

Original Research Article

Factors influencing implementation of electronic health records system in Nyeri level 5 hospital

Geoffrey M. Mukuria^{1*}, Kezia Njoroge², Daniel Muendo³, Catherine Nzioka¹

¹Department of Information Science, ²Department of Health System Management, ³Department of Information Technology, Kenya Methodist University, Nairobi, Kenya

Received: 11 October 2022

Revised: 23 November 2022

Accepted: 05 January 2023

*Correspondence:

Geoffrey M. Mukuria,

E-mail: jeffmk90@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Background: The six WHO blocks can be utilized to find numerous opportunities for health improvement. Each component of the WHO structure is critical. In order to improve performance, prosperous reinforcement of the health system necessitates pertinent, well-timed, and precise information. Adoption of an EMR system has been found to increase patient safety by reducing flaws in paper-based medical records.

Methods: The study used a descriptive survey design with a quantitative methodology. The study targeted 422 healthcare workers operating within the outpatient and inpatient department with a sample of 205 respondents. Questionnaires were used to collect quantitative data. Data was analysed using the Statistical Package for Social Science computer application (SPSS) version 26. Quantitative data were organized, presented, analysed, and interpreted using descriptive and inferential statistics.

Results: The results suggested that the implementation of the electronic health records system was positively and significantly influenced by health infrastructure ($\beta=0.402$, $p<0.05$), human workforce ($\beta=0.154$, $p<0.05$), health leadership ($\beta=0.452$, $p<0.05$), and service delivery ($\beta=0.168$, $p<0.05$). Health leadership was key in the implementation of the Electronic Health Records System as it is the one that carries the vision of the hospital. Based on the survey results, it was evident that there were a number of factors influencing the implementation of an electronic health records system.

Conclusions: There was a favorable and significant impact of health infrastructure, human workforce, health leadership and service delivery on implementation of electronic health records system.

Keywords: Electronic, Health, Records, Implementation

INTRODUCTION

An electronic health record system is systems that electronically captures patient medical information and make it accessible to patient wherever they go.²¹ The world health organization (WHO) has defined digital health to include eHealth, mHealth, computer sciences in enormous data, and artificial intelligence.³² In order to improve performance, prosperous reinforcement of the health system necessitates pertinent, well-timed, and precise

information.²³ When medical professionals have access to complete and accurate information, patients receive better medical care. Electronic health records (EHRs) can aid physicians in the diagnosis of diseases and the reduction of medical errors, which improves patient outcomes.¹⁰ Even though tremendous progress had been made in USA, many of the earlier expectations for EHRs have yet to be met, since most modern EHRs are still struggling to meet the demands of today's healthcare system.¹¹ States' interest in electronic health records did not take off until the American reinvestment and recovery act (ARRA) was

signed into law in 2009.⁶ EHR systems are utilized in Asia to anticipate seasonal outbreaks and high-risk locations, as well as to prevent disease infections and synchronize demographic data and community profiles.⁹ In the United Kingdom (UK), implementing EHR in healthcare organizations has proved difficult and time-consuming.²³ In order to handle patient data electronically, some healthcare facilities have begun integrating healthcare IT systems such as hospital information systems, hospital management information systems, and electronic medical records.²⁸ The effectiveness, efficiency, and user satisfaction of an EHR system, on the other hand, are highly influenced by its usability.¹⁶ Manual data collection has been identified as a major source of concern in DHIS2, contributing to poor data quality.²⁷ Due to legal and regulatory restrictions, the use of electronic health records is limited in South Africa. In health services provision, there is also an absence of infrastructure and coordination among the various levels of treatment, resulting in poor interoperability among the few systems now in use.¹⁵ There is limited data available to assess the actual performance of EHR adoption in Kenya, with success being defined as the EHRs' ability to improve patient care and enhance the health system.²⁵ Electronic health record systems have improved health record management, health project administration, and patient care quality.¹² The use of electronic health record systems enables for storage and management of huge amounts of healthcare data in databases, allowing data to be transferred more readily between physicians and organizations.¹⁹ Technological, institutional, and individual-related factors, such as perceived usefulness and satisfaction with system use, are the three main types of factors that influence the implementation of EHR systems in public health institutions.¹³ Adoption of an EMR system has been found to increase patient safety by reducing flaws in paper-based medical records. However, there are still a lot of concerns around the implementation of EHR systems that need to be carefully examined in order to maximize their advantages.⁴

Statement of the problem

An electronic health system should ideally enable user case-based thinking for decision support in patient care through secondary data, increase patient care, and minimize patient turnaround time. In healthcare, information technologies are becoming embraced as tools for improving service delivery, efficiency, and accountability.³¹ Regardless of how health systems look in different places, everyone should be able to trust the systems and receive quality care from them.¹⁸ Despite the rapid advancement of technology, EHR implementation in public hospitals has been gradual.⁸ Healthcare systems in Africa suffer from a lack of policies, neglect, and inadequate leadership, accumulating serious flaws across the six WHO blocks of healthcare delivery, of which Health Information is a major pillar.²⁶ The ministry of health developed a standards and guidelines for electronic medical Systems in Kenya in 2010 and had been developed from international standards, WHO guidelines, and best

practices for electronic medical records (EMR) installations. However, in Kenya, eHealth is in its infancy.¹⁷ Kenya, like many other poor countries, has had mixed results with several health informatics initiatives, including the DHIS and open medical records databases.²³ This study sought to examine the influence of health infrastructure, health workforce, health leadership and service delivery on implantation of electronic health records system in Nyeri level 5 hospital. This study was needed because it would employ an innovative way to further research into health system components impacting electronic health records system implementation.

METHODS

A descriptive survey design with a quantitative technique was used in this research. The study targeted 422 healthcare workers operating within the outpatient and inpatient department with a sample of 205 respondents. Doctors, clinical officers, and health records officers, as well as nurses, revenue clerks, radiologists, laboratory technologists, and pharmacists, were picked because they were aware of the information that influences the implementation of the EHR system.

Inclusion and exclusion criteria

All the consenting doctors, nurses, clinical officers, revenue clerks, radiologists, laboratory technologists, pharmacists, health record officers and administrators were included. All respondents unwilling to participate were also excluded from the research in this study were excluded.

Cooper and Schindler's formula was used to calculate the sample size.⁶ For the study, a purposive sample technique was employed to pick respondents from various strata. The sample size calculation was as follows.

$$n = N / (1 + N (e) 2)$$

Where n was the sample size, N denotes the population size, and e denotes the precision level. With a 95 percent confidence level and a probability of 5%, Thus sample size was calculated to be 205.

The participants were given standardized closed questionnaires to fill out. The respondents were physically contacted in their different fields of employment by the researcher. The questionnaire ensured that no data gaps were left in the data by applying likert scale questions. Questionnaires were preferred over verbal or telephone surveys, according to Dash since they were less expensive, required less labor from the questioner, and typically contain predefined responses that made data collecting simple.⁷ The Cronbach's alpha reliability test was performed to examine the internal consistency of the test items that were used to measure the variables of interest in this study. A Cronbach's score of 0.7 or higher implied that the tool was dependable.

The responses to the descriptive analysis were grouped into five categories and scored based on; their strong agreeability (5), agreement (4), neutrality (3), disagree (2), and strongly disagree (1). With the use of descriptive and inferential statistics, the data was structured, presented, analyzed, and interpreted. The regression equation was as follows:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \varepsilon$$

Where: Y=Electronic Health Records System Implementation, X1=Infrastructural factors, X2=Workforce factors, X3=Leadership factors, X4=Service delivery factors, β_1 , β_2 , β_3 and β_4 are coefficients of determination and ε is the Error term. Permission to conduct the research was granted by the National commission for science, technology, and innovation (NACOSTI) and the KeMU directorate of scientific ethics and research committee (SERC).

RESULTS

Response rate

The response rate for the research population was 99.5% since data were successfully collected and coded from 204 respondents out of the 205 respondents.

Demographic information

Majority 132 (64.7%) were Female while 72 (35.3%) were male. Nurses were the majority of the respondents at 135 (66.2%) while the least was administrators at 0.5%. 71 (34.8%) had a working experience of 5-10 years, 52 (25.5%) had 11-15 years (Table 1).

Implementation of electronic health records system

The information in the facility was displayed on a noticeboard. The decision makers used the information to inform their decision 143 (70%). 129 (63%) agreeing that feedback for corrective action was always shared. 82 (40%) agreed that the information shared was used to allocate funds for health services delivery (Table 2).

Health infrastructure factors influence on EHR system implementation.

More than a half (51%) agreed that the hospital had a proper maintenance of ICT equipment while 84 (41%) were not sure whether the computers had appropriate speed. 92 (45%) disagreed that the computers in the facility was adequate. 71 (35%) disagreed on whether the facility had full-time access to internet (Table 3).

Health workforce factors affecting EHR system implementation

Majority 129 (63.2%) agreed that male staffs preferred using the EHR system while 128 (62.8%) supported that

female staffs prefer using it. 98 (48%) were neutral about the communication on the Electronic Health record System implementation. 59 (29%) did not prefer manual operations to the technology-based hospital system (Figure 1).

Table 1: Demographic characteristics.

Parameters	N	%
Gender		
Male	72	35.3
Female	132	64.7
Total	204	100.0
Profession		
Administrator	1	0.5
Clinical officer	18	8.8
Health records officer	3	1.5
Laboratory technologist	8	3.9
Medical doctor	22	10.8
Nurse	135	66.2
Pharmacists	5	2.5
Radiologist	3	1.5
Revenue clerks	9	4.4
Total	204	100.0
Year of experience		
11-15	52	25.5
16-20	22	10.8
5-10	71	34.8
Less than 5	43	21.1
More than 20	16	7.8
Total	204	100.0
Level of education		
Certificate	21	10.3
Degree	72	35.3
Diploma	99	48.5
Masters	11	5.4
PhD	1	0.5
Total	204	100.0

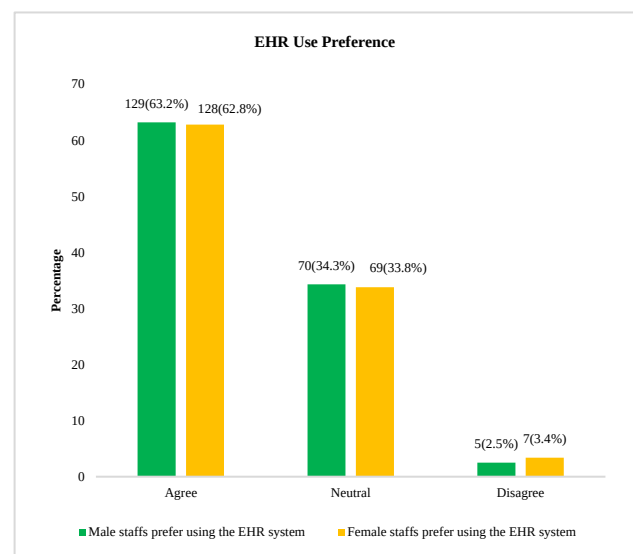


Figure 1: Socio-demographic traits.

Table 2: Resource allocation.

Parameters	Agree N (%)	Neutral N (%)	Disagree N (%)	Mean	SD
The department has enough funds for information generation	71 (35)	92 (45)	41 (20)	2.82	0.887
Money is allocated for the maintenance of the system	75 (37)	98 (48)	31 (15)	2.72	0.811
The information shared is used to allocate funds	82 (40)	98 (48)	24 (12)	2.66	0.892

Table 3: ICT Infrastructure

Response	The department has adequate computers N (%)	We have full-time access to the Internet N (%)	The computers have appropriate speed N (%)	We have good network connectivity that enables access to records N (%)	The hospital has proper maintenance of ICT equipment N (%)
Agree	49 (24)	64 (31)	61 (30)	73 (36)	104 (51)
Neutral	63 (31)	69 (34)	84 (41)	80 (39)	80 (39)
Disagree	92 (45)	71 (35)	59 (29)	51 (25)	20 (10)
Mean	2.94	2.76	3.02	2.85	2.50
SD	0.988	0.955	0.959	0.909	0.815

Health leadership factors influence on EHR implementation

The facility had effective leadership 141 (69.1%). 125 (61.3%) agreed that they received regular technical support from their leadership. 43 (21.1%) were not involved in planning for the implementation of the current EHR System. 114 (55.9%) agree that the current Kenyan laws foster EHR system implementation (Figure 2).

Service delivery factors influence on EHR implementation

Most agreed that the system supported sharing of patients' information to other specialists in the hospital. 29 (14.2%) agreed that automatic logoff was not implemented when the system was not in use. Most of the respondents were not sure whether the computer had an updated anti-virus (Table 4).

Table 4: Security.

Parameters	Agree N (%)	Neutral N (%)	Disagree N (%)	Mean	SD
The hospital has ensured lockable doors	173 (84.8)	21 (10.3)	10 (4.9)	1.72	0.858
The system asks for user login details	169 (82.8)	32 (15.7)	3 (1.5)	1.81	0.765
The computer has an updated anti-virus	89 (43.6)	78 (38.2)	37 (18.2)	2.62	0.982
The system offers audit trails of records accessed regularly by the user	99 (48.5)	76 (37.3)	29 (14.2)	2.53	0.954
The system ensures manual database backup	96 (47.1)	76 (37.3)	32 (15.6)	2.59	0.929
The system ensures automated database backup	105 (51.4)	70 (34.3)	29 (14.3)	2.51	0.939

Table 5: Test of normality.

Parameters	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
EHR system implementation	0.068	204	0.023	0.974	204	0.001
Health infrastructure	0.098	204	0.000	0.978	204	0.003
Human workforce	0.086	204	0.001	0.962	204	0.000
Health leadership	0.075	204	0.008	0.991	204	0.212
Service delivery	0.095	204	0.000	0.979	204	0.004

Lilliefors significance correction.

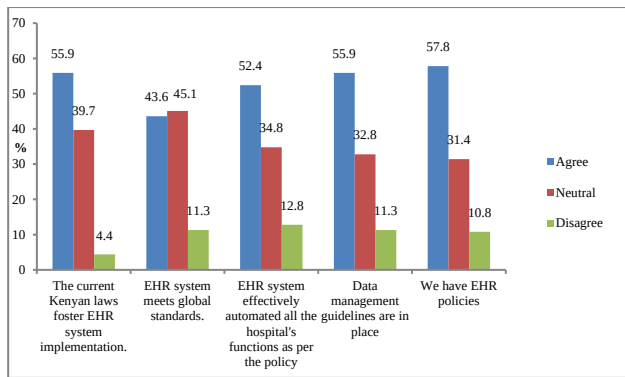


Figure 2: Policy.

Relationship between Health infrastructure, workforce, leadership and service delivery factors on implementation of electronic health records system in Nyeri level 5 hospital

The implementation of the electronic health records system was positively and significantly influenced by health infrastructure ($\beta=0.402$, $p<0.05$), human workforce ($\beta=0.154$, $p<0.05$), health leadership ($\beta=0.452$, $p<0.05$), and service delivery $\beta=0.168$, $p<0.05$). The combination of health infrastructure, human workforce, health leadership, and service delivery can account for 48.6% of the variation in the implementation of the EHR system at the hospital, according to the $R^2=0.486$ coefficient of determination. There was a statistically significant influence of health infrastructure, health workforce, health Leadership and service delivery on electronic health record system implementation in Nyeri level 5 hospital. Human workforce, according to the results of regression analysis indicated a regression coefficient of (0.154). This implied that a change in one unit of human workforce led to a positive increase 0.154 unit of EHR system implementation. Service delivery had a regression coefficient of (0.168) implying that a change in one unit of service delivery led to a positive increase 0.168 unit of EHR system implementation. Health infrastructure had a regression coefficient of (0.402) implying that a change in one unit of health infrastructure led to a positive increase 0.402 unit of EHR system implementation. The influence of health Leadership on the provision of EHR implementation was (0.452) which meant that a change in one unit of health leadership led to a positive increase 0.452 unit of EHR system implementation (Table 5).

DISCUSSION

The study found that majority of the responders were women majorly nurses. This seconded Salameh et al. results that regardless of sex, level of education, years of nursing experience, or age, nurses accepted computer-based documentation.²⁹ Going by the study finding, most of the system users were Diploma holders. The study findings contradicted Lanier et al. Conclusion that the higher a resident's postgraduate degree, the less likely he

or she was to use the EHR.²⁰ Further, Alanezi, summed it all in his study by concluding that age, gender, domicile, income, education, occupational position, and ethnicity are all socio-demographic aspects that influenced the e-health system's deployment which this study supports.² Most of the respondents had 5-10 years of experience working with Electronic Health records system which was adequate for one to freely interact with the system. The study results however supported Lanier et al. who concluded that the gender and amount of clinical experience of physicians influenced their use of the EHR.²⁰ The results indicated that the facility had quality information. The findings supported Agniel who found that EHR data are unsuitable for many research questions unless information quality was carefully considered.¹

The study result found that the information in the facility was reliable, consistent, current and relevant. Data quality assessment was regularly conducted and one could access the information from other departments on timely basis. Databases were continually updated. According to the study result, the respondent's ensured appropriate analysis of pertinent data which was an indication data demand and use was evident in the facility. The information in the facility was displayed on the noticeboard. Majority of the respondents agreed that the information in the facility was easily accessible and information demand in the facility was high. The decision makers used the information to inform their decision and shared feedback for corrective action. This finding agreed with Vos et al who summarized that Health-care providers must be able to obtain, comprehend, and authenticate one other's data.³⁰ The government's allocation of a separate fund for the deployment of the EHR system can make it less expensive for public hospitals and private clinics.¹⁴ The aforementioned statement was supported by the study results which indicated that the information shared was used to allocate funds for health services delivery. However, nearly a half of the respondents were neutral on use of information in allocating the funds and could not ascertain whether money was allocated for the system maintenance. The study findings were further supported by Alvandi results who concluded that financial, procedural, cultural, and political barriers impede EMR implementation.³

CONCLUSION

Electronic health records system implementation and utilization was majorly affected by infrastructure factors such as inadequate computers which had no appropriate speed, inadequate network connectivity and fulltime access to internet. The study also concluded that system security was exposed as it was not protected from the hackers through an updated antivirus. Finally, the research discovered a favourable and significant impact of health infrastructure, human workforce, health leadership and service delivery on implementation of electronic health records system.

ACKNOWLEDGEMENTS

Authors would like to thank Dr. Daniel Muendo and Dr. Kezia Njoroge for supporting the study. Authors would also like to thank Nyeri Level 5 hospital responders who took the time to complete the questionnaires for current research.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Agniel D, Kohane S, Weber M. Biases in electronic health record data due to processes within the healthcare system: retrospective observational study. *Br Med J*. 2018;361(1):6-7.
2. Alanezi F. Factors affecting the implementation of e-health system in the Kingdom of Saudi Arabia. *Int Health*. 2021;13(5):456-70.
3. Alvandi M. Optimizing the effect of electronic health records for healthcare professionals and consumers. *Am J Manag Care*. 2015;3(3):2-5.
4. Ariffin N, Ismail A, Kamal A. Implementation of electronic medical records in developing countries: challenges and barriers. *Int J Acad Res Progress Edu Dev*. 2018;7(3):187-99.
5. Bercaw RG, Knott KA, Snedaker ST. *The Lean Electronic Health Record: A Journey toward Optimized Care*. Product Press J. 2018.
6. Cooper R, Schinder S. *Business research methods*. 10th ed. USA: McGraw Hill; 2011.
7. Dash B. *Essentials of Nursing Research & Biostatistics*. India: Jaypee Brothers Medical Publisher (P) Ltd; 2009.
8. Destriana D, Juanda B. Influence of information technology on society. *Mat Sci Eng*. 2019;5(3):22-35.
9. Dornan L, Pinyopornpanish K, Jiraporncharoen W, Hashmi A, Dejkiengkraikul N, Angkurawaranon C. Utilization of electronic health records for public health in Asia: a review of success factors and potential challenges. *Biomed Res Int*. 2019;1(1):1-9.
10. Erickson TJ. Evidence of improved outcomes using patient-generated health data. *Nurs Manag*. 2022;53(6):12-5.
11. Evans R. Electronic Health Records: Then, Now, and in the Future. *Nurs Manag*. 2016;25(1), 48-61.
12. Halamka, D. *Health Policy Brief: Electronic Health Record Standards*. Health Affairs. 2010.
13. Isemeck S, Ngure K, Kariuki J, Muchene O. Factors influencing the adoption of electronic health records in public health facilities in Kisumu County, Kenya. *J Health Med Nurs*. 2019;4(1):74-101.
14. Katurura MC, Cilliers L. Electronic health record system in the public health care sector of South Africa: A systematic literature review. *Afr J Primary Health Care Family Med*. 2018;10(1):1-8.
15. Katuu S. Managing records in South Africa's public sector a review of the literature. *J South African Soc Arch*. 2015;48(1):4-8.
16. Kavuma, M. The usability of electronic medical record systems implemented in sub-Saharan Africa: A literature review of the evidence. *J Med Internet Res Human Fact*. 2019;6(1):8-9.
17. Kenya Health Policy. Kenya National e-Health Policy 2016-2030. Policy Doc J. 2016;3:13-9.
18. Kruk M, Gage D, Arsenault C, Jordan K, Leslie H, Roder-DeWan S, et al. High-quality health systems in the Sustainable Development Goals era: time for a revolution. *Lancet Global Health*. 2018;6(11):1196- 252.
19. Kruse S, Stein A, Thomas H, Kaur H. The use of electronic health records to support population health: a systematic review of the literature. *J Med Systems*. 2018;42(11):13-4.
20. Lanier C, Cerutti B, Dao D, Hudelson P. What factors influence the use of electronic health records during the first 10 minutes of the clinical encounter? *International J Gen Med*. 2018;11(1):393-8.
21. Mandal A, Dumar P, Bhandari S, Shrestha S, Shakya, S. Decentralized electronic health record system. *J Eng*. 2020;15(1):77-80.
22. Manyazewal T. Using the world health organization health system building blocks through survey of healthcare professionals to determine the performance of public healthcare facilities. *Arch Public Health*. 2017;75(1):1-7.
23. McCrorie C. Staff expectations for the implementation of an electronic health record system: A qualitative study using normalisation process theory. *Bio Med Central Med Inform Dec*. 2019;19(1):1-14.
24. Muinga N, Magare S, Monda J, English M, Fraser H, Powell J, et al. Digital health systems in Kenyan public hospitals: A mixed-methods survey. *Bio Med Central Med Inform Dec*. 2020;20(1):8-9.
25. Ngugi P, Babic A, Kariuki J, Santas X, Naanyu V, Were MC. Development of standard indicators to assess the use of electronic health record systems implemented in low-and medium-income countries. *Public Lib Sci*. 2021;16 (1):1-15.
26. Oleribe OE, Momoh J, Uzochukwu BS, Mbofana F, Adebisi A, Barbera T, et al. Identifying key challenges facing healthcare systems in Africa and potential Solutions. *Int J Gen Med*. 2019;12(1):395-403.
27. Omoleke A, Tadesse G. A pilot study of routine immunization data Hunzabonzanza local government area: Causes and possible remedies. *Pan Afr Med J*. 2017;27(239):1-9.
28. Pai M, Ganiga R, Pai R, Sinha K. Standard electronic health record (EHR) framework for the Indian healthcare system. *Health Ser Outcomes Res Method*. 2021;21(3):339-62.
29. Salameh B, Eddy L, Batran A, Hijaz A, Jaser S. Nurses' Attitudes toward the Use of an Electronic Health Information System in a Developing Country. *Nurs J*. 2019;5(1):1-8.

30. Vos J, Boonstra A, Kooistra A, Seelen M, Van M. The influence of electronic health record use on collaboration among medical specialties. *Bio Med Central Health Ser Res*. 2020;20(1):1-11.
31. Winter A, Takabayashi K, Jahn F, Kimura E, Engelbrecht R, Haux R, et al. Quality Requirements for Electronic Health Record Systems. *Method Inform Med*. 2017;56(1):92-104.
32. WHO guideline on recommendations on digital interventions for health system strengthening.

Available at: <http://doi.org/10.665/311941/9789241550505-eng.pdf?ua=1>. Accessed on 20 November 2021.

Cite this article as: Mukuria GM, Njoroge K, Muendo D, Nzioka C. Factors influencing implementation of electronic health records system in Nyeri level 5 hospital. *Int J Community Med Public Health* 2023;10:612-8.