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Effect of Technical Factors in the Uptake of EMRs in the Inpatient Department in Public Health Facilities in Kiambu County

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The management of the hardcopy inpatient information in public healthcare facilities in Kenya has proved to be an uphill task. That is informed by the fact that these types of records are more vulnerable as compared to electronic medical records. Electronic medical records are legal patient records that are created and stored in a digital format in health. Hardcopy medical records are prone to damage through wear and tear, fires, and getting lost because of misplacement. That is not the case with electronic medical records, which are more secure because they have a backup system and can be easily retrieved when needed. This difficulty in the utilization of hardcopy medical records necessitates the utilization of electronic medical records. The study analysed the effect of technical factors on the uptake of electronic medical records in the inpatient department in public health facilities in Kiambu County. The study adopted a descriptive research design. A sample of 85 respondents was selected through simple random sampling. The respondents were doctors, hospital administrators, clinicians, and nurses. Primary data was collected through the issuance of questionnaires. Data were analysed through descriptive statistics, correlation, and multiple regression analysis. Study findings were presented in figures and tables. Study findings indicate a positive and significant association between technical on the uptake of inpatient electronic records management in PHF in Kiambu County. The study suggested that there is a need for enhancement of the level of communication among all stakeholders. Organizations should have a budgetary allocation, regular human capacity building, senior management support, and clarity of strategic plan implementation to optimize the uptake of electronic medical records in public health facilities in Kiambu County. Further, there need for sensitization on the use of electronic medical records to optimize organizational efficiency and minimize medical errors. Further, there is a need for the development of strategies aimed at influencing EMR positively among the utilization of inpatients, clinical officers, and medical officers in public health facilities.

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INTRODUCTION

Electronic Medical Records (EMR) are digital versions of patients' health information that can be accessed and shared by authorized healthcare providers. EMR can improve the quality, safety, and efficiency of healthcare delivery, as well as facilitate public health surveillance and research. However, the uptake of EMR in inpatient department facilities is influenced by various technical factors, such as the availability of hardware and software, the interoperability of systems, the security and privacy of data, and the usability and functionality of EMR applications. These factors can affect the performance, satisfaction, and acceptance of EMRs by healthcare providers and patients. Therefore, it is important to assess and address these technical factors when implementing EMR in inpatient department facilities (El-Yafouri, 2022; Alharthi et al., 2019).

The adoption of technology in the health sector has brought a lot of efficiency revolution as well as improvement in service delivery globally (Ludwick & Doucette, 2009). Healthcare providers are now applying I.T. for the management and administration of patients, procurement, human resources, and emergency fleet management. Such tasks were previously managed using paper-based record-keeping systems. This system has proved to be inefficient when it comes to data quality, security, and information retrieval (Castle, 2015). The paper-based recordkeeping also makes it impossible to have concurrent data access (Griffin & Snook,

2006). Despite these drawbacks, many health workers still use paper-based records mainly due to the fact they are more familiar with these records following long-term use (Msiska et al., 2017). The other factor that makes paper-based record-keeping widely used is that this system does not need the relatively high number of technical skills and knowledge that are required for the case of electronic record-keeping (Singh & Prema, 2013).

Health Information Systems is one of the Six Building Blocks of a health system described by the World Health Organization (Manyazewal, 2017; World Health Organization, 2010). The health information system is cross-cutting among the other pillars: Service Delivery, Health Workforce, Access to Essential Medicines, Financing, and Leadership. Health information systems have four key components: Data Generation, Data Compilation, Data Analysis, Data Dissemination, and Utilization (Skolnik, 2010). KHP 2014-2030 identifies the efficient use of telemedicine as a fundamental principle in achieving equitable distribution of health services. Kenya has adopted an electronic web-based District Health Information System (DHIS), mobile technologies (mHealth), and Electronic Medical Records (EMRs). HIS utilization has been enhanced by the installation of electronic data management systems in health facilities (Karuri et al., 2014). Most facilities in Kenya especially in Kiambu County have adopted the EMR system, but the challenge is that some departments have the system being used, some departments do not have the EMR system, and

more so there are some cadres of healthcare providers during their shifts they rotate between use and not using the EMRs.

One of the areas in which the basic functional evaluation of the electronic medical records technology revolves around is the improved efficiency in hospitals. The introduction of EMR in hospitals is associated with boosting efficiency by reducing the time taken to retrieve documents from the database. Furthermore, it has also improved prescription legibility and patient satisfaction due to the drastic improvement in health services. Consequently, improved hospital efficiency lowers the cost of service administration or delivery (Buntin et al., 2011). That is because savings will be made through the elimination of unnecessary tests and admissions. Hence, Electronic Medical Records are very vital for any treatment undertaking (Mulusew, 2015).

Despite the above benefits, the use of EMR exposes health institutions to potential security threats (Fuentes, 2018). There is enough evidence that there are potential safety hazards linked with the use of this technology (McLeod & Dolezel, 2018). One of the quality issues in this respect is the emergence of errors with EMR. These errors lead to data loss, incorrect data entering, incorrect transmission of data, and incorrect display of data, which eventually leads to a lack of information integrity (Busagala, 2013). This has, in turn, scaled down the uptake of EMR due to potential data loss in case of a data breach in the EMR systems (Mulusew, 2015). Some of the missing information, for instance, is the billing information and personal statistics like weight and age. That could have resulted from data loss, incorrect data entry, incorrect data transmission, or incorrect data display. This missing information brings down the quality of data related to EMR and makes the potential for EMR-induced medical death, harm, or error increase significantly (Information Resources Management Association & Khosrow-Pour, 2006).

The functions of EMRs include patient billing, electronic prescribing, electronic

orders of medical investigation, recording, and synchronizing patients' data (Jones et al., 2012). Evidence in the existing literature showcases that EMRs have a positive return on investments. Jang et al. (2014) examined the use of EMRs in 17 Canadian hospitals. He discovered that the health institutions recouped their investments on an average of 10 months, with a range between 1 to 37 months. The majority (14 healthcare facilities) registered a positive return on their investment in EMRs (Jang et al., 2014). Despite the positive impact of EMRs, there are bottlenecks that affect their adoption and use, such as technology (Waithera, Muhia, Songole, 2017). The technical factors entail the availability of hardware support (computers, mobile phones, and internet routers), and software support, which entails the networks, internet, code updates, and fixing bugs.

Problem Statement

Electronic Medical Records (EMR) are digital collections of patient records stored in a computer database (Alpert, 2016). The Electronic Health Records (EHR) systems in a health facility enable efficient storage and retrieval of patient information for use by healthcare providers during a patient's hospitalization. EMR as a tool provides a platform to hospitals that allows for the provision of new functionalities and services that enhance medical care (Mwangi 2013). However, management of patient information can prove an uphill task if it is done manually because many things have to be recorded for each patient. Gathungu (2018), in his study on medical records in Nairobi hospitals, found out that these hospitals enter the patient's data manually, which led to many human errors. This difficulty, coupled with the fact that hardcopy documents are not easily accessible from a centralized point, and their susceptibility to wear and tear and loss due to fire at health facilities, necessitates electronic medical records. Data encryption enhances the quality of information sharing by creating several layers of security to protect the data in the system. That involves transforming the data into an unreadable format known as a cipher text, which can only be decrypted by the system administrators. Furthermore, the use of passwords and security

access limits the level of information access and distortion as it is transferred to different channels (Harrison & Coussens, 2007).

Several studies have been done in developing nations to study factors that influence the adoption and implementation of EMR technology. Some of the significant factors that influence the adoption are ease of use by the physician, the perception of the physician towards the system, and the cost of the adoption (Miller & Sim, 2004). However, the existing literature on Kenya is very thin, with most studies focusing on a specific health facility (Ministry of Health, 2010). The slow adoption of EMR in public health facilities in Kenya has become a critical challenge that needs to be examined. Speedy adoption of EMR is crucial in streamlining key processes in the healthcare industry. EMR systems in hospitals have significant impacts and benefits (Waithera et al., 2017). EMRs have been important in mitigating challenges in public health facilities, such as improving communication amongst healthcare personnel, reducing medical costs, and preventable errors (Ministry of Health, 2010). The use of EMRs has also exacerbated the elimination of legibility issues, making it easier to bill patients and have a patient data repository that improves the quality of patient care (Jensen et al., 2012; Raymond et al., 2015). It also reduces healthcare costs, integrates different activities across healthcare organizations, and improves the management of medical records and the quality of patient care. However, the rate of EMR use among healthcare providers in level 4 and 5 hospitals in Kiambu County remains low. Despite the Kiambu County government's commitment to increase the uptake of EMR, its adoption lag persists. The adoption of electronic records, despite being beneficial empirical evidence, has documented that its success is contingent on technical, organizational, and behavioural factors, which influence the level of EMR adoption. The barriers to the EMR adoption include; financial costs, time commitments, technical support availability, negative perception of its usefulness and ease of use, insufficient training in medical informatics, patient data confidentiality and security issues, a

slowdown in work downturn necessitated by the difficulty in entering data to the computers (Terry et al., 2009).

The utilization of information technology in the healthcare sector through EMR has enhanced and revolutionized the delivery of healthcare services across the globe (Msiska et al., 2017). However, the benefits of an efficient EMR system rely heavily on proper implementation. Several studies have been done on the factors that affect healthcare personnel's intention to adopt a new technological system that enhances their work. However, most of these past studies have been qualitative. They do not empirically evaluate the organizational, behavioural, and technical factors that affect the use of information by medical practitioners in public health facilities in developing nations. Kenya is trying to keep pace with the developments in healthcare-based technologies so as to improve the quality of healthcare of its citizens. However, the existing literature on the technical, organizational, and behavioural factors affecting the adoption of EMR in Kiambu County is thin. Few quantitative studies explore the views of healthcare providers in public health facilities regarding the adoption and implementation of EMR. Most studies concentrate on specific hospitals in the County. As such, these studies are not representative enough to conclude the general performance of EMR systems in Kiambu County. Therefore, this study set out to conduct a study exploring the technical and how they affect the adoption and implementation of EMRs in level four and five public health facilities in Kiambu County.

LITERATURE REVIEW

Aqil et al. (2009) states that a significant number of medical practitioners in developing nations have insufficient technical know-how and skills in operating EMRs, which results in resistance to the adoption of EMRs. Mugo & Nzuki (2014) examined the attributes that affect the adoption of e-health among developing countries and found that a lack of computer skills among health personnel negatively affected the adoption of EMRs.

Qureshi et al. (2013) state that slow internet connectivity and lack of proper training also affect the use of EMRS among medical practitioners. Several studies showcase that EMR system implementation can also pose challenges such; as high costs of development and installation; the difference in functionality amongst different EMR systems, which make them difficult to decipher and hence user-unfriendly; and poor interoperability between EMRs in health facilities, which hinders communication between medical practitioners (Fatt & Zain, 2016). Fernández-Alemán et al. (2013) state that an effective EMR system design needs security to ascertain the confidentiality, security, and ease of access to patients' data in real-time by authorized personnel. According to Bowman (2013), poor EMR system design and improper use can exacerbate the errors in the database, which can affect its integrity and endanger patient safety hence the need for proper implementation of EMRs to ensure improved performance, the safety of the patients, and improved quality of healthcare services.

Terry et al. (2009) examined the adoption of EMRs in family practice from a provider's perspective. They examined the perceived facilitators and barriers that affected the adoption of EMR. Two pivotal issues were found to influence the uptake of EMR: the level of computer literacy, the availability of trainers/facilitators, and the prerequisite training and infrastructure required to use electronic data in computers. Busagala (2013) investigated how the adoption of information communication technology in Tanzania affected healthcare services. Study findings indicate that healthcare has adopted the use of personal computers, mobile phones, the internet, fax machines, fixed telephones, electronic mail, and television in their healthcare provision. It was argued that technology adoption had simplified work and enhanced efficiency and effectiveness in the provision of health care. It was recommended that policies be developed so as to enhance the adoption of ICT. It was concluded that the adoption of ICT enabled health institutions to

access information that would aid in the provision of health care.

Kibugi et al. (2017) investigated the influence of infrastructural investment on the adoption of ICT in health information management in Nakuru County. Cross-section and deductive research designs were adopted. Study findings found that the lack of adequate ICT infrastructure has hampered ICT adoption in public universities in Nakuru County. It was recommended that there was a need for the improvement of ICT infrastructure. That would be possible through increased government resource allocation, human capital, and stakeholder participation. Ladan, Heather, and Windle (2019) investigated the adoption of eHealth and its use in health facilities in Sub-Saharan Africa. The design applied was exploratory, and 36 healthcare providers, including nurses and physicians, were the respondents. Univariate and bivariate techniques were used in the analysis of the data. There were four distinct classifications of eHealth: patient-focused eHealth advocates who adopted them through motivation by patients and family preferences, traditionalistic pragmatists who recognize the supportive value of eHealth, and tech-focused eHealth advocates who adopt ICT since they are motivated by technology. The availability of hardware support, software support, and technical skills significantly influenced the uptake of eHealth in the four distinct classifications. Where all these factors were present, the adoption was smooth and efficient. However, that was not the case when one of the factors was missing.

THEORETICAL REVIEW

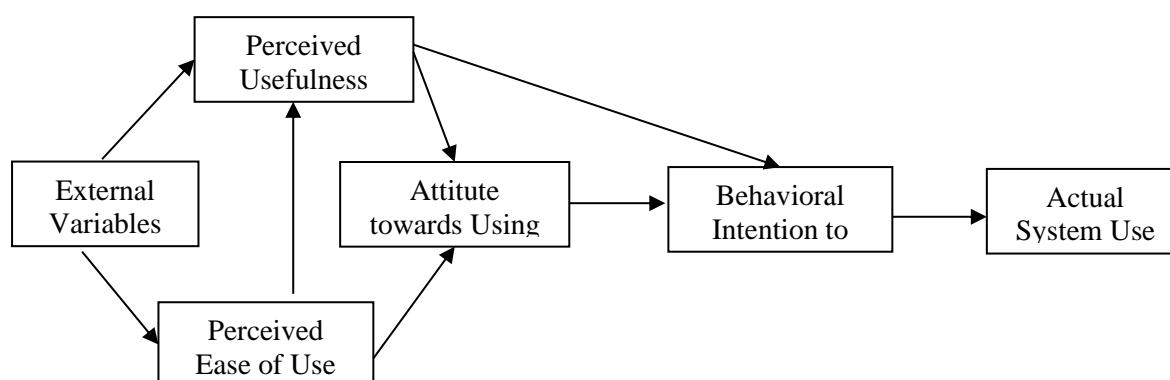
Technology Acceptance Model

The Technology Acceptance Model (TAM) was documented by Venkatesh (2000) to support the use of technology to promote economic development. The model is particularly applicable in the field of health information technology and how behavioural factors affect the adoption of technology in the healthcare sector. It narrows in on two distinct variables that are believed to influence the uptake of information technology in

health facilities: perceived usefulness (P.U.) and perceived ease of use ((PEOU). Perceived usefulness entails the degree to which medical personnel believe that adopting EMR will enhance their performance (Davis et al., 1989). The PEOU showcases how difficult the medical personnel believes that the proposed adoption of the EMR system would be to use. The constructs are based on reasoned action theory, which notes that an individual's behavioural intentions are

determined by his attitude and perceptions towards the adoption of a system. Several studies agree that TAM is the best model for investigating medical personnel's acceptance of telemedicine technology because it is well-researched, utilizes psychometric measurements, and the fact that and it is the dominant model used in investigating acceptance of user technology (Beiter et al., 2008; Chau & Hu, 2001, 2002; Holden & Karsh, 2010; Shin & Kim, 2008).

Figure 1: Technology Acceptance Model (TAM)



Source: (Venkatesh & Davis, 2000)

The theory calls for organizations to examine their technological needs to eliminate the likelihood of misusing their technological capacity. According to Li (2014), this has triggered changes in not only the operational framework of the organization but has also called for changes in culture failure to which maintenance of the status quo would lead to attrition of its competitive advantage. Technology acceptance is contingent on the perception of its usefulness and ease of using it (Wu & Chen, 2017). Perception of its usefulness supports its adoption as a tool for performance effectiveness, and ease of its use simplifies the performance of duties. The theory is appropriate for the study since the uptake of electronic records management is dependent on behavioural, technical, and organizational factors. It states that before the EMR adoption, there was a need to synchronize employee's attitudes and develop graphical user interfaces that are easy to apply. There is also the need for an organization to prepare human resources skills, allocate financial support, and build the capacity of employees who were crucial in the implementation of EMRs. The

health facility should be technically prepared through the acquisition of hardware, software, and networking capacity within its organization.

Research Gaps

Many studies (Jensen et al., 2012; Raymond et al., 2015) have been done in developed nations to study factors that influence the adoption and implementation of EMR technology. However, the existing literature on Kenya is very thin (Ministry of Health, 2010). The slow adoption of EMR in public health facilities in Kenya has become a critical challenge. Speedy adoption of EMR is crucial in streamlining key processes in the healthcare industry. EMR systems in hospitals have significant impacts and benefits to hospitals (Waithera et al., 2017). EMRs have been important in mitigating challenges in public health facilities, such as improving communication amongst healthcare personnel, reducing medical costs, and preventable errors (Ministry of Health, 2010). The use of EMRs has also exacerbated the elimination of legibility issues, making it easier to bill patients' methods and have a patients' data

repository that improves the quality of patient care (Jensen et al., 2012; Raymond et al., 2015); it also reduces healthcare costs, integrates different activities across the health care organizations, and improves the management of medical records and the quality of patient care. However, the rate of EMR use among healthcare providers in level 4 and 5 hospitals in Kiambu County remains low. Despite the Kiambu County government's commitment to increase the uptake of EMR, its adoption lag persists. The adoption of electronic records is beneficial, empirical evidence has documented that its success is contingent on technical which have an influence on the level of EMR adoption. The barriers to the EMR adoption include; financial costs, time commitments, technical support availability, negative perception of its usefulness and ease of use, insufficient training in medical informatics, patient data confidentiality and security issues, a slowdown in work downturn necessitated by the difficulty in entering data to the computers (Terry et al., 2009).

The benefits of an efficient EMR system rely heavily on proper implementation. Many studies have been done on the factors that affect healthcare personnel's intention to adopt a new technological system that enhances their work.

METHODOLOGY

The study used both descriptive and inferential statistics. In Kiambu County, there are 335 health facilities comprising 1 level five, 13 level four, 24 level three, and 70 dispensaries. The remaining are 17 mission hospitals, 5 nursing homes, 36 dispensaries, and 169 private clinics (<https://kiambu.go.ke>). Public and private facilities are accessible through road infrastructure (<https://kiambu.go.ke>). The target population was 14 public health facilities in levels four to five. The study population included health workers drawn from various departments. The health workers to be approached include those who have been using EMRs. This study, therefore, investigated doctors, clinicians, nurses and hospital administrators.

The use of a purposive sampling technique was adopted while selecting a sample from 14 (level four and five) health facilities since they have the highest bed capacity. The study selected one level five hospital since it was the only one and eight level four hospitals. The total population of the health personnel under study in level five and level four hospitals was 228. Further, simple random sampling using the Yamane (1967) formula was used to select 85 respondents drawn proportionately from level five and level four public health facilities. Sample of health workers to whom the questionnaires were administered were doctors, clinicians, nurses and hospital administrators estimated as follows:

$$n = N / (1 + Ne^2)$$

Where n is the sample size, N is the population size, and e is the level of precision.

$$n = 228 / [1 + 228(0.086)^2] = 85$$

The sample size for the respondents is 8 and 77 from level five and level four, respectively.

The questionnaire was the primary data-gathering tool. The responses were coded and entered into Statistical Packages for Social Scientists (SPSS, 23). Descriptive and inferential statistics were used to analyse the data. Descriptive statistics including mean, frequency, standard deviation, and percentages were used.

FINDINGS

Uptake of EMR in Inpatients Department

Descriptive statistics were adopted to examine the uptake of EMR in outpatients in Kiambu County public health facilities. Descriptive measures include frequency, percentage, mean, and standard deviation, as shown in *Table 1*. The majority of the medical officers, 89.7%, agreed, and 3.9% disagreed that they feel much in control of patient health records while electronically stored. (SD=Strongly Disagree, D=Disagree, U=Undecided, A=Agree, SA=Strongly Agree).

Table 1: Descriptive statistics on uptake of EMR

Through the use of EMR	N=77						Mean	Std. Dev
	SD	D	U	A	SA			
The medical officer controls	0	3.9	6.5	44.2	45.5		4.3	0.8

Key: S.D.- Strongly disagree, D- Disagree, U- Undecided, A-Agree, SA- Strongly agree.

Technical Factors Affecting EMR Uptake

First, an examination of the influence of technical factors on the uptake of EMR was done. The majority (72.1%) agreed, while 15.6% disagreed that their health facilities have developed requisite software that would support the uptake of EMRs. That shows that health facilities are technically prepared for the adoption of EMRs. Secondly, 80.5% agreed, and 9.1% disagreed that they have been equipped with the requisite skills that would aid in the adoption of EMR. Thirdly, 79.2%

agreed, and 9.1% disagreed that they voluntarily adopted the use of EMR. Further, 85.7% agreed, and 10.4% disagreed that challenges associated with internet connections influence the use of EMR. Moreover, 87% agreed, and 10.4% disagreed that security threats threatened the adoption of EMR. The majority, 83.1%, agreed, and 11.7% disagreed that quality of communication has an influence on the adoption of EMR. Finally, 84.4% agreed, and 9.1% disagreed that the quality of software that supported the use of EMR influenced its adoption.

Table 2: Technical factors affecting EMR uptake

	SD	D	U	A	SA	Mean	StD
Our health facilities have acquired requisite software that would support the uptake of EMRs	7.8	7.8	11.7	50.6	22.1	3.7	1.1
We have been equipped with the requisite skills for operating EMR.	5.2	3.9	10.4	58.4	22.1	3.9	1.0
There are challenges with internet connections.	5.2	5.2	3.9	59.7	26	4.0	1.0
Security threats may deter the adoption of EMR	3.9	6.5	2.6	75.3	11.7	3.8	0.9
Quality of communication systems have an influence on EMR adoption	6.5	5.2	5.2	63.6	19.5	3.8	1.0
The quality of software that supports the use of EMR influences its adoption	5.2	3.9	6.5	62.3	22.1	3.9	1.0
Overall mean						3.9	1.0

* S.D.- Strongly disagree, D- Disagree, U- Undecided, A-Agree, SA- Strongly agree.

The correlation analysis was carried out to examine the strength of the effect of technical factors on the uptake of EMR in PHF in Kiambu County. Findings indicate that technical factors

have a strong positive influence on the uptake of EMR in the inpatient department in PHF in Kiambu County ($\rho = 0.873$, $p\text{-value} = 0.00$).

Table 3: Correlation analysis

Technical Factors	Uptake of EMR	
	Pearson Correlation	.873**
	Sig. (2-tailed)	0.000
	N	77

Regression coefficient findings indicate that technical factors have a positive and significant influence on the uptake of EMR in PHF in

Kiambu County ($\beta = 0.295$, $t = 3.602$, $p\text{-value} = 0.001$).

Table 4: Regression Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	-0.012	0.039		-0.303	0.763
Technical Factors	0.295	0.082	0.299	3.602	0.001

a Dependent Variable: Uptake of EMR

This study agrees with Msiska et al. (2017), who said that technical factors positively influence the utilization of EMR in Malawian central hospitals. It also agrees with Miller & Sim (2004) who opined that the enhancement of technical factors such as training encourages physicians' use of electronic medical records.

CONCLUSION AND RECOMMENDATIONS

The study highlighted that technical factors significantly facilitated the adoption of Electronic Medical Records (EMR) in inpatient departments at Public Health Facilities (PHF) in Kiambu County. This positive influence underscores the importance of robust technical infrastructure in supporting the implementation and utilization of EMR systems. Additionally, there is a critical need to develop the necessary human capital skills to ensure that clinical information communicated through EMR is clear and comprehensible to all stakeholders involved. Furthermore, the study identified gaps in the uptake of both inter and intranet connectivity within PHFs in Kiambu County. Addressing these gaps is essential for improving communication among stakeholders and optimizing the operational efficiency of EMR systems. Based on these findings, it is evident that encouraging employees within PHFs to integrate EMR into their daily workflows is crucial for enhancing organizational efficiency and minimizing medical errors. The study recommended that PHFs in Kiambu County should prioritize acquiring and regularly updating their software infrastructure to ensure the effective uptake and utilization of EMR in inpatient departments. Moreover, there is a pressing need to enhance employee skills through training initiatives to mitigate resistance and improve acceptance of EMR systems. At the

policy level, both national and county governments should collaborate to improve internet infrastructure, thereby enhancing access to reliable internet connectivity in PHFs across the county. These concerted efforts are vital for optimizing healthcare delivery and improving patient outcomes through the effective use of EMR systems in Kiambu County.

Suggestions for Other Studies

From the study findings, there is a need to examine factors influencing the uptake of EMR in the outpatient department at PHF in Kiambu County. Since, quantitative data was relied on; there is a need for future studies to examine factors influencing the uptake of EMR using qualitative data.

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