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Health Worker Factors Influencing EHR Implementation in Machakos County, Kenya

Julius Mwaniki Ndungu[1], Dr. Violet Chepchirchir Maritim[2], Dr. (Sr) Margaret Wandera Nyongesa[3]

[1]School of Public Health, Department of Community Health and Biostatistics, Mount Kenya University-KENYA
[2]School of Public Health, Department of Community Health and Biostatistics, Mount Kenya University-KENYA
[3]School of Health and Biomedical Science, Department of Health Systems Management and Public Health, Technical University of Kenya-KENYA

Corresponding Author: Julius Mwaniki Ndung'u

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ABSTRACT

Electronic Health Records (EHR) is deemed to improve the efficiency and accuracy of health care delivery to the public by reducing clinical errors and generating high-quality data for decision-making. However, the implementation of EHR systems has faced challenges, particularly in resource-constrained settings like Machakos County, Kenya. This study focuses on the health workers related factors determining the implementation of electronic health records in public health facilities in Machakos County, Kenya. A cross-sectional descriptive design was used, with both quantitative and qualitative data collected from 411 healthcare workers, including key informants. The analysis identified significant associations between health workers' level of education, age, and the adoption of EHR systems. Health workers with higher education and younger age groups were more likely to adopt EHR systems. Qualitative interviews highlighted challenges such as inadequate training, resistance to change, and lack of technical support. The findings underscore the need for continuous professional development and organizational support to enhance EHR adoption. Policy recommendations include investment in training programs tailored to health workers and improved technical infrastructure.

Keywords: E-health, Health leadership, Health workforce, Electronic Health Records, EHR Adoption

INTRODUCTION

The healthcare sector in Kenya and worldwide has increasingly adopted Electronic Health Records (EHR) systems to enhance service delivery, minimize clinical errors, improve efficiency, turnaround time and improve patient outcomes. EHR systems streamline healthcare operations by providing efficient data collection, storage, and analysis crucial for decision making and planning. Kenya's health sector has seen a gradual uptake of EHR systems, with varying success across different regions and healthcare facilities.

Despite the potential benefits of EHR systems, their adoption in many Kenyan counties, including Machakos, has been slow. Several factors contribute to this lag, one of the most critical being the health workers who are the primary users of these

systems. Health worker-related factors such as technical expertise, attitude towards technology, training, and willingness to adapt to new systems can significantly influence the success or failure of EHR implementation.

In Machakos County, Kenya many public health facilities rely on manual data recording systems, contributing to inefficiencies and the risk of medical errors. The county's healthcare indicators, such as vaccination coverage and child malnutrition rates, reflect these operational inefficiencies. Understanding the role of health workers in EHR adoption is crucial to addressing these challenges and creating a sustainable pathway for digital health transformation.

This study explores the health workers-related factors that influence the adoption of EHR systems in the county health facilities in Machakos, Kenya. The study explores the demographic and professional characteristics of health workers and how these factors correlate with EHR adoption. The findings aim to enlighten the policymakers and healthcare managers and professionals to design strategies for improving EHR adoption through targeted interventions aimed at healthcare workers.

Furthermore, the findings are expected to address inefficiencies, improve data accuracy, and boost patient outcomes. The study's objectives include assessing the impact of health worker specific factors influences on EHR implementation. By meeting these objectives, the research aims to contribute new knowledge and propose actionable recommendations that promote a favorable environment for EHR adoption in Machakos County's public health sector.

Ultimately, the findings will serve as a model for EHR implementation in similar settings, in third world countries and support for human resources for health capacity building and support in EHR hence supporting the achievement of the sustainable development goals (SDG) on health and well-being and helping to shape healthcare policy in Kenya, globally.

MATERIALS & METHODS

A cross-sectional descriptive design was used in this study combining both quantitative and qualitative approaches to examine the health worker-related factors influencing EHR implementation in health facilities in Machakos County, Kenya. Focus was on healthcare workers across different cadres, including clinicians, nurses, ICT officers, and facility managers.

Study Area

Machakos County, Kenya was the study area due to its proximity to Nairobi County, the Kenyan capital city, and its underperformance on various health indicators for example, vaccination coverage and child malnutrition rates. Previous health reports from the Kenya DHS,2022 indicate that 16% of children under five classified as stunted and vaccination coverage at 88%. The county's economy is largely agricultural, and it has various healthcare and educational facilities.

Study Population and Sampling

The target population included 424 healthcare workers, with 411 respondents successfully participating in the study representing a 96.9% response rate. The study applied stratified random sampling to ensure representation from different levels of health facilities, including Machakos Level 5 and Kangundo Level 4 hospitals followed by random sampling within each stratum. Fisher's formula for calculation of the sample size was used, resulting in 424 respondents. The study also included 8 key informants, such as facility in-charges and medical superintendents, who were purposively selected.

Data Collection

Semi-structured questionnaires were used for quantitative data and key informant interviews for qualitative data. The questionnaires included open ended and closed ended questions in order to capture demographic data, professional characteristics, and opinions on EHR usage.

The principal investigator conducted the interviews, supported by three trained research assistants with expertise in health systems

STATISTICAL ANALYSIS

Descriptive statistics was used to analyze quantitative data, means and standard deviations, Chi-square test assessed the association between health worker factors (age, education level, years of experience) and EHR adoption (to determine relationships between nominal and ordinal variables). P-value less than 0.05 was considered statistically significant. Numerical variables were further analyzed with a T-test. Qualitative data from key informant interviews were transcribed and coded using NVIVO v12 software. The data were then categorized into themes using a deductive approach, and each objective's results were presented to show the descriptive analysis and associations. Statistical analysis was done using the statistical package for social sciences, SPSS v27.

RESULT

The results of the study were reported in accordance with the study goals. The analyzed data was shown using tables, figures, and charts. This section presents both qualitative and quantitative results. For data analysis, SPSS version 27, MS Excel version 2019, and NVivo were utilized. A total of 424 study participants were targeted, but the study was able to reach 411 participants for quantitative interviews, which was a response rate of 96.9%. Werner in his findings in 2004, a survey that has a response rate that surpasses 80%, then is considered reliable for analysis and to inform findings. For the qualitative interviews, all the 8 facilities in charge/medical superintendent targeted were interviewed.

Respondents' Socio-Demographic Characteristics

From the study results the majority of the respondents represented by 280 (68.1%) were female respondents, and 131 (31.9%), represented male respondents. The study participants age was majorly presented by 20-29 years 154 (37.5%), 119 (28.9%) aged between 30-39 years, 93 (22.6%) aged 40-49 years and those aged 50 and above were 41 (10.0%).

Table 1: The study participants level of education at 12 (2.9%), 156 (38.0%), 204 (49.6%), and 39 (9.5%) for certificate, diploma, bachelor, and post-graduate education level respectively. Participants of the study, years of experience, less than 1 year, 41 (10.0%), 1-5 years,182 (44.3%), 6-10 years of experience, 81 (19.7%) participants with over 10 years of experience, 107 (26.0%). The number of respondents who indicated that the health facility they work in had an electronic medical record (EMR) system was 297 (72.3%) as shown in Table 1.

Table 1: Socio-demographic characteristics of the respondents

Variable	Category	Frequency (n)	Percent (%)
Sex	Male	131	31.9
	Female	280	68.1
	Total	411	100
Age	Below 20 years	4	1.0
	20-29 years	154	37.5
	30-39 years	119	28.9
	40-49 years	93	22.6
	50 and above years	41	10.0
	Total	411	100
Highest Level of Education	Certificate	12	2.9
	Diploma	156	38.0
	Bachelors	204	49.6
	Post-graduate	39	9.5

	Total	411	100
Years of experience	Less than 1 year	41	10.0
	1-5 years	182	44.3
	6-10 years	81	19.7
	Over 10 years	107	26.0
	Total	411	100
If the facility has any form of EMR system	Yes	297	72.3
	No	114	27.7
	Total	411	100

The data presents demographic and professional characteristics of 411 individuals, along with their association with the presence of an electronic medical records (EMR) system in their facilities.

Sex Distribution

The majority of the respondents are female, comprising 68.1% of the sample, while males make up 31.9% as represented in figure 1 below. This indicates a significant gender imbalance in the sample, with females representing a dominant majority.

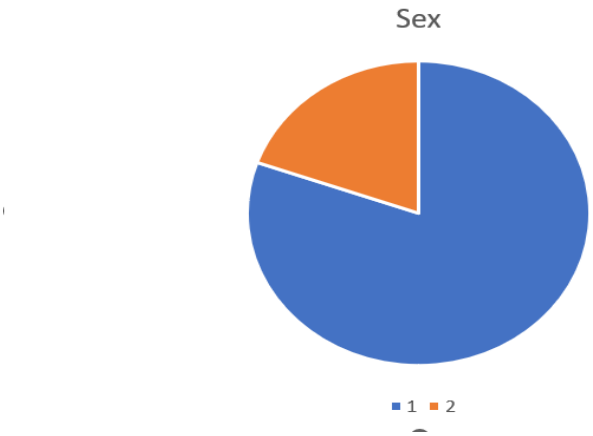

Figure 1: Respondents sex distribution

Age Distribution

The age distribution shows a diverse range of participants. The largest group falls within the 20-29 years category (37.5%), followed by 30-39 years (28.9%). The age group 40-49 years accounts for 22.6%, and those 50 and above represent 10.0% as illustrated in figure 2 below. The smallest group is those below 20 years (1.0%), suggesting that the majority of the respondents are relatively young to middle-aged adults.

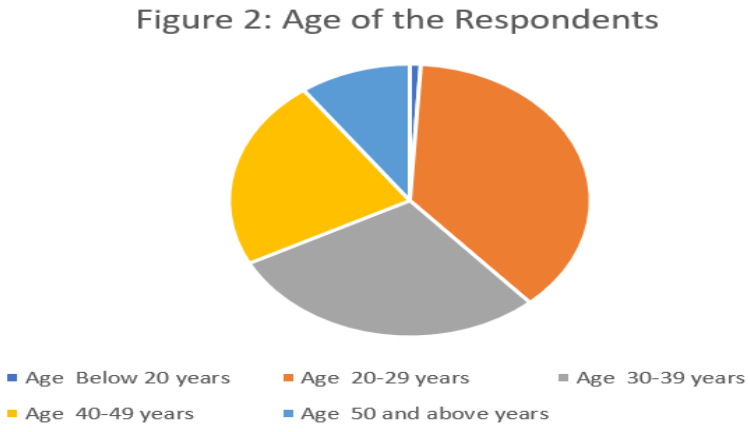

Figure 2: Respondents age distribution

Level of Education

Educational attainment varies among the respondents. The largest group holds a Bachelor's degree (49.6%), followed by those with a Diploma (38.0%). A smaller portion has a post-graduate degree (9.5%), and the smallest group holds only a Certificate (2.9%). This distribution indicates that the majority of the sample has at least a Bachelor's degree, reflecting a well-educated group as shown in figure 3 below.

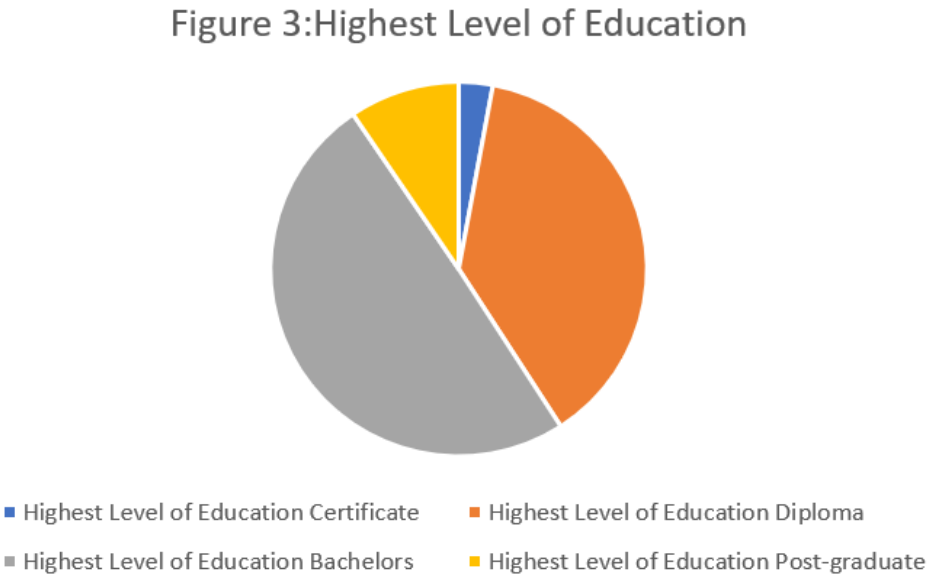

Figure 3: Respondents level of education

Participant's Years of Experience

The respondent's years of experience are predominantly in the 1-5 years range (44.3%), indicating a relatively experienced group with moderate tenure in their fields. The next largest group has over 10 years of experience (26.0%), followed by those with 6-10 years (19.7%). The smallest group has less than 1 year of experience (10.0%), suggesting that most individuals have substantial experience in their respective roles. The data is represented in Figure 4 below:

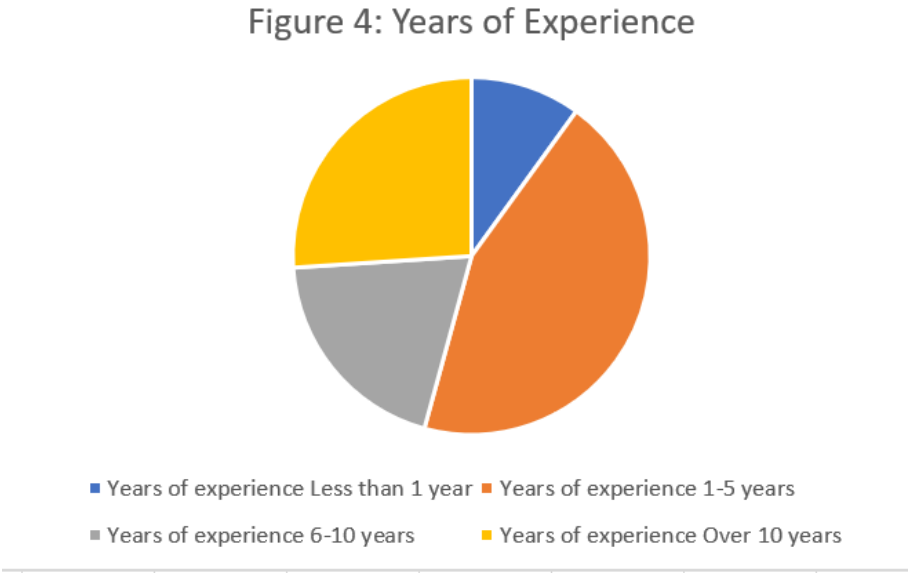

Figure 4: Respondents years of experience

EMR System Presence

Regarding the presence of an EMR system, 72.3% of the facilities have some form of EMR system in the facilities, while 27.7% do not have the systems. This indicates a high level of EMR adoption among the facilities represented in this data as in figure 5 below.

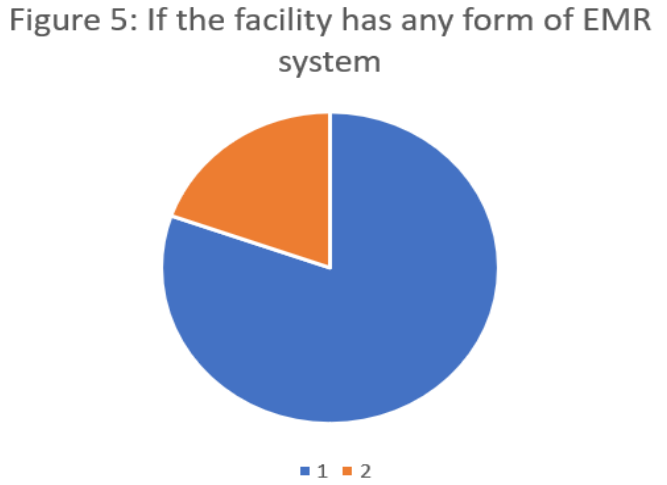

Figure 5: Presence of EMR system in the facilities

Association between socio-demographic characteristics and implementation of electronic health records

The results of the study indicate, the age cohort of below 20 and 21-29 years influenced the implementation of electronic health records with p values of (p=0.001) and (p=0.025). The level of education for bachelor's and postgraduate was associated with the implementation of the electronic health records with a p value of (p=0.002) and (p=0.027) respectively. The years of experience had no influence or not associated with the implementation of electronic health records with a p-value of (p=0.659).

The study findings are in line with the two key informant interview guides who indicated that '*A health care workers who have undergone a higher level of training such as bachelor's and post-graduate, better understand the need for EMRs and especially the young generation is prone to adopting this quickly'*. As shown in table 2 below.

Table 2: Socio-demographic characteristics association with the implementation of electronic health records

Predictors	**Health facilities have any form of electronic medical records system**		**χ2**	**Degree of freedom (df)**	**P value (p<0.05)**	**95% C. I**	
	No	**Yes**				**Lower**	**Upper**
Age				4			
Below 20 years	0 (0.0)	4 (45.0)	28.31	1	0.001	0.349	0.891
20-29 years	5 (3.2)	149 (96.8)		1	0.025	0.601	5.093
30-39 years	23 (19.3)	96 (80.7)		1	0.053	0.734	3.261
40-49 years	51 (54.8)	42 (45.2)		1	0.835	0.051	6.903
50 and above years	35 (85.4)	6 (14.6)					
Highest level of education				3	0.064		
Certificate	11 (91.7)	1 (8.3)	2.36				
Diploma	95 (60.9)	7 (39.1)		1	0.267	0.568	2.490
Bachelors	2 (1.0)	202 (99.0)		1	0.002	0.504	0.673
Post-graduate	6 (15.4)	33 (84.6)		1	0.027	0.741	3.475
Years of experience				3	0.659		

Less than 1 year	29 (70.7)	12 (29.3)	3.04				
1-5 years	37 (20.3)	145 (79.7)		1	0.835	0.282	2.093
6-10 years	15 (18.5)	66 (81.5)		1	0.406	0.35	5.641
Over 10 years	33 (30.8)	74 (69.2)		1	0.582	0.471	1.695

Health workers related factors

Basic knowledge on how to run and operate a computer

The study explored if the respondents had basic knowledge on how to run and operate a computer, 373 (90.8%) said they know, while only 38(9.2%) did not have basic knowledge as shown in figure 6 below.

The findings from key informant interviews agree with these findings and indicated that: "*With the current world of technology, majority of the health workers know how to use and operate computers, which is one of the basic requirements.*

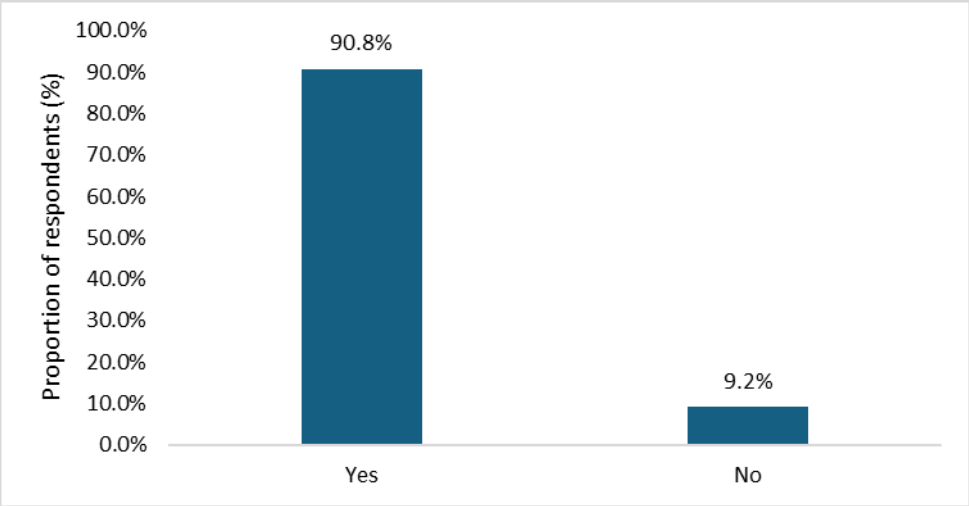

Figure 6: Basic knowledge on how to run and operate a computer

Analysis of the Likert Scale for health workers related factors.

The perceptions on items measured fall between "no extent" to "very large extent" as shown on the scale of 1–1.8 and 4.21–5, respectively. Healthcare workers rated modest mean scores, 1.881, indicating positive perceptions of the use of an electronic health system. Neutral respondents with means of 1.307 and 3.381 perceived a need for strong system-operating skills and expressed positive satisfaction with the EMR. Those with a large extent mean score (mean = 3.905 and 3.909) noted that electronic records enhance data retrieval, while those with a very large extent mean scores (mean = 4.463) showed sufficient ICT knowledge and skills.

Table 3) Association between health workers-related factors and implementation of electronic health records

Statement	Very large extent	Large extent	Neutral	Small extent	No extent at all	Mean	Std Deviation
The healthcare professionals possess sufficient ICT knowledge and skills.	66.2%	24.6%	1.7%	5.1%	2.4%	4.463	2.048
The ability to operate the electronic health records system is strong among users.	9.2%	14.8%	35.8%	26.5%	13.6%	2.606	1.307
The health care workers have positive perception on	9.2%	19.2%	25.3%	29.4%	16.8%	1.881	1.729

the systems use							
Healthcare professionals' attitudes on the changes brought forth by the electronic health records system are unfavorable.	19.7%	27.3%	18.7%	23.4%	10.9%	3.905	2.894
The healthcare workers have expressed a positive user satisfaction on the EMR system	10.9%	19.7%	28.5%	25.8%	15.1%	3.381	2.194
The electronic health records system has enhanced faster retrieval of data for the healthcare workers	21.7%	31.4%	18.0%	19.7%	9.2%	3.909	2.948

Health workers related factors association with the implementation of electronic health records

The relationship of the parameters linked to health workers and the use of electronic health records was determined by the study. The findings showed a strong correlation between healthcare professionals with adequate ICT knowledge and abilities (p=0.012), the ability to operate the electronic health records system (p=0.035) and the perception positively by health workers on the systems usage (p=0.050) with the adoption of electronic health records. On contrast, healthcare professionals' attitudes on the changes brought forth by the electronic health records system being unfavorable (p=0.136) was not statistically significant.

The study findings agreed with a key informant interview guide who indicated that; '*It is critical for health care workers to possess ICT skills and as the skills will enable them to navigate the system well and be able to actualize its operation and further recommend changes to be made'*. As illustrated in table 4 below

Table 4: Association between health workers-related factors and implementation of electronic health records

Predictors	**Health facility have any form of electronic medical records system**		**χ2**	**Degree of freedom (df)**	**P value (p<0.05)**	**95% C. I**	
	No	**Yes**				**Lower**	**Upper**
Health workers related factors				5			
The healthcare professionals possess sufficient ICT knowledge and skills.	38 (9.2)	373 (90.8)	19.05	1	0.012	3.962	5.084
The ability to operate the electronic health records system is strong among users.	312 (75.9)	99 (24.1)		1	0.035	1.056	3.053
The health care workers have perception positively on the systems usage	294 (71.5)	117 (28.5)		1	0.050	0.640	0.895
Healthcare professionals' attitudes on the changes brought forth by the electronic health system are unfavorable.	218 (53.0)	193 (47.0)		1	0.136	0.348	5.731
The healthcare workers have expressed a positive user satisfaction on the EMR system	285 (69.3)	126 (30.7)		1	0.091	0.609	1.370
The electronic health system enhanced faster retrieval of data for healthcare workers	193 (47.0)	218 (53.0)					

DISCUSSION

The study findings highlight the significant role of health worker-related factors in the successful implementation of health technologies, aligning with previous research. Education level and ICT exposure, particularly among younger health workers, were identified as key determinants of EHR adoption, consistent with Ajami and Tadi's (2019) findings in Africa. Resistance to change, especially among older health workers, suggests a need for targeted training and change management strategies to facilitate a smooth transition to digital systems. Additionally, respondents reported inadequate technical support, indicating a need for investment in ICT infrastructure and ongoing support to enhance EHR system functionality, sustainability, and scalability.

CONCLUSION

This study demonstrates that health worker-related factors, particularly age, education, and training, significantly affect and influence the implementation, adoption of electronic health systems in Machakos County, Kenya. To enhance and improve EHR implementation, healthcare facilities must invest in continuous capacity building programs, mentorships tailored to the requirements and need of health work force. Additionally, there is a need for robust technical support and organizational commitment to facilitate the transition from manual to digital health records

Recommendations:

Development and implementation of a structured training programs, capacity building programs, mentorships programs for healthcare workers, focusing on the technical aspects of EHR.

Introduction of change management strategies to address resistance to EHR adoption, particularly among older health work force/staffs.

Improvement of ICT infrastructure and providence of continuous technical support to ensure the smooth operation of EHR systems.

Declaration by Authors

Ethical Approval: Approved, we sought approvals from the institutional scientific and ethical review committee (ISERC), Mount Kenya University, Approval Number: 2655. National commission for science, technology and innovation (NACOSTI) Kenya license No: NACOSTI/P/24/34983.Informed consent was obtained from all participants involved in the study.

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