

**UPTAKE OF ELECTRONIC MEDICAL RECORD SYSTEM BY HEALTH
WORKERS IN SELECTED PUBLIC HOSPITALS IN KIAMBU COUNTY,
KENYA**

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DECLARATION

This Thesis is my original work and has not, to the best of my knowledge, been presented to any other college, university, and institution or examination body.

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DEDICATION

This thesis work is dedicated to the ALMIGHTY GOD and my family members for their unconditional support, humble time, prayers and words of motivation.

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May God bless you all.

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ABBREVIATIONS AND ACRONYMS

CPOE	Computerized Physician Order Entry
CPRs	Computerized Patient Records
DIT	Diffusion of Innovation Theory
EH	Electronic Health.
EHCRs	Electronic Health Care Records
HER	Electronic Health Records
EMR	Electronic Medical Records
EPR	Electronic Patient Records
HIS	Health Information System
HIT	Health Information Technology
ICT	Information Communication and Technology
IT	Information Technology
MOH	Ministry of Health
MRS	Medical Records Systems
NAHIT	National Alliance of Health Informational Technology
Open MRS	Open Medical Records System
PHR	Patient Health Record
PCMH	Patient Centered Medical History
SPSS	Statistical Packages for Social Sciences
USA	United State of America
WHO	World Health Organization

DEFINITIONS OF TERMS

Accessibility to Network: Ease of access or availability of network or internet or intranet connectivity to an institution. (Davis 1986, Davis et al 1989, Holden and Karsh 2010, Nielson 1993)

Deployment: All the necessary resources and equipment arranged and in place to implement a technology, Human Resources for Health, (2009).

Electronic Medical Records (EMR): An electronic record of health-related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within one healthcare organization, have the potential to provide substantial benefits to physicians, clinic practices, and health care organizations, EMRs and EHRs Healthcare Informatics, (October 2005)

EMR adoption: EMR adoption refers to the process of implementing electronic medical records in a healthcare facility or hospital.

Healthcare systems: The organization of people, institutions, and resources that deliver services of health care to meet the needs of a target population (WHO, 2009)

Public Health facilities: These are the facilities that provide health-based services to individuals (Mullan, Fitzhugh 1989).

Uptake of Electronic Medical records: Accepting the benefits and implementation of digitized patient's record systems and use of the technology for effective delivery (Hsiao CJ, et al 2008)

User Perception: Mental impression of how the physician understands, interprets or regards Technology (Habib JL, 2010).

ABSTRACT

Electronic Medical Records (EMRs) are transforming healthcare delivery globally, yet implementation in resource-constrained settings faces significant challenges. In Kiambu County, Kenya, despite substantial telecommunications infrastructure (98% mobile coverage), EMR utilization remains fragmented across healthcare facilities, with many continuing to rely predominantly on paper-based documentation. This study aimed to establish the uptake of electronic medical record systems among healthcare workers in Kiambu County. Specifically, the study sought to determine the level of uptake of the Electronic Medical Record system among health workers in Kiambu County; establish the individual characteristics influencing its uptake; examine the technological factors affecting adoption; and analyse the organizational factors contributing to its use among health workers in the county. The research was anchored in the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT), which explain how perceived usefulness, ease of use, facilitating conditions, and performance expectancy determine technology adoption behaviours. A descriptive cross-sectional research design was employed using quantitative and qualitative methods. The study targeted 2,703 healthcare workers in Kiambu County public facilities. Using Fisher's formula and proportionate sampling, 370 participants were selected, with 359 responding (97% response rate). Data was collected using structured questionnaires and analysed through descriptive statistics, chi-square tests, and logistic regression. The study found 88% of healthcare workers using EMRS despite 68.4% reporting systems did not save time. Healthcare workers who perceived patient information as secure were 3.6 times more likely to utilize EMRS ($p=0.005$). System performance significantly influenced adoption, with respondents reporting "very good" retrieval speeds three times more likely to use EMRS ($OR=2.513$; $p=0.012$). System usability similarly impacted adoption, with users finding systems easy to use being nearly four times more likely to utilize electronic documentation ($OR=3.802$; $p=0.014$). Regular system maintenance was significantly associated with higher utilization rates ($p=0.024$), while demographic characteristics showed no significant relationships with adoption (all $p>0.05$). The study concludes that while EMRS adoption among health workers in Kiambu County is notably high, this uptake is largely driven by organizational mandates. Technological performance and ongoing system maintenance emerged as critical enablers of meaningful use, while demographic factors played a minimal role. The findings underscore the need to prioritize user-centred design, targeted training, and responsive technical support to transform formal adoption into effective utilization. Addressing infrastructure and usability challenges is essential for sustaining and scaling EMRS implementation in similar settings.

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Electronic Medical Records (EMRs) represent a fundamental shift in healthcare information management, encompassing comprehensive patient-centered systems that digitally store and manage clinical histories, laboratory results, medications, and follow-up care documentation (Alomar et al., 2024). EMRs have evolved from basic electronic storage systems to complex integrated platforms facilitating improved clinical decision-making, enhanced patient safety, and streamlined healthcare delivery workflows (Hailegebreal et al., 2023). The uptake of EMRs by healthcare workers refers to the acceptance and implementation of these digital systems in clinical practice, measuring the degree to which healthcare professionals integrate electronic documentation into their daily routines (Senishaw et al., 2023). This digitization transcends traditional paper-based records, offering potential benefits including reduced medical errors, improved data retrieval, enhanced care coordination, and better resource allocation throughout healthcare facilities (Berihun et al., 2020). Successful EMR implementation requires not merely technological infrastructure but critical acceptance and utilization by the healthcare workers who serve as primary end-users and stewards of patient information within these systems (Ahmed et al., 2020).

The uptake of EMRs is influenced by multiple factors including individual characteristics, technological infrastructure, and organizational support mechanisms. Individual factors such as age, computer literacy, educational background, prior EMR training, knowledge of EMR benefits, and attitudes toward technology significantly predict adoption patterns among healthcare workers (Awol et al., 2020). Studies consistently demonstrate that healthcare professionals with higher computer literacy

skills exhibit 2.5-3.3 times greater readiness to adopt EMR systems compared to their less technically proficient colleagues (Hailegebreal et al., 2023). Technological factors including system quality, ease of use, network stability, and infrastructure reliability serve as critical determinants of successful implementation, with speed of information retrieval and perceived system security showing significant correlations with utilization rates (Ayaad et al., 2019). Organizational factors such as administrative support, adequate training programs, continuous technical assistance, and infrastructure investment similarly influence adoption, with healthcare facilities providing regular maintenance, dedicated EMR technical support, and ongoing education demonstrating substantially higher utilization rates (Oo et al., 2021). Together, these multidimensional factors create complex implementation environments requiring comprehensive approaches addressing both technology infrastructure and human factors to achieve successful EMR adoption (Walle et al., 2022).

In developed nations, EMR implementation has achieved substantial penetration with significant investment in both infrastructure and human resource development. The United States has demonstrated remarkable progress with approximately 96% of non-federal acute care hospitals and 86% of office-based physicians having adopted certified EMR systems by 2020, enabling advanced functionalities including comprehensive patient demographic tracking, medication management, and integrated diagnostic imaging (Mohammed et al., 2023). The National Health Service in England reported an increase from 3% to 97% in healthcare worker utilization of EMRs between 2014 and 2020, facilitating patient appointment booking and prescription management while progressing toward fully paperless record systems (Afolaranmi et al., 2021). Similarly, South Korea has conceptualized EMRs as comprehensive

electronic health records accessible by authorized providers within hospital networks, resulting in impressive adoption rates exceeding 90% in tertiary care facilities by 2022 (Ayaad et al., 2019). These countries demonstrate successful large-scale implementation through substantial financial investment, robust infrastructure development, extensive healthcare worker training, and supportive government policies establishing interoperability standards and incentive programs (Oo et al., 2021).

Despite impressive progress in developed economies, developed nations continue encountering significant implementation challenges even with their technological advantages. A comparative study across healthcare institutions in the United States identified ongoing concerns regarding data security, patient privacy, and technical interoperability barriers despite high adoption rates (Afolaranmi et al., 2021). Healthcare facilities in New Zealand encountered substantial workflow disruptions during EMR transition periods requiring extensive adaptation periods and workflow redesign despite comprehensive implementation planning (Mohammed et al., 2023). Technical challenges include inadequate training programs misaligned with healthcare worker needs, insufficient system customization to specialty-specific requirements, and integration difficulties between legacy systems and newer platforms (Ayaad et al., 2019). Additionally, studies from developed countries reveal persistent adoption gaps between larger healthcare institutions with greater resources and smaller facilities or rural providers with limited technical infrastructure or financial capacity for comprehensive EMR implementation (Oo et al., 2021). These experiences highlight that even in resource-rich environments, successful EMR implementation requires addressing multifaceted barriers including technological, organizational, and human factors resistance (Berihun et al., 2020).

African countries demonstrate considerably lower EMR implementation rates with distinctive challenges shaped by infrastructure limitations and resource constraints. Ghana and Malawi initiated national EMR implementation programs but encountered significant obstacles including inconsistent government support, inadequate technical infrastructure, unreliable electricity supply, and substantial healthcare worker resistance, resulting in implementation failures despite initial investment (Awol et al., 2020). Recent studies from Ethiopia reveal EMR readiness rates among healthcare workers ranging from 51% to 65%, with computer literacy, EMR knowledge, and technical support emerging as significant predictors of adoption willingness (Hailegebreal et al., 2023). In Nigeria, while approximately 71.5% of healthcare workers demonstrated good knowledge of EMR systems, actual implementation rates remained below 30% due to inconsistent power supply, limited internet connectivity, and inadequate hardware resources (Afolaranmi et al., 2021). South Africa faces unique challenges with fragmented implementation of multiple EMR systems from different vendors creating interoperability problems and information silos, with more than half of public hospitals continuing to rely primarily on paper-based record systems despite digitization efforts (Walle et al., 2022). These regional experiences highlight how infrastructure limitations, resource constraints, and technical support deficiencies create substantial barriers to successful EMR implementation across African healthcare systems (Tolera et al., 2022).

In Kenya, EMR implementation has progressed primarily through donor-funded disease-specific programs rather than comprehensive national systems (Kelly, 2022). The HIV program has been at the forefront, introducing open-source EMR systems in more than 600 clinics nationwide, with the Kenya-specific distribution of OpenMRS serving as a foundation for many implementations (Paton & Muinga, 2018). In 2012,

I-TECH designed and deployed KenyaEMR specifically for HIV/AIDS management, supporting implementation in over 300 hospitals throughout Kenya, representing one of Africa's most extensive open-source EMR deployments (Walle et al., 2022). The Ministry of Health has increasingly recognized the value of health information technologies in enhancing healthcare delivery processes and management capabilities in public hospitals, although implementation remains fragmented across facilities (Nkanata et al., 2018). Despite these advances, Kenya continues to face substantial implementation challenges including limited network infrastructure in rural areas, constrained financial resources for comprehensive system deployment, inadequate technical support personnel, and varying levels of computer literacy among healthcare workers (Berihun et al., 2020). In Kiambu County specifically, while EMR systems have been established in level 4 and 5 facilities and some level 3 facilities, implementation remains incomplete with many healthcare facilities continuing to rely predominantly on paper-based documentation despite known inefficiencies and information management challenges (Ahmed et al., 2020).

1.2 Statement of the problem

Despite considerable advancements in health information technology globally, healthcare workers' uptake of Electronic Medical Record systems remains slow throughout the healthcare industry, with users facing numerous implementation challenges and adoption barriers (Love et al., 2012; Wright et al., 2013). Although fully comprehensive EMR systems are still evolving, healthcare facilities worldwide are increasingly digitalizing components of medical records, yet a significant proportion of patient information continues to be documented in traditional paper formats (Mohammed et al., 2023; Tolera et al., 2022). The transition from paper-based to electronic documentation systems requires substantial investment in time, financial

resources, technical infrastructure, and comprehensive training programs, while simultaneously introducing fundamental changes to established clinical workflows and documentation practices (Hailegebreal et al., 2023; Ayaad et al., 2019).

In Kiambu County, the telecommunications infrastructure demonstrates promising potential for EMR implementation with mobile network coverage estimated at 98%, although fixed-line connectivity remains limited with approximately 214 landline connections serving the entire county (Kenya National Bureau of Statistics, 2019; Communications Authority of Kenya, 2021). While the county government has publicly committed to establishing ICT compliance across all twelve sub-counties, EMR implementation has progressed unevenly, with systems predominantly established in higher-level healthcare facilities including level 5 hospitals, level 4 facilities, and a limited number of level 3 centers (Kiambu County Integrated Development Plan, 2018-2022; Ministry of Health Kenya, 2020). Despite the recognized inefficiencies and information management challenges associated with paper-based documentation, the majority of patient records within the county continue to be maintained in traditional formats (Walle et al., 2022; Berihun et al., 2020). Although connectivity infrastructure expansion was projected to facilitate comprehensive EMR implementation across all healthcare facilities including hospitals, health centers, and dispensaries by the end of 2020, adoption remains incomplete due to various implementation barriers including healthcare worker attitudes and limited recognition of EMR benefits (Ahmed et al., 2020; Senishaw et al., 2023).

1.3 Justification of the study

The Kiambu County government has made significant initial investments in health information technology, connecting 17 health facilities with Electronic Medical Record systems, including 2 level 5 hospitals, 11 level 4 hospitals, and 4 health centers (Kiambu County Health Department, 2021). However, this represents only a fraction of the county's 109 public health facilities, indicating substantial gaps in EMR implementation that warrant investigation (Ministry of Health Kenya, 2022). Recent national health policy directives emphasize digitalization of health information systems to enhance service delivery, improve clinical decision-making, and facilitate health system research, making proper patient information management increasingly crucial for quality healthcare provision (Oo et al., 2021).

Studies from various regions in Kenya indicate EMR implementation rates ranging from 30-65% with significant variations across facility levels, geographic locations, and healthcare worker categories, highlighting the need for county-specific research to address localized implementation challenges (Walle et al., 2022; Ahmed et al., 2020). While neighboring counties have conducted comprehensive assessments of EMR uptake and associated factors, no systematic evaluation has been undertaken in Kiambu County despite its strategic importance as one of Kenya's most populous regions with proximity to the capital city (Kenya Health Information System, 2022; Berihun et al., 2020). The gap between established telecommunications infrastructure (98% mobile coverage) and actual EMR implementation represents a critical research opportunity to identify specific barriers limiting technology adoption in a relatively well-resourced setting (Communications Authority of Kenya, 2021; Hailegebreal et al., 2023).

Further, previous studies in similar settings have demonstrated that healthcare worker acceptance significantly determines EMR implementation success, with regional variation in factors including computer literacy levels (ranging from 20-75%), organizational support mechanisms, and technology perception (Tolera et al., 2022; Senishaw et al., 2023). This research is necessary to identify whether Kiambu County's healthcare workers exhibit similar adoption patterns or face unique challenges requiring tailored interventions (Ayaad et al., 2019; Mohammed et al., 2023). Findings from this study will provide essential evidence for county health administrators, policy makers, and technology implementation teams to develop targeted strategies addressing specific barriers to EMR uptake, ultimately enhancing health information management, improving service delivery, and strengthening health system performance throughout Kiambu County (Afolaranmi et al., 2021; Awol et al., 2020).

1.4 Research questions

- i. What is the level of uptake of Electronic Medical Record system among health workers in Kiambu County?
- ii. What are the individual characteristics influencing EMRs uptake among health workers in Kiambu County?
- iii. What are the technological factors influencing EMRs uptake among health workers in Kiambu County?
- iv. What are the organizational factors influencing EMRs uptake among health workers in Kiambu County?

1.5 Null Hypothesis

The null hypotheses of the study:

H0: Individual characteristics, technological factors, and organizational factors have no relationship with EMRs uptake in Kiambu County, Kenya.

1.6 Objectives

1.6.1 Broad objective

To establish the uptake of electronic medical record system among the health care workers in Kiambu County Kenya

1.6.2 Specific objectives

- i. To determine the level of uptake of Electronic Medical Record system among health workers in Kiambu County
- ii. To assess the individual characteristics influencing Electronic Medical Record system uptake among health workers in Kiambu County
- iii. To determine the technological factors influencing Electronic Medical Record system uptake among health workers in Kiambu County
- iv. To analyse the organizational factors influencing Electronic Medical Record system uptake among health workers in Kiambu County

1.7 Significance of the study

The study analysed the uptake of EMR by health workers in Kiambu County. The study will be very important to both the national government, county government and other important stakeholders like NGOs in targeting health policies, make informed decisions and measures to support information technology. Resource allocation will

also be considered on the fact that the EMRs is crucial and of importance to the health care organization.

1.8 Limitation and delimitation

This study will only concentrate on public hospitals in Kiambu County where EMRs has been deployed but is not fully accepted. The research thus becomes limited since the findings are not generalized to private and faith-based healthcare institutions. The study participation is delimited to public health facilities that have deployed EMRs utilization in Kiambu County. The study is also delimited to EMRs uptake rate by the healthcare workers with critical examination of four variables namely: level of uptake rate, individual characteristics, technological and organizational factors.

1.9 Conceptual Framework

The conceptual framework illustrates the relationship between the independent variables (individual characteristics, technological factors, and organizational factors) and the dependent variable (adoption and use of EMR systems) as shown in Figure 1.1. This framework is adapted from the DeLone and McLean Information System Success Model, which explains how various factors contribute to the successful implementation and use of information systems in organizations. In this framework, individual characteristics include age, gender, education level, and experience of healthcare providers. Technological factors encompass system quality (measured through ease of use, system reliability, and response time), information quality (measured through accuracy, completeness, and relevance of data), and service quality (measured through technical support and maintenance). Organizational factors include management support, training opportunities, and resource allocation. The framework also recognizes intervening variables such as government policies, infrastructure availability, and health facility level that may moderate the relationship between the independent variables and the dependent variable.

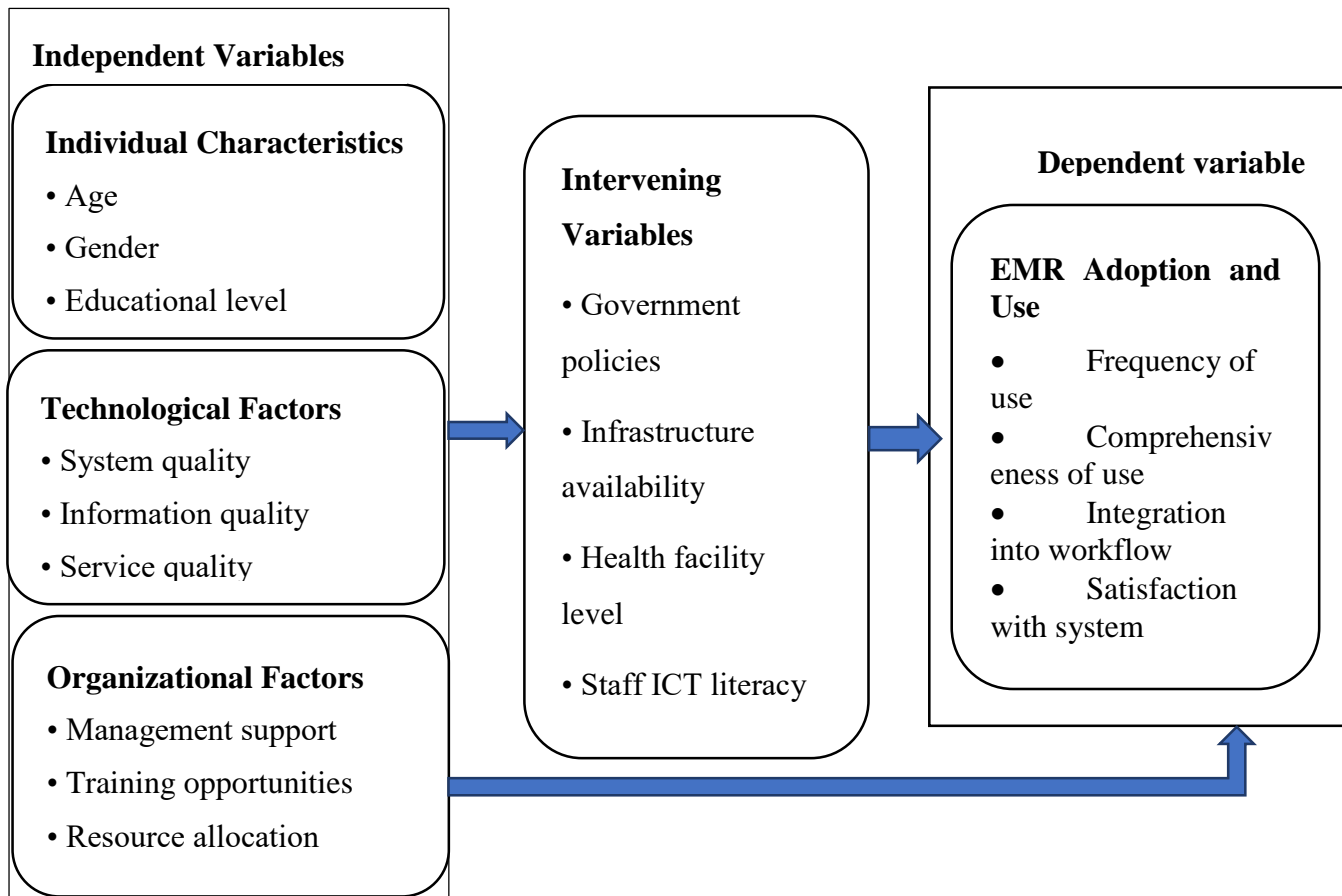


Figure 1.1: Conceptual framework

Source: Adopted from DeLone and MacLean (D&M) model (1992).

CHAPTER TWO: LITERATURE REVIEW

2.0 Overview

This chapter critically analyzes current literature related to Electronic Medical Record (EMR) systems in healthcare settings. It examines the conceptual foundation of EMRs, reviews recent global and local implementation trends, and investigates factors that influence EMR adoption among healthcare professionals. The literature is organized into thematic sections covering EMR concepts, adoption levels, individual characteristics, technological factors, and organizational influences that affect successful EMR implementation. This review establishes the theoretical framework for the study and identifies significant gaps in existing research, particularly in the Kenyan context.

2.1 Electronic Medical Records

Electronic Medical Records (EMRs) represent a transformative technology in the healthcare sector, revolutionizing how patient information is captured, stored, and utilized. The healthcare industry has witnessed significant digital transformation in recent years, with EMRs becoming central to modern healthcare delivery systems (Kruse et al., 2020). The global focus on improving healthcare quality, containing costs, and enhancing patient experience has accelerated the need for EMR adoption (Waithera et al., 2020; Mikalef et al., 2022).

Recent initiatives worldwide demonstrate the growing importance of EMR systems. In New Zealand, the Digital Health Work Programme 2020, launched in 2018, facilitated integrated healthcare access through a unified EMR system that presents comprehensive health information in a single interface accessible to both patients and healthcare providers (Durand-Zaleski, 2019; Wells et al., 2021). Similarly, the European Union's eHealth Action Plan 2019-2023 has prioritized the implementation of interoperable electronic health record systems across member states to enhance cross-border healthcare (European Commission, 2020).

In the African context, several countries have initiated EMR implementation with varying degrees of success. South Africa's National Health Insurance (NHI) program has incorporated EMR systems as a foundational element of their healthcare reform (Ataguba & McIntyre, 2021). Rwanda's comprehensive eHealth strategy has resulted

in significant EMR adoption across its healthcare facilities, improving service delivery and health outcomes (Binagwaho et al., 2020).

EMRs are defined as electronic repositories of health-related information that can be generated, collected, managed, and consulted by authorized healthcare providers within a healthcare organization (Park & Lee, 2019). Modern EMR systems encompass multiple functionalities including clinical data warehousing, computerized patient record management, decision support applications, system integration capabilities, and transaction processing features. Contemporary EMR platforms have evolved beyond basic data storage to include advanced analytics, clinical decision support systems, and interoperability with other health information technologies (Atasoy et al., 2019; Adler-Milstein et al., 2020).

While EMR systems offer numerous benefits, including improved patient care coordination, enhanced clinical decision-making, and reduced medical errors, their implementation faces considerable challenges. Research by Palabindala et al. (2021) and Shah et al. (2022) identifies several barriers to EMR implementation including high initial costs, concerns about workflow disruption, data security issues, and the need for extensive training. In my analysis, these challenges are particularly pronounced in resource-constrained settings like Kenya, where infrastructure limitations and competing healthcare priorities may impede EMR adoption.

The healthcare ecosystem encompasses various EMR users, including hospital administrators, diverse healthcare workers, and patients. The primary users who regularly interact with EMRs are clinical professionals such as physicians, nurses, pharmacists, and laboratory technologists. From my field observations in Kenyan healthcare settings, the daily interaction of these professionals with EMR systems makes their acceptance critical to successful implementation. Resistance from healthcare workers can significantly undermine even well-designed EMR initiatives. This reality underscores the importance of understanding the factors that influence healthcare providers' willingness to adopt and consistently use EMR systems in their clinical practice.

2.2 Level of Uptake of Electronic Medical Record System

EMR uptake refers to the extent to which healthcare professionals accept and integrate electronic record systems into their regular clinical workflows. The degree of EMR adoption can be measured through various indicators including frequency of use, comprehensiveness of documentation, integration into clinical decision-making, and user satisfaction (Alsohime et al., 2019; Tubaishat, 2022).

Global EMR adoption rates vary significantly. High-income countries generally demonstrate higher rates of EMR implementation. In the United States, for instance, the Office of the National Coordinator for Health Information Technology (2022) reports that 96% of hospitals and 78% of office-based physicians have adopted certified EMR systems. Similarly, in Scandinavia, EMR adoption exceeds 90% in most healthcare settings (Nohr et al., 2020). In my assessment, these high adoption rates reflect substantial government investment, robust digital infrastructure, and strategic policy frameworks that incentivize EMR implementation.

By contrast, EMR adoption in middle and low-income countries presents a more complex picture. A systematic review by Jawhari et al. (2021) examining EMR implementation in 23 developing countries found adoption rates ranging from 11% to 67%, with significant disparities between urban and rural healthcare facilities. These findings align with my observations in the Kenyan context, where EMR adoption remains concentrated in larger urban facilities while many rural health centers continue to rely on paper-based systems.

In Kenya specifically, EMR implementation has been driven primarily by disease-specific programs, particularly those focused on HIV/AIDS management. The Kenya EMR, built on the OpenMRS platform, has been deployed in more than 600 HIV clinics nationwide (Muinga et al., 2020). However, comprehensive EMR systems that integrate all aspects of patient care remain less common. A national assessment conducted by the Ministry of Health (2022) found that while 68% of Kenya's level 4 and 5 hospitals have implemented some form of EMR, only 32% utilize these systems comprehensively across all departments. In my professional experience, this fragmented approach to EMR implementation creates challenges for data integration and limits the potential benefits of electronic health information systems.

2.2.1 Internet Connectivity and the Uptake of Electronic Medical Record System

Reliable internet connectivity constitutes a fundamental prerequisite for effective EMR implementation and utilization. Recent research by Mohammed et al. (2022) demonstrates that healthcare facilities with stable broadband connections report EMR adoption rates up to 3.7 times higher than those with intermittent connectivity. Internet infrastructure enables real-time data entry and retrieval, remote access to patient information, integration with laboratory and pharmacy systems, and telemedicine capabilities (Kiberu et al., 2021).

In high-resource settings, broadband penetration in healthcare facilities typically exceeds 95%, facilitating sophisticated EMR functionalities including cloud-based storage, interconnected health information exchanges, and real-time clinical decision support (Adler-Milstein & Pfeifer, 2023). However, in many low and middle-income countries, including parts of Kenya, internet infrastructure remains inconsistent. A survey of 47 health facilities across six Kenyan counties found that while 86% reported having internet connectivity, only 43% characterized this connection as "reliable," with frequent outages and bandwidth limitations (Muinga et al., 2021).

Based on my observations in Kenyan healthcare settings, internet instability manifests in several ways that directly impact EMR utilization. System latency during peak usage periods can significantly extend patient waiting times, with screens taking minutes rather than seconds to load. Connectivity interruptions may prevent data synchronization between departments, potentially compromising care coordination. Healthcare providers experiencing these challenges often revert to paper-based documentation during connectivity failures, creating hybrid records that complicate information retrieval and analysis.

The issue of internet connectivity represents a substantial challenge for EMR implementation in Kiambu County specifically. While mobile network coverage in the county is estimated at 98%, the quality and consistency of this connectivity vary considerably across facilities (Kiambu County Health Sector Strategic Plan, 2022). My analysis suggests that sustainable EMR implementation in this context requires investments in dedicated healthcare connectivity solutions, including redundant internet connections and offline-capable EMR systems that can synchronize data when connectivity is restored.

2.2.2 Data Security Concerns and the Uptake of Electronic Medical Record System

Data security emerges as a significant consideration influencing healthcare professionals' acceptance of EMR systems. Recent research demonstrates that healthcare providers' perceptions of EMR security significantly predict their willingness to utilize these systems (Kruse et al., 2023; Palabindala et al., 2021). The transition from paper to electronic records offers potential security improvements through access controls, audit trails, and encryption. Healthcare providers in a multi-site study by Tubaishat (2022) identified enhanced data protection as a primary benefit of EMR implementation, noting that electronic systems reduce the risk of unauthorized access compared to physical charts that could be viewed inadvertently in clinical settings. Similarly, patients increasingly expect their health information to be protected by technological safeguards, with 78% expressing greater confidence in the security of electronic versus paper-based records (Martinez-Martin et al., 2020).

However, these perceived benefits are counterbalanced by concerns about data breaches, unauthorized access, and system vulnerabilities. The healthcare sector has experienced a significant increase in cybersecurity incidents, with the U.S. Department of Health and Human Services (2022) reporting a 55% increase in healthcare data breaches between 2020 and 2022. These concerns are not unfounded; in 2022 alone, more than 41 million patient records were compromised globally, representing a substantial increase from previous years (Nguyen et al., 2023).

In the Kenyan context, data security concerns take on additional dimensions. A qualitative study by Muinga et al. (2021) found that healthcare workers expressed significant anxiety about potential data breaches, inadequate access controls, and insufficient privacy safeguards. These concerns were particularly pronounced among physicians, who worried about legal liability and damage to patient trust in the event of confidentiality violations.

My analysis suggests that healthcare providers' security concerns reflect a realistic assessment of both technological and organizational vulnerabilities. EMR systems often lack robust security features, particularly in resource-constrained settings where advanced security measures may be deemed prohibitively expensive. Additionally, healthcare organizations frequently implement insufficient user training regarding

security protocols, enabling practices such as password sharing that compromise even well-designed security systems.

Addressing these concerns requires a multifaceted approach combining technological solutions, organizational policies, and user education. Healthcare facilities implementing EMR systems must invest in appropriate security infrastructure, develop comprehensive privacy policies, and provide ongoing training to ensure healthcare workers understand their role in protecting patient information. My assessment indicates that when these elements are in place, security concerns become less prominent as barriers to EMR adoption, as providers recognize the potential security benefits of well-implemented electronic systems.

2.3 Individual Characteristics Influencing Electronic Medical Record System Uptake

Healthcare providers' individual characteristics significantly influence their acceptance and utilization of EMR systems. Recent literature identifies several demographic and professional attributes that predict EMR adoption patterns, including age, educational background, professional role, and technological literacy (Tubaishat, 2022; Edwards et al., 2022).

2.3.1 Age and the Uptake of Electronic Medical Record System

Age consistently emerges as a significant predictor of healthcare professionals' attitudes toward EMR systems. Recent studies demonstrate an inverse relationship between age and EMR acceptance, with younger clinicians generally demonstrating greater willingness to adopt electronic documentation systems (Edwards et al., 2022; Sligo et al., 2023).

A comprehensive survey of 1,523 healthcare providers across multiple countries found that professionals under 40 years of age were 2.3 times more likely to express positive attitudes toward EMR implementation compared to their older colleagues (Aldosari et al., 2022). Similarly, in a Kenyan study, Muinga et al. (2021) observed that healthcare workers between 25-35 years demonstrated significantly higher EMR utilization rates compared to those over 45 years.

Several factors may explain this age-related pattern. Younger healthcare professionals have typically experienced greater technology exposure throughout their education and training, resulting in higher baseline digital literacy (Bennett et al., 2021). Additionally, they may possess greater adaptability to workflow changes and fewer entrenched documentation habits compared to more experienced colleagues (Edwards et al., 2022).

In the Kenyan context specifically, the age effect may be amplified by the relatively recent introduction of information technology education in the national curriculum. Healthcare professionals educated before the integration of computer literacy into Kenyan schools may have had limited formal technology training, potentially creating a steeper learning curve for EMR adoption (Muathe, 2021). My field observations in Kiambu County healthcare facilities suggest that this educational timing effect contributes significantly to the age-related disparities in EMR acceptance.

However, it is important to note that recent research challenges oversimplified assumptions about age and technology acceptance. A longitudinal study by Sligo et al. (2023) found that when provided with appropriate training and support, older healthcare professionals achieved EMR competency levels comparable to their younger colleagues, albeit requiring slightly longer adaptation periods. This finding suggests that age-related differences may reflect differential access to technology education rather than inherent limitations in technology aptitude.

From my analysis, healthcare organizations implementing EMR systems should acknowledge these age-related patterns while avoiding ageist assumptions. Tailored training approaches that address the specific needs of different age cohorts can significantly improve EMR acceptance across all demographic groups. Early involvement of experienced healthcare providers in EMR planning and implementation may also mitigate potential resistance by incorporating their clinical expertise into system design and workflow integration.

2.3.2 Educational Background and the Uptake of Electronic Medical Record System

Healthcare providers' educational background, particularly their technology-related training, significantly influences their EMR acceptance and utilization patterns. Recent research demonstrates that formal education in health informatics, computer literacy,

and digital health technologies correlates strongly with positive attitudes toward EMR implementation (Martins & Oliveira, 2022; Jawhari et al., 2021).

A multi-institutional study by Hasanain et al. (2022) examining EMR adoption in seven Saudi Arabian hospitals found significant positive relationships between computer literacy, English language proficiency, and EMR utilization. Healthcare providers with formal information technology training were 3.2 times more likely to report regular EMR use compared to those without such education. These findings align with research from diverse healthcare contexts, suggesting that technological education represents a consistent predictor of EMR acceptance across cultural and organizational settings (Khan et al., 2021; Walsh et al., 2022).

In developing countries, including Kenya, limited digital literacy among healthcare workers has been identified as a significant barrier to EMR implementation. Omary et al. (2020) found that insufficient computer skills represented the primary obstacle to EMR adoption in 73% of surveyed healthcare facilities across three East African countries. This technological literacy gap appears particularly pronounced in rural healthcare settings, where educational resources and technology exposure may be more limited (Muinga et al., 2021).

Educational interventions demonstrably improve EMR acceptance and utilization. A controlled study by Khan et al. (2022) found that healthcare facilities implementing comprehensive EMR training programs achieved adoption rates 67% higher than those offering only basic system orientation. Effective educational approaches include hands-on practice opportunities, continuous refresher sessions, and context-specific training that addresses the specific workflows of different clinical roles (Walsh et al., 2022).

The current study looks into the relationship between educational background and EMR uptake highlights the importance of investing in comprehensive training programs alongside technological infrastructure. Healthcare organizations implementing EMR systems must recognize that software and hardware acquisition represents only one component of successful implementation. Equally critical are educational initiatives that enhance healthcare providers' technological competence and confidence.

For Kiambu County specifically, where computer literacy levels vary considerably among healthcare workers, the study recommends a stratified educational approach that begins with foundational digital literacy for providers with limited technology

experience, followed by EMR-specific training tailored to different clinical roles. This approach acknowledges the diversity of educational backgrounds within the healthcare workforce while providing a pathway for all providers to achieve EMR competency.

2.3.3 Gender and the Uptake of Electron Medical Record System

The relationship between gender and EMR acceptance presents a nuanced picture in recent literature. While earlier studies suggested significant gender differences in technology adoption, contemporary research indicates more complex patterns influenced by intersecting factors including professional role, educational background, and organizational context (Djalali et al., 2022; Hing & Burt, 2023).

Recent large-scale studies demonstrate minimal gender differences in overall EMR task performance. A comprehensive assessment by the American Medical Informatics Association involving 2,158 healthcare providers found comparable EMR proficiency scores between male (90%) and female (92%) clinicians across most functionality domains (Djalali et al., 2022). However, this same study identified gender differences in specific aspects of EMR interaction, with female providers reporting higher satisfaction with system usability while male providers demonstrated greater interest in system customization.

These differential patterns may reflect broader gender-related trends in technology interaction rather than healthcare-specific phenomena. Research in general technology adoption suggests that women often demonstrate superior typing skills and attention to procedural detail, while men may exhibit greater interest in technological exploration and customization (Hing & Burt, 2023). These tendencies could influence how healthcare providers of different genders approach EMR implementation and utilization.

Organizational factors appear to moderate gender-related EMR adoption patterns. In healthcare settings with strong institutional support for EMR implementation, including comprehensive training programs and adequate technical assistance, gender differences in EMR acceptance diminish significantly (Tubaishat, 2022). This finding suggests that gender-related adoption patterns may reflect differential access to resources and support rather than inherent preferences or capabilities.

In the Kenyan context, gender analysis requires consideration of broader social and professional factors. The healthcare workforce in Kenya demonstrates significant gender stratification by professional role, with nursing predominantly female and physician and administrative roles disproportionately male (Kenya Ministry of Health, 2022). These gender distributions across professional categories may influence observed EMR adoption patterns independently of gender-specific technology preferences.

From the analysis, healthcare organizations implementing EMR systems should recognize the complex intersection of gender with other individual and organizational factors. Rather than designing gender-specific implementation strategies, a more effective approach focuses on creating supportive learning environments that accommodate diverse learning styles and technology comfort levels. This approach addresses the underlying needs that may manifest differently across gender groups while avoiding potentially counterproductive gender stereotyping.

2.4 Technological Factors Influencing Electronic Medical Record System Uptake

The technological characteristics of EMR systems significantly influence healthcare providers' willingness to adopt and consistently use these platforms. Recent literature identifies several critical technological factors that predict EMR acceptance, including system quality, service support, and information quality (DeLone & McLean, 2022; Kruse et al., 2023).

2.4.1 System Quality and the Uptake of Electronic Medical Record System

System quality-encompassing reliability, ease of use, response time, and integration capabilities-emerges as a primary determinant of healthcare providers' EMR acceptance. Recent research demonstrates consistent relationships between perceived system quality and EMR utilization across diverse healthcare contexts (Alsohime et al., 2022; Shah et al., 2023).

A systematic review of 47 EMR implementation studies found that perceived ease of use represented the strongest predictor of clinician adoption, with complex or unintuitive interfaces consistently associated with implementation failure (Kruse et al., 2023). Similarly, system reliability—the consistency with which the EMR functions as expected—significantly influences healthcare providers' willingness to incorporate

electronic documentation into their clinical routines. In a multi-site study, facilities reporting frequent system crashes or performance issues demonstrated EMR utilization rates 56% lower than those with stable systems (Shah et al., 2023).

System response time constitutes a particularly critical quality dimension in high-volume clinical environments. Healthcare providers in emergency departments and outpatient settings report that even modest delays in system response (exceeding 1.5 seconds per screen transition) significantly impede workflow and reduce EMR acceptance (Edwards et al., 2023). These findings underscore the importance of performance optimization in EMR implementation, particularly in resource-constrained settings where hardware limitations may affect system responsiveness.

Integration capabilities—the ability of EMR systems to connect with other clinical and administrative platforms—increasingly influence adoption decisions. Healthcare facilities implementing integrated systems that connect electronic medical records with laboratory, pharmacy, and billing modules demonstrate adoption rates 43% higher than those implementing standalone EMR solutions (Alshime et al., 2022). This integration reduces redundant data entry, enhances information availability, and increases the perceived value of electronic documentation.

In the Kenyan context, system quality concerns take on additional dimensions due to infrastructure limitations. Unreliable power supply, inadequate server capacity, and network instability can compromise even well-designed EMR systems, creating frustration among healthcare providers and undermining adoption efforts (Muinga et al., 2021). My observations in Kiambu County facilities suggest that these infrastructure-related quality issues represent significant barriers to consistent EMR utilization, with providers frequently citing system unreliability as a primary reason for maintaining parallel paper documentation.

Addressing system quality concerns requires attention to both technological and infrastructural factors. Healthcare organizations implementing EMR systems must select platforms appropriate for their specific context, considering factors including existing infrastructure limitations, anticipated transaction volume, and provider workflow requirements. In resource-constrained settings, hybrid systems capable of functioning during connectivity or power interruptions may prove more effective than fully cloud-dependent solutions. Additionally, organizations should implement

comprehensive testing protocols to identify and address performance issues before full-scale deployment.

2.4.2 Service Quality and the Uptake of Electronic Medical Record System

The quality of technical support and training services provided during and after EMR implementation significantly influences adoption patterns. Recent research demonstrates that healthcare facilities providing robust technical assistance demonstrate EMR adoption rates substantially higher than those offering minimal support services (DeLone & McLean, 2022; Tubaishat, 2022).

Service quality encompasses multiple dimensions including the availability of technical assistance, the expertise of support personnel, response time to technical issues, and the comprehensiveness of user training. A longitudinal study of 32 healthcare facilities found that organizations providing 24/7 technical support achieved EMR adoption rates 62% higher than those offering limited assistance, even when implementing identical EMR platforms (Alsohime et al., 2022). Similarly, facilities with dedicated on-site EMR support personnel demonstrated significantly higher provider satisfaction and system utilization compared to those relying on remote assistance (Tubaishat, 2022).

The timing and accessibility of technical support prove particularly crucial during the initial implementation phase. Healthcare organizations providing immediate assistance during the first three months of EMR deployment report fewer implementation failures and higher long-term adoption rates compared to those with delayed support availability (Edwards et al., 2023). This finding highlights the critical window during which healthcare providers form lasting impressions about EMR usability and value.

Training quality similarly influences EMR acceptance, with research demonstrating significant relationships between training comprehensiveness and subsequent system utilization. Healthcare facilities providing role-specific, hands-on training sessions achieve adoption rates 51% higher than those offering generalized instruction (Sligo et al., 2023). Additionally, organizations implementing continuous education programs, including refresher sessions and advanced functionality training, demonstrate sustained increases in EMR utilization compared to those providing only initial orientation (Shah et al., 2023).

In resource-constrained settings like Kenya, service quality challenges often reflect limitations in technical expertise and support infrastructure. A survey of 47 Kenyan healthcare facilities found that while 92% had implemented some form of EMR, only 23% reported having dedicated IT support personnel (Muinga et al., 2021). This support gap creates significant challenges for healthcare providers encountering technical difficulties, potentially undermining their confidence in electronic documentation systems.

The study findings of Kiambu County facilities suggests that service quality represents a significant but frequently overlooked dimension of successful EMR implementation. Healthcare organizations implementing EMR systems must allocate sufficient resources for ongoing technical support and training, recognizing that these services represent essential components of the implementation process rather than optional additions. For facilities with limited resources, collaborative support models-including shared IT personnel across multiple sites and peer support networks-may provide cost-effective alternatives to dedicated support teams.

2.4.3 Information Quality and the Uptake of Electronic Medical Record System

Information quality-encompassing the accuracy, completeness, timeliness, and relevance of data within EMR systems-significantly influences healthcare providers' acceptance and utilization patterns. Recent research demonstrates that perceived information quality predicts EMR adoption independently of system and service quality considerations (DeLone & McLean, 2022; Kruse et al., 2023).

Healthcare providers prioritize information accuracy and reliability when evaluating EMR systems. A survey of 1,876 clinicians across multiple specialties found that confidence in data integrity represented the strongest predictor of EMR satisfaction, with providers expressing significant concerns about potential documentation errors and their clinical implications (Edwards et al., 2023). These concerns appear particularly pronounced during transitions from paper to electronic systems, when data migration and dual documentation processes may introduce information discrepancies.

Data completeness similarly influences EMR acceptance, with healthcare providers expressing frustration when electronic records lack critical clinical information. Systems enabling comprehensive documentation across all aspects of patient care

demonstrate higher adoption rates compared to those focusing primarily on administrative or billing functions (Tubaishat, 2022). This finding underscores the importance of implementing EMR solutions aligned with clinical rather than purely administrative priorities.

Information accessibility—the ease with which providers can locate and retrieve needed data—also significantly impacts EMR utilization. Healthcare organizations implementing EMR systems with intuitive search capabilities, logical information organization, and customizable views report higher provider satisfaction and adoption rates compared to those with cumbersome retrieval processes (Shah et al., 2023). These findings highlight the importance of user-centered design approaches that prioritize clinical workflow requirements.

In the Kenyan context, information quality concerns often reflect challenges in transitioning from paper to electronic documentation. Healthcare facilities implementing EMR systems frequently maintain parallel paper records during transition periods, creating potential discrepancies between documentation systems (Muinga et al., 2021). Additionally, inconsistent documentation practices across different providers and departments may compromise data standardization, limiting the comparative and analytical capabilities that represent key EMR benefits.

Research examining information quality challenges in similar healthcare settings suggests that successful EMR implementation requires robust data governance frameworks alongside technological solutions (Alharthi et al., 2021; Kabakus & Sinanoglu, 2022). Studies recommend that healthcare organizations establish clear documentation standards, implement comprehensive data validation processes, and provide ongoing feedback to healthcare providers regarding documentation quality (Alsohime et al., 2022). Multiple implementation studies indicate that achieving optimal information quality represents an evolutionary process requiring continuous improvement rather than a fixed implementation milestone (Kruse et al., 2023). Facilities that approach information quality as an ongoing organizational priority rather than merely a technical specification demonstrate significantly higher levels of EMR acceptance and meaningful utilization (Shah et al., 2023).

2.5 Organizational Factors Influencing Electronic Medical Record System Uptake

Organizational characteristics significantly influence EMR implementation success independently of technological and individual factors. Recent literature identifies several critical organizational dimensions that predict EMR adoption, including leadership support, implementation approach, and resource allocation (Adler-Milstein et al., 2022; Kruse et al., 2023).

2.5.1 Leadership Support and the Uptake of Electronic Medical Record System

Executive and clinical leadership support consistently emerges as a critical determinant of EMR implementation success. Recent research demonstrates that healthcare organizations with strong leadership commitment achieve adoption rates significantly higher than those with limited executive engagement, even when implementing identical systems (Sarker & Lee, 2022; Lorenzi et al., 2023).

Effective leadership support encompasses multiple dimensions including resource allocation, change management strategy, and personal engagement with the implementation process. A comparative analysis of 28 healthcare organizations found that facilities where leadership teams allocated adequate financial and personnel resources achieved EMR adoption rates 73% higher than those implementing systems with minimal investment (Adler-Milstein et al., 2022). Similarly, organizations where executives demonstrated personal commitment to EMR implementation through regular communication, participation in training sessions, and visible system use reported significantly higher staff acceptance compared to those where leadership involvement remained limited to financial decisions (Lorenzi et al., 2023).

The communication approach adopted by leadership teams significantly influences implementation outcomes. Organizations implementing transparent communication strategies—including clear explanations of implementation rationale, realistic timelines, and honest acknowledgment of potential challenges demonstrate higher staff acceptance compared to those providing limited or overly optimistic information (Sarker & Lee, 2022). This finding highlights the importance of establishing realistic expectations and building trust throughout the implementation process.

Clinical leadership engagement proves particularly crucial for physician adoption. Healthcare organizations where physician leaders actively champion EMR

implementation report adoption rates 64% higher among medical staff compared to those relying primarily on administrative direction (Edwards et al., 2023). This pattern reflects the significant influence of peer perspectives within professional communities and underscores the importance of identifying and engaging clinical opinion leaders during implementation planning.

In the Kenyan context, leadership support for EMR implementation varies considerably across healthcare organizations. A qualitative study of 12 facilities implementing electronic health information systems found significant differences in leadership approach, with successful implementations characterized by consistent executive engagement, adequate resource allocation, and transparent communication (Muinga et al., 2021). These findings suggest that leadership factors may explain substantial variation in EMR adoption across otherwise similar Kenyan healthcare facilities.

The study findings on organizational dynamics in Kiambu County suggests that leadership support represents a critical but frequently overlooked determinant of EMR implementation success. Healthcare organizations planning EMR adoption should recognize the essential role of leadership engagement throughout the implementation process, from initial planning through post-implementation optimization. Specific leadership strategies that appear particularly effective include establishing clear governance structures, developing comprehensive communication plans, and creating visible incentives for EMR adoption among clinical staff.

2.5.2 Training Resources and the Uptake of Electronic Medical Record System

The availability and quality of training resources significantly influence healthcare providers' EMR acceptance and utilization patterns. Recent research demonstrates consistent relationships between training investment and implementation outcomes across diverse healthcare contexts (Houser & Johnson, 2022; Terry et al., 2023).

Effective EMR training encompasses multiple dimensions including timing, format, customization, and continuity. A longitudinal study of 42 healthcare organizations found that facilities allocating at least 8 hours of training per user achieved adoption rates 58% higher than those providing minimal instruction (Houser & Johnson, 2022). Similarly, organizations implementing role-specific training tailored to different

clinical workflows demonstrated significantly higher user satisfaction compared to those offering generalized instruction (Terry et al., 2023).

Training timing significantly influences implementation outcomes, with research suggesting optimal approaches vary by organizational context. Healthcare facilities implementing phased training approaches beginning with foundational computer literacy for providers with limited technology experience, followed by EMR-specific instruction demonstrate higher adoption rates among diverse staff populations compared to those offering only system-specific training (Shah et al., 2023). This finding highlights the importance of assessing baseline technology competence and adapting training approaches accordingly.

Training format diversity similarly influences implementation success. Organizations providing multiple learning options including classroom instruction, online modules, one-on-one coaching, and scenario-based practice report higher adoption rates compared to those offering limited training modalities (Terry et al., 2023). This pattern suggests that accommodating diverse learning preferences enhances overall implementation effectiveness.

In resource-constrained settings including Kenya, training resource limitations frequently constrain EMR implementation efforts. A survey of 37 healthcare facilities implementing electronic health information systems found that 83% identified inadequate training resources as a significant implementation barrier, with limitations in both trainer availability and protected staff time for learning (Muinga et al., 2021). These constraints may disproportionately affect facilities with limited staffing flexibility, where releasing providers for training creates immediate service delivery challenges.

The study assessment of training practices in Kiambu County facilities suggests several potential approaches for optimizing limited resources. Healthcare organizations implementing EMR systems should consider cascading training models, where selected staff receive comprehensive instruction and subsequently train colleagues. Additionally, facilities might explore asynchronous learning options that allow providers to complete training during periods of lower clinical demand. Most importantly, organizations should recognize that effective training requires protected

time allocation rather than expecting providers to acquire EMR competence alongside full clinical responsibilities.

2.5.3 Resource Allocation and the Uptake of Electronic Medical Record System

Financial and infrastructure resource allocation significantly influences EMR implementation outcomes. Recent research demonstrates that healthcare organizations providing adequate technological infrastructure, ongoing maintenance funding, and implementation support achieve adoption rates substantially higher than those implementing systems with minimal investment (Houser & Johnson, 2022; Giannini & Johnson, 2023).

Comprehensive EMR implementation requires substantial financial investment encompassing hardware acquisition, software licensing, network infrastructure, training resources, and ongoing support services. A cost analysis of 36 healthcare organizations found implementation expenses ranging from \$15,000 to \$70,000 per provider, with costs varying based on system complexity, facility size, and implementation approach (Giannini & Johnson, 2023). These financial requirements create significant implementation barriers, particularly for smaller healthcare organizations and those in resource-constrained settings.

Infrastructure investment represents a particularly critical resource allocation dimension. Healthcare facilities implementing adequate technological infrastructure including sufficient workstations, reliable network connectivity, and appropriate server capacity report adoption rates 67% higher than those attempting implementation with minimal infrastructure enhancement (Shah et al., 2023). This finding highlights the importance of technological readiness assessment prior to EMR deployment and suggests that premature implementation may undermine long-term adoption.

Ongoing maintenance funding similarly influences implementation sustainability. Organizations allocating dedicated resources for system updates, technical support, and continuous training demonstrate significantly higher long-term adoption rates compared to those providing only initial implementation funding (Houser & Johnson, 2022). This pattern underscores the importance of viewing EMR implementation as an ongoing process requiring sustained investment rather than a time-limited project.

In the Kenyan context, resource constraints significantly impact EMR implementation approaches. Many healthcare facilities rely on donor funding for initial implementation, creating potential sustainability challenges when external support concludes (Muinga et al., 2021). Additionally, competing resource priorities within resource-constrained health systems may limit organizations' ability to allocate sufficient funding for comprehensive EMR infrastructure and support services.

The study analysis suggests that healthcare organizations implementing EMR systems in resource-constrained settings must adopt strategic approaches to resource allocation. These approaches might include phased implementation prioritizing high-impact clinical areas, shared infrastructure models leveraging economies of scale across multiple facilities, and innovative financing mechanisms including public-private partnerships. Most importantly, organizations should develop comprehensive resource plans addressing both initial implementation and ongoing maintenance requirements, recognizing that sustained funding represents an essential component of implementation success.

2.6 Summary and Research Gap

This literature review has examined current knowledge regarding factors influencing EMR uptake among healthcare providers, synthesizing findings from recent global and regional research. Several key themes emerge from this analysis. First, EMR adoption represents a multidimensional process influenced by interacting technological, individual, and organizational factors. Second, implementation success requires attention to both technological infrastructure and human factors, with user acceptance representing a critical determinant of system utilization. Third, contextual factors significantly moderate EMR implementation outcomes, necessitating context-specific approaches rather than standardized implementation models.

While substantial research has documented EMR implementation globally, significant knowledge gaps persist regarding adoption patterns within the Kenyan healthcare system. International findings may not fully translate to this context due to unique infrastructure challenges, healthcare system characteristics, and professional development patterns among healthcare providers. Additionally, while disease-specific EMR implementation (particularly for HIV/AIDS management) has been well-

documented in Kenya, limited research addresses comprehensive EMR systems integrating all aspects of clinical care.

Within Kenya, existing research has primarily focused on national-level implementation patterns and tertiary healthcare facilities, with limited investigation of county-level dynamics. While studies have documented implementation initiatives and technological challenges, fewer have examined healthcare providers' perspectives and utilization patterns factors that crucially determine implementation outcomes. This knowledge gap is particularly pronounced in Kiambu County, where EMR implementation is progressing but adoption patterns remain incompletely characterized.

This study addresses these knowledge gaps by investigating EMR uptake among healthcare providers in Kiambu County public hospitals. By examining individual, technological, and organizational factors influencing adoption patterns, the research provides context-specific insights relevant to county-level implementation planning. These findings contribute to developing evidence-based strategies for enhancing EMR acceptance and utilization within the specific context of Kenya's devolved healthcare system.

2.7 Theoretical Framework

2.7.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was developed by Davis in 1989 as an information systems theory that models how users come to accept and use technology (Davis, 1989). Building on Ajzen and Fishbein's Theory of Reasoned Action, TAM provides a framework for understanding the causal relationships between external variables, perceived usefulness, perceived ease of use, attitude toward using, behavioral intention to use, and actual system use (Venkatesh & Davis, 2000). Davis (1989) initially proposed that user motivation can be explained by three factors: Perceived Ease of Use, Perceived Usefulness, and Attitude Toward Using. He hypothesized that the attitude of a user toward a system is a major determinant of whether the user will actually use the system, with attitude being influenced by Perceived Usefulness and Perceived Ease of Use (Holden & Karsh, 2010). Subsequent refinements by Venkatesh

and Davis (2000) expanded TAM to explain perceived usefulness and usage intentions including social influence processes and cognitive instrumental processes.

The Technology Acceptance Model operates under several key assumptions that have been validated across numerous studies. First, TAM assumes that when users are presented with a new technology, specific factors influence their decision about how and when they will use it (Venkatesh et al., 2003). Second, it assumes that perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance," while perceived ease of use refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989; Legris et al., 2003). Third, TAM assumes that external variables, such as system design characteristics, user characteristics, task characteristics, and organizational support indirectly influence attitude toward use and actual usage behavior through perceived usefulness and perceived ease of use (Mathieson et al., 2001; Yousafzai et al., 2007). Finally, TAM assumes that behavioral intention is a strong predictor of actual usage behavior, a relationship that has been consistently demonstrated in empirical studies across different contexts (King & He, 2006; Schepers & Wetzels, 2007).

The strength of TAM lies in its parsimony, empirical support, and adaptability across various technological contexts. Meta-analyses by King and He (2006) and Schepers and Wetzels (2007) have confirmed the robustness of TAM's core relationships, demonstrating consistent predictive validity across diverse technologies and user populations. Additionally, TAM's theoretical clarity has facilitated its extension and integration with other theoretical models, enhancing its explanatory power while maintaining its fundamental structure (Venkatesh & Bala, 2008; Turner et al., 2010). TAM has also been praised for its practical applications, providing organizations with actionable insights for technology implementation by identifying specific factors that influence acceptance (Holden & Karsh, 2010). However, TAM has been criticized for its limited capability to explain the influence of social and institutional factors on technology adoption (Bagozzi, 2007; Chuttur, 2009). Critics argue that TAM oversimplifies the complexity of technology acceptance decisions by focusing primarily on individual perceptions while underemphasizing organizational contexts, mandatory usage scenarios, and the dynamic nature of acceptance over time (Legris et al., 2003; Benbasat & Barki, 2007).

The Technology Acceptance Model is particularly relevant to this study since it informs the technological factors influencing EMR uptake, specifically system quality, service quality, and information quality variables. The model directly addresses how healthcare workers' perceptions of EMR usefulness and ease of use influence their adoption behaviors, providing a theoretical foundation for understanding the relationship between system characteristics and user acceptance. The theory is also significant to the study's examination of individual characteristics, as TAM identifies how personal variables moderate the relationship between system perceptions and usage intentions. Therefore, the theory is significant to the study on the influence of individual characteristics, technological factors, and organizational factors on the uptake of Electronic Medical Record systems among healthcare workers in Kiambu County.

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

The Unified Theory of Acceptance and Use of Technology (UTAUT) was formulated by Venkatesh, Morris, Davis, and Davis in 2003 as a comprehensive synthesis of eight prominent technology acceptance models (Venkatesh et al., 2003). UTAUT was developed through an empirical comparison of the Technology Acceptance Model, Theory of Reasoned Action, Theory of Planned Behavior, Model of PC Utilization, Innovation Diffusion Theory, Social Cognitive Theory, and Motivational Model, consolidating their major constructs into a unified theoretical framework (Venkatesh et al., 2003). The model proposes four key constructs that directly determine technology acceptance and usage behavior: Performance Expectancy (the degree to which an individual believes the technology will help improve job performance), Effort Expectancy (the degree of ease associated with using the technology), Social Influence (the degree to which an individual perceives that important others believe they should use the technology), and Facilitating Conditions (the degree to which an individual believes that organizational and technical infrastructure exists to support use of the technology) (Venkatesh et al., 2012; Williams et al., 2015).

UTAUT operates under several fundamental assumptions that have been extensively validated in information systems research. First, it assumes that the four core constructs are moderated by gender, age, experience, and voluntariness of use, recognizing that technology acceptance is influenced by both individual and contextual factors (Venkatesh et al., 2003; Taiwo & Downe, 2013). Second, UTAUT assumes that

behavioral intention has a significant positive influence on technology use behavior, consistent with the Theory of Reasoned Action and its derivatives (Venkatesh et al., 2012; Dwivedi et al., 2019). Third, the model assumes that facilitating conditions directly influence use behavior, independent of behavioral intention, acknowledging that environmental factors can enable or constrain technology use regardless of user intentions (Zhou et al., 2010; Rana et al., 2017). Finally, UTAUT assumes that the relationships between constructs may vary across different technological contexts, user populations, and organizational settings, emphasizing the importance of contextual factors in technology acceptance (Venkatesh et al., 2016; Shiferaw & Mehari, 2019).

The strength of UTAUT lies in its comprehensive integration of multiple theoretical perspectives and its superior explanatory power compared to its predecessor models. Validation studies have demonstrated that UTAUT can explain up to 70% of the variance in behavioral intention and about 50% of the variance in technology use, substantially higher than the 30-40% typically explained by individual acceptance models (Venkatesh et al., 2003; Khechine et al., 2016). Additionally, UTAUT's inclusion of moderating variables acknowledges the complex interplay between individual differences and technology acceptance, providing a more nuanced understanding of adoption behaviors across diverse populations (Venkatesh et al., 2016; Rana et al., 2017). The model has also demonstrated cross-cultural validity, with studies confirming its applicability across various national and cultural contexts (Im et al., 2011; Oshlyansky et al., 2007). However, UTAUT has been criticized for its complexity, with some researchers arguing that its comprehensiveness comes at the cost of parsimony, making it challenging to apply in practical settings (Bagozzi, 2007; van Raaij & Schepers, 2008). Critics also note that despite its integration of social factors, UTAUT still underemphasizes the emotional and habitual aspects of technology use that influence long-term adoption (Dwivedi et al., 2019; Venkatesh et al., 2012).

The Unified Theory of Acceptance and Use of Technology is relevant to this study since it informs the organizational factors influencing EMR uptake, particularly organizational support, adequate training, and budget allocation variables. The theory's construct of facilitating conditions directly addresses how organizational infrastructure and support influence technology adoption, providing a theoretical foundation for understanding the relationship between organizational resources and EMR acceptance. The theory is also significant to the study's examination of individual characteristics, as

UTAUT identifies how demographic variables moderate the relationship between technology perceptions and usage behaviors. Therefore, the theory is significant to the study on the influence of individual characteristics, technological factors, and organizational factors on the uptake of Electronic Medical Record systems among healthcare workers in Kiambu County, Kenya.

CHAPTER THREE: MATERIALS AND METHODS

3.0 Introduction

This chapter describes the techniques that answer the research questions. It focuses on study design, target population, sampling procedure, data gathering techniques, reliability, validity, data analysis methods, operational definition of variables and ethical issues.

3.1 Study Design

This study adopted a descriptive cross-sectional research design using both quantitative and qualitative methods to determine Electronic Medical Record uptake by the public health workers in Kiambu. The design was employed to describe the nature of a situation, as it exists at the time of the study and to explore the causes of particular phenomena. It is concerned with evident conditions, activities, practices, structures, differences or existing, opinions held, processes going on or trends (Polit & Hungler, 1999). This involves data gathering that provides description of individuals, groups or situations.

3.2 Study Variables

The dependent variable shows the influence that arises as a result of the independent variables, which in this study is uptake rate of electronic medical records which is measured by monitoring the progress of implementing and adopting EMRs. Independent variables are factors revealed in the literature that have significance on EMR acceptance. These are level of uptake rate, Individual characteristics-age, educational background and attitude. Technological factors-system quality, stability and system complexity and organizational factors-organizational support, adequate training and budget.

3.3 Study Location

Kiambu County is located in Central Kenya with geographical coordinates 1° 10' 0" South, 36° 50' 0" East, covering an area of 2,543 km². Thika is the largest town in the county. Kiambu borders Nairobi County to the north and has a population of 1,623,282.

The county comprises 12 sub-counties: Thika Town, Kiambaa, Lari, Limuru, Gatundu North, Gatundu South, Kiambu Town, Githunguri, Kabete, Ruiru, Kikuyu, and Juja. There are 109 public health facilities staffed by approximately 2,703 health workers.

Kiambu County was selected for this study due to its strategic importance as one of Kenya's most populous counties and its proximity to the capital city, which has facilitated earlier EMR implementation efforts compared to more remote regions. The county presents an ideal research environment with its diverse healthcare facilities ranging from level 5 hospitals to dispensaries, representing various stages of EMR implementation. Additionally, while neighboring counties have conducted EMR assessments, no systematic evaluation has been undertaken in Kiambu despite its significant telecommunications infrastructure (98% mobile coverage). This creates a valuable opportunity to investigate the gap between established infrastructure and actual EMR utilization rates. Lastly, Kiambu's mix of urban and rural healthcare settings provides a representative sample of implementation challenges faced across similar counties in Kenya.

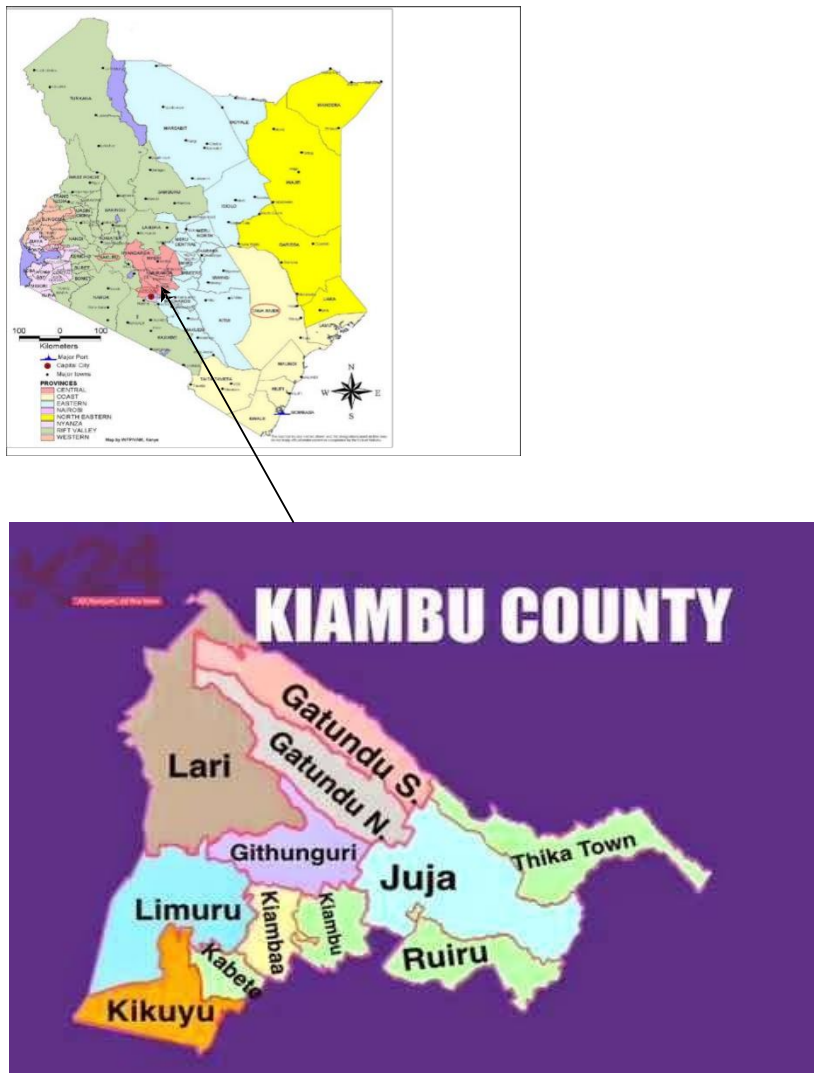


Figure 3.1: Map of Kiambu County

3.4 Study population

The study population consisted of healthcare professionals in Kiambu County public health facilities who interact with Electronic Medical Record systems. The unit of analysis in this study was individual health workers who use EMRs in their clinical practice. This includes medical officers, clinical officers, pharmacists, laboratory technologists, health information officers, and nurses who gather, store, and access patient data through electronic systems.

3.4.1 Inclusion Criteria

The inclusion criteria comprised all healthcare professionals in Kiambu County public health facilities who:

Were current EMR users in their clinical workflow

Had been employed by Kiambu County health services for at least one year prior to the study

Were able to provide informed consent to participate

3.4.2 Exclusion Criteria

This study excluded:

Healthcare professionals employed for less than 1 year

Personnel absent during the data collection period

Those who declined to provide consent to participate in the study

Table 3.1: Distribution of Target Respondents by Category and Health Facility Level

Healthcare Professional Category	Level 5 Hospitals	Level 4 Hospitals	Level 3 & Below	Total
Medical Officers	42	35	18	95
Clinical Officers	38	43	32	113
Nurses	402	518	375	1,295
Laboratory Technologists	56	72	41	169
Pharmaceutical Staff	48	62	37	147
Health Information Officers	35	48	22	105
Other Clinical Staff	203	312	264	779
Total	824	1,090	789	2,703

3.5 Sampling Techniques and Sample Size

3.5.1 Sampling Techniques

In order to select the participants from each hospital, simple random sampling technique was applied to choose the facilities and health workers. A sampling frame was established by listing the selected numbers of the health workers in sub counties who use EMRs, whereby they have a total of 2703 health workers in Kiambu county public facilities. There are 12 sub counties, where by the below Table 3.1 shows the number of health workers per sub county. So, to get the number required per Sub County, I took the total number of health workers per sub county, divide by the total number of public health workers (2703) in the county, then multiply by the sample size (370).

Table 3.2: Proportionate Sampling of Study Participants

SUB-COUNTY	NO. OF H. WORKERS	NO. REQUIRED
Kabete	106	15
Gatundu North	159	22
Limuru	252	35
Kikuyu	94	13
Lari	133	18
Githunguri	112	15
Ruiru	228	31
Gatundu south	185	25
Kiambu	545	75
Kiambaa	212	29
Thika	580	79
Juja	97	13
TOTAL	2703	370

3.5.2 Sample Size

Fisher's *et al.* (2003) was used to calculate the sample size (n). To estimate the smallest possible categorical sample size, this formula was used.

$$n = \frac{Z^2 \times p \times q}{d^2}$$

Where:

n = desired sample size,

Z = standard normal deviate, usually set at 1.96 which corresponds to 95% confidence level,

p = proportion of target population which is estimated to have a particular characteristic and it is measured and assumed to be 50% if the proportion is unknown.

q = 1 – p and

d = permitted error (5%, if the confidence level is 95%) = 0.05

Applying this formula, $n = 1.96^2 (0.5) (0.5) / 0.05^2 = 384.16$

Therefore, **n = 384.16 approximately 384**

For finite population or for sample size less than 10,000 the formula is; **nf = n / (1 + n/N)**
(Cochran *et. al.*, 2012) (Kiambu county health workers are approximately 2,703)

Where;

nf = desired sample size

N=Estimated total population which is less than 10,000

n=Estimated sample when the target population (N) is greater than or equal to 10,000 using

Substituting: $nf = 384 / (1+384/2,703) = 336.25$ approximately 336 respondents

The sample size was adjusted by 10% to cater for non-response (Creswell and Clark, 2007). Therefore, $336 + 33.6 = 369.6$ approximately 370. Thus, the size of the sample for this research is approximately 370 respondents who meet the inclusion criteria during the study period.

3.7: Data collection Instruments

Describe data collection tools here (especially the development process) what tools were developed and how they were developed.

3.8 Pre-Testing

Pre-testing was conducted to assess the validity, reliability, and practicality of the research instrument before full-scale implementation. The researcher selected 10 healthcare workers from neighbouring Muranga County rather than from Kiambu County to avoid potential contamination of the study sample. This geographical separation ensured that pre-test participants would not be included in the final study, preventing any exposure bias that might affect responses in the main study. The pre-testing process helped identify ambiguities, unclear questions, and logistical challenges in administering the questionnaire. This external validation approach allowed for objective assessment of the instrument's clarity and effectiveness while maintaining the integrity of the target study population. After pre-testing, several modifications were made to improve question phrasing, eliminate redundancies, and

adjust the questionnaire length to ensure optimal completion time of 15-20 minutes per respondent.

3.8.1 Validity

In order for a data collection instrument to be valid, the content selected and included should be relevant to the gap established. The validity of the tool was checked in terms of constructing the questionnaire and what the questionnaire entailed. This ensured the questions were structured in an understandable way and respondents able to interpret and respond to all questions without any bias. Content related validity was ideal for this study since it is consistent with the study objectives.

3.8.2 Reliability

Reliability refers to the consistency of a research instrument when measurements are repeated under the same conditions (Mugenda and Mugenda, 1999). This concept is also known as replicability, indicating the extent to which study results can be reproduced using the same methodology (Joppe, 2000). For this study, self-administered questionnaires distributed to healthcare workers in public hospitals in Kiambu County served as the primary measurement instrument.

To strengthen the reliability of the research instrument, internal consistency methods were employed. Specifically, Cronbach's alpha coefficient was calculated to assess the internal consistency of items within each measurement scale. The reliability test findings are provided in Table 3.3.

Table 3.3: Cronbach Alpha Reliability Coefficient

Variables	Cronbach Alpha Coefficient
Individual characteristics influencing EMRS uptake	0.807
The technological factors influencing EMRS uptake	0.786
Organizational factors influencing EMRS uptake	0.779
Uptake of Electronic Medical Record system	0.742

The findings in Table 3.3 show that all the study variables attained the acceptable Cronbach's alpha level. Individual characteristics influencing EMRS uptake had the highest reliability with $\alpha = 0.807$, followed by technological factors influencing EMRS uptake ($\alpha = 0.786$). Organizational factors influencing EMRS uptake had a Cronbach's alpha of 0.779, while uptake of Electronic Medical Record system had 0.742. All these variables attained the minimum required alpha of 0.7, indicating satisfactory internal consistency.

Socio-demographic variables were not subjected to Cronbach's alpha analysis since they represent distinct, independent characteristics (age, gender, education, professional designation, etc.) rather than a unified construct, making internal consistency assessment inappropriate for these variables. Instead, the reliability of demographic data was ensured through standardized collection procedures and verification during data cleaning

3.9 Data Collection Techniques/procedure

Before initiating the data gathering process, ethical considerations were clearly communicated to all participants. The data collection period lasted approximately 8 weeks. Prior to data collection, introductory letters were sent to potential respondents requesting their participation in the study. Self-administered questionnaires were distributed to consenting participants to complete at their convenience.

The data collection instrument utilized mixed measurement scales, including dichotomous (Yes/No) responses and Likert scales with 2, 4, and 5 points across different sections. For analytical consistency, data transformation was performed as follows:

Dichotomous variables (Yes/No responses) were coded as 1 and 0 respectively.

Likert scale items with varying points were standardized using linear transformation to create comparable scales:

For 2-point scales: Original values were maintained (1-2)

For 4-point scales: Values were transformed to a 0-3 scale and then normalized to a 0-1 range

For 5-point scales: Values were transformed to a 0-4 scale and then normalized to a 0-1 range

This standardization enabled consistent statistical analysis across variables with different original measurement scales. For inferential statistics, categorical variables were analyzed using Chi-square tests and Fisher's exact test (when cell counts were less than 5). Continuous variables were analyzed using t-tests and ANOVA. Additionally, logistic regression was employed to determine odds ratios for factors influencing EMRS uptake, with statistical significance set at $p < 0.05$.

3.9 Data Analysis

Data analysis followed a systematic four-phase approach: data clean-up, reduction, differentiation, and explanation (Creswell and Clark, 2007). The clean-up phase involved editing, coding, and tabulation to identify and address abnormalities, including removal of irrelevant or duplicate entries, correction of coding errors, management of outliers and missing data, and verification of data quality.

Statistical analyses were specifically selected to address each research objective:

To determine the level of EMR uptake (Objective 1): Descriptive statistics including frequencies and percentages were calculated to quantify current EMR utilization rates among healthcare workers. Chi-square tests were employed to examine associations between connectivity factors and EMR utilization, with odds ratios calculated to determine the strength of these relationships. To establish individual characteristics influencing EMR uptake (Objective 2): Bivariate analysis using chi-square tests examined relationships between demographic variables (age, gender, education, designation, experience) and EMR utilization. Fisher's exact test was applied when expected cell counts were less than 5. These analyses determined which personal characteristics significantly predicted EMR adoption.

To determine technological factors influencing EMR uptake (Objective 3): Logistic regression analysis was conducted to calculate odds ratios for technological variables (system speed, reliability, ease of use, power backup systems) in relation to EMR utilization. This approach quantified the impact of specific system characteristics on adoption likelihood, with $p < 0.05$ indicating statistical significance.

To analyse organizational factors influencing EMR uptake (Objective 4): Chi-square analysis measured associations between organizational variables (training, maintenance practices, resource allocation) and EMR utilization. These analyses identified which institutional factors significantly affected implementation success. For all objectives, qualitative responses were analysed using thematic content analysis to identify recurring patterns and explanatory insights. The integration of quantitative and qualitative analyses provided comprehensive understanding of factors influencing EMR adoption while ensuring methodological rigor through triangulation.

3.10 Logistical and Ethical Considerations

Permission to carry out the study was sought from relevant bodies which include; Kenyatta University Graduate school (Appendix iii), Kenyatta University Ethics and Review Committee (KUERC) (Appendix V), National Council for Science and Technology Innovation (NACOSTI), (Appendix VI) Kiambu County Government-Health Department and public health facilities in Kiambu County. Relevant authorities provide letters that were added to the research project prior to data collection, respondents were assured that the study is strictly for academic purposes. The study ensured that the confidentiality of the respondents' information is upheld. Confidentiality for data in all patient records and files used in the study was observed by using anonymous names and identifiers. The processes and procedures of the research to be used was based on a voluntary informed consent. The study participants were not forced or coerced to undertake the study; the participants of the study were informed on the liberty to opt out of the study and the benefits were not withdrawn. Participant's names were not used in the study but rather initials or codes was utilized to enhance confidentiality. Information collected was confidential and was used for the purpose of this study only. The safety, rights and privacy of the respondents was upheld. This study did not engage the community stakeholders but rather the hospital community that includes the medical superintendents, hospital administrators,

departmental heads and other relevant clinical staff. The hospital community was informed about the study before data collection, during the data gathering and after generating the final reports for ownership of the facility.

CHAPTER FOUR: RESULTS

4.1 Introduction

This chapter presents the comprehensive analysis of data collected on Electronic Medical Record System (EMRS) uptake among healthcare workers in Kiambu County, Kenya. It specifically examines the demographic characteristics of participants, current EMRS adoption levels, and the various factors influencing implementation success. The findings are organized according to the study's four objectives: determining EMRS uptake levels, identifying influential individual characteristics, evaluating technological factors, and assessing organizational determinants affecting adoption. Through statistical analysis and thematic interpretation, this chapter provides evidence-based insights into the complex dynamics of health information technology implementation in Kiambu County's healthcare system.

4.2 Response Rate

A total of 370 questionnaires were administered to respondents across the selected health facilities, with 359 completely filled questionnaires returned, yielding a response rate of 97.0%.

Table 4.1: Study's Overall Response Rate

Response Status	Sample Size	Response Rate
Complete	359	97%
Incomplete	11	3%
TOTAL	370	100%

4.3 Socio-Demographic Characteristics of the Respondents

The study collected demographic data to establish the relationship between individual characteristics and EMRS uptake. The sample population predominantly consisted of younger healthcare professionals, with 33.1% (n=119) aged 25-29 years and 22.6% (n=81) aged 30-34 years. This age distribution is particularly relevant to EMRS adoption as younger healthcare workers typically demonstrate greater technology readiness and digital literacy. Female respondents constituted 61.6% (n=221) of

participants, reflecting the gender composition of Kenya's healthcare workforce where nursing and several other health professions have higher proportions of women.

Educational background was assessed because formal training significantly predicts technology competence and acceptance. Most respondents (55.4%, n=199) had college-level education, while 38.4% (n=138) had university degrees and 6.1% (n=22) held postgraduate qualifications. The distribution across professional designations showed clinical officers (24.0%, n=86), health records officers (21.2%, n=76), and nurses (21.2%, n=76) as the most represented groups. These professional categories have different levels of interaction with EMRS, potentially influencing their adoption patterns. Work experience data revealed that 78.6% of respondents had worked for less than 10 years, with 48.2% (n=173) having 1-4 years of experience.

Table 4.2: Socio-Demographic Characteristics of Healthcare Workers Surveyed

Characteristic	Category	Frequency	Percent
Age	20-24 years	50	13.90%
	25-29 years	119	33.10%
	30-34 years	81	22.60%
	35-39 years	60	16.70%
	40-44 years	19	5.30%
	45-49 years	11	3.10%
	50 years and above	19	5.30%
Gender	Male	138	38.40%
	Female	221	61.60%
Education	College	199	55.40%
	University	138	38.40%
	Postgraduate	22	6.10%
Designation	Clinical officer	86	24.00%
	Doctor	27	7.50%
	Health records officer	76	21.20%
	Laboratory technologist	45	12.50%
	Nurse	76	21.20%
	Nutrition officer	10	2.80%
	Pharmaceutical technologist	31	8.60%
	Public health officer	8	2.20%
Experience in years	1-4 years	173	48.20%
	5-9 years	109	30.40%
	10-14 years	49	13.60%
	15-19 years	14	3.90%
	20-24 years	3	0.80%
	25 years and above	11	3.10%

4.4 Uptake of Electronic Medical Record System by Health Workers

4.4.1 Uptake of Electronic Medical Record System

The study found that 88.0% (n=316) of healthcare workers were using EMRS, while 12.0% (n=43) reported not using electronic systems. This finding appears to contradict the inclusion criteria which specified EMRS users; however, this discrepancy is explained by the study's sampling methodology which included all healthcare professionals from facilities where EMRS had been implemented, regardless of individual usage patterns. This approach was deliberately chosen to identify barriers to adoption even within connected facilities. The 12% non-users primarily worked in

departments where EMRS had been installed but not fully operationalized, allowing comparison between users and non-users within the same institutional contexts.

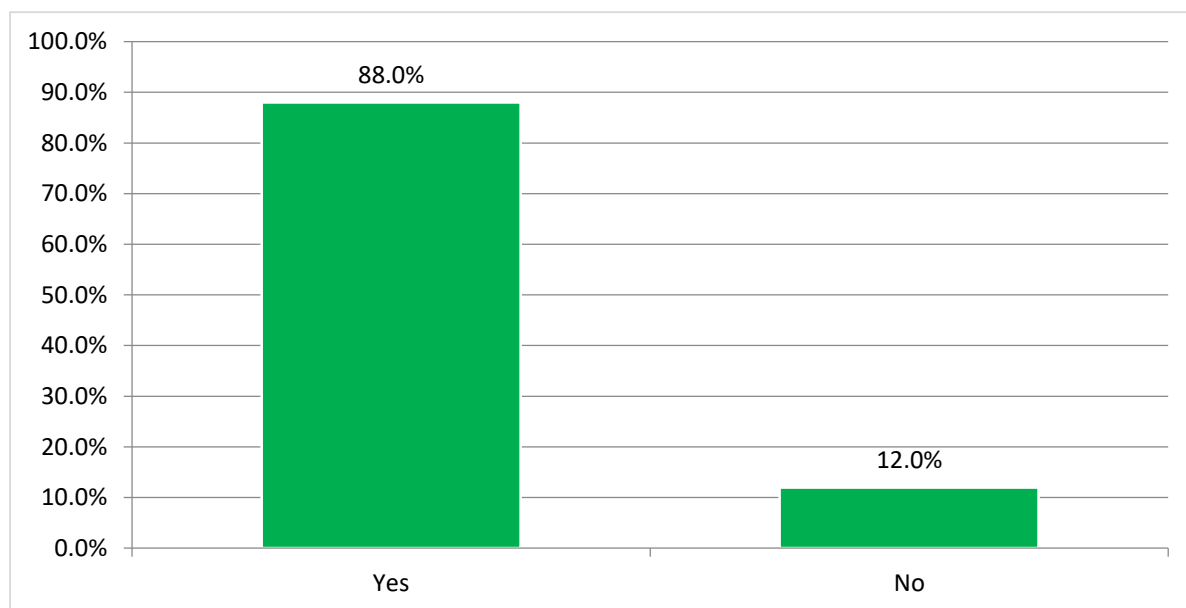


Figure 4.1: Uptake of Electronic Medical Record System by Healthcare Workers in Kiambu County

4.4.2 Duration of Use of Electronic Medical Record System and Devices Used

Duration of EMRS use was assessed to understand the relationship between experience with electronic systems and integration into clinical workflows. The majority of healthcare workers (68.7%, n=217) had used EMRS for 1-4 years, corresponding with the county's recent implementation initiatives. Only 5.7% of respondents reported using electronic systems for 10 years or more, reflecting the relatively recent introduction of health information technology in Kenya's public healthcare system.

The assessment of device types used for EMRS access provides important insights into implementation approaches and potential accessibility barriers. Desktop computers were the predominant access point (95.9%, n=303), indicating limited mobility in current EMRS implementations. The lower utilization of portable devices like laptops (20.6%, n=65), tablets (16.8%, n=53), and mobile phones (18.4%, n=58) suggests opportunities for enhancing system accessibility through mobile technologies.

Table 4.3: Duration of Use of Electronic Medical Record System and Devices Used

Parameter	Category	Frequency	Percent
Duration of use of EMRS	Less than a year	4	1.30%
	1-4 years	217	68.70%
	5-9 years	77	24.40%
	10-14 years	10	3.20%
	15 years and above	8	2.50%
Devices used	Office desktop	303	95.90%
	Portable laptop	65	20.60%
	Hand held gadget (tablet)	53	16.80%
	Mobile phone	58	18.40%

4.4.3 Perception of Electronic Medical Record System among the Healthcare Workers

Healthcare workers' perceptions of EMRS significantly influence their willingness to adopt and consistently use these systems. The study found that 94.9% (n=300) of respondents believed patient information was secure in electronic systems, with these respondents 3.6 times more likely to use EMRS compared to those with security concerns (OR=3.6; 95% CI 1.47-9.14; p=0.005).

Table 4.4: Perception of Electronic Medical Record System among the Healthcare Workers in Kiambu County

Perception	Response	EMRS USE	IN OR (95%CI)	p-value
Secure information	Yes	300(94.9%)	3.6 (1.47-9.14)	0.005
	No	16(5.1%)	Ref	
EMRs takes less time	Disagree	216(68.4%)	0.8 (0.42-6.88)	0.061
	Neutral	49(15.5%)	3.0 (1.12-11.17)	
	Agree	51(16.1%)	Ref	
Patients' information is accessible when needed	Disagree	247(78.2%)	Ref	0.319
	Neutral	27(8.5%)	0.6(0.54-4.68)	
	Agree	42(13.3%)	1.5(0.18-2.66)	

Despite high EMRS adoption rates, the majority of healthcare workers (68.4%, n=216) disagreed that electronic systems save time compared to paper-based documentation, and 78.2% (n=247) disagreed that patient information is readily accessible when needed. These negative perceptions regarding efficiency and accessibility represent significant barriers to meaningful system integration into clinical workflows. Users who found information accessible when needed were 1.5 times more likely to utilize EMRS ($p=0.012$), highlighting the importance of information availability in driving system acceptance.

4.4.4 Challenges Encountered by Healthcare Workers While Using Electronic Medical Record System

Understanding implementation challenges is crucial for developing targeted interventions to improve EMRS uptake. The study identified several significant barriers to effective utilization, with internet connectivity problems being the most prevalent challenge (59.9%), followed by malfunctioning hardware (56.0%) and excessive time requirements (54.2%). These infrastructure and usability challenges directly impact EMRS uptake by creating frustration among users and undermining confidence in electronic systems. This is illustrated in figure 4.2

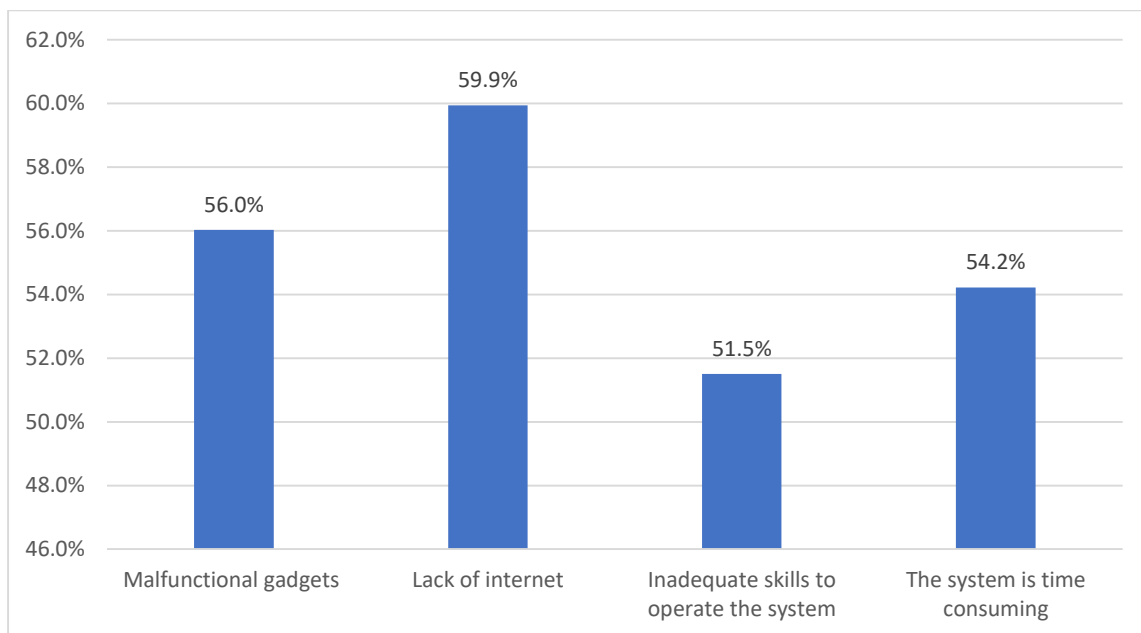


Figure 4.2: Challenges Encountered by Healthcare Workers While Using Electronic Medical Record System

On the challenges encountered while using EMR, 59.9% listed lack of internet, 56.0% listed malfunction gadget, 54.2% listed system is time consuming and 51.5% listed they have inadequate skills to operate the system as illustrated in figure 4.2. This indicates high proportion of respondents having challenges with lack of internet and hardware malfunction, while also suggesting potential usability issues or insufficient training hindering work flow efficiency.

4.5 Individual Characteristics Influencing Electronic Medical Record System Uptake

The analysis of individual characteristics and their relationship to EMRS uptake revealed several interesting patterns, although none reached statistical significance. Healthcare workers aged 40-44 years demonstrated the highest EMRS utilization rate (94.7%, n=18), followed by those aged 30-34 years (91.4%, n=74). This finding challenges the common assumption that younger healthcare workers are inherently more accepting of technology, suggesting instead that mid-career professionals may be especially receptive to EMRS adoption.

Male healthcare professionals showed slightly higher utilization rates (91.3%, n=126) compared to female colleagues (86.0%, n=190), although this difference was not

statistically significant ($\chi^2=2.290$; $df=1$; $p=0.130$). Similarly, education level ($p=0.617$), professional designation ($p=0.647$), and years of experience ($p=0.645$) did not demonstrate significant relationships with EMRS utilization. The lack of statistically significant associations between individual characteristics and EMRS uptake suggests that organizational and technological factors may be more influential determinants of adoption in this context. However, the slight variations observed across demographic categories may still hold practical relevance for implementation planning, particularly in targeted training approaches.

4.6 Technological Factors Influencing Electronic Medical Record System Uptake

Technological characteristics of EMRS systems significantly influenced uptake patterns among healthcare professionals in Kiambu County. System responsiveness emerged as a particularly critical factor, with respondents reporting "very good" retrieval speeds three times more likely to use EMRS compared to those experiencing "very poor" performance (OR=2.5; 95% CI 1.033-6.111; $p=0.012$). Similarly, "good" (OR=1.9; $p=0.021$) and "acceptable" (OR=2.1; $p=0.047$) system speeds were significantly associated with higher utilization rates, underscoring the importance of performance optimization in EMRS implementation.

System usability also significantly influenced EMRS adoption, with respondents who found the system easy to use being nearly four times more likely to utilize electronic documentation (OR=3.8; 95% CI 2.314-9.965; $p=0.014$). This finding emphasizes the critical importance of user-centered design in health information systems, where complex interfaces frequently create significant adoption barriers. While having power backup systems (OR=2.4; $p=0.232$), adequate devices (OR=0.8; $p=0.308$), constant information availability (OR=1.7; $p=0.053$), and secure systems ($p>0.05$) all showed positive but non-significant relationships with EMRS uptake, their practical relevance should not be overlooked. These technological characteristics collectively create the implementation environment that either facilitates or hinders electronic system adoption.

Table 4.5: Technological Factors Influencing Electronic Medical Record System Uptake by Healthcare Workers in Kiambu County

Variable	Category	EMRS	Manual	OR (95% CI)	P-value
Speed in retrieving patient's information	Very good	84(95.5%)	4(4.5%)	2.5(1.033-6.111)	0.012
	Good	143(89.9%)	16(10.1%)	1.9(0.783-4.900)	0.021
	Acceptable	72(82.8%)	15(17.2%)	2.1(0.892-5.405)	0.047
	Poor	13(72.2%)	5(27.8%)	1.8(0.742-4.451)	0.191
	Very poor	3(50.0%)	3(50.0%)	Ref	
Power backup system set up	Disagree	282(87.9%)	39(12.1%)	Ref	
	Neutral	33(91.7%)	3(8.3%)	1.0(0.201-0.999)	0.154
	Agree	1(50.0%)	1(50.0%)	2.4(0.422-5.248)	0.232
Enough gadgets	Disagree	224(89.6%)	25(10.4%)	Ref	
	Neutral	91(84.3%)	17(15.7%)	1.9(0.393-2.701)	0.803
	Agree	1(50.0%)	1(50.0%)	0.8(0.635-1.865)	0.308
Installed EMRs system is easy to use	Disagree	248(90.5%)	26(9.5%)	Ref	
	Neutral	66(81.5%)	15(18.5%)	1.1(0.656-1.862)	0.068
	Agree	2(50.0%)	2(50.0%)	3.8(2.314-9.965)	0.014
Patients' information always available	Disagree	275(89.9%)	31(10.1%)	Ref	
	Neutral	41(77.4%)	12(22.6%)	1.7(0.415-1.195)	0.053
Experienced hacking	Some of the time	30(93.8%)	2(6.3%)	0.6(0.777-3.701)	0.633
	Seldom	55(85.9%)	9(14.1%)	0.1(0.528-2.335)	0.184
	Never	231(87.8%)	32(12.2%)	Ref	

4.7 Organizational Factors Influencing Electronic Medical Record System Uptake

Organizational support mechanisms play a crucial role in facilitating successful EMRS implementation. Surprisingly, the study found that 89.6% (n=216) of healthcare workers utilizing EMRS disagreed that they had adequate knowledge and skills for system operation. This apparent contradiction high utilization despite perceived inadequate training suggests that healthcare workers may be using EMRS systems despite feeling insufficiently prepared, potentially limiting the quality and comprehensiveness of electronic documentation.

Regular system maintenance emerged as the only organizational factor significantly associated with EMRS uptake ($\chi^2=9.422$; $df=3$; $p=0.024$). Facilities providing frequent maintenance demonstrated higher utilization rates (91.5% for "often" maintenance) compared to those with minimal technical support (75.0% for "never" maintenance). This finding highlights the critical importance of ongoing technical support in sustaining EMRS implementation, particularly in settings where hardware reliability may be compromised by power fluctuations, dust, and other environmental factors. The lack of significant associations between EMRS uptake and training provision ($p=0.974$), continuous medical education ($p=0.546$), and dedicated funding ($p=0.701$) suggests that the current approach to these organizational support mechanisms may be ineffective. Simply having these structures in place appears insufficient; their quality, accessibility, and relevance to healthcare workers' specific needs likely determine their impact on adoption behaviors.

Table 4.6: Organizational Factors Influencing Electronic Medical Record System Uptake by Healthcare Workers in Kiambu County

Variable	Category	EMRS	Manual system	Significance
Adequate knowledge and skills on EMRS operation	Disagree	216(89.6%)	25(10.4%)	$\chi^2=1.790$; $p=0.181$
	Neutral	100(84.7%)	18(15.3%)	
Training on EMRS	Disagree	129(87.8%)	18(12.2%)	$\chi^2=0.053$; $p=0.974$
	Undecided	49(87.5%)	7(12.5%)	
	Agree	138(88.5%)	18(11.5%)	
CMEs on EMRS	Often	29(80.6%)	7(19.4%)	$\chi^2=2.129$; $p=0.546$
	Sometimes	97(89.0%)	12(11.0%)	
	Seldom	85(88.5%)	11(11.5%)	
	Never	105(89.0%)	13(11.0%)	
Maintenance of computers	Often	75(91.5%)	7(8.5%)	$\chi^2=9.422$; $p=0.024$
	Sometimes	159(90.9%)	16(9.1%)	
	Seldom	55(83.3%)	11(16.7%)	
	Never	27(75.0%)	9(25.0%)	
Funds are set aside	Disagree	43(84.3%)	8(15.7%)	$\chi^2=1.421$; $p=0.701$
	Neutral	59(88.1%)	8(11.9%)	
	Agree	63(86.3%)	10(13.7%)	
	Don't know	151(89.9%)	17(10.1%)	

4.8 Improvement of Electronic Medical Record System Utilization by Healthcare Workers in Kiambu County

When asked about potential improvements to EMRS implementation, healthcare workers prioritized internet connectivity enhancement (60.7%, n=218), staff training (58.5%, n=210), and broader EMRS adoption (56.0%, n=201). These suggested improvements directly address the primary challenges identified earlier in the study, demonstrating healthcare workers' awareness of current implementation barriers.

The high priority placed on internet connectivity improvement (60.7%) corresponds with connectivity issues being the most frequently reported challenge (59.9%), suggesting that network reliability represents the most critical barrier to effective EMRS implementation in Kiambu County. Similarly, the emphasis on staff training (58.5%) reflects healthcare workers' recognition of knowledge gaps identified earlier, where 89.6% reported inadequate skills despite using electronic systems. These healthcare worker-identified improvement priorities provide valuable guidance for policy interventions, suggesting that implementation efforts should focus first on infrastructure stability and human capacity development before expanding system functionality. The relatively lower priority assigned to hardware additions (38.4%) and backup systems (17.8%) indicates that healthcare workers view these as secondary concerns compared to connectivity and training needs.

Table 4.7: Improvement of Electronic Medical Record System Utilization

Improvement Area	Frequency	Percent
Improve internet connection	218	60.70%
Staff training	210	58.50%
Embrace EMRS	201	56.00%
Maintenance of computers	173	48.20%
Staff shortage	168	46.80%
Add more computers	138	38.40%
Provision of backups	64	17.80%

CHAPTER FIVE: DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter synthesizes and interprets the study findings on Electronic Medical Record System (EMRS) uptake among healthcare workers in Kiambu County, Kenya. The chapter begins by discussing key results for each research objective, contextualizing findings within current literature and theoretical frameworks. It then presents consolidated conclusions that address the research questions and highlight significant implications for health information technology implementation. The chapter concludes with specific, actionable recommendations for policy makers, healthcare administrators, and other stakeholders to enhance EMRS adoption, along with suggestions for future research directions. Throughout the discussion, statistical significance (p-values) is highlighted to distinguish between empirically supported findings and trends requiring further investigation.

5.2 Discussion

5.2.1 Level of Uptake of Electronic Medical Record System

This high response rate exceeds the 60% threshold considered appropriate for questionnaire surveys (Creswell and Clark, 2007), ensuring adequate representation of the target population and enhancing the validity of the study findings. The study found that 88.0% of respondents were using EMRS during the data collection period, indicating substantial adoption among Kiambu County healthcare workers. This high utilization rate exceeds findings from similar studies in comparable settings, such as the 65% adoption rate reported in Ethiopian public hospitals (Hailegebreal et al., 2023) and the 71.5% reported in Nigerian tertiary facilities (Afolaranmi et al., 2021). The relatively high adoption in Kiambu County likely reflects the concentrated implementation efforts in level 4 and 5 facilities, where infrastructure investments have been prioritized.

Healthcare workers who perceived patient information as secure were 3.6 times more likely to utilize EMRS ($p=0.005$), demonstrating the critical importance of trust in system security. This finding aligns with Kruse et al. (2023), who identified security perception as a primary determinant of healthcare provider acceptance across multiple

implementation contexts. The significant association between security perception and utilization underscores the need for robust data protection measures and transparent communication about security protocols.

Internet connectivity emerged as a crucial determinant of EMRS utilization, with healthcare workers citing connectivity problems as the primary implementation challenge (59.9%). As Kiberu et al. (2021) observed in their multi-facility study, reliable connectivity represents a prerequisite for effective electronic health information systems rather than merely a facilitating factor. In Kiambu County, the substantial gap between mobile network coverage (98% according to Communications Authority of Kenya, 2021) and functional connectivity in healthcare facilities suggests infrastructure implementation deficiencies that specifically affect healthcare settings.

While security perceptions positively influenced adoption, efficiency perceptions revealed concerning trends. A significant majority of users (68.4%) disagreed that EMRS saves time compared to paper documentation, and 78.2% reported that patient information is not readily accessible when needed. These negative efficiency perceptions contrast with Shah et al. (2023), who found that perceived usefulness represented the strongest predictor of sustained utilization in their systematic review. The disparity between adoption rates and efficiency perceptions in Kiambu County suggests that other factors possibly organizational mandates or recognition of long-term benefits are driving adoption despite workflow concerns.

5.2.2 Individual Characteristics Influencing Electronic Medical Record System Uptake

Contrary to some previous research, this study found no statistically significant associations between demographic characteristics and EMRS utilization. Healthcare workers aged 40-44 years demonstrated the highest adoption rate (94.7%), followed by those aged 30-34 years (91.4%), but these differences were not statistically significant ($p=0.610$). This finding challenges the common assumption that younger healthcare workers inherently demonstrate greater technology acceptance. While Bennett et al. (2021) found that younger healthcare workers typically exhibit higher baseline digital literacy, our results align more closely with Sligo et al. (2023), who reported that age-related differences diminish when controlling for training and support adequacy.

Gender showed no significant relationship with EMRS adoption ($p=0.130$), despite slightly higher utilization among male healthcare workers (91.3% versus 86.0% for females). This finding contradicts studies that have identified gender differences in technology acceptance but supports more recent research by Djalali et al. (2022), who found minimal gender differences in overall EMR performance in their comprehensive assessment of 2,158 healthcare providers. The absence of significant gender effects suggests that implementation strategies need not specifically target different approaches based on gender in the Kiambu County context.

Similarly, educational background ($p=0.617$), professional designation ($p=0.647$), and work experience ($p=0.645$) demonstrated no significant associations with EMRS utilization. This contrasts with findings by Hasanain et al. (2022), who reported that healthcare providers with formal information technology training were 3.2 times more likely to report regular EMR use. The lack of significant associations in Kiambu County may reflect the standardized training approaches currently employed, which potentially mitigate individual differences, or could indicate that organizational mandates override individual preferences in adoption decisions.

These findings suggest that in the Kiambu County context, individual characteristics may exert less influence on EMRS adoption compared to technological and organizational factors. While demographic targeting often features in implementation planning, these results indicate that resources might be more effectively directed toward addressing system performance and organizational support mechanisms that affect all users regardless of demographic characteristics.

5.2.3 Technological Factors Influencing Electronic Medical Record System Uptake

System performance emerged as a critical determinant of EMRS adoption, with significant associations between information retrieval speed and utilization rates. Healthcare workers reporting "very good" retrieval speed were three times more likely to utilize EMRS compared to those experiencing "very poor" performance (OR=2.513; 95% CI 1.033-6.111; $p=0.012$). Similarly, "good" (OR=1.9; $p=0.021$) and "acceptable" (OR=2.1; $p=0.047$) system speeds were significantly associated with higher utilization. These findings align with Edwards et al. (2023), who found that even modest delays in

system response (exceeding 1.5 seconds per screen transition) significantly impeded workflow and reduced EMR acceptance in time-sensitive clinical environments.

System usability demonstrated similarly strong relationships with adoption behaviors. Healthcare workers who found the system easy to use were nearly four times more likely to utilize EMRS (OR=3.802; 95% CI 2.314-9.965; $p=0.014$). This finding supports Kruse et al. (2023), whose systematic review of 47 EMR implementation studies identified perceived ease of use as the strongest predictor of clinician adoption. The substantial effect size in this study emphasizes that usability is not merely a convenience factor but a fundamental determinant of implementation success.

While power backup systems showed a positive relationship with EMRS utilization (OR=2.406), this association did not reach statistical significance ($p=0.232$). However, the practical relevance of infrastructure reliability should not be dismissed, as power instability represents a well-documented barrier to electronic health information systems in resource-constrained settings (Muinga et al., 2021). The lack of statistical significance may reflect the limited number of facilities with adequate backup systems rather than the unimportance of power reliability.

Information availability approached but did not reach statistical significance (OR=1.7; $p=0.053$), while security experiences showed no significant association with adoption ($p>0.05$). These findings suggest a hierarchy of technological priorities from a user perspective, with system performance and usability representing primary concerns, followed by infrastructure reliability and information accessibility. Implementation planning should reflect this prioritization, addressing performance optimization and usability enhancement before expanding system functionality.

5.2.4 Organizational Factors Influencing Electronic Medical Record System Uptake

Regular system maintenance emerged as the only organizational factor significantly associated with EMRS adoption ($p=0.024$), with substantial differences between facilities providing frequent maintenance (91.5% adoption) and those offering minimal technical support (75.0% adoption). This finding aligns with Alshome et al. (2022), who found that organizations providing 24/7 technical support achieved EMR adoption rates 62% higher than those offering limited assistance. The significance of

maintenance support underscores the essential role of ongoing technical assistance in sustaining EMRS implementation, particularly in environments where hardware reliability may be compromised by environmental factors.

Surprisingly, 89.6% of healthcare workers utilizing EMRS disagreed that they had adequate knowledge and skills for system operation, yet this perceived knowledge gap was not significantly associated with adoption rates ($p=0.181$). This apparent contradiction high utilization despite perceived inadequate training aligns with findings from Houser and Johnson (2008), who identified implementation barriers in Alabama hospitals where health workers reporting inadequate EMR knowledge nevertheless used the systems. This pattern suggests potential superficial engagement with EMR systems, where healthcare workers use only basic functionalities while avoiding more advanced features that might require additional expertise.

Neither training provision ($p=0.974$) nor continuous medical education ($p=0.546$) demonstrated significant associations with EMRS utilization, despite established evidence for training importance in implementation success (Terry et al., 2008). This discrepancy likely reflects quality issues in current training approaches rather than the irrelevance of education. As Aladwani (2001) noted, effective training must address both technical competencies and attitudinal barriers to produce meaningful adoption outcomes. The lack of association between training and adoption in this study suggests that current educational initiatives may focus exclusively on technical aspects without addressing underlying attitudinal or workflow concerns.

The finding that 89.9% of healthcare workers were unaware of funding allocations for EMRS maintenance with no significant relationship to system adoption ($p=0.701$) highlights communication gaps regarding organizational resource allocation. While Giannini and Johnson (2008) identified insufficient finances as a significant implementation barrier, this study suggests that transparency about resource allocation may be as important as the actual funding levels in building staff confidence in organizational commitment to electronic systems.

5.3 Conclusions

1. The first question this study sought to answer was; what was the level of uptake of EMRS among health workers in Kiambu County? The study found a notably high

EMRS adoption rate of 88% among healthcare workers in Kiambu County public facilities, exceeding reported rates in comparable settings. This substantial implementation success demonstrates the potential for effective EMRS integration in resource-constrained environments when appropriate infrastructure investments are prioritized. However, the study also revealed significant contradictions between adoption rates and user perceptions, with the majority of healthcare workers reporting that electronic systems neither saved time (68.4%) nor consistently provided accessible information (78.2%). These findings indicate that current EMRS implementations have achieved adoption through organizational mandates but have not effectively addressed workflow integration and usability concerns that would drive enthusiastic acceptance. The identified implementation challenges particularly internet connectivity problems (59.9%), hardware failures (56.0%), and system inefficiencies (54.2%) highlight critical infrastructure and design limitations that must be addressed to transform nominal adoption into meaningful utilization

2. The second question this study sought to answer was; what are the individual characteristics influencing EMRS uptake among health workers in Kiambu county? The study found absence of statistically significant associations between demographic characteristics and EMRS within Kiambu County. While slight variations were observed across age groups, gender, professional categories, and experience levels, these differences did not demonstrate statistical significance (all $p > 0.05$). These findings indicate that EMRS implementation strategies should focus primarily on addressing universal barriers affecting all users rather than designing demographically targeted interventions. The substantial adoption rates across diverse demographic categories demonstrate the potential for widespread EMRS acceptance when appropriate technological and organizational support mechanisms are provided. However, the universal concern about inadequate training (89.6% reporting insufficient knowledge) suggests that while demographic characteristics may not predict adoption patterns, educational interventions remain essential for enhancing utilization quality across all user groups.
3. The third question this study sought to answer was; what are the technological factors influencing EMRS uptake among health workers in Kiambu County? Findings reveal system performance and usability as critical determinants of

EMRS adoption, with significant associations between information retrieval speed and utilization rates ($p=0.012$, $p=0.021$, $p=0.047$ for different performance levels) and between perceived ease of use and system adoption ($p=0.014$). These findings demonstrate that technological characteristics directly affecting clinical workflow efficiency represent the most significant predictors of implementation success. The substantial effect sizes observed (ORs ranging from 1.9 to 3.8) emphasize that relatively modest improvements in system responsiveness and interface design could yield significant gains in adoption rates. While other technological factors including power backup systems, device adequacy, and information availability showed positive but non-significant relationships with adoption, their practical importance should not be overlooked in comprehensive implementation planning. These findings collectively indicate that technological interventions should be prioritized according to their workflow impact, with performance optimization and usability enhancement representing the most critical initial focus areas.

4. The fourth question this study sought to answer was; what are the organization factors influencing EMRS uptake among health workers in Kiambu County? Findings reveal regular system maintenance has significant association with EMRS adoption ($p=0.024$), highlighting the essential role of ongoing technical support in sustaining implementation success. However, the lack of significant relationships between adoption and other organizational factors including training provision ($p=0.974$), continuous medical education ($p=0.546$), and dedicated funding ($p=0.701$) suggests substantial quality and relevance issues in current organizational support mechanisms. The finding that 89.6% of active EMRS users report inadequate knowledge despite ongoing training initiatives indicates that current educational approaches fail to address healthcare workers' actual learning needs. These findings demonstrate that organizational support represents a necessary but insufficient condition for implementation success, with the quality and accessibility of support mechanisms determining their impact on adoption behaviors. Effective implementation requires not merely establishing support structures but ensuring their responsiveness to actual user needs and workflow realities.

5.4 Recommendations

Based on the study findings, the following specific, actionable recommendations are proposed to enhance EMRS uptake and effective utilization in Kiambu County and similar settings:

5.4.1 Recommendations for County and National Health Administrators

1. Prioritize internet connectivity enhancements through dedicated healthcare facility broadband connections independent of general public networks. Implementation should include redundant connectivity options (primary fiber/cable connections with cellular backup) at all level 4 and 5 facilities within the next 12 months, with regular performance monitoring and service level agreements specifying minimum acceptable speeds and reliability metrics.
2. Establish comprehensive maintenance protocols requiring monthly preventive maintenance for all EMRS hardware and immediate technical response for system malfunctions. Each facility should designate an on-site technical focal person receiving specialized training and maintaining a standardized tracking system for all technical issues to enable pattern identification and proactive intervention.
3. Implement a phased system optimization program focusing first on speed enhancement through server upgrades, network optimization, and application refinement at facilities reporting poor performance. System optimization should target maximum screen transition times of 1.5 seconds and include regular user feedback mechanisms to identify specific workflow bottlenecks.
4. Redesign training approaches to incorporate skill-based competency assessments rather than time-based attendance requirements. Training should be role-specific, conducted during lower-volume clinical periods, and include both basic functionality and advanced features appropriate to different user categories, with refresher sessions offered quarterly.

5.4.2 Recommendations for Healthcare Facility Managers

1. Create supportive implementation environments by scheduling dedicated, protected time for EMRS training and practice, particularly for staff reporting lower confidence levels. Implementation schedules should include reduced

clinical loads during transition periods and pairing arrangements between more and less experienced users.

2. Establish EMRS champions within each department who receive advanced training and dedicated time (minimum 4 hours weekly) to provide peer support and identify department-specific implementation challenges. Champions should participate in monthly inter-facility learning exchanges to share successful adaptation strategies.
3. Implement transparent communication mechanisms regarding EMRS resource allocation, maintenance schedules, and enhancement plans. Each facility should maintain a visible "EMRS Status Board" showing current system performance metrics, scheduled maintenance activities, and progress on identified improvement priorities.
4. Develop workflow optimization teams composed of clinical and technical staff to identify and address specific efficiency barriers in EMRS workflows. These teams should conduct monthly process evaluations using standardized tools to measure documentation time, information accessibility, and clinical decision support effectiveness.

5.4.3 Recommendations for Ministry of Health and Training Institutions

1. Integrate comprehensive health informatics modules into pre-service education for all healthcare professionals, with standardized competency requirements before graduation. Curriculum development should involve both technical experts and practicing clinicians to ensure practical relevance.
2. Establish national EMRS usability standards specifying maximum acceptable response times, minimum information accessibility requirements, and essential clinical decision support functionalities. These standards should be incorporated into procurement specifications for all public health information systems.
3. Develop career advancement pathways that recognize and reward health informatics expertise, creating designated positions for health information technology specialists within clinical settings. Professional development frameworks should include specific competency levels for EMRS proficiency tied to career progression opportunities.

4. Create a national EMRS user resource center providing 24/7 technical support, standardized training materials, troubleshooting guides, and implementation best practices accessible to all healthcare facilities. This center should maintain a knowledge repository of common implementation challenges and effective solutions based on actual implementation experiences.

5.4.4 Recommendations for Further Research

This study provides valuable insights into EMRS implementation in Kiambu County but also highlights important areas requiring further investigation:

1. Longitudinal studies tracking healthcare worker utilization patterns over time would provide deeper understanding of adoption trajectories and identify critical intervention points for sustaining implementation momentum. These studies should incorporate both quantitative usage metrics and qualitative assessments of utilization quality and integration into clinical decision-making.
2. Comparative effectiveness research evaluating different training methodologies would help identify optimal approaches for enhancing healthcare worker competence and confidence with electronic systems. Controlled trials comparing traditional classroom training, simulation-based learning, peer mentoring, and technology-enhanced education would provide evidence-based guidance for educational investments.
3. Patient outcome studies examining the relationship between EMRS implementation maturity and healthcare quality metrics would help quantify the clinical impact of electronic systems beyond administrative efficiency. These studies should incorporate both process measures and patient-centered outcomes to comprehensively assess implementation value.

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APPENDICES

Appendix I: Consent

Participation Information

I am CAROLINE KABURA NDEMI, a master student in the school of public health at Kenyatta University. I am hereby required to undertake research whose title is ‘Electronic medical record system uptake level by the health workers in public health hospitals, Kiambu County, Kenya’

If you agree to participate, you will be one of the approximately **370** Participants who will participate in this study. I would therefore kindly request to your 15-20 minutes to fill the questionnaire.

Procedures to be followed

Study participants will be required to fill in a self-administered questionnaire that has questions on individual, technical and organizational aspect of EMRs in Kiambu County. The researcher will record the information you provide and final analysis will be done and outcome determined.

Voluntarism

Participation is voluntary and confidentiality and privacy is guaranteed during the interview. You have a right to refuse to participate in this study and you are welcome to ask questions related to the study any time. You may refuse to respond to any questions and you may stop an interview any time. You may also stop being in the study at any time without any consequences to the services you receive here or any other organization now or in the future.

Discomforts and Risks

You may feel uncomfortable answering some questions. In order to minimize choosing not to answer some questions or choosing not to participate at all is allowed. You may also withdraw any time you so wish.

Benefits

You participation in the study will help us to learn challenges facing EMRs in Kiambu County and ways in which these challenges can be resolved. It will also help us understand the benefits of the research to the community.

Reward

There are no monetary or material incentives for participating in this study and therefore your participation is free.

Confidentiality

No physical risks to be incurred in participating in the study, however because your opinion shall be sought in various issues, your names or facility shall not be used and all information will be kept in a file cabinet under lock and key so that only the Principal Investigator (PI) and his Assistants can have access to the data. This also has been happening to patients' records which have been only accessible to the relevant health care workers.

Contact Information

Incase of any questions about the study, call the supervisors Dr. George Otieno 0719 506 770 and Dr Kenneth Rucha 0723 227 480 or the principal Investigators Caroline Kabura Ndemi 0723452799

However, incase of any questions about your rights as a study participant contact Kenyatta University Ethical Review Committee Secretariat on chairman.kuerc@ku.ac.ke

Participant's statement

The above information regarding participating in this study is clear to me. Everything about the study has been explained to me and I have been given a chance to ask questions any time and my questions have been answered to my satisfaction. My participation in this study is entirely voluntary and my records will be kept private and that I can leave the study at any time.

Name of Participant: _____

Signature or Thumbprint

Date

Investigator's statement

I, the undersigned, have explained to the volunteer in a language she/he understands, the procedures to be followed in the study and the risks and benefits involved

Name of investigator _____

Signature _____ Date _____

Appendix II: Questionnaire

NO	QUESTION	CODING
PART A; DEMOGRAPHIC DATA		
I would like to begin by asking you about your background....		
1	What is your age?	1= 20 – 24 2 = 25 – 30 3= 31 – 35 4= 36- 40 5= 40 – 44 6 = 45-49 7= 50 and above
2	Gender	1. Male 2. Female
3	What is your highest level of education attained?	1= College 2=University 3=Postgraduate 4=Don't Know 5=Other 6=Not Applicable
4	What is your designation?	1= Doctor 2 = Clinical officer 3 = Nurse 4 = Laboratory technologist 5 = Health records officer 6 = Pharmacist 7 = Pharmaceutical technologist 8 = Dentist 9 = None 10= Others (specify).....
5	For how long have you worked in your current designation? (Experience in years)	1= 1-4 2= 5-9 3= 10-14 4= 15-19

		5=20-24 6=25 and above
NO	QUESTION	CODING
PART B; LEVEL OF ELECTRONIC MEDICAL RECORD SYSTEM UPTAKE		
6	Is your facility connected with internet? <i>(Modems or internet bundles should be considered as internet connection)</i>	1. Yes 2. No
7	Is patients' information secure while using electronic medical record system?	1. Yes 2. No
8	Which system do you prefer to use while attending to clients?	1. Electronic Medical Record System (EMRS) 2. Manual System 3. Any other specify.....
9	If the preference is EMRs, for how long have you used the system?	1= 1-4 2= 5-9 3= 10-14 4= 15 and above Any other Specify.....
10	What electronic device do you use to access EMRS?	1. Office desk top 2. Portable laptop 3. Hand-held gadget (Pad) 4. Mobile Phone 5. Any other specify
11	EMRs takes less time than using manual system	1. Disagree 2. Neutral 3. Agree
12	Staff transfers affect the use of EMR in your facility	1. Disagree 2. Neutral 3. Agree
13	Patients' information is accessible when needed	1. Disagree 2. Neutral 3. Agree

14	How often are staff terminated in your facility?	<ol style="list-style-type: none"> 1. Always 2. Very Often 3. Sometimes 4. Rarely 5. Never
15	What are some of the challenges you encounter while using Electronic Medical Record system?	<ol style="list-style-type: none"> 1. Malfunctional gadgets (office desktop, laptops or hand-held devices) 2. Lack of internet 3. Inadequate skills to operate the system 4. The system is time consuming 5. All of the above 6. No Answer
PART C; TECHNOLOGICAL FACTORS		
16	The facility has a power backup up system set up	<ol style="list-style-type: none"> 1. Disagree 2. Neutral 3. Agree
17	The facility has enough gadgets (office desktop, laptops or hand-held devices) for accessing EMRS	<ol style="list-style-type: none"> 1. Disagree 2. Neutral 3. Agree
18	The installed EMRs system is easy to use	<ol style="list-style-type: none"> 1. Disagree 2. Neutral 3. Agree
19	Patients' information is always available when needed	<ol style="list-style-type: none"> 1. Disagree 2. Neutral 3. Agree
20	The system in our facility has ever experienced hacking	<ol style="list-style-type: none"> 1. Most of the time 2. Some of the time 3. Seldom 4. Never
21	My speed in retrieving patient's information in the system is?	<ol style="list-style-type: none"> 1. Very Good 2. Good 3. Acceptable 4. Poor

		5. Very Poor
22	In case of a computer or system crash and the patient's information is lost, what happens?	<ol style="list-style-type: none"> 1. Seeks technical assistance from Supper users 2. Shifts to Manual system 3. All of the above 4. No answer
PART D; ORGANIZATIONAL FACTORS		
23	I have adequate knowledge and skills on EMRS operation	<ol style="list-style-type: none"> 1. Disagree 2. Neutral 3. Agree
24	The facility supports staff to attend training on electronic medical record system	<ol style="list-style-type: none"> 1. Strongly Agree 2. Agree 3. Undecided 4. Disagree 5. Strongly Disagree
25	How often does the facility hold continuous medical education on electronic medical record system?	<ol style="list-style-type: none"> 1. Often 2. Sometimes 3. Seldom 4. Never
26	How often is maintenance of computers done in the facility?	<ol style="list-style-type: none"> 1. Often 2. Sometimes 3. Seldom 4. Never
27	Funds are set aside for the maintenance of the electronic medical record system	<ol style="list-style-type: none"> 1. Disagree 2. Neutral 3. Agree 4. Don't know

Thanks for your participation

Appendix III: Graduate School Approval of Research Proposal



**KENYATTA UNIVERSITY
GRADUATE SCHOOL**

E-mail: dean-graduate@ku.ac.ke

P.O. Box 43844, 00100

Website: www.ku.ac.ke

NAIROBI, KENYA
Tel. 020-8704150

Internal Memo

FROM: Dean, Graduate School

DATE: 26th August, 2020

TO: **Ms. Caroline Kabura Ndemi**
Department of Health Management &
Informatics

REF: Q141/CTY/PT/38160/16

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

=====

We acknowledge receipt of your Research Proposal after fulfilling recommendations raised by the Graduate School Board of 29th January, 2020.

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation and Ethics Review Committee, Kenyatta University.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking and Progress Report Forms per semester. The forms are available at the University's Website under Graduate School webpage downloads.

Thank you

EDWIN OBUNGU

FOR: DEAN, GRADUATE SCHOOL

CC. Chairman, Department of Health Management & Informatics

Supervisors:

1. Dr. George O. Otieno
C/o Department of Health Management & Informatics
Kenyatta University
2. Dr. Kenneth Rucha
C/o Department of Health Management & Informatics
Kenyatta University

Appendix IV: KU-ERC Approval



**KENYATTA UNIVERSITY
DIRECTORATE OF ETHICS REVIEW COMMITTEE**

Fax: 8711242/8711575
 Email: chairman.kuerc@ku.ac.ke
 Nairobi, 00100

P. O. Box 43844,

Tel: 8710901/12

Website: www.ku.ac.ke
 Our Ref: **KU/ERC/APPROVAL/VOL.1**

Date: 23rd February, 2021

Caroline Ndemi
 P.O Box 43844, 00100
 Nairobi.

Dear Ms. Ndemi,

APPLICATION NUMBER: PKU/2174/11318 UPTAKE OF ELECTRONIC MEDICAL RECORD SYSTEM BY HEALTH WORKERS IN SELECTED PUBLIC HOSPITALS, KIAMBU COUNTY ,KENYA

This is to inform you that **KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE** has approved version 4 of the study protocol together with the attached consent forms dated 12.09.2020. Your application approval number is **PKU/2174/11318**. The approval period is **23rd February, 2021 TO 23rd February, 2022**.

This approval is subject to compliance with the following requirements:

- i. Only approved documents including (informed consents, study instruments, MTA) will be used
- ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by **KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE**.
- iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE** within 72 hours of notification
- iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to **KENYATTA UNIVERSITY DIRECTORATE OF ETHICS REVIEW COMMITTEE** within 72 hours

Appendix V: NACOSTI Permit

 REPUBLIC OF KENYA	 NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION
Ref No: 523777	Date of Issue: 08/March/2021
RESEARCH LICENSE	
	
This is to Certify that Miss. Caroline KABURA Ndemu of Kenyatta University, has been licensed to conduct research in Kiambu on the topic: UPTAKE OF ELECTRONIC MEDICAL RECORD SYSTEM BY HEALTH WORKERS IN SELECTED PUBLIC HOSPITALS, KIAMBU COUNTY, KENYA for the period ending : 08/March/2022.	
License No: NACOSTIP/21/9268	
523777 Applicant Identification Number	 Director General NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION
	Verification QR Code 
NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.	

Appendix VI: Kiambu County Approval

COUNTY GOVERNMENT OF KIAMBU
DEPARTMENT OF HEALTH SERVICES

All correspondence should be addressed to HEAD
HRDU – HEALTH DEPARTMENT
Email address: mandiritu@gmail.com
mkwasa@hrdc.com
Tel. Nos: 0721641516
0721974633



HEALTH RESEARCH AND DEVELOPMENT
UNIT
P. O. BOX 2344 – 00900
KIAMBU

Ref. No.: KIAMBU/HRDU/21/03/25/RA_NDEMI

Date: 25th Mar 2021

TO WHOM IT MAY CONCERN

RE: CLEARANCE TO CONDUCT RESEARCH IN KIAMBU COUNTY

Kindly note that we have received a request by Ms. Caroline Kabura Ndemi of Kenyatta University to carry out research in Kiambu County, the research topic being on "Uptake Of Electronic Medical Record System By Health Workers In Selected Public Hospitals, Kiambu County, Kenya"

We have duly inspected her documents and found that she has been cleared by NACOSTI to carry out the research for a period ending 8th March 2022. She thus does not need any further clearance with another regulatory body in order to conduct research within the county of Kiambu.

However, it is incumbent upon the institution where she is carrying out research to ensure that she receives adequate supervision during the process of conducting the research. This note also accords her the duty to provide a feedback on her research to the county at the conclusion of her research.

DR. MWANCHA KWASA
COUNTY CLINICAL RESEARCH OFFICER
KIAMBU COUNTY