strategy to enhance the adoption and sustainability of e-Health systems, leading to improved healthcare outcomes and service delivery. MOH can adopt the proposed architecture as a national guideline and consider piloting the proposed architecture in selected facilities and iteratively refine it based on feedback before scaling up as nationwide adoption.

5.4 Suggestions for further study

Routinization is fundamental in enhancing quality service delivery in healthcare through ensuring that processes, practices and procedures of a technology becomes standardized into daily workflow operations. This study was limited to routinization of e-Health systems in public healthcare facilities. Future studies should consider investigating the socio-economic factors that influence the implementation and utilization of e-Health systems by understanding the impact of variables such as income levels, education and regional disparities on the acceptance and use of e-Health systems to inform targeted interventions. Also, researchers can examine the role of policy and regulatory frameworks in the success of e-Health systems by analysing how different policies, standards and regulations affect the implementation and sustainability of e-Health technologies.

REFERENCES

Achieng, M., & Ruhode, E. (2021). EHealth technologies integration with healthcare work activities in public hospitals: A critical realist perspective.

Adam, A. M. (2020). Sample size determination in survey research. *Journal of Scientific Research and Reports*, 90-97.

Adler-Milstein, J., & Jha, A. K. (2017). HITECH Act Drove Large Gains In Hospital Electronic Health Record Adoption. Health Affairs*, 36*(8), 1416–1422.

Adu, J., Taremwa, I. M., Kimeu, R. K., Alemu, A., & Boateng, G. O. (2023). Sustainability of digital health interventions in low- and middle-income countries: A systematic review. *JMIR Formative Research*, 7, e41487.

Access Afya. (2021). *Afya Pap and iSikCure: Mobile health solutions*. Access Afya. https://accessafya.com

Akanbi, M. O., Ocheke, A. N., Agaba, P. A., Daniyam, C. A., Agaba, E. I., Okeke, E. N., & Ukoli, C. O. (2012). Use of Electronic Health Records in sub-Saharan Africa: Progress and challenges. *Journal of Medicine in the Tropics, 14*(1), 1–6

Al Zefeiti, S. M. B., & Mohamad, N. A. (2015). Methodological considerations in studying transformational leadership and its outcomes. International Journal of Engineering Business Management, 7(1), 1–11.

Alenoghena, C. O., Onumanyi, A. J., Ohize, H. O., Adejo, A. O., Oligbi, M., Ali, S. I., & Okoh, S. A. (2022). e-Health: A survey of architectures, developments in mHealth, security concerns and solutions. International Journal of Environmental Research and Public Health, 19(20), 13071.

Ankem, K., Uppala, V. & Dhawan, A. (2017). Electronic Health Record System Implementa- tion in a Health Informatics Program: A Case Study, Journal of the Midwest Associa- tion for Information Systems (JMWAIS), vol. 2017, no. 2, p.Article 9

Barua, S. B. S., Shahriar, F., Mahi, U. N., Abrar, M. H., Fahad, M. A. R., & Hoque, A. S. M. L. (2025). Design and implementation of a scalable clinical data warehouse for resource-constrained healthcare systems.

Bensbih, S., Essangri, H., & Souadka, A. (2020). The Covid19 outbreak: a catalyst for digitization in African countries. Journal of the Egyptian Public Health Association, 95, 1-2.

Bergua, V., & Bouisson, J. (2008). Aging and routinization: A review. Psychologie & NeuroPsychiatrie du vieillissement, 6(4), 235-243.

Blaya, J. A., Fraser, H. S., & Holt, B. (2010). E-Health technologies show promise in developing countries. *Health Affairs*, 29(2), 244-251.

Bolarinwa, O. A. (2015). Principles and methods of validity and reliability testing of questionnaires used in social and health science researches. Nigerian Postgraduate Medical Journal, 22(4), 195-201.

Boonstra, A., & Broekhuis, M. (2010). Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions. *BMC Health Services Research, 10*(1), 231

Buntin, M. B., Burke, M. F., Hoaglin, M. C., & Blumenthal, D. (2011). The benefits of health information technology: a review of the recent literature shows predominantly positive results. *Health Affairs*, 30(3), 464–471

Braa, J., Monteiro, E., & Sahay, S. (2007). Networks of Action: Sustainable Health Information Systems Across Developing Countries. MIS Quarterly, 31(2), 337–362

Carayon, P., Hoonakker, P., Hundt, A. S., Salwei, M., & Wetterneck, T. B. (2015). Integrating health information technology into workflow redesign, summary report. *Agency for Healthcare Research and Quality (AHRQ)*.

Centers for Disease Control and Prevention (CDC) Kenya. (2018). *Laboratory information systems strengthening in Kenya*. U.S. Centers for Disease Control and Prevention. https://www.cdc.gov/globalhealth/countries/kenya

Chatterjee, A., Prinz, A., Riegler, M. A., & Das, J. (2023). A Systematic Review on ICT-based Remote and Automatic COVID-19 Patient Monitoring and Care.

Chukwu E, Garg L, Foday E, Konomanyi A, Wright R, Smart F Electricity, Computing Hardware, and Internet Infrastructures in Health Facilities in Sierra Leone:Field Mapping Study JMIR Med Inform 2022;10(2):e30040

Coiera, E., & Hovenga, E. J. S. (2007). Building a Sustainable Health System Major Trends, Challenges, 11–18.

County public service board Annual Report 2020 – County government of Kakamega. https://kakamega.go.ke/download/cpsb-annual-report-2020/

Creswell, J. W. (2003). Research design: Qualitative, quantitative and mixed methods. Thousand Oaks:SAGE Publications

Cresswell, K., & Sheikh, A. (2013). Organizational issues in the implementation and adoption of health information technology innovations: An interpretative review.

International Journal of Medical Informatics, 82(5), e73–e86

Cunningham, S. G., Wake, D. J., Waller, A., & Morris, A. D. (2014). Definitions of e-Health. e-Health, care and quality of life, 15-30.

Cruz-Martínez, R. R., Noort, P. D., Asbjørnsen, R. A., van Niekerk, J. M., Wentzel, J., Sanderman, R., & van Gemert-Pijnen, L. (2019). Frameworks, models, and theories used in electronic health research and development to support self-management of cardiovascular diseases through remote monitoring technologies: Protocol for a metaethnography review. JMIR research protocols, 8(7), e13334.

De Vaus, D. (2001). Research design in social research. Research design in social research, 1-296.

DoctorsExplainFM. (2023a, May 15). Healthcare services interoperability in Kenya. https://www.linkedin.com/pulse/healthcare-services-interoperability-kenya-doctorsexplainfm-z4rjf

DoctorsExplainFM. (2023b, May 10). Healthcare services interoperability in Kenya. *DoctorsExplain Magazine.* https://magazine.doctorsexplain.net/healthcare-services-interoperability-in-kenya

Duettmann, W., Naik, M. G., Zukunft, B., Osmonodja, B., Bachmann, F., Choi, M., ... & Budde, K. (2021). e-Health in transplantation. *Transplant International*, 34(1).

Etikan, I. (2017). Combination of probability random sampling method with non probability random sampling method - Sampling versus sampling method Biometrics & Biostatistics International journal, 5(6)

Fixsen, D. L., Naoom, S. F., Blase, K. A., Friedman, R. M., & Wallace, F. (2005).

Implementation research: A synthesis of the literature (FMHI Publication No. 231). University of South Florida, Louis de la Parte Florida Mental Health Institute, The National Implementation Research Network. https://nirn.fpg.unc.edu/resources/implementation-research-synthesis-literature

Gagnon, M. P., Desmartis, M., Labrecque, M., Car, J., Pagliari, C., Pluye, P., … & Légaré, F. (2012). Systematic review of factors influencing the adoption of information and communication technologies by healthcare professionals. Journal of Medical Systems, 36(1), 241–277

GeeksforGeeks. (2024, June 21). Types of monitoring in system design. GeeksforGeeks. https://www.geeksforgeeks.org/system-design/types-of-monitoring-in-system-design/

Githinji, S., Wamari, A., & Ndirangu, G. (2021). Implementation of Electronic Health Records in Kenya: Progress, challenges, and opportunities. *BMC Health Services Research, 21*, 900.

Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of innovations in service organizations: Systematic review and recommendations. *Milbank Quarterly, 82*(4), 581–629.

Golafshani, N. (2015). Understanding reliability and validity in qualitative research. The Qualitative Report. doi: 10.46743/2160-3715/2003.1870

Goh, J. M., Gao, G., & Agarwal, R. (2011). Evolving work routines: Adaptive routinization of information technology in healthcare. Information Systems Research, 22(3), 565-585. doi: 10.1287/ISRE.1110.0365.

Greenhalgh, J., & Thorogood, N. (2018). Qualitative methods for health research, 1-440.

SAGE

Grguric, A., Khan, O., Ortega-Gil, A., Markakis, E. K., Pozdniakov, K., Kloukinas, C., Medrano-Gil, A. M., Gaeta, E., Fico, G., & Koloutsou, K. (2021). "Reference Architectures, Platforms, and Pilots for European Smart and Healthy Living—Analysis and Comparison." *Electronics*, 10(14), 1616.

Goodhue, D. L., & Thompson, R. L. (1995). Task-technology fit and individual performance. MIS Quarterly, 19(2), 213–236. https://doi.org/10.2307/249689

Harding, Kimberly1; Biks, Gashaw Andargie2; Adefris, Mulat3; Loehr, Jordann3; Gashaye, Kiros Terefe3; Tilahun, Binyam4; Volynski, Michael5; Garg, Shashank6; Abebaw, Zeleke4; Dessie, Kassahun4; Mersha, Tesfaye B.7. A mobile health model supporting Ethiopia's eHealth strategy. *Digital Medicine* 4(2):p 54-65, April 2018

Heath, M. L. (2018). The Impact of Individual Learning on Electronic Health Record Routinization: An Empirical Study.

Iacobucci, D. (2014). Gilbert A. Churchill Jr.'s Editorship of Journal of Marketing Research, 1979-1982. Journal of Marketing Research, 51, 105-106.

Imbamba, E. N., & Kimile, N. (2017). A review of the status of e-government implementation in Kenya.

Insight7. (2024). The importance of performance monitoring and evaluation. https://insight7.io/importance-of-performance-monitoring-and-evaluation/

Junior, S. H. D. L., Silva, F. Í. C., Albuquerque, G. S. G., de Medeiros, F. P. A., & Lira, H. B. (2020). Enterprise Architecture in Healthcare Systems: A systematic literature review. arXiv preprint arXiv:2007.06767.

Kakamega County Government. (2023). Kakamega County Integrated Development Plan (CIDP) 2023–2027.

Keesara, S., Jonas, A., & Schulman, K. (2020). Covid-19 and health care's digital revolution. *New England Journal of Medicine*, 382(23), e82. https://doi.org/10.1056/NEJMp2005835

Kenya National Bureau of Statistics (KNBS). (2019). 2019 Kenya Population and Housing Census – Volume I: Population by County and Sub-County.

Kiberu, V. M., Mars, M., & Scott, R. E. (2017). Barriers and opportunities to implementation of sustainable e-Health programmes in Uganda: A literature review. *African Journal of Primary Health Care & Family Medicine, 9*(1), a1305. https://doi.org/10.4102/phcfm.v9i1.1305

Kimathi, F., Omwenga, E., & Kimenyi, M. (2020). County eHealth Implementation in Kenya: A study of Kakamega and Kisumu Counties. *Kenya Medical Research Institute (KEMRI) Report.*

Khoja, S., Durrani, H., Nayani, P., & Fahim, A. (2013). *Scope of Policy Issues in eHealth: Results from a Structured Literature Review*. Journal of Medical Internet Research, 15(2), e34.

Kothari, C.R, "Sample size determination. Research Methodology". New Age International Publications. (2004). Sample size determination. Encyclopedia of Statistical Sciences.

Larbi, D., Anthun, K. S., Asah, F. N., Debrah, O., & Antypas, K. (2022). Assessing Strategic Priority Factors in e-Health Policies of Four African Countries. In 2022 IST-Africa Conference (IST-Africa) (pp. 1-9). IEEE.doi: 10.23919/ist-africa56635.2022.9845650.

Ludwick, D. A., & Doucette, J. (2009). Adopting electronic medical records in primary care: Lessons learned from health information systems implementation experience in seven countries. *International Journal of Medical Informatics, 78*(1), 22–31.

Maina, I., Oyugi, B., & Njenga, S. M. (2022). Disparities in health worker training opportunities in devolved health systems: Evidence from Kenya. *BMC Health Services Research*, 22, 843

Mair, F. S., May, C., O'Donnell, C., Finch, T., Sullivan, F., & Murray, E. (2012). Factors that promote or inhibit the implementation of e-health systems: an explanatory systematic review. *Bulletin of the World Health Organization*, *90*, 357-364.

Mamuye, A. L., Yilma, T. M., Abdulwahab, A., Broomhead, S., Zondo, P., Kyeng, M., ... & Tilahun, B. C. (2022). Health information exchange policy and standards for digital health systems in africa: a systematic review. PLOS Digital Health, 1(10), e0000118. doi: 10.1371/journal.pdig.0000118

Manby, L., Aicken, C., Delgrange, M., & Bailey, J. V. (2022). Effectiveness of e-Health interventions for HIV prevention and management in sub-Saharan Africa: systematic review and meta-analyses. AIDS and Behavior, 26(2), 457-469.

May, C., & Finch, T. (2009). Implementing, embedding, and integrating practices: An outline of normalization process theory. Sociology, 43(3), 535–554. https://doi.org/10.1177/0038038509103208

Meseret, M., Ehetie, T., Hailye, G., Regasa, Z., & Biruk, K. (2022). Occupational injury and associated factors among construction workers in Ethiopia: a systematic and meta-analysis. Archives of Environmental & Occupational Health, 77(4), 328-337.

Ministry of Health Kenya. (2019). *Kenya eHealth Strategy 2019–2023*

Ministry of Health Kenya. (2016). *Kenya eHealth Policy 2016–2030*

Mousavi, S. M., Takian, A., & Tara, M. (2018). Design and validity of a questionnaire to assess national e-Health architecture (NEHA): a study protocol. BMJ open, 8(12), e022885.

Muchira, J. M., Kamau, N., & Wanjiru, H. (2021). Challenges in adoption and use of e-health systems in Kenya's public hospitals: A case of Western Kenya. *African Journal of Health Informatics, 9*(2), 34–41.

Muinga, N., Magare, S., Monda, J. *et al.* Digital health Systems in Kenyan Public Hospitals: a mixed-methods survey. *BMC Med Inform Decis Mak* 20, 2 (2020)

Munyisia, E. N., Yu, P., & Hailey, D. (2014). The impact of an electronic nursing documentation system on efficiency of documentation by caregivers in a residential aged care facility. *Journal of Clinical Nursing, 23*(19–20), 2940–2949

Naamati-Schneider, L., Arazi-Fadlon, M., & Daphna-Tekoah, S. (2024). Navigating moral and ethical dilemmas in digital transformation processes within healthcare organizations. *Digital Health, 10*. https://doi.org/10.1177/20552076241260416

Nemesure, M. D., Lopez, L., VanderZee, K., & Clark, D. (2023). Health information system interoperability: A systematic review. *BMC Medical Informatics and DecisionMaking,23(112).*

Ngongo, B., Mmbuji, P., & Rumisha, S. (2010). The burden of disease surveillance and health management information systems in Tanzania: A case for urgent reform.

BMC Medical Informatics and Decision Making, 10, 36.

Njoroge, M., Zurovac, D., Ogara, E. A., Chuma, J., & Kirigia, D. (2017). Assessing the feasibility of e-Health and mHealth: a systematic review and analysis of initiatives implemented in Kenya. BMC research notes, 10, 1-11.

Nourimand, F., Keramat, A., Sayahi, M., Bozorgian, L., & Hashempour, Z. (2022). A systematic review of e-Health modes in preventing sexually transmitted infections. Indian Journal of Sexually Transmitted Diseases and AIDS, 43(2), 117-127.

Nurmaidah, N., Kustiningsih, N., & Rahayu, S. (2024). Change management strategy in the implementation of electronic medical record system in the era of digital transformation: Case study at Rahman Rahim Hospital. Gema Wiralodra, 15(1), 228-238.

Nwagwu, W. E., & Onyancha, O. B. (2022). Visualization and mapping of global e-Health research based on keywords. Global Knowledge, Memory and Communication, 73(3), 453-476.

Nzivo, C., Were, M. C., & Kimenyi, M. (2022). Capacity-building gaps in health information management across Kenyan counties: Implications for routine data use. *Journal of Global Health Reports, 6*, e2022078.

Ochieng, C. A., Muga, R., Mwaura, F., Wambugu, J., & Were, M. C. (2024). Assessing the use of electronic medical record systems for health systems strengthening in Homa Bay County, Kenya. *BMC Health Services Research, 24*(1), 112.

O'Connor, Y., & Heavin, C. (2018). Defining and Characterising the Landscape of e-Health. In Encyclopedia of Information Science and Technology, Fourth Edition (pp. 5864-5875). IGI Global. doi: 10.4018/978-1-5225-2255-3.CH510.

Oduor, C., Kamau, J., & Gatimu, S. (2021). Health workforce burnout and the need for continuous professional development in Kenyan counties. Healthcare, 9(3), 350

Okpechi, I. G., Muneer, S., Ye, F., Zaidi, D., Ghimire, A., Tinwala, M. M., ... & Bello, A. K. (2022). Global e-Health capacity: secondary analysis of WHO data on e-Health and implications for kidney care delivery in low-resource settings. BMJ open, 12(3), e055658.

OpsPros. (2023, August 10). The role of monitoring and feedback loops in continuous deployment. https://opspros.com/the-role-of-monitoring-and-feedback-loops-in-continuous-deployment/

Ouma, S., & Herselman, M. (2008). E-health in rural areas: Case of developing countries. *International Journal of Biological and Life Sciences*, 4(4), 194–200.

Paina, L., & Peters, D. H. (2012). Understanding pathways for scaling up health services through the lens of complex adaptive systems. *Health Policy and Planning, 27*(5), 365–373. https://doi.org/10.1093/heapol/czr054

Park, D. (2020). Circular reasoning for the evolution of research through a strategic construction of research methodologies. International Journal of Quantitative and Qualitative Research Methods, 8(3), 1–23. https://www.eajournals.org/wp-content/uploads/Circular-reasoning-for-the-evolution-of-research.pdf

Pineda Rincón, E. A., & Moreno-Sandoval, L. G. (2021). Design of an architecture contributing to the protection and privacy of the data associated with the electronic health record. Information, 12(8), 313.

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

Sæbø, J. I., Kossi, E. K., Titlestad, O. H., Tohouri, R. R., & Braa, J. (2011). Comparing strategies to integrate health information systems following a data warehouse approach in four countries. *Information Technology for Development*, *17*(1), 42-60

Safaricom. (2022). *M-TIBA: Mobile health financing platform*. Safaricom PLC. https://www.safaricom.co.ke/personal/m-tiba

Saunders, M., Lewis, P., & Thornhill, A. (2009). Research Methods for business students fifth edition.

Saunders, M., Lewis, P., & Thornhill, A. (2019). Research methods for business students (8th ed.). Pearson Education.

Scott, R. E., Mars, M., & Jordanova, M. (2017). Would universal adoption of mHealth improve healthcare delivery in resource-limited settings? *Yearbook of Medical Informatics*, 26(1), 134–139.

Sevic, A., Hashemi, N. S., Thørrisen, M. M., Strømstad, K., Skarpaas, L. S., Storm, M., & Brønnick, K. K. (2023). Effectiveness of e-Health interventions targeting employee health behaviors: Systematic review. Journal of Medical Internet Research, 25, e38307.

Sinabell, I., & Ammenwerth, E. (2022). Agile, easily applicable, and useful e-Health usability evaluations: systematic review and expert-validation. Applied clinical informatics, 13(01), 67-79.

Shirandula, A. H., Omieno, K. K., & Ondulo, J. (2022). E-Health Implementation in Kenya: Current Position.

Snowdon, A., & Cohen, J. A. (2011). Strengthening health systems through innovation: Lessons learned. Ivey International Centre for Health Innovation.

Soiferman, L. K. (2010). Compare and contrast inductive and deductive research approaches. https://files.eric.ed.gov/fulltext/ED542066.pdf

Su, J. J., Liu, J. Y. W., Cheung, D. S. K., Wang, S., Christensen, M., Kor, P. P. K., ... & Leung, A. Y. M. (2023). Long-term effects of e-Health secondary prevention on cardiovascular health: a systematic review and meta-analysis. European Journal of Cardiovascular Nursing, 22(6), 562-574.

Sylva, P., Abeysinghe, B., James, C. C., Jayatilake, A., Lunuwila, S., Sanath, D., ... & Wijekoon, A. (2012). A review of e-Health policies that underpin global health care digitization. Sri Lanka Journal of Bio-Medical Informatics, 2(4).

Talwar, P., Kaur, S., Kumar, S., & Arora, S. (2021). Overcoming barriers to eHealth adoption: A multi-stakeholder perspective. *Journal of Medical Systems, 45*(11), 1–10. https://doi.org/10.1007/s10916-021-01794-8

Tazi, S., Idrissi, M. K., & Bennani, S. (2019). *Electronic health record implementation in Morocco: Opportunities and challenges*. *International Journal of Medical Informatics, 129*, 376-384.

Tian, H., & Chen, J. (2022). A bibliometric analysis on global e-Health. Digital Health, 8, 20552076221091352.

Twycross, A., & Shields, L. (2004). Validity and reliability–what's it all about? Part 1 validity in quantitative studies. *Paediatric Care*, *16*(9), 28-28. https://doi.org/10.7748/paed2004.11.16.9.28.c954

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425–478. https://doi.org/10.2307/30036540

Wakaba, M., Mbindyo, P., Ochieng, J., & Edwards, N. (2014). *The public health sector human resource training gaps in Kenya: A case study of Meru County*. The Pan African Medical Journal, 20, 334.

Were, M. C., Sinha, C., Catalani, C., & Were, E. (2019). Exploring the role of training in electronic medical record system adoption and sustainability. *JMIR Human Factors, 6*(2), e14692. https://doi.org/10.2196/14692

Were, M. C., Shen, C., Tierney, W. M., & Mamlin, B. (2021). Evaluation of an EMR system in sub-Saharan Africa: Lessons from Kenya. *International Journal of Medical Informatics, 146*, 104–117. https://doi.org/10.1016/j.ijmedinf.2020.104117

Wickramasinghe, N., Schaffer, J., & Gupta, J. (2016). *e-Health: A Global Perspective*. Springer.

WHO. (2010). e-Health Solutions In The African Region: Current Context And Perspectives. Retrieved from http://www.afro.who.int/declarations/DeclarationOuagadougou-en.pdf

WHO-ITU. (2012). National E-Health Strategy Toolkit.

World Health Organization. (2019). *WHO guideline: Recommendations on digital interventions for health system strengthening*. Geneva: WHO

Wong, Z. S., Siy, B., Da Silva Lopes, K., & Georgiou, A. (2020). Improving patients' medication adherence and outcomes in nonhospital settings through e-Health: Systematic review of randomized controlled trials. Journal of medical Internet research, 22(8), e17015.

Yusif, S., Hafeez-Baig, A., & Soar, J. (2020). An exploratory study of the readiness of public healthcare facilities in developing countries to adopt health information technology (HIT)/E-HEalth: The case of Ghana. *Journal of Healthcare Informatics Research*, *4*(2), 189-214. https://doi.org/10.1007/s41666-020-00070-8

Zhang, Y., Yu, P., & Shen, J. (2012). The benefits of health information technology: A review of the recent literature shows predominantly positive results. Journal of the American Medical Informatics Association, 19(3), 435–440. https://doi.org/10.1136/amiajnl-2011-000411

APPENDICES

Appendix 1: Questionnaire

Dear Respondent,

I am a student from MMUST, conducting a study on a R**outinization Architecture for e-Health implementation in public healthcare facilities Kenya: A case study of Kakamega County**. I therefore kindly request your assistant by sparing a few minutes of your time to respond to the questions in the questionnaire below.

Please Note

1. There are no correct/wrong answers, your honest opinion is the right answer.
2. For responses requiring to fill in, use the **tick ☑ sign**
3. **e-Health** - is any system that captures, stores, manages, transmits information related to the health of individuals or the activities of organizations that work within the health sector.
4. Any given information will be treated in the strictest confidence and will not be used for any other purposes other than this research study.

Part A: Demographic Information

1. Gender:

- ☐ Male
- ☐ Female

2. Age Bracket:

- ☐ Below 24 yrs
- ☐ 25- 34

- ☐ 35- 44
- ☐ 45- 54
- ☐ Above 55 yrs

3. Sub County of healthcare facility you work in

- ☐ Lurambi
- ☐ Malava
- ☐ Ikolomani
- ☐ Butere

4. Please tick your job title/cadre/ role.

- ☐ Clinician
- ☐ Doctor (GP/Consultant)
- ☐ Pharmacist
- ☐ Med Lab technician/Technologist
- ☐ Nurse
- ☐ Radiologist
- ☐ ICT Administrator
- ☐ HRIO
- ☐ Health Administrator (Med Sup, Matron, In charge)
- ☐ Cashiers/billing

Others____

5. Please rate your level of comfort using a computer-based technology.

- ☐ Not at all comfortable
- ☐ Slightly comfortable
- ☐ Moderately comfortable

- ☐ Very comfortable
- ☐ Extremely comfortable

6. Professional Experience

- ☐ Below 5 years
- ☐ 6 - 10 years
- ☐ 11 - 15 years
- ☐ Above 15 years

7. Does your facility have an e-Health system?

- ☐ Yes
- ☐ No

8. If yes, how frequently do you use e-Health system?

- ☐ Daily
- ☐ 2-3 times a week
- ☐ Once a week
- ☐ Monthly
- ☐ Never

Part B: Study Variables

e-Health Status

e-Health is the use of ICT in delivery of health services and can include the use of health information management systems, email, text messaging, websites, and mobile-based applications

1.1 Legislation, Policy and Standards

Does your facility have any of the following?

i.	ICT Policy?	Yes [ ]	No [ ]	I Don't know []
ii.	ICT Standards and protocols	Yes [ ]	No [ ]	I Don't know []
iii.	ICT Guideline	Yes [ ]	No [ ]	I Don't know []

1.2 Infrastructure

Does your facility have

i.	Power connectivity	Yes [ ] No [ ]
ii.	Power Generator/Electricity/Solar	Yes [ ] No [ ]
iii.	Do you have a stable power?	Yes [ ] No [ ]

1.3 Communication Systems

Does your facility have any of the following? if yes what do you use to communicate

i.	Corporate e-mail system	Yes [ ] No [ ]	I Don't know [ ]
ii.	Mobile app for work collaboration	Yes [ ] No [ ]	I Don't know [ ]
iii.	Website	Yes [ ] No [ ]	I Don't know [ ]
iv.	Office telephone	Yes [ ] No [ ]	I Don't know [ ]

1.4 Connectivity

i.	Does your office have a functional computer?	Yes [ ] No [ ]
ii.	Does your facility have a Local Area Network/Wifi?	Yes [ ] No [ ]
iii.	Do you have a printers and other ICT appliances?	Yes [ ] No [ ]

iv. Does your office have internet connection? Yes [ ] No [ ]

v. If yes, in (iv) above, is the internet stable? Yes [ ] No [ ]

vi. Does the hospital use any Management Information System e.g. KenyaEMR, DHIS, CHIS? Yes [ ] No [ ] Don't know [ ]

If yes, proceed to B 1.5, if no, skip to B 1.6

Please indicate the extent to which you agree with the various statements on the study variables. Use the following scale: **1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree.**

User Characteristics

Opinion Statements	**1**	**2**	**3**	**4**	**5**
There is a clearly known way to use the e-Health system.					
Employees have a positive attitude towards changes brought by the e-Health system					
The e-Health system is routine					
Utilization of e-Health system has been embraced by majority of the staff					
The use of the e-Health system is integrated in my daily routine.					
The tasks associated with the e-health system are repetitious.					
The e-health system works the same way most of the time					
Perceptions and fears have driven other staff to resist the usage of e-Health system					
I am willing to learn more about the e-Health system to enhance my effectiveness in my current position.					

Technology Availability

Opinion Statements	1	2	3	4	5
Integration of e-Health technologies into existing healthcare systems is paramount for seamless user experiences and for enhancing the continuity					
The sophistication and user-friendliness of e-Health software are crucial for ensuring that both healthcare providers and patients can utilize these technologies effectively.					
Robust hardware and reliable networking infrastructure are foundational to the success of e-Health initiatives.					

Organisational Support

Opinion Statements	1	2	3	4	5
Support from top management is essential for the successful implementation of e-Health systems					
Conducting a thorough needs assessment allows organizations to tailor e-Health solutions to the specific requirements of their healthcare providers and patients					

Active engagement with stakeholders, including healthcare professionals, patients, and tech providers, is crucial for the development and implementation of e-Health system					
Investing in capacity building—through training healthcare staff and upgrading IT infrastructure.					

Routinization Process of e-Health

Opinion Statements	**1**	**2**	**3**	**4**	**5**
Various stakeholders should comprehend the specific context of e-Health system					
Essential components such as telemedicine, patient records, and clinical decision support should be defined					
e-Health system should be divided into logical layers					
Develop interfaces that allow seamless communication between different e-Health components					
Establish governance mechanisms to oversee the e-Health system's development, maintenance, and security.					
Adapt relevant components to fit health system's requirements.					
Implement robust security measures to protect patient data.					
Design the architecture to handle increasing user loads and data volumes.					
Rigorously test each component for functionality, interoperability, and performance.					

Train healthcare professionals and system administrators on using the e-Health system effectively.					

Net Benefits of e-Health

Opinion Statements	**1**	**2**	**3**	**4**	**5**
e-Health technologies enhance healthcare service delivery by enabling more accurate diagnostics					
e-Health systems streamline many administrative and clinical processes					
The real-time data and analytics provided by e-Health platforms empower healthcare providers to make more informed decisions.					
e-Health offers sophisticated data management capabilities that improve the organization, storage, and retrieval of patient information.					
By integrating into the normal routines of healthcare work, e-Health systems reduce disruptions, promote standardization, and enable healthcare professionals					

Appendix 2: List of Public Health Facilities in Kakamega County

Code	Name	Keph level	Facility type	Sub county	Ward
26087	Munzakula Dispensary	Level 2	Dispensary	Lurambi	Mahiakalo
25984	Silungai Dispensary	Level 2	Dispensary	Malava	Manda-shivanga
25833	Eshinamwenyuli Health Centre	Level 3	Basic Health Centre	Butere	Marama Central
25831	Bululwe Dispensary	Level 2	Dispensary	Butere	Marama West
25809	Nyortis Dispensary	Level 2	Dispensary	Likuyani	Nzoia
25720	Itete Dispensary	Level 2	Dispensary	Matungu	Koyonzo
25730	Mukavakava Dispensary	Level 2	Dispensary	Malava	Butali/Chegulo
25699	Lutasio Health Centre	Level 3	Basic Health Centre	Matungu	Khalaba
25698	Namasanda HealthCentre	Level 2	Basic Health Centre	Matungu	Kholera
25697	Emaira Dispensary	Level 2	Dispensary	Butere	Marama West
25694	Shichinji Dispensary	Level 2	Dispensary	Ikolomani	Idakho North
25692	Munasio Dispensary	Level 2	Dispensary	Shinyalu	Isukha West
25508	Nyapeta Dispensary	Level 2	Dispensary	Mumias West	Etenje
25507	Musanda Dispensary	Level 2	Dispensary	Mumias West	Musanda

25498	Ichinga Dispensary	Level 2	Dispensary	Mumias West	Mumias North
25506	Emung'abo Dispensary	Level 2	Dispensary	Khwisero	Kisa Central
25166	Mumias Level IV Hospital	Level 4	Primary care hospitals	Mumias West	Mumias Central
24686	Eshibembe HealthCentre	Level 3	Basic Health Centre	Butere	Marama South
23136	Mayuge Dispensary	Level 2	Dispensary	Malava	West Kabras
22979	Shiyunzu Dispensary	Level 2	Dispensary	Lurambi	Butsotso Central
22973	Shirakalu Dispensary	Level 2	Dispensary	Lurambi	Butsotso East
22759	Shirumba Dispensary	Level 2	Dispensary	Ikolomani	Idakho Central
22670	Elwakana Dispensary	Level 2	Dispensary	Mumias East	Lusheya/Lubinu
22668	elwakana dispensary	Level 2	Dispensary	Mumias East	Lusheya/Lubinu
22551	Milimani Dispensary	Level 2	Dispensary	Ikolomani	Idakho South
22544	Buyemi Dispensary(Ikolomani)	Level 2	Dispensary	Ikolomani	Idakho Central
22441	Chirobani Dispensary	Level 2	Dispensary	Shinyalu	Isukha East
22191	Vuyika Dispensary	Level 2	Dispensary	Lugari	Chevaywa
21935	Sheywe Dispensary	Level 2	Dispensary	Malava	Shirungu-mugai
21891	Ingolomosio Dispensary	Level 2	Dispensary	Shinyalu	Isukha North
21788	Eshibinga Health Centre	Level 3	Basic Health Centre	Khwisero	Kisa East

21777	Koromaiti Community Dispensary	Level 2	Dispensary	Lugari	Chekalini
21695	Imakuyi Dispensary	Level 2	Dispensary	Shinyalu	Murhanda
21100	Musango Dispensary	Level 2	Dispensary	Mumias East	Malaha/Isongo/Makunga
21089	Ivochio Dispensary	Level 2	Dispensary	Shinyalu	Murhanda
21088	Chepkombe Dispensary	Level 2	Dispensary	Shinyalu	Isukha Central
21043	Shivakala Dispensary	Level 2	Dispensary	Malava	South Kabras
21020	Kakamega County Beyond Zero Mobile Clinic	Level 2	Dispensary	Lurambi	Shirere
20921	Ikhanyi Dispensary	Level 2	Dispensary	Malava	South Kabras
20870	Mukhuyu Dispensary	Level 2	Dispensary	Malava	East Kabras
20843	Malichi Dispensary	Level 2	Dispensary	Malava	Chemuche
20837	Tombo Dispensary	Level 2	Dispensary	Malava	Manda-shivanga
20752	Buyangu Dispensary	Level 2	Dispensary	Shinyalu	Isukha North
20679	Eshikalame Dispensary	Level 2	Dispensary	Mumias West	Musanda
20678	Wang'nyang' Dispensary	Level 2	Dispensary	Mumias West	Etenje
20674	Kamuchisu Dispensary	Level 2	Dispensary	Malava	West Kabras
20673	Ekambuli Health	Level 3	Basic Health	Khwisero	Kisa Central

	Centre		Centre		
20672	Mungungune Dispensary	Level 2	Dispensary	Butere	Marama West
20671	Lubanga Dispensary	Level 2	Dispensary	Matungu	Namamali
20516	Mundobelwa Health centre	Level 3	Basic Health Centre	Khwisero	Kisa North
20515	Ebuhala Health Centre	Level 3	Basic Health Centre	Khwisero	Kisa West
20194	Shianda Dispensary	Level 2	Dispensary	Mumias East	East Wanga
20174	Vikunga Dispensary	Level 2	Dispensary	Shinyalu	Isukha West
20044	Kisembe Dispensary	Level 2	Dispensary	Navakholo	Bunyala West
20043	Butingo Dispensary	Level 2	Dispensary	Navakholo	Bunyala West
20041	Sisokhe Dispensary	Level 2	Dispensary	Navakholo	Bunyala West
20039	Emukaba Dispensary	Level 2	Dispensary	Lurambi	Butsotso East
19991	Isumba Dispensary	Level 2	Dispensary	Lurambi	Butsotso South
19900	Ikomero Dispensary	Level 2	Dispensary	Khwisero	Kisa West
19899	Eshiabwali Health Centre	Level 3	Basic Health Centre	Khwisero	Kisa East
18941	Imanga Health Centre	Level 3	Basic Health Centre	Butere	Marama Central
18940	Eshibimbi Health Centre	Level 3	Basic Health Centre	Butere	Marama North
18939	Butere Iranda HealthCentre	Level 3	Basic Health	Butere	Marama West

			Centre		
18802	Kamashia	Level 2	Dispensary	Mumias East	Lusheya/Lubinu
18779	Mugai Dispensary	Level 2	Dispensary	Malava	Shirungu-mugai
18625	Mlimani Dispensary	Level 2	Dispensary	Likuyani	Sinoko
18624	Lumino Dispensary	Level 2	Dispensary	Likuyani	Likuyani
18361	Eluche	Level 2	Dispensary	Mumias East	East Wanga
18101	Kakamega Police Line VCT	Level 2	VCT	Lurambi	Shirere
17931	Mirere Health Centre	Level 3	Basic Health Centre	Matungu	Namamali
17929	Indangalasia Dispensary	Level 2	Dispensary	Matungu	Koyonzo
17681	Manda Dispensary	Level 2	Dispensary	Malava	Manda-shivanga
17597	Mugomari Dispensary	Level 2	Dispensary	Shinyalu	Isukha West
17596	Shinyalu Model Health Centre	Level 3	Basic Health Centre	Shinyalu	Isukha Central
17410	Mwikalikha Health Centre	Level 3	Basic Health Centre	Khwisero	Kisa North
17409	Emalindi Health Centre	Level 3	Basic Health Centre	Khwisero	Kisa East
17298	Lukohe Health Centre	Level 3	Basic Health Centre	Butere	Marama North
17297	Mabole Health Centre	Level 3	Basic Health Centre	Butere	Marenyo-shianda

17217	Eshikulu Dispensary	Level 2	Dispensary	Mumias West	Etenje
17178	Namirama Dispensary	Level 2	Dispensary	Navakholo	Bunyala East
17150	Malaha Dispensary	Level 2	Dispensary	Mumias East	Malaha/Isongo/Makunga
17133	Eshirembe Dispensary	Level 2	Dispensary	Lurambi	Butsotso South
17082	Nyaporo Dispensary	Level 2	Dispensary	Mumias East	Malaha/Isongo/Makunga
16865	Musembe Dispensary	Level 2	Dispensary	Shinyalu	Isukha Central
16867	Ematiha Dispensary	Level 2	Dispensary	Navakholo	Ingoste-matiha
16154	Turbo Forest Dispensary	Level 2	Dispensary	Likuyani	Likuyani
15883	Eshiongo Dispensary	Level 2	Dispensary	Navakholo	Shinoyi-shikomari-esumeiya
16033	Mulwanda Health Centre	Level 3	Basic Health Centre	Khwisero	Kisa Central
16077	National Youth Service Dispensary (Turbo)	Level 2	Dispensary	Lugari	Lumakanda
16054	Muting'ong'o Dispensary	Level 2	Dispensary	Malava	Chemuche
16086	Nzoia Matete Dispensary	Level 2	Dispensary	Lugari	Lwandeti
16111	Shikunga Health	Level 3	Basic Health	Butere	Marenyo-shianda

	Centre		Centre		
15914	Kakamega Forest Dispensary	Level 2	Dispensary	Shinyalu	Isukha Central
16084	Nzoia (ACK) Dispensary	Level 2	Dispensary	Likuyani	Sinoko
16027	Muhaka Health Centre	Level 3	Basic Health Centre	Khwisero	Kisa West
15801	Ap Line Dispensary	Level 2	Dispensary	Lurambi	Shirere
15803	Apostles Clinic	Level 2	Dispensary	Butere	Marama Central
15804	Approved Dispensary	Level 2	Dispensary	Lurambi	Mahiakalo
15810	Buchangu Dispensary	Level 2	Dispensary	Navakholo	Bunyala Central
15812	Budonga Dispensary	Level 2	Dispensary	Navakholo	Bunyala West
15817	Bukaya Health Centre	Level 3	Basic Health Centre	Mumias West	Etenje
15820	Bukura Health Centre	Level 3	Basic Health Centre	Lurambi	Butsotso South
15827	Bungasi Health Centre	Level 3	Basic Health Centre	Mumias West	Musanda
15833	Bushiri Health Centre	Level 3	Basic Health Centre	Navakholo	Ingoste-matiha
16108	Shihalia Dispensary	Level 2	Dispensary	Ikolomani	Idakho Central
15850	Chegulo Dispensary	Level 2	Dispensary	Malava	Butali/Chegulo
15836	Butere Sub	Level 4	Primary	Butere	Marama Central

	CountyHospital		care hospitals		
15857	Chevoso Dispensary	Level 2	Dispensary	Malava	South Kabras
15872	Elukhambi Dispensary	Level 2	Dispensary	Lurambi	Butsotso South
15873	Elwasambi Dispensary	Level 2	Dispensary	Mumias East	Lusheya/Lubinu
15874	Elwesero Model Health Centre	Level 3	Basic Health Centre	Lurambi	Shirere
15882	Eshikhuyu Dispensary	Level 2	Dispensary	Lurambi	Butsotso Central
15892	GK Prisons Dispensary (Kakamega Central)	Level 2	Dispensary	Lurambi	Shirere
15900	Ileho Health Centre	Level 3	Basic Health Centre	Shinyalu	Isukha East
15901	Imbiakalo Dispensary	Level 2	Dispensary	Malava	West Kabras
15902	Ingotse Dispensary	Level 2	Dispensary	Navakholo	Ingoste-matiha
15899	Iguhu Sub County Hospital	Level 4	Primary care hospitals	Ikolomani	Idakho East
15916	Kambiri Health Centre	Level 3	Basic Health Centre	Shinyalu	Isukha North
15931	Khalaba Health Centre	Level 3	Basic Health Centre	Matungu	Khalaba
15934	Kharanda Health Centre	Level 3	Basic Health Centre	Navakholo	Bunyala West

15936	Khaunga Dispensary	Level 2	Dispensary	Mumias East	East Wanga
15945	Kilingili Health Centre	Level 3	Basic Health Centre	Ikolomani	Idakho South
15949	Kimangeti Dispensary	Level 2	Dispensary	Malava	Chemuche
15955	Kongoni Health Centre	Level 3	Basic Health Centre	Likuyani	Kongoni
15959	Kuvasali Health Centre	Level 3	Basic Health Centre	Malava	East Kabras
15940	Khwisero Health Centre	Level 3	Basic Health Centre	Khwisero	Kisa North
15964	Lugari Forest Dispensary	Level 2	Dispensary	Lugari	Lugari
15961	Likuyani Sub-County Hospital	Level 4	Primary care hospitals	Likuyani	Likuyani
15970	Lumani Dispensary	Level 2	Dispensary	Lugari	Chevaywa
15972	Lung'anyiro Health Centre	Level 3	Basic Health Centre	Matungu	Namamali
15974	Lunyito Dispensary	Level 2	Dispensary	Lugari	Lugari
15977	Lusheya Health Centre	Level 3	Basic Health Centre	Mumias East	Lusheya/Lubinu
15981	Lwandeti Dispensary	Level 2	Dispensary	Lugari	Lwandeti
15983	Mabusi Health Centre	Level 3	Basic Health Centre	Likuyani	Nzoia
15987	Mahanga Dispensary	Level 2	Dispensary	Lugari	Lwandeti

	(Lugari)				
15988	Majengo Dispensary	Level 2	Dispensary	Lugari	Lumakanda
15991	Makunga Rhdc	Level 3	Basic Health Centre	Mumias East	Malaha/Isongo/Makunga
15997	Malekha Dispensary	Level 2	Dispensary	Malava	Shirungu-mugai
16000	Mapengo Dispensary	Level 2	Dispensary	Lugari	Chekalini
16005	Matete Health Centre	Level 3	Basic Health Centre	Lugari	Chevaywa
16009	Maturu Dispensary	Level 2	Dispensary	Lugari	Lwandeti
16011	Mbagara Dispensary	Level 2	Dispensary	Lugari	Mautuma
16008	Matunda Sub-DistrictHospital	Level 4	Primary care hospitals	Likuyani	Nzoia
16010	Mautuma Sub County Hospital	Level 4	Primary care Hospitals	Lugari	Mautuma
16031	Mukuyu Dispensary	Level 2	Dispensary	Lugari	Mautuma
16035	Mumias Model Health Centre	Level 3	Basic Health Centre	Mumias West	Mumias Central
16042	Mung'ung'u Dispensary	Level 2	Dispensary	Matungu	Koyonzo
16046	Munyuki Dispensary	Level 2	Dispensary	Lugari	Lumakanda
16041	Mung'ang'a Dispensary	Level 2	Dispensary	Mumias East	East Wanga
16051	Musembe Dispensary	Level 2	Dispensary	Lugari	Chekalini

	(Lugari)				
16055	Emutsesa Health Centre	Level 3	Basic Health Centre	Khwisero	Kisa Central
16037	Matungu Sub-County Hospital	Level 4	Primary care Hospitals	Matungu	Mayoni
16059	Nabongo Dispensary	Level 2	Dispensary	Lurambi	Sheywe
16064	Namagara Dispensary	Level 2	Dispensary	Malava	Manda-shivanga
16065	Namasoli Health Centre	Level 3	Basic Health Centre	Khwisero	Kisa Central
16070	Namulungu Dispensary	Level 2	Dispensary	Matungu	Kholera
16107	Shibwe Sub-County Hospital	Level 4	Primary care Hospitals	Ikolomani	Idakho Central
16078	Navakholo Sub-District Hospital	Level 4	Primary care Hospitals	Navakholo	Bunyala Central
16100	Sango Dispensary	Level 2	Dispensary	Likuyani	Sango
16102	Seregeya Dispensary	Level 2	Dispensary	Likuyani	Likuyani
16104	Shamakhubu Health Centre	Level 3	Basic Health Centre	Shinyalu	Murhanda
16105	Shamberere HealthCentre	Level 3	Comprehensive health Centre	Malava	South Kabras
16101	Savane Dispensary	Level 2	Dispensary	Ikolomani	Idakho East
16109	Shihome Dispensary	Level 2	Dispensary	Malava	South Kabras
16110	Shikokho Dispensary	Level 2	Dispensary	Ikolomani	Idakho East

16112	Shikusa Health Centre	Level 3	Basic Health Centre	Shinyalu	Isukha North
16113	Shikusi Dispensary	Level 2	Dispensary	Shinyalu	Isukha South
16115	Eshinutsa Health Centre	Level 3	Basic Health Centre	Khwisero	Kisa East
16116	Shiraha Health Centre	Level 3	Basic Health Centre	Butere	Marama North
16118	Shisaba Dispensary	Level 2	Dispensary	Butere	Marama West
16119	Shiseso Health Centre	Level 3	Basic Health Centre	Ikolomani	Idakho North
16121	Shitsitswi Health Centre	Level 3	Basic Health Centre	Butere	Marama Central
16122	Shivanga Health Centre	Level 3	Basic Health Centre	Malava	Manda-shivanga
16123	Shibanze Dispensary	Level 2	Dispensary	Matungu	Kholera
16127	Sinoko Dispensary (Likuyani)	Level 2	Dispensary	Likuyani	Sinoko
16134	Soy Sambu Dispensary	Level 2	Dispensary	Likuyani	Sango
16144	Chief Milimu Dispensary	Level 2	Dispensary	Shinyalu	Isukha South
16147	Sivilie Health Centre	Level 3	Comprehensive health Centre	Navakholo	Bunyala East
16481	Imulama Dispensary	Level 2	Dispensary	Ikolomani	Idakho North

16483	Shikumu Dispensary	Level 2	Dispensary	Ikolomani	Idakho Central
16484	Imalaba Dispensary	Level 2	Dispensary	Ikolomani	Idakho South
16714	Elwangale Health Centre	Level 3	Basic Health Centre	Khwisero	Kisa East
16717	Ikuywa Dispensary	Level 2	Dispensary	Shinyalu	Isukha East
15915	Kakamega County General Hospital	Level 5	Secondary care Hospitals	Lurambi	Shirere
15969	Lumakanda Sub County Hospital	Level 4	Primary care hospitals	Lugari	Lumakanda
16762	Emusanda Health Centre	Level 3	HEALTH CENTRE	Lurambi	Butsotso Central
15851	Chekalini Health Centre	Level 3	HEALTH CENTRE	Lugari	Chekalini
16006	Matioli Dispensary	Level 2	Dispensary	Lurambi	Butsotso South
15859	Chombeli Health Centre	Level 3	Basic Health Centre	Malava	Shirungu-mugai
15996	Malava Sub County Hospital	Level 4	Primary care hospitals	Malava	Shirungu-mugai
16114	Eshimukoko Health Centre	Level 3	Basic Health Centre	Butere	Marama North
15999	Manyala Sub-County Hospital	Level 4	Primary care hospitals	Butere	Marama South

Appendix 3: Letter of Approval

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

Tel: 056-30870
Fax: 056-30153
E-mail: directordps@mmust.ac.ke
Website: www.mmust.ac.ke

P.O Box 190
Kakamega – 50100
Kenya

Directorate of Postgraduate Studies

Ref: MMU/COR: 509099

Date: 07th July, 2021

Shikuyi Jackline Waburaka,
SIT/G/01-57294/2016
P.O. Box 190-50100,
KAKAMEGA.

Dear Ms. Waburaka,

RE: APPROVAL OF PROPOSAL

I am pleased to inform you that the Directorate of Postgraduate Studies has considered and approved your Masters proposal entitled: *'A Framework for Routinization of E-Health in Public Healthcare Facilities"* and appointed the following as supervisors:

1. Dr. Jasper M. Ondulo - School of Computing and Informatics, MMUST
2. Dr. Kelvin K. Omieno - School of Computing and Informatics, MMUST

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, Computer Science Department. Kindly adhere to research ethics consideration in conducting research.

It is the policy and regulations of the University that you observe a deadline of two years from the date of registration to complete your Master's 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,

Dr. Consolata Ngala
DEPUTY DIRECTOR, DIRECTORATE OF POSTGRADUATE STUDIES

Appendix 4: Research Permit

REPUBLIC OF KENYA

NACOSTI

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **139472**

Date of Issue: **01/December/2021**

RESEARCH LICENSE

This is to Certify that Miss.. Jackline Waburaka Shikunyi of Masinde Muliro University of Science and Technology, has been licensed to conduct research in Kakamega on the topic: A FRAMEWORK FOR E-HEALTH ROUTINIZATION IN PUBLIC HEALTHCARE FACILITIES, KENYA for the period ending : 01/December/2022.

License No: **NACOSTI/P/21/12259**

139472

Applicant Identification Number

Director General

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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