Electronic Medical Record Utilization, Determinant Factors and Barriers Among healthcare Providers at Selected Health Facilities in Addis Ababa, Ethiopia

Gebretsadik Keleb[1*], Girma Taye[2], Wondimu Ayele[2], Berhan Tassew[2], Ephrem Biruk[2], Tigist Habtamu[2], Daniel Getachew[3], Mesfin Addise[2]

Abstract

Background: Electronic medical record (EMR) is a longitudinal collection of patient information that can be created and managed by authorized clinicians. In developing nations, the adoption of EMR is extremely slow, and the fundamental barriers are not addressed. Despite the effort to digitize the health system in Ethiopia, evidence shows that the progress of utilizing EMR is very slow, with only limited individuals utilizing the system over ten years since its inception. Therefore, this study aims to assess the utilization of EMR and its determinants among healthcare providers in Addis Ababa.

***Method*:** A mixed study design was conducted, enrolling 367 healthcare providers and 12 key informants at selected health facilities in Addis Ababa from May to August 2020. A multi-stage sampling technique was used to identify participants. STATA version 15 was used to analyze quantitative data, while Atlas.ti was used to manage qualitative data. Descriptive statistical summary measures were used to describe variables. Stepwise logistic regression was used to select variables. Variables with a p-value of less than 0.05 in the multivariable logistic regression model were considered statistically significant.

***Result*:** A total of 353 respondents, mainly nurses (48.2%) and physicians (11.6%), were enrolled, yielding a response rate of 96.2%. The overall rate of EMR utilization was 68.5% (95% CI = 63.7, 73.4). EMR utilization was significantly associated with access to EMR training (AOR, 5.8; 95% CI = 1.6, 20.7), age (AOR, 0.37; 95% CI = 0.1, 0.9), type of health institution (AOR, 7.17, 95 % CI=3.2, 16.2), being pharmacists (AOR=9.61, 95% CI=1.97, 46.8) and having a favorable attitude (AOR, 2.3; 95% CI = 1.2, 4.5). On the other hand, qualitative exploration revealed that power fluctuation, shortage of EMR administrators, absences of guidelines, and vendor phase-out were hindering the utilization of EMR.

***Conclusion*:** The utilization of EMR was found to be relatively low, owing to lack of EMR training, age, being a pharmacist, the attitude of healthcare professionals and type of health institution. The absence of clear EMR guidelines, phase-out of vendors, and power fluctuation hinders EMR utilization and needs intervention. We recommend periodic training, deploying EMR admins and making the EMR interface friendly. Furthermore, a strict binding agreement and clear phase-out strategy with EMR vendors are recommended. [*Ethiop. J. Health Dev*. 2022;36 (SI-1)]

***Keywords*:** EMR, healthcare Providers, Health Information System, Ethiopia

Introduction

Electronic Medical Record (EMR) is a longitudinal compilation of patient medical data on an individual that can be compiled, gathered, managed, and consulted by authorized clinicians (1). It fosters immediate access to individual and population-related information to support efficient processes for healthcare delivery and decision-making (2). It is an enabling technology to pursue quality improvement, improve the legibility and accessibility of progress notes, and easily analyse and report data(3,4). Properly authenticated EMR is important to maintain the confidentiality and privacy of patient information collected during the healthcare process. With appropriate safeguards and role-based distribution of tasks on EMR, it offers more security than the traditional paper-based record (5).

To advance the work process, patient safety, and healthcare quality, EMR has been widely implemented by health facilities worldwide(6). Ethiopia has also successfully implemented four successive rounds of health sector development programs (HSDP) and a health sector transformation plan (HSTP), all putting information revolution as a key implementation strategy(7). As part of the realization of the Information Revolution (IR) road map, Tulane University Technical Assistance Program for Ethiopia (TUTAPE) introduced EMR implementation software called "smart care" with Federal Ministry of Health (FMOH) and Center for Disease Control and Prevention (CDC) in 2008(8).

Developed countries have identified the major barriers to the utilization of EMR. However, the implementation of EMR in developing countries is very slow, and the major factors that hinder the utilization of EMR are not addressed (5). World Health Organization (WHO) recommends countries adopt EMR to improve health management processes and patient safety at an affordable cost(1). In Ethiopia, the effort to implement EMR was started in 2008, with the desire to transform the traditional paper-based medical record system into an electronic system(8). Initially, it was implemented in Dill Chora Hospital, Dire Dawa, Ethiopia, as a pilot program to implement at the national level(8).

Despite the effort to digitize the health system, improve the culture of data use and make evidence-based decisions, evidence showed that the progress of utilizing EMR is very slow, with evidence that only a tiny fraction of healthcare providers adopted the

[1] School of Public Health, College of Medicine and Health Sciences, Jigjiga University, Jigjiga, Ethiopia.
[2] School of Public Health, College of Health Sciences, Addis Ababa University, Addis Ababa, Ethiopia
[3] Plan, Policy, Monitoring and Evaluation Directorate, Ministry of Health, Addis Ababa, Ethiopia
*Corresponding Author email- keleb82@gmail.com

system over 10 years period since its initiation. According to evidence, healthcare professionals are not using EMR as desired (9). In a study conducted in five hospitals in Ethiopia, immediately after the implementation of EMR, 76.1% of healthcare professionals were using the system. But after 3 years of implementation, only 31.7% were using EMR(9). The study assesses only determinants of staff dissatisfaction but doesn't identify determinants of utilization of EMR. No sufficient evidence was generated to understand the problem at the end-user level. The main objective of this study was to assess the utilization of EMR, its determinant factors and barriers among healthcare providers at selected health facilities in Addis Ababa city administration 2020.

The findings of this study will have a substantial benefit for society to obtain high-quality, timely and cost-effective healthcare. Furthermore, it gives scientifically sound information to health facilities, the Ministry of Health-Ethiopia, and RHBs on the potential obstacles that impede the utilization of EMR to make informed decisions. This study identified future researchable gaps and will assist them in exploring more EMR-related research topics.

Methods

Study area and period

The study was conducted in Addis Ababa city at seven selected health facilities (Tikur Anbessa specialized and teaching hospital, St' Peter comprehensive specialized hospital, Teklehymanot general hospital, Kadisco general hospital, Selam health center, Entoto Fana health center, and vision higher clinic). The facilities were selected based on the implementation of the EMR system for six months and above. According to the 2019/2020 annual performance report, Addis Ababa has 13 functional government-owned hospitals, one under-construction hospital, 98 currently functional government health centers, 978 private clinics, and 30 private hospitals(10). The study was conducted from May 2020-August 2020.

Study design

In four hospitals, two health centers, and one higher clinic, a cross-sectional study design was conducted employing quantitative and qualitative approaches (Concurrent triangulated study approach). The qualitative case study was utilized to investigate factors that influence EMR utilization that a quantitative study would otherwise miss. The target population for the study was all healthcare professionals currently working in selected private and public health facilities in Addis Ababa city administration. The sample size was calculated using the formula for estimating a single population proportion. A prior study conducted in five Ethiopian hospitals, which yielded a maximum sample size, was used to calculate the sample size. In this study, EMR was utilized by 31.7% of healthcare professionals (9). The sample size was computed at a 95% confidence interval and a 5% margin of error. The final sample size becomes 367 when using a 10% non-response rate, a design effect of 1.5, and the population correction calculation.

Sampling procedure

A multi-stage sampling procedure was used to select study participants. The initial stage was to group health centers and hospitals by facility type (owner) to find those deployed EMR. In the second step, all public health institutions that use an EMR system and two private hospitals and one private clinic, were chosen randomly from each cluster. In the third step, healthcare providers with expertise using EMR were stratified by professions such as medical physicians, nurses, midwives, laboratory professionals, pharmacists, and health officers from the selected health institutions. The sample size was then proportionally allocated based on the total eligible population of each facility. For the qualitative interview, purposive sampling was utilized to choose key informants. The participants were selected for their ability to deliver the most accurate information and to represent all departments.

Data collection tool and procedure

A standardized self-administered questionnaire derived from previous works of literature (11) and the Agency for healthcare Research and Quality (AHRQ) EMR end-user assessment instrument was used to obtain quantitative data. There are five components to the questionnaire. The first section covered the respondents' socio-demographic information and the EMR systems' core 12 components. The second component evaluates EMR experience, the third part evaluates EMR training, and the fourth and fifth parts were created to evaluate health professionals' attitudes and barriers to EMR use. Six health professionals oriented, administered and collected the data. An interview guide was used with purposively selected 12 key informants. Interviews were made in a quiet room and were tape-recorded after consent was obtained from each participant. Immediately after the interview date, all Amharic interviews were transcribed verbatim and translated.

Data Management and Analysis

Missing values and inconsistent data were removed from the data collected. Epi-data was used to enter the data, and STATA version 15 was used to analyze it. Variables were described using descriptive statistical summary measures. The association between the dependent and independent variables was assessed using binary logistic regression analysis using odds ratios and their 95 % confidence intervals. The variables with a p-value of less than 0.25 were then included in Hosmer-Lemeshow's backward selection multivariable logistic analysis model(12).

The qualitative data was tape-recorded and transcribed into Amharic before being translated into English. To organize qualitative data, Atlas.ti software was employed. In Atlas, the imported raw data was thoroughly reviewed text by text and codes were labelled. After that, the codes were categorized. The primary themes were then identified from the categories, and the data was then thematically analyzed. These themes include user experience with

EMR's functionality, missing elements, and major impediments to EMR adoption, including technical, organizational, administrative, financial, behavioral, and legal barriers.

Data Quality Control

The completed questionnaires were thoroughly checked before being used. A pre-test on 5% of the sample size was undertaken on facilities outside the study area to ensure that the study tools were reliable. Cronbach's alpha was assessed, and reliability coefficients of 0.84 and above were observed for attitude toward EMR, perceived ease of using EMR, and training. The reliability coefficient for key barriers and basic components of EMR was found to be 0.70 and higher, indicating that the questionnaires needed to be corrected and the necessary amendment was made to the data collection tool.

Operational definition

EMR Utilization: Number of healthcare professionals who were using half and above half of the 12 core functionalities of the EMR system, such as; capturing patient clinical profiles, ordering and displaying laboratory and radiologic orders, e-prescription, the clinical decision support system, patient scheduling, referral between departments, financial billing system, and exchange of feedback between staff and higher administrators.

Barrier: Barrier is a factor that prevents healthcare providers from using EMR software. It was measured by asking a list of ten major barriers from a five-point severity scale assessment questions and ranked based on their severity from 1 (the least severe barrier) to five (the most severe barrier). Finally, the mean was used to rank barriers based on their severity.

Attitude: It is the perception, feeling, or thinking towards EMR. It was measured by asking 15 questions, such as benefit (4 questions), the effect on the quality of care (2 questions), ease of use (5 questions), and organizational benefit (4 questions). The basis for classifying favorable and unfavorable attitudes towards EMR was based on the mean of each score. Individuals who scored the mean and above the mean were considered to have favorable attitude towards EMR.

Ease of using EMR: The relative ease of EMR in performing different tasks. The ease of using EMR was assessed by 1-5 scale difficulty level assessment questions adapted from Furukawa et al(13). The mean composite score was calculated to determine individuals who scored above and below the mean.

Result

General Socio-Demographic Characteristics

A total of 353 people responded, resulting in a 96.2% response rate. More than half of the responders, 196 (55.5%), were females. Respondents were 30.5 years old on average (95% CI: 30.0, 30.9). Because each healthcare facility employs many nurses, 179 (50.7%) of those polled were nurses. A total of 244 (69.1%) responders were from government health facilities. (Table 1).

Table 1. General socio-demographic characteristics of study respondents in Addis Ababa health facilities, October 2020 (n=353)

Sex of respondent	Frequency	Percent (%)
Male	157	44.5
Female	196	55.5
Age		
23-28	133	37.7
29-34	172	48.7
35+	48	13.6
Marital status		
Single	170	48.2
Married	183	51.8
Level of education		
Diploma	22	6.2
Degree	260	73.7
Masters & above	71	20.2
Profession		
GP	41	11.6
Specialist	22	6.2
Health Officer	37	10.5
Nurse & midwifery	179	50.7
Pharmacist	36	10.2
Laboratory	38	10.8
Work experience		
<5 years	222	62.9
5-10 years	96	27.2
>10 years	35	9.9

Socio-demographic characteristics of key informants

Twelve key informants took part in the qualitative interview. Males made up almost 8 (66.6%) of the

participants. The average age of the participants was 31.75 years (95 % CI: 29.07-34.4). Medical directors accounted for 2 (16.7 %), EMR Administrators for 5 (41.6 %), curative service core processors for 2 (16.7 %), general practitioners for 2 (16.7 %), and matron nurses for 1 (8.3%). To standardize the themes, a structured interview guide was employed. The interview lasted an average of 25.13 minutes (95 % CI: 18.51-31.76).

Types of EMR systems implemented in each health facility

Different institutions use different types of EMR software. Some facilities shifted from one EMR system to another when vendors were phased out and technical support was unavailable. St. Peter's hospital was the only hospital using a web-based EMR developed by local software developers. (Table 2).

Table 2. Type of EMR systems implemented at respective facilities, October 2020.

Name of facility	Name of EMR
Tikur Anbessa specialized hospital	I-care
St. Peters speciality hospital	Abay Connected Health Record (ACHR)
Teklehaymanot general hospital	Prime-care
Kadisco general hospital	Brisk EMR systems
Entoto Fana health center	SMART-care/Tena-care
Selam health center	SMART-care/Tena-care
Vision Higher clinic	Unnamed

Utilization of EMR and user experience towards EMR System

Overall, about 242 (68.5%) healthcare professionals (95% CI = 63.7–73.4) used half or more than half of the 12 fundamental EMR components. Compared to private and public health facilities, 143 (58.6%) healthcare providers from public facilities and 99 (90.8%) healthcare providers from private health facilities used EMR. The most widely used patient data recording system was a hybrid of paper and computerized recording systems, 283 (81.6 %). For patient information documentation, the most common functional features utilized by healthcare providers among the fundamental components of the EMR were to order and show laboratory tests 266 (75.4%) and e-prescribing 49 (70.5%), the clinical decision support system (CDSS) 65 (18.4%) was the least used feature. About 288 (81.6%) respondents chose the EMR system.

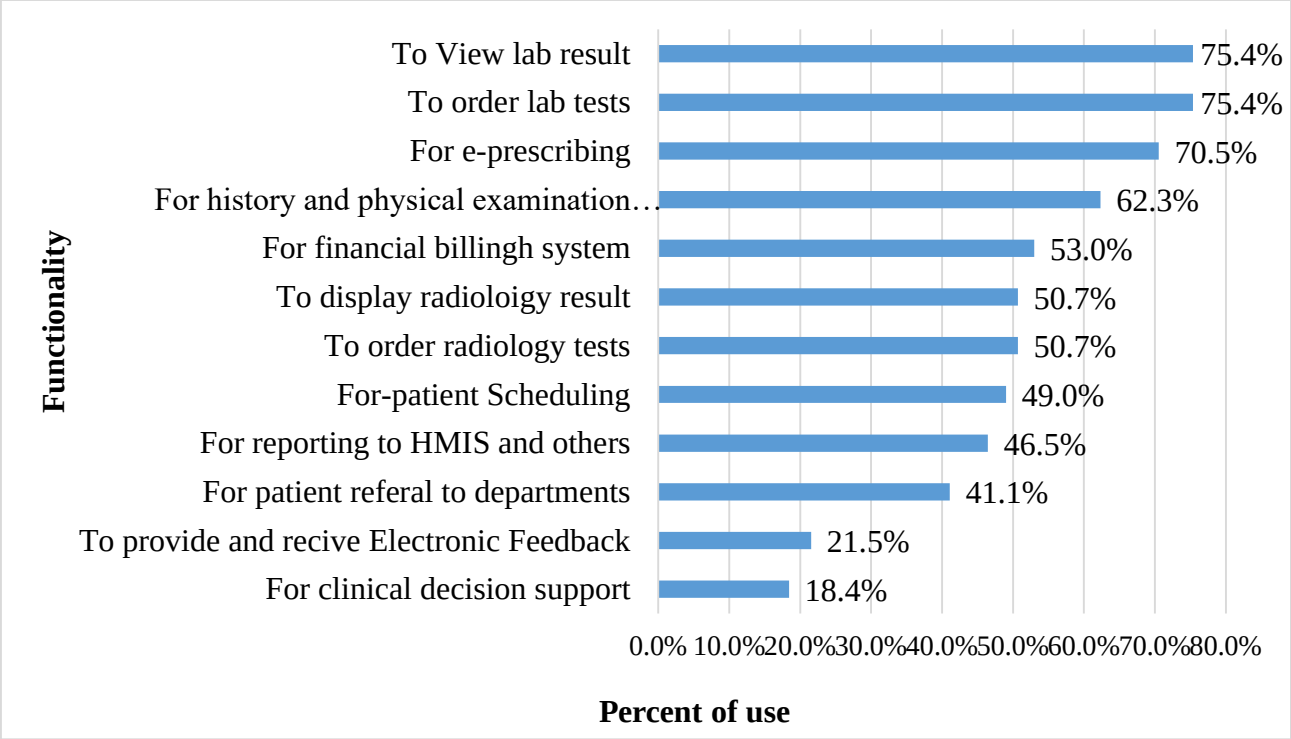

Figure 1: Basic components of EMR utilized by healthcare professionals in Addis Ababa Health facility, October 2020

Participants in the key informant interview mentioned the benefits they received from using the system. They said that the EMR technology assists them in quickly retrieving patient information and saves time spent looking for paper cards. One medical professional emphasized:

> *"I care system is advantageous for patient information recording and developing a subsequent plan in good order of coherence. And we can easily access data in good order of arrangement." (KII R12)*

One EMR admin from the government hospital added;

> *"…For the surgical ward, it shows how many patients are on the waiting list for the next surgical procedure, what case, and who is a responsible physician. It reduces the redundancy of work and forces to take accountability for the work being done. Especially for elective surgical procedures to know the date of admission and how many days the patient is on the waiting list." (KII R6).*

User experience towards functional and missed features in the EMR software

Most EMR software was created by companies based outside of the country. Only two government hospitals were adopting EMR software made locally. One of the hospitals used a web-based EMR. According to one EMR administrator from a government health facility:

> "… *Previously, we used desktop application EMR, which was developed by Tulane University. The system has time-bound, and it stops in between. That was a one-time software that did not allow updating or adding additional templates; we were forced to implement the new web-based EMR. In this new web-based EMR, some features are not functional. For example, laboratory order and drug prescription features are not being used." (KII R6)*

The least commonly used functional feature in almost all health facilities was the clinical decision support feature. One key informant strengthened this idea;

> "*The system does not have basic clinical decision support functions; it doesn't provide drug-drug interaction alerts, overdose warnings and it doesn't provide missed appointment notifications." (KII R12).*

All the EMR systems had no scanning capability to include previous paper cards in the EMR. As a solution, some facilities manually summarize and write previous patient information into the system.

The satisfaction of users towards EMR

In total, 162 (45.9%) healthcare professionals were dissatisfied with the EMR system. About 70 (64.2 %) healthcare professionals from private health facilities were satisfied with the EMR system. Almost 123 (50.4%) public health workers were unsatisfied with the EMR system.

Healthcare provider's experience towards the ease of using EMR

About 159 (45%) respondents mentioned, "EMR system is somewhat easy to access and review patient information." EMR is difficult to collect and examine patient information, according to 65 (18.41%) respondents, and around 196 (55.5%) respondents mentioned the existing EMR makes it very difficult to obtain patient information from offsite locations (Table 2). The overall mean score for ease of use of EMR was 3.14 (95% CI=3.06-3.22). Based on the composite analysis, 188 (53.2%) healthcare practitioners scored the mean and above and were categorized as accepting the system as easy to utilize.

Table 3: Assessment of the ease of using EMR among healthcare providers in Addis Ababa, October 2020 (n=353).

Variables	Not-applicable N (%)	Very difficult N (%)	Somewhat difficult N (%)	Somewhat easy N (%)	Very easy N (%)	**Total**
To obtain and review patient information	43(12.2)	25(7.1)	65(18.4)	159(45.0)	61(17.3)	
To prevent adverse events	37(10.5)	125(35.4)	101(28.6)	73(20.7)	17(4.8)	
To review trends in lab values.	42(11.9)	57(16.2)	90(25.5)	113(32.0)	51(14.5)	
Manage chronic disease conditions	55(15.6)	42(11.9)	73(20.7)	140(39.7)	43(12.2)	353
Manage orders	24(6.8)	55(15.6)	71(20.1)	161(45.6)	42(11.9)	
To analyze the outcomes of care	41(11.6)	70(19.8)	93(26.4)	120(34.0)	29(8.2)	
Retrieve patient information	29(8.22)	61(17.28)	102(28.90)	134(37.96)	27(7.65)	
Access the EHR from offsite locations	30(8.5)	196(55.5)	53(15.0)	62(17.6)	12(3.4)	
Enhance the continuity of care	25(7.1)	67(19.0)	75(21.3)	155(43.9)	31(8.8)	
Communicate with my colleagues	17(4.8)	44(12.5)	95(26.9)	151(42.8)	46(13.0)	

Training and related issues towards EMR

Only 115 (32.58%) and 107 (30.31%) of study respondents had access to ongoing training on how to use computers and the EMR system, respectively. Overall, 160 (45.3%) healthcare professionals disagree with the question, "I have received technical support from the IT staff whenever I need it" (median=3, IQR=2). Only 140 (39.7%) were satisfied with the support from IT staff (median=3, IQR=2).

The attitude of healthcare professionals towards EMR

One hundred seventy-seven (50.14%) of survey participants agree that "EMR promotes practice productivity", and 190 (53.82%) agree with the statement that "EMR helps to avoid medical errors." In terms of their level of agreement on the influence of EMR on service costs, 127 (36%) agree with the statement "EMR has an impact on service costs" (Table 3). The overall attitude score of healthcare providers towards EMR was 3.49. Of the total 203, 57.51%) of respondents scored the mean or above and were categorized as having a favorable attitude towards the EMR system.

Table 4: Attitude of healthcare providers towards EMR in Addis Ababa facilities, October 2020 (n=353).

Variables	**Strongly disagree** No (%)	**Disagree** No (%)	**Neutral** No (%)	**Agree** No (%)	**Strongly agree** No (%)
EMR Increase practice productivity	27(7.7)	28(7.9)	46(13.0)	177(50.1)	75(21.3)
Improves the quality of work	17(4.8)	18(5.1)	24(6.8)	205(58.1)	89(25.2)
Improve the quality of care	19(5.4)	21(6.0)	27(7.7)	202(57.2)	84(23.8)
Reduces hard work	37(10.5)	51(14.5)	27(7.7)	163(46.2)	75(21.3)
Need more time for training	27(7.7)	90(25.5)	61(17.3)	139(39.4)	36(10.2)
EMR benefits outweigh the costs	16(4.5)	50(14.2)	75(21.3)	165(46.7)	47(13.3)
EMR has an impact on the cost of service	26(7.4)	54(15.3)	110(31.2)	127(36)	36(10.2)
EMR improves the confidentiality of patient information	19(5.4)	47(13.3)	78(22.1)	152(43.1)	57(16.2)
EMR increases patient acceptance	21(6.0)	60(17.0)	59(16.7)	169(47.9)	44(12.5)
EMR decreases the waiting time of patients	19(5.4)	43(15.1)	53(15.1)	160(45.5)	67(19.0)
EMR is more complex than paper-based record	63(17.9)	133(37.6)	61(17.3)	71(20.1)	25(7.1)
EMR improves interaction with colleagues	17(4.8)	51(14.5)	81(2)	166(47.0)	38(10.8)
EMR improves clinicians' access to updated knowledge	18(5.1)	37(10.5)	67(19.0)	184(52.1)	47(13.3)
EMR helps to avoid errors	21(6.0)	29(8.2)	76(21.5)	190(53.8)	37(10.5)
EMR should be implemented at large	29(8.2)	22(6.2)	64(18.1)	174(49.3)	64(18.1)

Major barriers ranked by healthcare professionals towards the use of EMR

The most frequently stated barrier, ranked first by healthcare providers, was power and connection fluctuation, with a mean score of 3.25 (95% CI =3.11-3.40) on a five-point severity scale. When comparing private and public health facilities, the first hurdle that both private and public facilities had in common was power and connection fluctuations. A paucity of computer and EMR training for public health institutions, and a lack of supportive IT employees and skilled EMR administrators for private health facilities were the second and third key barriers to EMR adoption, respectively. (Figure 2).

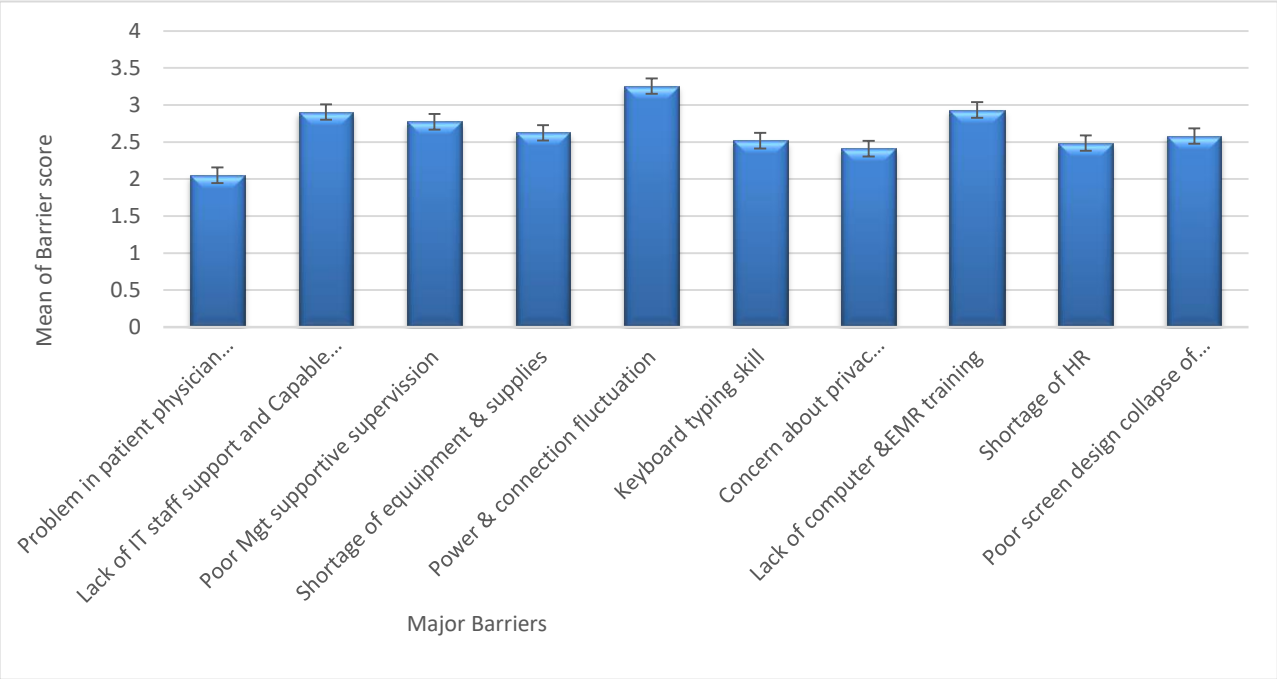

Figure 2. Major barriers perceived by healthcare professionals towards the utilization of EMR in Addis Ababa health facilities, October 2020

Barriers to the use of EMR identified from the key informant interview

Healthcare providers related barriers

Resistance and poor adaptation during the first phase of EMR implementation were reported as barriers in all facilities. One key informant raised;

> *"...there is a difficulty in adding previous paper-based records into the EMR system. Physicians are reluctant and busy to summarize and add previous patient information from paper-card to the electronic system. They are reluctant to compile the data; they prefer writing on a previous paper card." (KII R12).*

Some individuals are also reported to have "computer phobia". The other behavioral determinant was related to patient-physician interaction, and customers also requested paper-based prescriptions due to unfamiliarity with the electronic system.

The lack of timely maintenance and support, a non-user-friendly EMR template and a physician's keyboard typing speed, have all been highlighted as common technical impediments to EMR use. It was also difficult to implement EMR because of healthcare practitioners' skilsl and familiarity with basic computer applications and EMR.

A senior nurse from one private hospital stated;

> *"...I am spending a lot of time writing patient history and examination findings on a non-properly specified template. The writing template is like writing on a word. So, rather than writing on the EMR with slow keyboard typing skills, I prefer writing on the paper chart which I am familiar with for a long time." (KII R10)*

The malfunctioning of computers regularly and the lack of timely maintenance from the ICT departments were also mentioned. They stated that three government-owned health facilities lacked competent EMR administrative support. In paediatrics, obstetrics & gynacology, MRI & CT-Scan, and cancer treatment centers, the EMR system was not deployed.

Technology related barriers

Interoperability of the system

The capacity of a system to work seamlessly across departments is referred to as interoperability. Technical impediments to EMR use include improper integration of the EMR system with the new District Health Information System (DHIS) and the absence of some disease classification lists in the system. The system's lack of integration with laboratory machines, digital national reporting tools like DHIS2, and the National Classification of Diseases was cited as a key issue (NCoD). They claim that the system's "Time bomb" was causing a time-dependent lock, posing a severe barrier to care continuity and service sustainability.

Institution related barriers

i. Administrative support and sustainability of the system

Key interviewees cited a lack of administrative assistance for the overall adoption of EMR. The non-institutionalization of the system was a common issue. According to one EMR administrator, during the early stages of EMR adoption, the hospital's leader placed a strong priority on digitizing the institution, but when he quit, the system entirely collapsed. The system has been down for almost two years between the exchange of directors'.

One medical doctor added that;

> "*The hospital administration has no strict procedures it is loose. The hospital seems to be without a leader. There should be enforcement in using the system. Top-level managers are expected to fix and fully implement the system. The system is now effective it has passed its trial phase, and it must be implemented in all departments." (KII R12)*

According to key informants, the lack of enforcement to use the existing EMR system is why they are not using it. Due to the phase-out of EMR vendors, another important problem was ensuring the system's long-term viability. TUTAPE supported three assessed health facilities; however, the vendor is being phased out, and one institution's EMR is failing, while the other has redesigned the system. They claim it is due to a knowledge transfer gap and the lack of a formal agreement between the vendor and the health facility.

One key informant (medical director) from one government health center, heightened;

> *"The major challenge is related to the phase-out of NGO that introduced the system. The system should not be given to non-governmental organizations. They can assist financially or provide some technical support. If the system is given to local developers, it would not be a problem we can call them at any time whenever we need them." (KII R1).*

Even at the national level, the lack of rules, SOPs, and policy was another hurdle cited by key sources. Furthermore, according to one key informant, the EMR system must be included in the academic curriculum to provide a favorable opportunity for the system to be adapted.

ii. Power and connection fluctuation

Power and connectivity fluctuations were frequently noted as a stumbling block to use the EMR system fully. Although no power fluctuations have been detected at private health institutions, they report that lengthy computer restart time, even after a one-minute power outage, is a challenge. Power fluctuations are an issue for government health facilities. No human resource available to operate the standby generator at one government health center.

iii. Shortage of human resources, equipment, and supplies

In government health facilities, computers, power cables, and servers and were scarce. The RHB and MOH were also criticized for their lack of assistance. A shortage of HIT professionals and equipment for government health facilities was a problem. The country's largest tertiary hospital lacks an EMR administrator to keep the system running smoothly.

One key informant responded,

> *"We have a shortage of computers and human resources to maintain computers and other equipment. The other enormous problem was the server. When the previous server was burned it takes about four months for the MOH and RHB to provide a functional server." (KII R 1)*

iv. Financial barriers

One health center was not maintaining computers due to financial constraints. Financial barriers were not raised as a barrier in private health facilities and one government health center that NGO supported. One EMR administrator said;

> *"This hospital is a large institution it needs equipment and infrastructures. There is no preexisting setup for the EMR system, and it's difficult to implement it at once. If an existing system is available, it reduces the cost, now we are installing networking cables and computers that require high investment." (KII R11).*

v. Legal barriers

The absence of clear policy and guidelines to order narcotic and psychotropic medications and when to use mobile devices were mentioned as legal barriers. The other major legal issue mentioned was the available EMR system has no data encryption features to maintain the security of patient information. Another constraint was the absence of clear guidelines on when to discard and what to be included in the EMR system.

One EMR admin from a private hospital responded;

> *"The principal reason for not using paperless EMR is that ministry of health didn't allow using EMR independently, they need backup from paperwork. Even if a computer-based data recording system is available, using a paperless EMR system is not allowed. They have no 100% trust in the electronic system." (KII R9).*

Fearing the confidentiality and security of patient information, some clinics, like ART clinic, were not integrated into the EMR system not to expose ART patient information.

Factors associated with the use of EMR

According to a multivariate logistic regression model, pharmacists were 9.61 times more likely than other healthcare workers to use EMR (AOR=9.61, 95% CI=1.97, 46.8). Private health facilities were 7.17 times more likely than public health facilities to use EMR (AOR=7.17, 95% CI=3.189, 16.15). Individuals with favorable attitudes (AOR=2.30, 95% CI=1.26, 4.19) and access to EMR training (AOR=3.22, 95% CI=1.57, 6.63) were shown to be more likely to use EMR. Individuals aged 35 and over were 63.4% (AOR=0.36, 95% CI=0.143-0.94) less likely to use EMR than those aged 23 to 28 (Table 5).

Table 5. Summary of multivariable analysis of factors associated with the Utilization of EMR in Addis Ababa Health facilities, October 2020 (n=353).

Variable	Utilize EMR		COR (95% CI)	AOR (95% CI)
	Yes Frequency (%)	No Frequency (%)		
Age of Respondent				
23-28	94(70.7)	39(29.3)	1.00	1.00
29-34	124(72.1)	48(27.9)	1.07(0.65-1.77)	1.01(0.54-1.88)
35+	24(50.0)	24(50.0)	0.41(0.21-0.82) *	0.37(0.14-0.94) *
Profession				
General	32(78.1)	9(22.0)	1.00	1.00
practitioner	26(70.3)	11(29.7)	0.67(0.24-1.85)	1.25(0.38-4.15)
Health officer	99(55.3)	80(44.7)	0.35(0.16-0.77) *	0.50(0.19-1.26)
Nurse &	33(91.7)	3(8.3)	3.09(0.77-12.47)	9.61(1.97-46.80) *
midwifery	30(79.0)	8(21.1)	1.06(0.36-3.09)	1.37(0.39-4.86)
Pharmacist				
Laboratory				
Type of health facility				
Public	143(58.6)	101(41.4)	1	1.00
Private	99(90.8)	10(9.2)	6.99(3.48-14.06) *	7.17(3.18-16.15) *
User-friendly EMR interface				
Yes	179(74.9)	60(25.1)	2.42(1.51-3.87) *	2.85(1.56-5.22) *
No	63(55.3)	51(44.7)	1	1.00
Attitude to EMR				
Favorable attitude	154(75.9)	49(24.1)	2.21(1.40-3.50) *	2.30(1.26-4.19) *
Unfavorable attitude	88(58.7)	62(41.3)	1	1.00
Access to basic EMR training				
Yes	93(86.9)	14(13.1)	4.32(2.33-8.02) *	3.23(1.57-6.63) *
No	149(60.6)	97(39.4)	1	1.00

*Significant at p<0.05, COR-Crude Odds Ratio; AOR-Adjusted Odds Ratio, CI-Confidence Interval.

Discussion

This study was conducted to assess EMR utilization and identify factors that impede system utilization among healthcare providers currently employed in private and public health facilities. All the selected health facilities have implemented an EMR system, but the level of functionality and utilization varies by facility. In this study, 68.5% of healthcare professionals utilized EMR. In comparison to previous research findings, the results of this study show that EMR utilization was consistent with a study from Dire Dawa Hospital (67.7%)(14) but higher than studies from the West Oromia Region (42%) (15) and Gondar University Hospital (31.7%) (9). The result was lower than the Ayder referral hospital study (87.6%) (16). The higher utilization level in the latter hospital could be related to the fact that it was a pilot EMR implementation site with a long period between implementation and evaluation of EMR usage in our study scenario. Another possible explanation is that the use of EMR in public hospitals is declining due to the phase-out of vendors who introduced the technology to the facilities in our study.

"To order and show laboratory findings, followed by e-prescribing and history and physical examination documentation," were the basic EMR components used by healthcare practitioners in our study. A study undertaken in the Oromia and Tigray regions yielded a consistent outcome(15,16). The clinical decision support feature (18.5%) was the least used component of the EMR, which could be attributed to professionals not being aware of the system's basic functionalities. According to key informant interviews, the clinical decision support functionality was not operating, and the EMR software had no scanning capacity.

Individuals aged 35 and up were less likely to use EMR than those aged 23-28, according to a multivariable analysis of factors affecting EMR use. A study conducted in Ethiopia (17) and a systematic review of primary care clinicians found that young primary care physicians were more likely to use electronic medical records than older physicians (18). This could be explained by the fact that younger health professionals are more familiar with technologies than aged healthcare professionals, emphasizing the significance of refreshment and on-job training for aged healthcare professionals. However, pharmacists were more likely than others to use EMR. This could be because pharmacists are forced to use computers daily for better dispensing and auditing.

The type of health facility further influenced the utilization of EMR, healthcare providers from private hospitals were more likely to utilize it than those from public hospitals. This discrepancy could be attributable to the level of enforcement available in each health facility. Having EMR training was also strongly associated with the use of the EMR system among the criteria associated with its use. Only 30.3% of healthcare practitioners in this survey had undergone

basic EMR training. According to a survey conducted at the University Referral Hospital in Gondar, 64% of healthcare providers have received EMR training (9). The inconsistency may be related to the high number of nurses in our study, and it might be difficult to train all professionals in tertiary-level hospitals.

The other factor positively associated with the use of EMR was the attitude of healthcare providers towards EMR. About 57.51% of healthcare providers have a favorable attitude towards EMR. A similar result was reported in the study from the northern part of the country in which 56.1% and 54.6% have a good attitude towards EMR in Gondar and Ayder referral hospitals, respectively(17,19), but a high level of good attitude was reported from a study conducted in Malawi (70%), Tehran(87.2%) and Dire Dawa hospitals in Ethiopia (72.8%)(14,20,21). A similar finding reported that EMR training and the attitude of healthcare providers were significantly associated with the use of EMR systems in a study from Dire Dawa, Malawi, Saudi Arabia, and Tehran hospitals(6,14,20,21). The similarity might be because new technologies require training and capacity-building activities, signifying the importance of supporting healthcare providers to learn and adapt to new technology.

In a study that assesses barriers to using EMR, the most frequently cited barriers among all hospitals were "loss of access to medical records transiently if a computer crashes or power fails, followed by "lack of continuous training/support from information technology staff in hospital" (22). This is consistent with the findings of our study, in which respondents listed power and connection fluctuation as the top barrier, followed by a lack of EMR training. According to a study from Ghana and Kenya (23,24), the greatest impediment was a lack of skilled EMR administrators to manage the EMR system and a lack of computers and scanners. The findings were consistent with our study's, which revealed that a lack of equipment and a competent EMR administrator were the two most significant barriers to EMR implementation. Basic computer and EMR training, and a lack of commitment on the part of facility admins, were identified as major hurdles to using the EMR system. Temporary vendors who introduced the system to individual health institutions, and a problem with knowledge transfer between the implementing company and the health facilities, were the third and possibly most significant barriers cited. On the contrary, in a systematic review conducted in the United States, the most frequently reported barrier was the cost of implementation (25). The variation could be attributable to the fact that in our study, the EMR was implemented by NGOs.

Technical constraints related to keyboard typing speed, and the system's frequent collapse, were also cited by key informants. They also noted a lack of human resources to maintain and update EMR software and power sources. A systematic review examining challenges to EMR deployment came to a similar conclusion (26,27). In addition, our study found that a lack of cooperation from the regional health bureau and the Ministry of Health in providing essential equipment was impediment. According to another study, strong administrative and physician leadership is essential to analyze all potential risks for medical error, system failure, and legal liability when deploying EMR long-term (28). The opposition of healthcare professionals to the EMR system during the early stages of EMR implementation was mentioned as one of the basic behavioral variables. The findings matched the research conducted in Nigerian hospitals (27). This may be attributed to the fact that resistance to change is the main hindrance during introducing new technologies, implying the importance of careful change management.

Significant hurdles were improper EMR system integration with the DHIS, national disease classification, and laboratory machines. This could result in work redundancy and data misreporting. Data was first transcribed in paper-based HMIS reporting books and then re-entered into the DHIS2, which was found to be error-prone, according to research conducted in Tanzania(29). This could be owing to a lack of qualified EMR administrators and ICT professionals to integrate the system. Non-institutionalization of the EMR system was another prevalent element that hampered the system's long-term viability signifying the importance of securing sustainable funding sources, knowledge transfer and deployment of EMR administrators to own the program.

A key issue was the lack of defined EMR guidelines at the facility and even at the national level. Restrictions on prescribing narcotic and psychotropic drugs were mentioned as a legal impediment. A lack of clear standards and policies caused the gaps in using the EMR system. According to a study conducted in Saudi Arabia, substantial impediments to the use of EMR include a lack of policies/procedures that control EMR at the hospital level, a lack of rules or legislation that govern EMR at the national level, and how the EMR system is easily accessed/disclosed.(30). The finding of the study implies that governing documents and implementation guidelines for the step-by-step implementation of EMR are mandatory. The concern about the confidentiality and security of patient information was another legal issue mentioned by key informants. Most healthcare facilities used a personal password shared across departments and was not role-based, raising concerns about patient confidentiality and security. Even though one higher hospital was employing a web-based EMR, no facility implemented advanced security methods such as data encryption techniques. Similar findings in Ethiopia by Binyam et al. strongly asserted this condition(31). The finding signifies that EMR systems that use public networks to transmit data should use data encryption technologies to avoid data breaches.

Strengths and limitations of the study

The study used a mixed study design to better understand the problem by incorporating front-line health professionals and key informants, and the response rate was also quite high. The study includes

both private and public health facilities to better understand the challenges of EMR use. However, the patient's perspective on the EMR system was not evaluated in this study. Due to the current COVID-19 competing interests, it was difficult to interview and obtain thorough information from high-level hospital representatives. Furthermore, the study does not evaluate data quality compared to paper-based documentation, and the patient information security and confidentiality features were not evaluated.

Conclusion

Overall, the study found that EMR utilization was relatively low in Addis Ababa. Even if an EMR system is in place in a health facility, it is fragmented, and patient information documentation is mostly performed manually. Basic EMR features were found to be underutilized, with most of them being used to request and display laboratory investigations. Healthcare professionals did not use the clinical decision support tool. The study's findings imply that access to basic EMR training, healthcare professionals' attitudes, profession, type of health institution, and the EMR interface all influence EMR utilization. The study also found that system interoperability problems, shortage of EMR administrators, power, and internet connection fluctuation impede EMR utilization.

The study ascertained that utilization of EMR was hindered by the absence of clear EMR guidelines, regulations from the FMOH, frequent exchange of directors, phase-out of vendors and concern about the confidentiality and security of patient information. To keep the confidentiality and security of patient information, no facility was using advanced security systems such as data encryption technologies. We propose the following recommendations based on the finding of the study.

1. The FMOH should establish clear policies and standards for using the EMR system. After addressing the basic hindering factors, it is recommended to implement EMR in all health facilities to maximize the service provision and improve the culture of data use. Furthermore, when the EMR system is installed, it is advised that implementation partners have a firm binding agreement and a clear phase-out strategy.
2. Regional health bureaus should provide basic technical support for the maintenance of EMR and power sources, provide equipment, and facilitate basic computer and EMR training for aged healthcare providers working in government-owned health facilities.
3. For efficient usage of the EMR system, health facilities should provide refresher training and make the system more user-friendly. Furthermore, they should deploy EMR admins and consider the individual difference in the level of acceptance of technologies. To improve care coordination and reduce patient hassles, the system should be implemented throughout all departments. In addition, enforcing the system's use and adjusting its operating guidelines are required.
4. For researchers: This study only looks at the current utilization status and major barriers, but it neglects to assess data quality in comparison to paper-based records, patients' perspectives on EMRs, and key legal issues such as patient information security and confidentiality, mainly data encryption systems that use public networks which should be properly assessed.

Acronyms

CPOE: Computerized Provider Order Entry
DHS: Demography and Health Survey
EHR: Electronic Health Record
EMR: Electronic Medical Record
FMOH: Federal Ministry of Health
HMIS: Health Management Information System
HSDP: Health Sector Development Program
HSTP: Health Sector Transformation Plan
STATA: Statistical Data
WHO: World Health Organization

Acknowledgements

We would like to express our sincere gratitude to the head of each health facility for allowing us to carry out this study. Special thanks to Dr Zelalem Tesfaye and Dr Ayele Belachew for their unreserved support in conducting this thesis at Kadisco and Tikur Anbessa specialized hospitals. We are also very grateful to data collectors, study participants and respondents.

Funding Statement

This study was made possible with the support of the Doris Duke Charitable Foundation (DDCF) through John Snow Research and Training Incorporated (JSI) and Addis Ababa University. We thank those funding bodies for making this study successful.

Ethical Considerations

The study obtained ethical approval from Addis Ababa university ethical review board (approval reference number-559/SPH/2012) and Addis Ababa regional health bureau (permission letter reference number-አአ/ጤ/8065/227). The study was carried out following relevant ethical guidelines and regulations. The heads of each health facility gave their permission. Prior to interviewing, information regarding the aim of the study, the right of respondents and the absence of any potential risk for participating in the survey was provided. Finally, respondents signed a consent form.

Competing interests

None declared.

References

1. World Health Organziation, Pan American Health Organization. Handbook for Electronic Health Records Implementation. World Heal Organ [Internet]. 2017;(June):75. Available from: http://www.paho.org/ict4health/images/docs/DRAFT-Handbook_EHR_Implementation.pdf
2. Jeyakodi T, Herath D. Acceptance and Use of Electronic Medical Records in Sri Lanka. Sci Res J [Internet]. 2016;IV(I):1–5. Available

from: www.scirj.org

3. Wang SJ, Middleton B, Prosser LA, Bardon CG, Spurr CD, Carchidi PJ, et al. A cost-benefit analysis of electronic medical records in primary care. Am J Med [Internet]. 2003 Apr 1;114(5):397–403. Available from: https://doi.org/10.1016/S0002-9343(03)00057-3
4. Menachemi N, Collum. Benefits and drawbacks of electronic health record systems. Risk Manag Healthc Policy [Internet]. 2011 May;4:47. Available from: http://www.dovepress.com/benefits-and-drawbacks-of-electronic-health-record-systems-peer-reviewed-article-RMHP
5. Ariffin NA bt N, Ismail A bt, Kadir IKA, Kamal JIA. Implementation of Electronic Medical Records in Developing Countries: Challenges & Barriers. Int J Acad Res Progress Educ Dev [Internet]. 2018;7(3):187–99. Available from: http://dx.doi.org/10.6007/IJARPED/v7-i3/4358
6. Fahad AlOtaybi H, Mohammad Al-Raddadi R, Munshi A, Hassan Bakhamees F, Khalid Mohammed khalil A, Hussein Mukhtar Y. Performance, Barriers, and Satisfaction of healthcare Workers Toward Electronic Medical Records in Jeddah, Saudi Arabia. Orig Res Artic [Internet]. 2018;118(2):118–44. Available from: www.ijmrp.com
7. Ministry Of Health. Health Sector Transformation Plan 2015/16 - 2019/20:The Federal Democratic Republic of Ethiopia. Addis Ababa; 2015.
8. Mengesha T. Electronic solutions for ethiopian health sector. Oulu University; 2011.
9. Tilahun B, Fritz F. Comprehensive Evaluation of Electronic Medical Record System Use and User Satisfaction at Five Low-Resource Setting Hospitals in Ethiopia. JMIR Med Informatics. 2015;3(2):e22.
10. Ministry of Health-Ethiopia. Annual Performance report. Addis Ababa; 2020.
11. Lakbala P, Dindarloo K. Physicians' perception and attitude toward electronic medical record. Springerplus [Internet]. 2014 Dec 3;3(1):63. Available from: https://springerplus.springeropen.com/articles/10.1186/2193-1801-3-63
12. Iyer R, Hosmer DW, Lemeshow S. Applied Logistic Regression. Vol. 40, The Statistician. 1991. 458 p.
13. Furukawa MF, King J, Patel V. Physician attitudes on ease of use of EHR functionalities related to Meaningful Use. Am J Manag Care. 2015;21(12):e684–92.
14. Oumer A. Utilization of Electronic Medical Record and Associated Factors Among Health Professionals in Public Health Facilities With Service Delivery , Eastern Ethiopia. 2017;1–16.
15. Samuel S, Bayissa G, Asaminewu S, Alaro T. Electronic Information Sources Access and Use for Healthcare Services in Governmental and Non-Governmental Hospitals of Western Oromia, Ethiopia: A Cross Sectional Study. Ethiop J Health Sci. 2016;26(4):341–50.
16. Berhe M, Tadesse K, Berhe G, Gebretsadik T. Evaluation of Electronic Medical Record Implementation from User's Perspectives in Ayder Referral Hospital Ethiopia. J Heal Med Informatics. 2017;08(01):1–13.
17. Yehualashet G, Andualem M, Tilahun B. The Attitude towards and Use of Electronic Medical Record System by Health Professionals at a Referral Hospital in Northern Ethiopia: Cross-Sectional Study. J Heal Inf Afr. 2015;3(1):19–29.
18. O'Donnell A, Kaner E, Shaw C, Haighton C. Primary care physicians' attitudes to the adoption of electronic medical records: A systematic review and evidence synthesis using the clinical adoption framework 11 Medical and Health Sciences 1117 Public Health and Health Services [Internet]. Vol. 18, BMC Medical Informatics and Decision Making. 2018 [cited 2019 Aug 29]. p. 101. Available from: https://doi.org/10.1186/s12911-018-0703-x
19. Biruk S, Yilma T, Andualem M, Tilahun B. Health Professionals' readiness to implement electronic medical record system at three hospitals in Ethiopia: A cross sectional study. BMC Med Inform Decis Mak. 2014 Dec 12;14(1).
20. Habibi-Koolaee M, Safdari R, Bouraghi H. Nurses readiness and electronic health records. Acta Inform Medica. 2015;23(2):105–7.
21. Msiska KEM, Kumitawa A, Kumwenda B. Factors affecting the utilisation of electronic medical records system in Malawian central hospitals. Malawi Med J. 2017;29(3):247–53.
22. El Mahalli A. Adoption and Barriers to Adoption of Electronic Health Records by Nurses in Three Governmental Hospitals in Eastern Province, Saudi Arabia. Perspect Heal Inf Manag. 2015;12.
23. Gyamfi A, Mensah KA, Oduro G, Donkor P, Mock CN. Barriers and facilitators to Electronic Medical Records usage in the Emergency Centre at Komfo Anokye Teaching Hospital, Kumasi-Ghana. African J Emerg Med. 2017 Dec 1;7(4):177–82.
24. Waithera L, Muhia J, Songole R. Impact of Electronic Medical Records on Healthcare Delivery in Kisii Teaching and Referral Hospital. Med Clin Rev. 2017;03(04):1–7.
25. Kruse CS, Kristof C, Jones B, Mitchell E, Martinez A. Barriers to Electronic Health Record Adoption: a Systematic Literature Review. J Med Syst. 2016;
26. Boonstra A, Broekhuis M. Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions. BMC Health Serv Res. 2010;10.
27. Gesulga JM, Berjame A, Moquiala KS, Galido A. Barriers to Electronic Health Record System Implementation and Information Systems Resources: A Structured Review. In: Procedia

Computer Science. Elsevier B.V.; 2017. p. 544–51.

28. Palabindala V, Pamarthy A, Jonnalagadda NR. Adoption of electronic health records and barriers. J Community Hosp Intern Med Perspect. 2016 Jan;6(5):32643.
29. Kikoba BR, Kalinga E, Lungo J. Integrating electronic medical records data into national health reporting system to enhance health data reporting and use at the facility level [Internet]. Vol. 551, IFIP Advances in Information and Communication Technology. Springer International Publishing; 2019. 532–543 p. Available from: http://dx.doi.org/10.1007/978-3-030-18400-1_44
30. Khalifa M. Barriers to health information systems and electronic medical records implementation a field study of Saudi Arabian hospitals. In: Procedia Computer Science. Elsevier B.V.; 2013. p. 335–42.
31. Fritz F, Tilahun B, Dugas M. Success criteria for electronic medical record implementations in low-resource settings: A systematic review. J Am Med Informatics Assoc. 2015 Mar 1;22(2):479–88.