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**COLLEGE OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH**

**ELECTRONIC MEDICAL RECORD UTILIZATION, ITS DETERMINANT
FACTORS AND BARRIERS AMONG HEALTH CARE PROVIDERS AT
SELECTED HEALTH FACILITIES IN ADDIS ABABA, ETHIOPIA**

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

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Declaration

I, the undersigned, declare that this thesis is my original work and it has not been presented in other universities, colleges or institutions for a similar degree or other purposes. I have duly acknowledged all sources of the materials used in this thesis.

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ACRONYMS

AOR	Adjusted Odds Ratio
CDC	Communicable Disease Control
COR	Crude Odds Ratio
CI	Confidence Interval
CPOE	Computerized Provider Order Entry
CSA	Central Statistics Agency
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
IOM	Institute of Medicine
NGO	Non-Governmental Organization
S-P-O	Structure -Process-Outcome
STATA	Statistics and Data
WHO	World Health Organization

ABSTRACT

Background: Electronic Medical Record (EMR) is a longitudinal collection of health-related information that can be created and managed by authorized clinicians. In Ethiopia, Electronic Medical Record is one part of the information revolution road map to transform the culture of data use. Limited studies have been conducted to determine the progress and determinants of utilization of Electronic Medical Record. The aim of this study is, therefore, to assess the current utilization of EMR and its determinant factors among health care professionals working in Ababa city administration, 2020.

Method: A mixed study design was used among 367 health care providers and 12 key-informants. Four government and three private health facilities were included. A multi-stage sampling technique was used. Data were entered by epi-data and analyzed by STATA version 15. Atlas.ti version 7 was used to manage qualitative data. An ethical clearance letter was obtained from Addis Ababa University. Descriptive statistical summary measures were used to describe variables. Binary logistic regression with odds ratio and along with 95% confidence interval was used. Variables with a p-value of less than 0.25 were entered into the multivariable logistic analysis model. Finally, variables with a p-value of less than 0.05 were considered statistically significant.

Result: A total of 353 respondents participated, making the response rate of 96.2%. Most of the respondents (48.2%) were nurses, followed by physicians (11.6%). Overall, 68.6% (95% CI= 63.7-73.4%) of health care professionals were utilizing the EMR system. Only 30.2% have received EMR training. Factors such as access to basic EMR training (AOR=5.8, 95% CI=1.6-20.7), a favorable attitude of health care providers (AOR=2.3, 95% CI=1.2-4.5), and user-friendly EMR interface (AOR=2.7, 95% CI=1.4-5.1) were positively associated with the use of EMR. However, individuals aged 35 & above were 66.4% less likely to use EMR than individuals aged 23-28. Key informants mentioned; power fluctuation, shortage of capable EMR administrator, phase-out of vendors, absence of guidelines and policies, shortage of equipment and legal issues as major barriers to utilize EMR.

Conclusion: EMR utilization by health care professionals from private health facilities was better than government facilities. Overall utilization of EMR was low. The finding suggests that access to basic EMR training, the attitude of health care providers and the EMR interface were affecting the use of EMR. Besides, absence of clear EMR guidelines, power and connection fluctuation hinders EMR utilization and needs intervention. We recommend periodic training for professionals and make the EMR interface friendly. There should be clear guidelines on how to use EMR, strict binding agreement, and clear phase-out strategy when giving EMR implementation for NGO EMR vendors.

Keywords: EMR, Health Care Providers, Health Facility, Ethiopia

CHAPTER 1: INTRODUCTION

1.1. Background

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 and staff within one health care organization in a digital format (1). It fosters immediate access to individual and population-related information to support efficient processes for health care delivery and decision-making(2). Electronic Medical Record has the potential to provide substantial benefits to physicians, clinic practices, health care organizations, and individuals(3). It is an enabling technology to pursue quality improvement, improve the legibility and accessibility of progress notes, and easy analysis and reporting of data(3,4).

Patient information like patient demographic characteristics, history, physical examination findings, medications, progress notes, past medical history, laboratory, and radiologic data, and other problems like drug allergies are recorded and retrieved by using an electronic record(5,6). EMR helps health care providers to perform important information documentation procedures. Important procedures such as; clinical decision support, patient education, order entry and prescribing, health information and reporting, security and confidentiality maintenance features, exchange of electronic information, for e-prescribing, electronic alerts and reminders, providing reports for financial management, quality assurance, chronic disease management, and public health data collection are some of the basic functions(7,8).

EMR has some of the following components and capabilities. Such as flow sheets, to organize data on vital signs, smoking status, immunizations, referrals, laboratory tests, and drug therapy; templates, pre-structured entry formats filled by typing, auto-fill or operated by drop-down buttons used to organize, present, and capture clinical data within the system; Computerized Provider Order Entry (CPOE)- systems that allow health care providers prescribe medical orders electronically into the system. Others like electronic prescribing (e-prescribing), to send accurate, understandable prescriptions directly to the pharmacy from point-of-care and reporting formats(7).

Properly authenticated EMR is important to maintain the confidentiality and privacy of patient information collected during the health care process, which can cause significant harm to economic, psychological, and social life if disclosed. With appropriate safeguards and role-based distribution of tasks on EMR, it offers more security than the traditional paper-based record(9).

Most of the developed and some developing countries are implemented and on the way to implementation, EMR to advance the work process, patient safety, and quality of healthcare(10). As a developing country,

Ethiopia has successfully implemented four successive health sector development goals (HSDP I, HSDP II, HSDPIII, HSDPIV) and significant progress is being achieved under a program called health sector transformation plan (HSTP), among which information revolution is a primary concern. According to the Ethiopian Federal Ministry of Health (FMOH) 2020 annual performance report, EMR is one part of the information revolution road map to transform and improve the culture of data use, intending to provide evidence-based decision making to enhance population health. EMR is implemented in six hospitals and 12 health centers in 2020 at the national level. Currently, health service coverage is almost 100% in Addis Ababa with 98 fully functional health centers, 13 functional hospitals(11).

To realize this information revolution road map, Tulane University Technical Assistance Program for Ethiopia (TUTAPE) introduced EMR implementation software called “smart care” with FMOH and CDC in 2008(12). Implementing an EMR system only does not improve the quality of health care delivery system, the government should ensure that information documented by physicians is accurate, timely, and available when needed. The information documented by paper-based records is the base for effective EMR implementation. To improve the implementation of EMR, challenges faced so far and barriers to use EMR have to be assessed, identified, and addressed accordingly.

1.2. Statement of the Problem

The health care industry is operating under computerized technologies among which EMR is its priority concern(13). Implementing EMR helps to increase productivity, quality, and profit of health care organizations. Developed countries have identified the major challenges and barriers to implementing EMR. However, the implementation of EMR in developing countries is very slow and the major factors that hinder the implementation of EMR are not addressed (5). World Health Organization (WHO) recommends countries to adopt and implement EMR to improve health management processes and patient safety at an affordable cost. It states that EMR must be a public good that enables universal health access and universal health coverage(1).

In Ethiopia, the effort to implement EMR started in 2008, with the desire to transform the traditional paper-based medical record system into an electronic system(12). Initially, it was implemented in Dill Chora Hospital, Dire Dawa, Ethiopia as a pilot program to implement at the national level(12). Currently, the newer EMR software “I-Care” is implemented as a pilot program at Tikur Anbesa Specialized Hospital by FMOH and Ministry of Science and Technology in 2018(14). Despite this effort to transform the traditional medical record system, evidence showed that the progress of using EMR is very slow, with evidence that only a tiny fraction of facilities adopting the system over 10 years’ period since its initiation. Most health care professionals in Addis Ababa are using paper for most of their daily tasks. Evidence showed that physicians and other health care professionals are not using EMR as desired(15). In a study conducted in five low resource setting hospitals in Ethiopia in 2014, the result showed that immediately after implementation 76.1% of health care professionals were using the system. But during the actual date of data collection (after 3 years of implementation) only 31.7% were using EMR. In this study, about 64.4% of participants were dissatisfied with the use of EMR(15). The study assesses only determinants of staff dissatisfaction but doesn’t identify determinants of utilization of EMR and barriers to use EMR in Ethiopia and specifically in Addis Ababa. The progress of the utilization of EMR was not assessed in Addis Ababa health facilities. No sufficient evidence generated to understand the problem at the end-user level. So, this study assessed the current level of utilization of EMR and factors that hinder the utilization of EMR and it is expected to fill the gap of EMR implementation.

1.3. Significance of the Study

The finding of this study will have a significant benefit to:

Society: The gaps are identified and recommended to be addressed accordingly. So, it will help patients to get quality and effective health services. Besides, using EMR helps patients to get continuous care from their physicians electronically.

Hospitals/Health Centers: This study provides scientifically sound information and recommendation on potential factors that hinder the use of EMR, and it will help to make an informed decision making.

The Ministry of Health/Regional health bureau: The study provides valuable information on utilization, the reasons and underlying barriers to implementation of EMR, and associated factors among health care providers. It will serve as an evidence-based decision-making tool by making health and health-related data easily available after the problems are identified and addressed accordingly. Besides, it will have a significant impact on the selection of an appropriate implementation strategy in respective health facilities.

Researchers: This study provides future researchable gaps and will help them explore further research problems related to EMR and its implementation.

1.4. Research Questions

1. What is the current level of utilization of EMR by health care providers at selected health facilities?
2. What are the barriers to the utilization of EMR faced by health care providers at selected health facilities?
3. What are the factors affecting the use of EMR by health care providers at selected health facilities?

CHAPTER 2: LITERATURE REVIEW

2.1. Health Information System and Evolution of Electronic Medical Record

Sound and timely information system is an important determinant factor for evidence-based decision making. The health information system offers timely and full decision-making information and has four principal functions: data collection, compilation, interpretation and synthesis, and communication and usage. A good health information system brings together all relevant partners to ensure that users of health information have access to reliable, authoritative, useable, understandable, and comparative data(16).

EMR started in the 1960s and 1970s in academic medical centers. Originally, the Institute of Medicine (IOM) called computer-based patient recorders. EMRs have had many other names, including electronic health records, computerized medical records, longitudinal patient records, and electronic charts. These names referred to something intended to replace the paper chart. In 2003, the IOM chose the name Electronic Health Records. It was in the 1980s more efforts made to increase the use of EMR after the IOM recognized the need for serious analysis of paper-based records. IOM undertook a study and reported on barriers to implement and propose a means to convert paper-based records to electronic records (5).

2.2. Electronic Medical Record in Ethiopia

Ethiopia is a country with 10 regional administrations (Amhara, Oromia, Tigray, Afar, Somali, Benishangul Gumuz, Gambella, Harari, Sidama and Southern Nations and Nationalities) and two city administration (Addis Ababa City Administration and Dire Dawa City Administration). According to the Central Statistical Agency (CSA) national census projection, the projected population of Addis Ababa in 2017 was 3,433,999(17). In response to the increasing number of populations in the city, the government is constructing and expanding the existing health facilities. In Addis Ababa around 98 fully functional health centers, 13 functional hospitals, and 1 under-construction hospital are available(11).

Irrespective of the growing number of health facilities in the country, limited facilities have implemented EMR. The Ethiopian Federal Ministry of Health (FMOH) has implemented the Health Management Information System (HMIS) to “support informed strategic decision-making by providing quality data that help managers and health workers plan and manage the health service system.” To advance this health information system, Smart care was introduced in 2008 in Ethiopia. Smart Care was first developed, tested, and deployed in Zambia by CDC for HIV/AIDS care and treatment. In Ethiopia, the Smart care software program was developed and implemented by TUTAPE (Tulane University’s Technical Assistance Program for Ethiopia) software developers, in collaboration with the Zambia Smart care team and FMOH. Smart care is an electronic health record system that supports longitudinal record-keeping for

clinical care, especially for HIV/AIDS treatment, TB care, VCT, and antenatal care. The system is being implemented at the national level and provides clinical decision support and data portability via the use of smart cards. Dire Dawa region has successfully implemented this EMR(12,18,19).

2.3. Benefits of Electronic Medical Record

EMR offers the advantage of making information about patient care available in a secured way to multiple certified users. It provides integrated information from multiple sources and provides a more comprehensive view of patient care. Besides, it increases access to tools like clinical decision support reminders that help clinicians and teams in providing care on the best evidence(7).

Different experts explained various use of EMR among them a qualitative study conducted by R. Miller in California concluded EMR is important for quality improvement which mainly depends on physician's use of EMR not paper for most of their daily tasks(20) and it helps to retrieve and manage large and exhaustive data easily(21,22).

A study that aims to compare EMR and paper-based medical record concluded that "EMR does not change the time nurses spent on various activities such as medication administration, verbal communication and documentation time(23), but it improves nurse's documentation compliance and workflow". It can cause unintended adverse consequences like incomplete information about the patient, late addition of a new resident's medication profile in the record, and nurses forgetting to record resident's information due to power interruption(24).

In a study conducted in Saudi Arabia, EMR reduces the physician error by checking for drug interactions, dosage levels, and allergies. It improves record keeping and documentation of medical examination(25). In a review conducted by Shamliyan et al. to examine the association between computerization of physician order prescription medication error, compared to paper-based order 80% of studies reported a significant reduction in total prescription errors. A significant reduction in prescribing medical error was associated with implementing an EMR system(26).

A cost-benefit analysis conducted to estimate the net benefit and cost of implementing EMR about paper-based medical record found that the net benefit of the EMR system was \$86,400 per provider. It shows that the net benefit of using EMR is positive and decreases net health care expenditures per beneficiary to decrease chart pulls, drug expenditure, and increasing utilization of radiologic tests. Its benefit increases as more features are added, and the time duration of using EMR increases(3,27).

EMR also has a significant effect on the quality of documentation. In a study conducted to compare the quality of documentation in paper-based documentation and electronic documentation in nursing-based care centers, a better quality of documentation was obtained from EMR systems than previous paper-based systems. The overall completeness and comprehensiveness rate of admission form were poor but high in EMR based system than the paper-based medical record system(28). Physicians from Kenya highlighted the importance of support training, leadership, and change management as important before EMR implementation(29,30).

In a pre-post intervention study conducted in Ethiopia to examine the completeness of medical records before and after intervention by using a simple computer database program of patient information search, the result showed the time required to retrieve medical records was significantly decreased. Medical record completeness was also increased from 6.5% to 45.7% after the intervention of the program. The authors concluded that a well-planned medical record management system is effective in enhancing the accessibility and completeness of patient information to support clinical practice(31).

2.4. Utilization of Electronic Medical Record

In a study conducted in Saudi Arabia Jeddah in 2015, the most commonly utilized component of EMR was to obtain and review lab results (86.5%), document patient discharge instructions (62.7%) but no utilization of any communication tools with other co-workers(32). In a cross-sectional study conducted in Ghana, among 396 health care professionals around 59% of health care professionals showed low use of EMR services in their hospitals(33). Another cross-sectional study in Malawi, the result showed that the most commonly used component of EMR was to capture demographic data (82.9%) followed by capturing and assessing clinical data (68.8%)(34).

In a quantitative cross-sectional study conducted in Ethiopia (n=406) in 2014, the utilization of EMR was 31.7% during the time of data collection. In this study, 64.4% of respondents were dissatisfied with the use of EMR. Among those majority of dissatisfied professionals were nurses(15). In another study conducted in Ayder Referral Hospital, Mekelle, northern Ethiopia (n=255) found that 94.4% of respondents have used EMR in some part of their day of the week and 80% use the system throughout the week. Nurses were the least users of EMR when compared with other professionals(35). In another study conducted in Dire Dawa and Harari hospitals, the utilization of EMR was 67.7%, with 54% use it on daily basis. Besides, a higher proportion of health professionals 34% prefer paper-based recorded(36).

2.5. Barriers to the Utilization of Electronic Medical Record

Among the various barriers, organizational, technological and social factors such as cost of implementation, training, physicians' resistance to new technologies, and physicians' experience to computers are major barriers to the implementation and use of EMR. Others like lack of financial incentives, physicians' attitudes, and inadequate support are underlying barriers to the use of EMR(20,25). Robert M. et. al argued that improvement in electronic data exchange, performance incentives, and support from information staff can help to transform from inefficient to efficient advanced users(20,37).

A systematic review conducted to identify, categorize and analyze barriers to the use of EMR concluded that despite the positive effect of using EMR in health care practice, the adoption rate of the system is low and encountered resistance from physicians. Among the most significant category of barriers, they mentioned financial, technical, time, psychological, social, and legal barriers. The study recommends, "Policymakers should be more aware of the reality that removing technical, financial and legal barriers is not sufficient to ensure the realization of the promise of EMR"(38).

A national survey of physicians (n=2758) conducted among ambulatory care physicians showed that only four percent of physicians reported having full and intensively full functional EMR. Among physicians who did not have used EMR capital cost (66%) and concern for the sustainability of the system were the most commonly cited barriers to use EMR(39).

In a study conducted in Irish, very significant differences were found in using EMR among Irish health care providers. Vocational training was a requirement to use EMR. Other factors like lack of time and lack of computer skills were other barriers to use EMR. The author was generalizing that health care providers who were more likely to use EMR were young, male, and working in group practices and those who take vocational training(40).

In a synthesis of three qualitative studies about barriers to the implementation of EMR, the major findings were time to learn how to use EMR, training, information technology staff support and provider's readiness were significant barriers to use EMR. These authors pointed out that a critical success factor in implementing EMR is the presence of a champion leader, problem solver for the system, and training is essential to bring all users to use EMR(41).

In a study to examine EMR usability and perceived burden of using EMR, a live observation design combined with post-observational surveys showed that EMR use frustration was significantly higher among senior-level physicians than more junior level physicians. The cause for the frustration of

physicians was; remembering software menu, button names, command use, and performing tasks that are not straight forward. Additionally, they mentioned system speed and reliability as frustration factors to use EMR(42). In a Delphi study with a panel of experts along with the survey of general practitioners in Canada, medical practices were hindered by behavioral, cognitive economical, and technical barriers to fully implement EMR. In this study key challenges to implement EMR in private facilities were economic and knowledge barriers(43).

A quantitative cross-sectional study from Massachusetts asserted the computer skill of health care providers and colleague's availability of computer technical support, loss of contact with patients, too slow computers, inability to type quickly and lack of time to acquire knowledge about the system were significant barriers to use EMR by physicians. These authors mentioned startup financial costs, ongoing financial cost, privacy, or security concerns were other mentioned barriers to use EMR(44,45).

In a study conducted to determine barriers to implement EMR in Japan, the result showed that inadequate funding for adoption and maintenance, potential adverse effect on workflow was mentioned barriers to implement EMR. They argued that to implement and attract health care professionals to use EMR, they should focus on decreasing the time required to produce a medical record and establish an appropriate clinical guideline that residents require(46). In another study conducted regarding barriers and satisfaction to use EMR technical factors related to hardware and software, security concerns, lack of time and workload were the most cited barriers to use EMR(47).

In a qualitative study conducted in Hawaii to assess barriers to use EMR among health care professionals, system compatibility and communication problems with health care providers and the hospital were a common barrier to adopt and use EMR(48). In another study conducted in Saudi Arabia, the most commonly cited barrier to use EMR was "loss of access to medical records transiently if computer crashes or power fails", followed by poor continuous training and support from information technology staff in the hospital(32). A similar study in the same continent showed that most health care providers responded EMR is easier than previous routines in accessing previously documented patient information (82.1%), entering daily notes (77.9%), and getting laboratory results easily (77%)(10).

Descriptive qualitative study design from Kenya reported that system reliability, power, and the internet, interoperability between system and component, were the major challenges to the adoption of EMR(30). In another study conducted in Ghana found that financial resource, data entry error, a constraint of logistics, and human resource shortage were major barriers to EMR. Besides, lack of computer competence,

shortage of technical personnel to install and operate EMR were significantly associated with EMR utilization(49).

The other common factors that hinder the implementation of EMR was attitude and perception of health care providers towards EMR. In a study conducted in Tehran university medical college among nurses revealed that 87.2% of nurses had the most positive attitude towards EMR. The most positive attitude towards EMR “it helps to establish proper communication among health care providers’ (87.2%) and avoid duplication (87.2%) with a mean attitude score of 4.36 from a range of 1-5 and the most negative attitude towards EMR was “to causes complexity of service delivery” (40.8%)(50). A study conducted in Malawi hospital showed that using EMR doesn’t interfere with providing consultation to patients. Among them, around 70% of respondents felt that EMR was more useful than a paper-based record. Managerial support, computer availability, level of education were negatively affecting the use of EMR(34).

In a study conducted in Ethiopia, nonfunctional computers and power fluctuation were the major reasons for not using EMR(15). In another study conducted in Ayder Referral Hospital, Mekelle, northern Ethiopia, nurses were the least users of EMR when compared with other professionals. Among the factors that hinder the use of EMR in this hospital were challenges in learning to use EMR, the problem in electronic connectivity, and power interruption(35)

In a study conducted in five hospitals in Ethiopia, 71.3% and 54.6% of professionals had good knowledge and attitude towards EMR, respectively. Having a good attitude towards EMR was significantly associated with readiness to implement EMR (AOR-1.56, CI-95%). Increasing awareness, knowledge, and skills of healthcare professionals on the EMR system before system implementation is recommended to improve the use of EMR (51). In another study in northern Ethiopia (n=428), 56.1% of respondents had a good positive attitude towards EMR. Health care providers' age, work experience, training, and computer skill were significantly associated with having a good positive attitude towards EMR(52).

2.6. Conceptual Framework

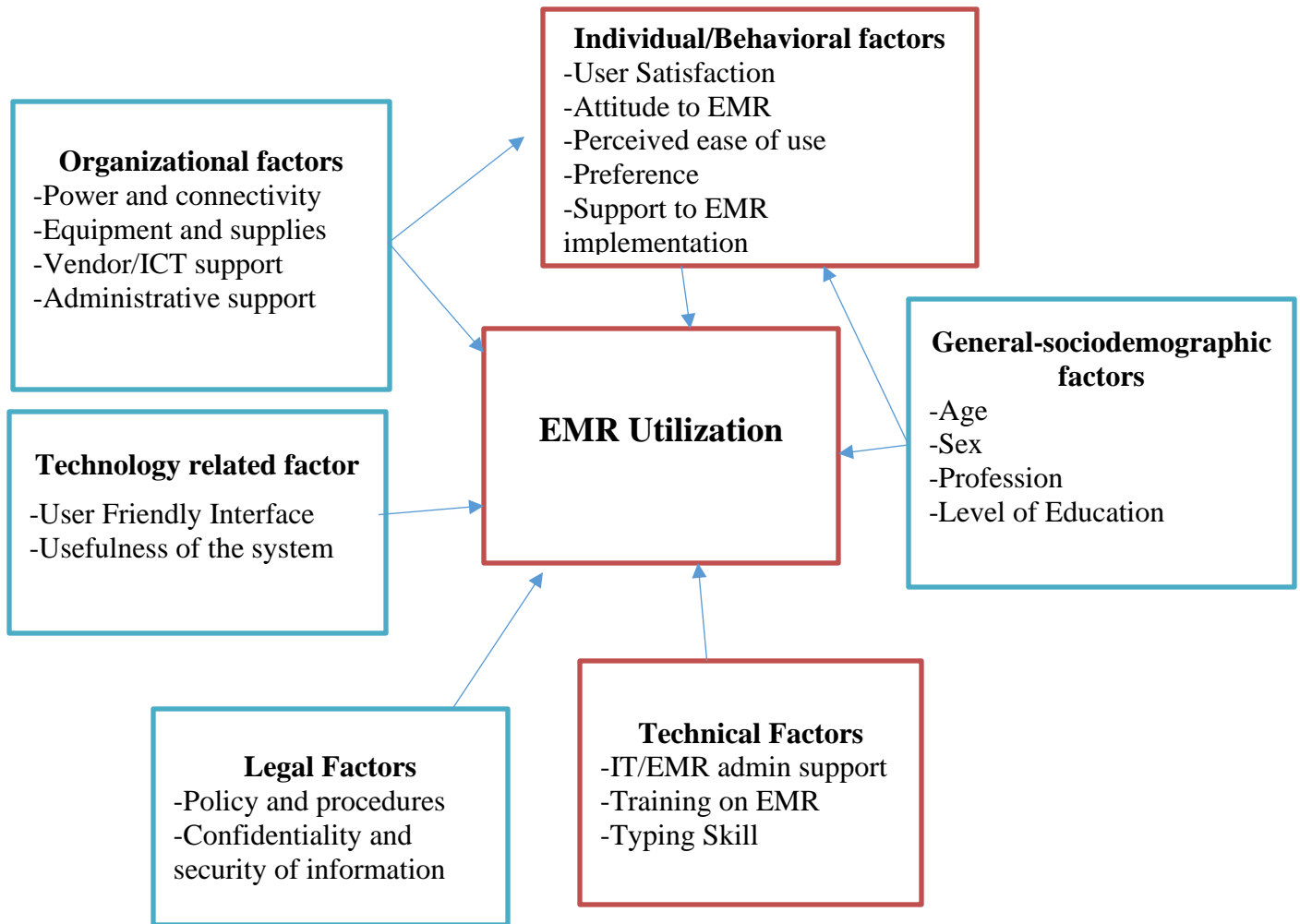


Figure 1. The conceptual framework for the utilization of EMR developed from reviewed literature, 2020

CHAPTER 3: OBJECTIVE

3.1. General Objective

The general objective of this study was to assess the utilization of EMR, its determinant factors and barriers among health care providers at selected health facilities of Addis Ababa city administration 2020.

3.2. Specific Objectives

1. To assess the utilization of EMR among health care professionals at selected health facilities in Addis Ababa city administration 2020.
2. To determine factors associated with the use of the EMR system among health care professionals at selected health facilities of Addis Ababa city administration 2020.
3. To explore barriers to use of EMR system among health professionals at selected health facilities of Addis Ababa city administration 2020.

CHAPTER 4: METHOD AND MATERIALS

4.1. Study area and period

The study was conducted in Addis Ababa city. According to the 2019/2020 annual performance report, Addis Ababa has 13 functional government-owned hospitals and 1 under-construction hospital, 98 currently functional government health centers, 978 private clinics, and 30 private hospitals. The total number of health care professionals in government health facilities was 10,697. However, there was a gap in data regarding total professionals in private health facilities, it is estimated that around 60,000 health workforce is deployed in private health facilities at the national level(11). The health service coverage in Addis Ababa concerning geographical accessibility is almost 100%. The study was conducted from May 2020-August 2020.

4.2. Study design

A cross-sectional study design using quantitative and qualitative methods (Concurrent triangulated study approach) was used to determine the utilization of EMR, its determinant factors and barriers to the utilization of EMR in four hospitals, two health centers and 1 clinic. The qualitative interview was used to explore factors that affect the utilization of EMR, otherwise, that cannot be captured using the quantitative survey.

4.3. Target population

The target population for the study was all health care professionals currently working in selected private and public health facilities in Addis Ababa city administration.

4.4. Source population

The source population for this study were all eligible health care professionals currently working in selected 2 public hospitals, 2 private hospitals, and 2 public health center and 1 private clinic.

4.5. Study population

The study population for this study were all systematically selected health professionals in each stratum from medical doctors, nurses/midwifery, laboratory technologists/technicians, pharmacists/druggists, and health officers currently working in selected health facilities.

4.6. Sample size determination

The sample size was determined by using a formula for estimating population proportion recommended by Cochran(53). To determine the sample size previous study conducted in five low resource setting hospitals in Ethiopia, which gives a maximum sample size, was used. The utilization of EMR by health care professionals in this study was 31.7%(15).

$$n = \frac{Z^2 P(1 - P)}{d^2}$$

Where: n = the required sample size

Z =the value of Z in the standard normal distribution that corresponds to a level of 0.05

p =Assumed population proportion $p=31.7\%$

d =the margin of error (precision) =5%

$$\text{So, } n = \frac{1.96^2(0.317(1-0.317))}{0.05^2} = 333$$

10% non-response rate and the design effect of 1.5 was used. Since the total population is <10,000 population correction formula was used and the final sample size becomes 367.

4.7. Sampling procedure

4.7.1. For the quantitative study

A multi-stage sampling technique was used. The first stage was clustering by facility type (owner) to select those health centers and hospitals that implemented EMR. In the second stage from each cluster, all public health facilities that implement a system of EMR were included in the study. Two private hospitals from 29 hospitals and one private clinic from 5 clinics, that implement EMR were selected randomly. In the third stage, from the selected health facilities, those health care providers who had experience in using EMR were stratified by professions such as medical doctors, nurses, midwifery, laboratory professionals, pharmacists, and health officers. Then, the proportional allocation of the sample size was made based on the total eligible population of each facility. Finally, the sample size was proportionally allocated for each stratum (profession), and study subjects were selected using a systematic random sampling technique.

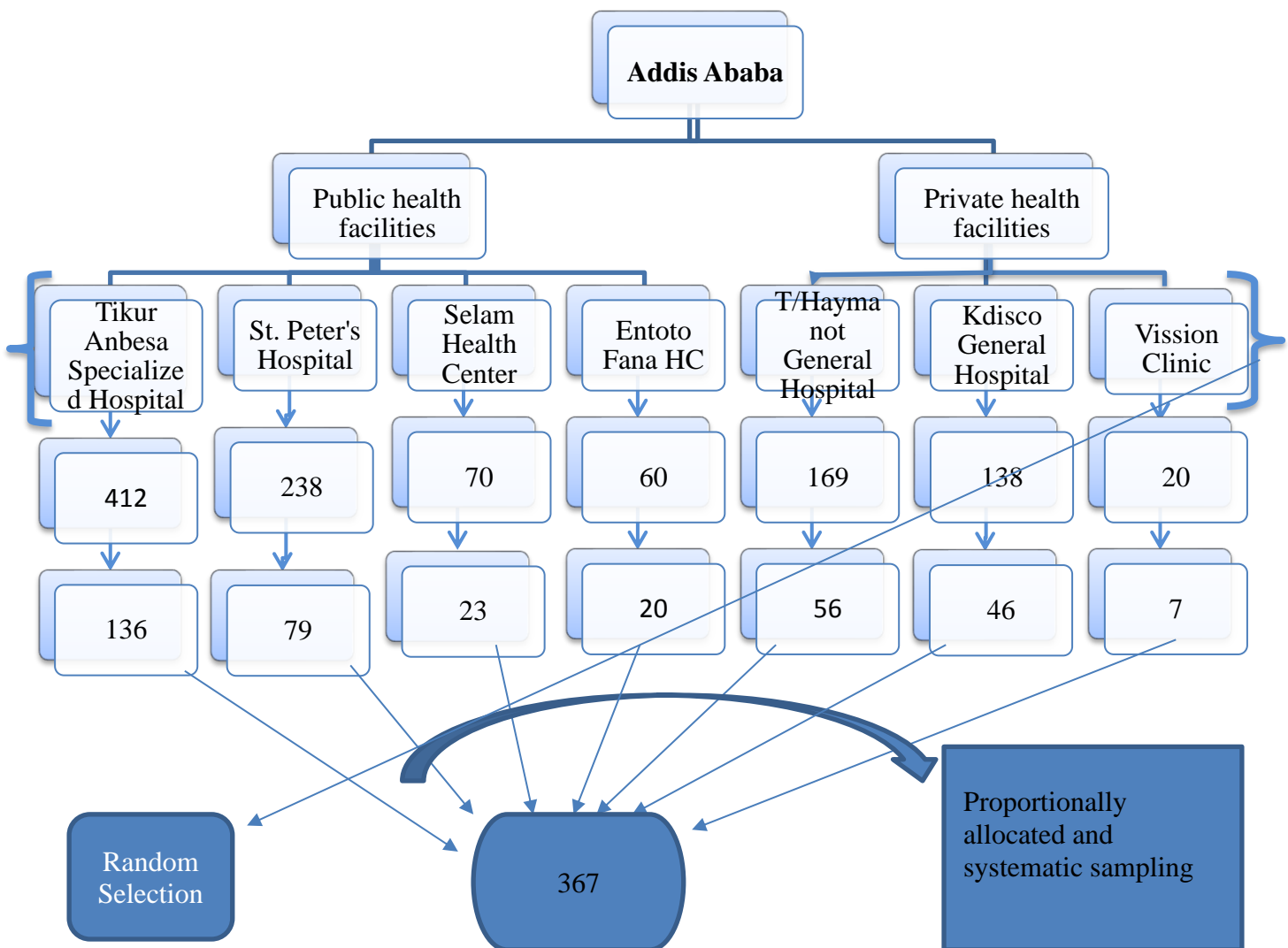


Figure 2. Sampling procedure for assessment of the utilization of EMR among health care professionals in Addis Ababa City Administration, 2020

4.7.2. For the qualitative study

For the qualitative interview, purposive sampling was used to select key informants. The participants were selected based on being able to provide the best information and are assumed to represent departments, and efforts were made to include health care providers who are working as department heads and were previously or currently using EMR system.

4.8. Inclusion and exclusion criteria

4.8.1. Inclusion criteria

Health care providers and resident physicians worked for six months and above and who were selected systematically in the selected health centers and hospitals.

4.8.2. Exclusion criteria

Health care providers who were in annual leave and study leave were excluded from the study.

4.9. Data collection tool and procedure

4.9.1. Quantitative data collection tool and procedure

Data was collected using a structured self-administered questionnaire adapted from similar works of literature(54) and the Agency for Health care Research and Quality (AHRQ) EMR end-user survey assessment tool. The questioner has five parts. The first part addressed the socio-demographic characteristics of the respondents and the basic 12 components of EMR system, a series of open-ended questions were suggested to understand their preference over the paper-based record and the dissatisfying factors towards EMR system. The second part experience and skill towards EMR assessing questions, the third part on training and related issues towards EMR, the fourth and fifth part were developed to assess the attitude of health professionals and major barriers to the utilization of the EMR. Data was collected by 6 nurses'/health officers and the orientation was given for data collectors regarding the purpose of the study, detail of the questions, how to maintain data quality, and the overall approach of the study. The questionnaires were prepared in English, and clarification was given for every unclear question on the request of respondents.

4.9.2. Qualitative data collection tool and procedure

An interview guide with flexible probing techniques was made with purposively selected key informants. All interviews conducted in Amharic was tape-recorded, translated and transcribed on the same day of the interview. Participants were encouraged to express their ideas freely and describe their experiences related to the topic. All interviews were conducted by the principal investigator with the trained research assistant.

4.10. Study variables

4.10.1. Dependent variable

- Utilization of Electronic Medical Record

4.10.2. Independent variable

- Age
- Sex
- Level of education
- Profession
- The perceived ease of using EMR
- Attitude to EMR
- Preference
- Perceived user-friendliness of EMR
- Support towards EMR implementation
- Training on EMR
- Training on Computer
- IT/EMR admin support
- Administrative support
- Availability of policy/guideline
- Type of health facility

4.11. Operational Definition

Electronic Medical Record: Medical record of patient information by using electronic devices available in physician's office, laboratory and pharmacy units for writing patient history, physical examination finding, diagnosis, and treatment and ordering laboratory and receiving results, prescribing medications, tracing drug-drug interactions and allergies without direct physical contact between providers.

Electronic Medical Record Utilization: Number of health care professionals who were using EMR at least 6 (half) out of 12 core functionalities of EMR system such as; writing a patient clinical profile, order and display laboratory and radiologic orders, e-prescription, the clinical decision support system, patient scheduling, patient referral between departments, the financial decision system, reporting and exchange of feedback between staff and higher administrators of health facilities.

Barrier: Barrier is any obstacle or factor that prevents health care providers and organizations from using EMR software. It includes human (managerial or immediate supervisor) action or response to the operation of one activity that hinders the progress of the work. It was measured by asking a list of ten major barriers from a five-point severity scale assessment questions to rank based on their severity from 1 (the least severe barrier) to five (the most severe barrier). Finally, 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 to the patient side (4 questions), the effect on the quality of care (2 questions), ease of use (5 questions), and cost of implementation and organizational benefit (4 questions). The bases for the classification of favorable and unfavorable attitudes towards EMR was based on the mean of each score.

- **Favorable attitude:** - Attitude scores that fell to the mean and above.
- **Unfavorable Attitude:** -Attitude score below the mean.

Ease of using EMR: It is the relative ease of EMR in performing different tasks. Ease of using EMR was assessed by 1-5 scale difficulty level assessment questions adapted from the work of Furukawa et.al (55). It is assessed by 10 ease assessing questions such as ease of EMR in documenting patient information, retrieving patient information, analyzing the trend of lab data, ease to accessing data from offsite locations, preventing drug-drug interaction and warnings, manage orders, enhancing continuity of care, communicating with colleagues, analyze the outcome of care and its easiness in managing chronic disease condition of patients. Finally, the mean composite score was calculated to determine individuals who scored above and below the mean.

4.12. Data Management and Analysis

4.12.1. Quantitative data management and analysis

Collected data was cleaned for missing value and inconsistent data. The data was entered into Epi-data and analysis was carried out by using STATA, version 15. For ordinal data, a five scale Likert scale data analysis was used, and the mean was calculated to classify favorable and unfavorable attitude towards EMR. For continuous data, descriptive statistics like; numerical summary measures, frequencies, and graphs (diagrams) were used. A chi-square test was used for describing the variables. Binary logistic regression analysis with odds ratio along with their 95% confidence interval was used to assess the association between dependent and independent variables. Then variables with a p-value of less than 0.25 were entered into the backward selection multivariable logistic analysis model as recommended by Hosmer-Lemeshow(56). In the model goodness-of-fit test, the Omnibus test of significance was $P < 0.001$ and the corresponding Hosmer-Lemeshow test chi-square result was 4.417 with a P-value of 0.818. The final finding was reported using crude odds ratio (COR), adjusted odds ratio (AOR) along with 95 % CI.

4.12.2. Qualitative data management and analysis

The tape-recorded data was transcribed to Amharic and translated to English. Atlas. ti software was used to code and categorize qualitative data. The imported raw data in Atlas. ti was read thoroughly text by text and codes were labelled. After that, codes were categorized into categories. Then every category was explained to conceptualize the interpretations of the whole data using the raw data. Then major themes were identified, coded and analyzed thematically. These themes include user experience towards the functionalities & missed features of EMR, and major barriers such as technical barriers, organizational and administrative barriers, financial barriers, behavioral constraints and legal barriers for the utilization of EMR.

4.13. Data Quality Control Methods

To ensure the completeness and consistency of data collection, clarification was given for data collectors. A meeting session was held on every day of the data collection period and thorough checking was done before using the filled questionnaires. A pre-test on 5% of the sample size was conducted on facilities outside the study area to check for the reliability of study tools before the actual data collection time. Cronbach's alpha was calculated and reliability coefficients for attitude towards EMR, perceived ease of EMR use and training were found to be 0.84 and above. The reliability coefficient for major barriers and basic components of EMR was found to be 0.70 and above, so the necessary correction such as ordering of questions, estimating the time required to finish the questions and rearranging not to elicit non-responses and don't knows were made on the assessment tool. Data editing was conducted daily by data collectors and principal investigator to check for completeness of the questionnaires. Data were entered and cleaned by the principal investigator before analysis.

4.14. Ethical Considerations

Ethical approval to conduct the study was sought from Addis Ababa university ethical review board and Addis Ababa regional health bureau. Permission was obtained from the head of each health facility. Written consent was obtained from respondents before intervening. The data was collected on volunteer individuals. Study participants were informed that they have the right to stop the interview and no potential risk by participating in the study. All study respondents were treated equally and they were informed about the aim, method and anticipated benefit of the research. All the study procedures were conducted based on scientific principles. The investigators make sure that the confidentiality of the information was assured in such a way that no disclosure of the study subjects concerning the finding was made.

4.15. Dissemination of Result

The survey result will be presented to Addis Ababa University, School of Public Health, for the partial fulfilment of the degree of master of public health in health system management. The document will also be disseminated to Addis Ababa regional health bureau. The result of the survey will also be disseminated to health facilities and concerned stakeholders. Finally, the study findings presentation and discussion will be held at the national level and effort will be made to publish the paper in internationally reputable journals.

CHAPTER 5: RESULT

5.1. General Socio-Demographic Characteristics

A total of 353 respondents were participated in the survey, making a response rate of 96.2%. More than half of the respondents were females 196 (55.5%). The mean age of respondents was 30.5 years (95% CI=30.0-30.9). Regarding their level of education, most respondents have degree 260 (73.7%) followed by masters 39 (11.1%) and specialty level of education 30 (8.5%).

In terms of their profession, due to the large proportion of nurses in each health facility, 170 (48.2%) of respondents were nurses followed by general practitioners 41 (11.6%) and laboratory professionals 38 (10.76%). Regarding the work experience of the participants, the mean work experience was 5.27 ± 0.32 years. Two hundred twenty-two (62.9%) of respondents had less than five years' work experience and 96 (27.2%) had 5-10 years' work experience. Over half of the respondents were from the government health facilities, accounting for approximately 244 (69.1%). The remaining respondents 109(30.9%) were from private health facilities (Table 1).

Table 1. General socio-demographic characteristics of study respondents in Addis Ababa health facilities, October 2020

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	166	47.0
Married	183	51.8
Divorced	4	1.1
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
Total	353	100.00

5.2. Socio-demographic characteristics of key informants

For the qualitative interview, 12 key informants participated. Around 8 (66.6%) of participants were males. The mean age of participants was 31.75 (95% CI = 29.07-34.4) years. Among them, 2 (16.7%) were medical directors, 5 (41.6%) EMR administrators, 2 (16.7%) curative service core processors, 2 (16.7%) general practitioners, and 1 (8.3%) matron nurse who are working at selected health facilities in Addis Ababa. A structured interview guide was used to standardize the topics. The average time of the interview was 25.13 (95% CI = 18.51-31.76) minutes.

5.3. Types of EMR system implemented in each health facility

From the key informant interview, different institutions implemented a different type of EMR software. Two government health centers, namely Entoto Fana health center and Selam health center, were using SMART-care/Tena-care; Tulane University was previously supporting both of them. One of the country's largest hospital, Tikur Anbessa specialized hospital, implemented an EMR called I-care developed by local software developers. St. Peters specialized hospital was previously implemented Tena-care, but when the software time-bound reached they switched to the new software called Abay Connected Health Record (ACHR), a web-based EMR developed by local software developers. The remaining private hospitals, Teklehaymanot general hospital and Kadisco general hospital use Prime-care and Brisk EMR systems, respectively.

5.4. Utilization of EMR and user experience towards EMR System

Of the total, 242(68.6%) health workers were utilizing EMR. Compared with private and public health facilities, 143(58.6%) health care providers from public health facilities and 99(90.8%) health care providers from the private health facilities were using EMR. From the chi-square test, a statistically significant association between the use of EMR and the type of health facility was found at $P < 0.001$. The most commonly used patient data recording system was combined use of both paper and electronic recording system 283 (81.6%), and paper only recording system 36 (10.4%). Only 21 (8.1%) of health care providers responded they were using paperless EMR. Most respondents 288 (81.6%) prefer the EMR system for patient information documentation. A statistically significant relationship was found between the preference of EMR and type of health facility (Table 3).

Table 2. Chi-square test of usage and preference of health care professionals towards EMR in Addis Ababa private and public health facilities, October 2020.

	Type of health facility		Chi2 (P-value)
	Private (%)	Public (%)	
Do you currently use EMR?			
Yes	99(90.8)	143(58.6)	36.3 (<0.001) *
No	10(9.2)	101 (41.4)	
Total	109(100)	244(100)	
Commonly used for documentation (N=347) **			
Paper only	6 (5.6)	30 (12.6)	
EMR only	12 (11.1)	16 (6.7)	5.4 (>0.05)
Combined use	90 (83.3)	193 (80.8)	
Total	108(100)	239(100)	
Prefer EMR over Paper-based record			
Yes	98 (89.9)	190 (77.9)	
No	11 (10.1)	54 (22.1)	7.3 (<0.01) *
Total	109(100)	244(100)	

*-Significant at $p < 0.01$; ** 6 missing values

Among the basic components of the EMR, the most common functional feature used by health care professionals were to order and display laboratory tests 266 (75.4%), for e-prescribing 249 (70.5%), and to document the history and physical examination findings 220 (62.3%). The least used feature was the clinical decision support system 65 (18.4%) such as drug-drug interaction and overdose notifications followed by electronic feedback system 76 (21.5%) and for patient referrals to other units 145 (41.1%).

From an open-ended questioner to assess the preference of EMR to the paper-based record, from the total of 21 individuals, 9 (42.9%) respondents mentioned that: “*I prefer the EMR system to write my final diagnosis, to order laboratory tests and for e-prescribing.*” The other 4 (19 %) respondents said that “*they prefer EMR than paper-based record because of its easiness and simplicity in performing tasks, preventing cross-contamination, saving time and reducing the loss of paper and human resource mismanagement in paper-based records.*” Around 3 (14.3%) mentioned that if power and connection fluctuation were stable and if all departments have access to the EMR system, they prefer EMR than paper-based records. The other 4 (19%) responded that if the system is inclusively implemented in all departments and easily accessible for everyone for all activities, they prefer EMR than the paper-based record. The remaining 1 (4.8%) respondent prefer EMR for information exchange with colleagues.

Generally, 68.6% (95% CI= 63.7-73.4%) of health care providers were utilizing half and above half of the 12 basic EMR components.

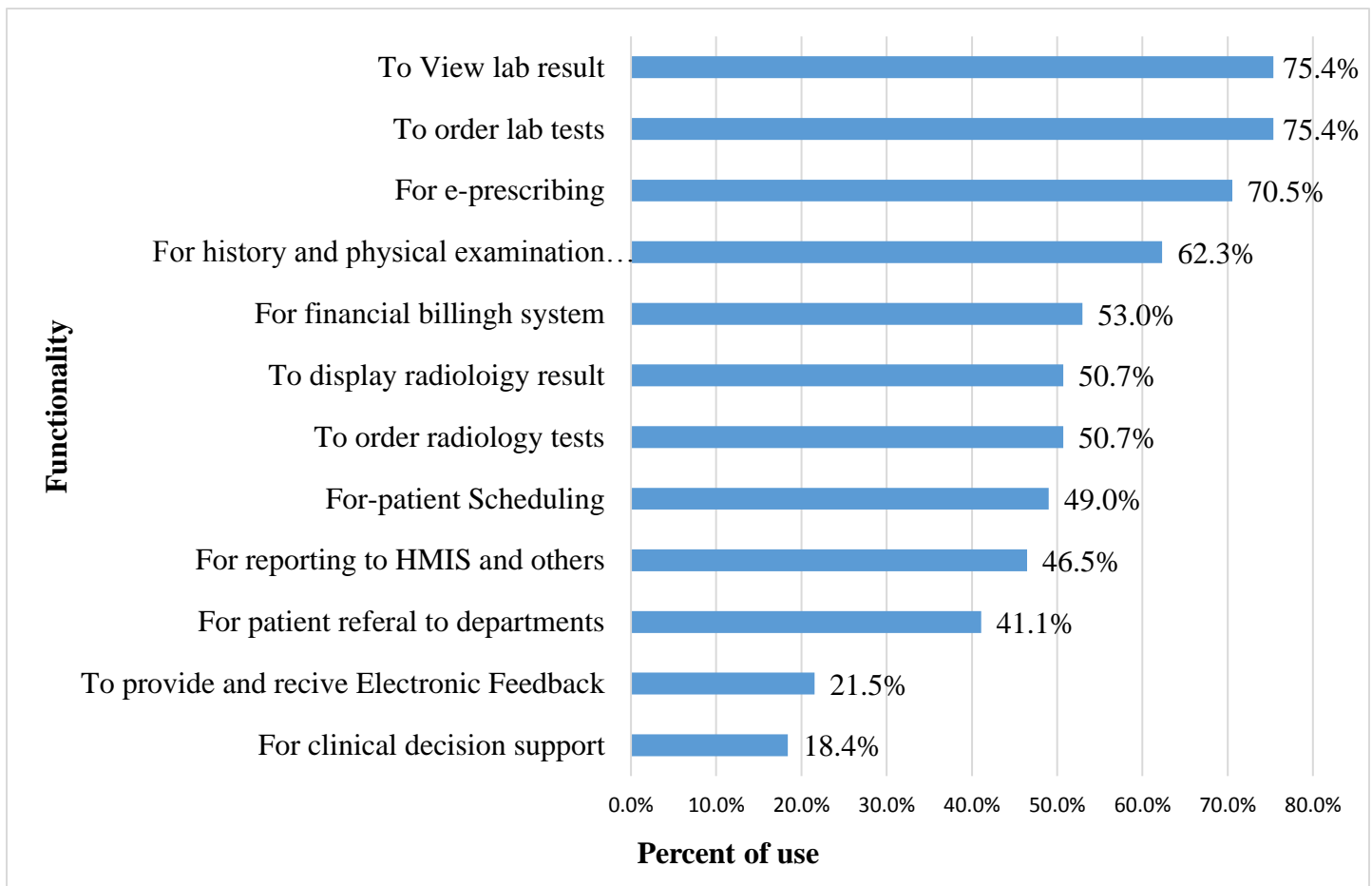


Figure 3: Basic components of EMR used by health care professionals in Addis Ababa Health facility, October 2020.

From the key informant interview, participants mentioned the major advantages they have got by using the system. Among this, they mentioned the EMR system helps them for easy retrieval of patient information, saves time spent on finding paper cards, and they also mentioned the system has improved communication between health care providers.

One key informant (Medical Director) explained that;

“... Everything is written clearly and legibly without erasing information. Once written and saved, it does not allow us to change what is already written. Besides this, the major challenge with the paper-based record relative to EMR was a loss of papers, but now this is not the problem. The existence of EMR in the facility helps us for easy retrieval of patient information whenever we need it by using patient master patient index (MPI) numbers, our time is saved which can be lost spending searching patient paper cards.” (KII R1)

The health care professional key informants from outpatient department mentioned several other advantages of the EMR system, such as patient information documented by using the EMR system is long-lasting and it is not easily liable to lose, fade-up, and breach. One key informant perceived that the system is highly helpful for patient information recording, developing subsequent plans and reduction of cost of service for the institution through the reduction of printing paper charts.

One Medical doctor emphasized;

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

Another EMR admin key informant mentioned that;

“The desired success is being achieved. The system has significantly reduced paper chart printing costs and other related paper publication costs. Besides, the number of times the patient is suffering to receive care spend by moving from one department to the other is reduced.” (KII R11)

They were also asked about the advantage of EMR in improving patient waiting time and its impact on the improvement of queue management in admission and surgical wards. Most of the facilities were properly using the system in outpatient departments, but the system was not implemented in inpatient departments.

One EMR admin from the government hospital raised the issue that;

“... In the emergency department, it helps to urgently triage patients to treatment OPDs without waiting for a queue. It provides emergency alerts. Every manager or ward head can easily access every day’s data that is done within a matter of minutes. They can retrieve information and trend of the number of patients seen, who is doing too much. They can also easily determine which individual is available in his workplace and what resources are required to which department through analysis of every day’s data electronically.” (KII R6).

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).

5.4.1. User experience towards functional and missed features in the EMR software

This theme describes the basic usefulness and functional features of the EMR system that are expected from every type of basic EMR. The participants were mainly asked about the twelve basic components of the system, including how the clinical decision support system is functioning, the financial billing system and other missed functional features in the system. Most of the EMR software's developed by vendors outside the country. Only two government hospitals were using locally developed EMR software. Among them, one hospital was using web-based EMR.

One EMR administrator from the government health facility mentioned;

“... Previously we were using desktop application EMR, developed by Tulane University. The system has time-bound, and it stops in between. That was a onetime software that did not allow to update or add additional templates, then we were forced to implement the new web-based EMR. In this new web-based EMR, some features are not functional. We are in the development stage. For example, laboratory order and drug prescription features are not being used.” (KII R6)

The least commonly used functional features in almost all health facilities was the clinical decision support feature. They mentioned the system has reduced medical errors due to illegible prescription papers and problems related to remembering dose and form of drugs. The EMR system is filled with diagnosis list with corresponding drug dose, concentration, and type available that helps to remember and access up-to-date knowledge.

One key informant strengthened this idea;

“The system does not provide basic clinical decision support functions, for example, it does not provide drug-drug interaction alerts or 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 into the EMR. As a solution, some facilities summarize and write previous patient clinical information into the system. Besides, key informants complained pediatric departments were not given priority to implement EMR system, on the contrary to the fact that their clinical profile is required for long-term surveillance and research.

One medical doctor key informant mentioned that;

“...The system has no scanning capacity. We summarize and re-write previous records, lab values, and referral histories in the EMR system, but it is tiresome and requires time. The documents also lose their originality when summarized, and the original document is discarded that may have a serious medico-legal issue.” (KII R12)

5.5. The satisfaction of users towards EMR

Among all, 162(45.9%) health care professionals were not satisfied with the EMR system. Above half of health care professionals from the private health facilities, 70 (64.2%) were satisfied with the EMR system. Around 123 (50.4%) health care professionals from the public health facilities were dissatisfied with the EMR system. From the chi-square test, there was a statistically significant association between the satisfaction of users to EMR and type of health facility at $P < 0.01$.

An open-ended question was suggested in a self-administered questionnaire to specify the reason for their dissatisfaction. The most commonly cited factor for their dissatisfaction mentioned by 15 (50%) individuals was, “the EMR system not being implemented in all departments. It is creating redundancy of work and adding additional burden on our work.” The other dissatisfying factor mentioned by 4 (13.3%) respondents was the frequent connection and power fluctuation and slow computer startup time. Other mentioned factors for the dissatisfaction towards EMR was, being out of training and not well informed about the system 3 (10%), concern about the confidentiality of information 1(3.3%), the template was not easy to manipulate 2 (6.7%) and the system has no alert or drug-drug interaction notification and overdose warning and it does not support time and trend analysis of patient information and laboratory values 3 (10%). Additional factor raised by 2 (6.7%) respondents mentioned priority was given for physicians as a factor. Around 239(67.7%) health care providers perceived that the system is user friendly. The majority, 325(92.1%) of health care providers support the overall implementation of the EMR system (Table 3).

Table 3: Cross-tabulation of satisfaction, support, and user-friendly interface towards EMR by Public and Private health facilities in October 2020 (n=353).

Variables	Type of health facility		Chi2 (P-value)
	Private (%)	Public (%)	
Overall, are you satisfied with the EMR?			
Yes	70 (64.2)	121 (49.6)	6.5 (0.01) *
No	39 (35.8)	123 (50.4)	
Do you support the overall implementation			
Yes	104 (95.4)	221 (90.6)	2.4 (0.12)
No	5 (4.6)	23 (9.4)	
Total	109 (100)	244 (100)	

* Significant at $p < 0.05$

5.6. Health care provider’s experience towards the ease of using EMR

Ease of using the EMR was assessed based on a five-point difficulty level assessment scale compared to the paper-based medical record. Among all, 159 (45%) mentioned that “EMR system is somewhat easy to get and review patient information”. Around 65 (18.41%) of respondents responded that EMR is somewhat difficult to obtain and review patient information when compared with the paper-based medical record. From the difficulty level assessment questions, around 196 (55.5%) respondents responded that the current EMR is very difficult to access patient information from offsite locations. Regarding the ease of using EMR to prevent and reduce adverse drug events such as drug-drug interaction and drug-allergy notifications around 125 (35.41%) responded that the EMR is very difficult and 101 (28.6%) said that the EMR is somewhat difficult to prevent adverse drug events (Table 4).

Table 4: Assessment of the ease of using EMR among health care providers in Addis Ababa, 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 (e.g. Lab result)	43(12.18)	25(7.08)	65(18.40)	159(45.00)	61(17.28)	
To prevent adverse events, (e.g. drug-drug interaction)	37(10.5)	125(35.41)	101(28.6)	73(20.68)	17(4.82)	
To review trends in lab values.	42(11.9)	57(16.15)	90(25.5)	113(32.01)	51(14.45)	
Manage chronic disease conditions for my patients	55(15.58)	42(11.90)	73(20.68)	140(39.66)	43(12.18)	353
Manage orders	24(6.8)	55(15.58)	71(20.11)	161(45.6)	42(11.9)	
To analyze outcomes of care	41(11.6)	70(19.83)	93(26.4)	120(33.99)	29(8.2)	
Retrieve patient information easily	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(18.98)	75(21.25)	155(43.91)	31(8.78)	
Communicate with my colleagues to coordinate care	17(4.82)	44(12.46)	95(26.91)	151(42.78)	46(13.03)	

From the composite analysis of ease of using EMR, the overall mean score of ease of using EMR was 3.14 (95% CI=3.06-3.22). From a five-point difficulty level assessment scale, 188 (53.26%) health care providers have scored the mean and above the mean.

5.7. 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%) of health care professionals disagree with the question “I have received technical support from the IT staff whenever I need it” (median=3, IQR=2). Regarding health care professional’s satisfaction with the support they have received, only 140 (39.7%) were satisfied with the support from IT staffs (median=3, IQR=2). Around 167 (47.3%) of respondents disagree with the idea that the current EMR system provides useful reminders and notification. Above half 180 (51%) of respondents agree with the idea that the EMR screen responds instantly, and 156 (44.2%) replied the EMR system had helped them to analyze trends in laboratory data of patients.

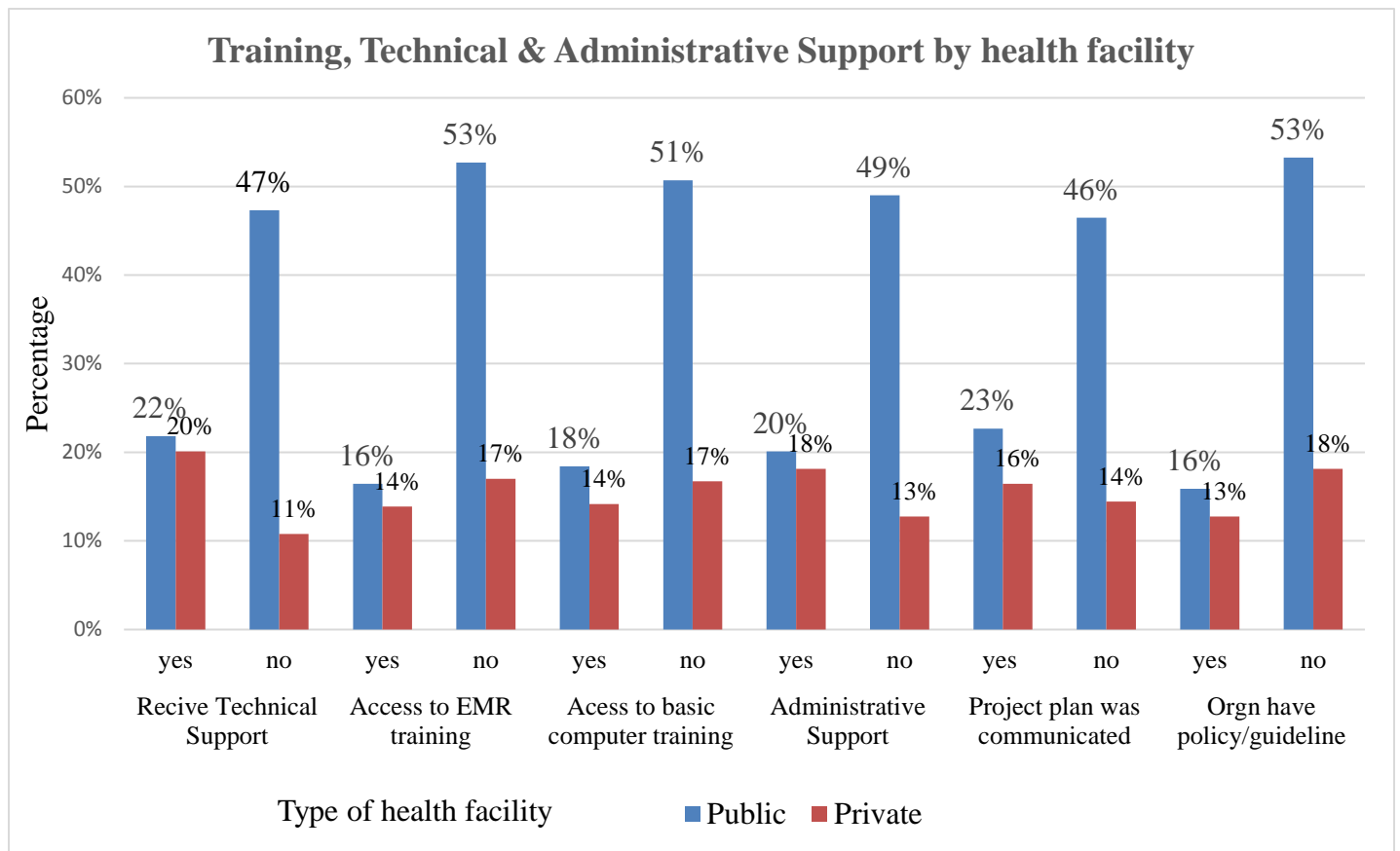


Figure 4. Access to training, IT, and administrative support to health care providers at Addis Ababa health facilities in October 2020.

5.8. The attitude of health care professionals towards EMR

Respondents were asked about their level of agreement on the benefit of EMR for patients, its effect on the quality of care and impact on the cost of services. Half of the study respondents 177 (50.14%) agree with the idea that “EMR increases practice productivity such as an increase in the number of patients seen per day”, and 190 (53.82%) agree with the statement “EMR helps to avoid medical errors”. Around 184(52.12%) agree with the idea that EMR helps to get up-to-date knowledge and 166(47.03%) approved EMR improves communication with colleagues. Regarding their level of agreement on the effect of EMR on the cost of service, 127(36%) agree with the question “EMR has an impact on the cost of service”, and 165(46.74%) agree with the statement, “EMR benefit outweighs the cost.” (Table 5). The overall attitude score of health care providers towards EMR was 3.49. Two hundred three (57.51%) of respondents had a favorable attitude towards EMR system.

Table 5: Attitude of health care 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(7.65)	28(7.93)	46(13.03)	177(50.14)	75(21.25)
EMR improves the quality of work practice	17(4.82)	18(5.10)	24(6.80)	205(58.07)	89(25.21)
EMR improve quality of care	19(5.38)	21(5.95)	27(7.65)	202(57.22)	84(23.80)
EMR reduces hard work	37(10.48)	51(14.45)	27(7.65)	163(46.18)	75(21.25)
EMR need more time to spend on training	27(7.65)	90(25.5)	61(17.28)	139(39.38)	36(10.2)
EMR benefits outweigh the costs	16(4.53)	50(14.16)	75(21.25)	165(46.74)	47(13.31)
EMR has an impact on the cost of service	26(7.37)	54(15.30)	110(31.2)	127(36)	36(10.2)
EMR improves confidentiality of patient information	19(5.38)	47(13.31)	78(22.1)	152(43.1)	57(16.15)
EMR increases patient acceptance	21(5.95)	60(17.00)	59(16.71)	169(47.88)	44(12.46)
EMR decreases waiting time of patients	19(5.40)	43(15.06)	53(15.06)	160(45.45)	67(19.03)
EMR is complex than paper-based record	63(17.85)	133(37.6)	61(17.28)	71(20.11)	25(7.08)
EMR improves interaction with colleagues	17(4.82)	51(14.45)	81(23)	166(47.03)	38(10.76)
EMR improves clinicians’ access to up-to-date knowledge	18(5.10)	37(10.48)	67(18.98)	184(52.12)	47(13.31)
EMR helps to avoiding errors	21(5.95)	29(8.22)	76(21.53)	190(53.82)	37(10.48)
EMR should be implemented at large	29(8.22)	22(6.23)	64(18.13)	174(49.29)	64(18.13)

5.9. Major barriers ranked by health care professionals towards the use of EMR

Major barriers were mentioned and respondents were requested to rank those problems based on the severity of the barrier to implementing the EMR system from 1 (least problem) to 5 (most severe problem). Among the list of major barriers that slow the full utilization of EMR, the most commonly cited barrier ranked first by health care professionals was power and connection fluctuation with the mean score of 3.25 (95% CI=3.11-3.40) from a five-point severity scale. When compared with private and public health facilities the first barrier common to both public and private health facilities was power and connection fluctuation. The second-ranked major barrier to the utilization of EMR was a shortage of computer and EMR training for public health facilities, and lack of supportive IT staff and capable EMR administrator for private health facilities (Graph 6).

In an open-ended self-administered questionnaire, 3 (50%) individuals stressed that lack of in-depth professional training and lack of even distribution of EMR materials to all departments, lack of commitment, job overburden, and inadequate computer availability as major barriers to the full utilization of EMR. One (16.6%) respondent said that *“The system is not well functional in inpatient departments; some residents use EMR to display only laboratory results. I think there is a gap in knowledge transfer and it should be supported by IT professionals.”* The other 2 (32.2%) respondents added, *“The system needs periodic maintenance from the IT department, I fear the system may collapse without a proper backup of patient information.”*

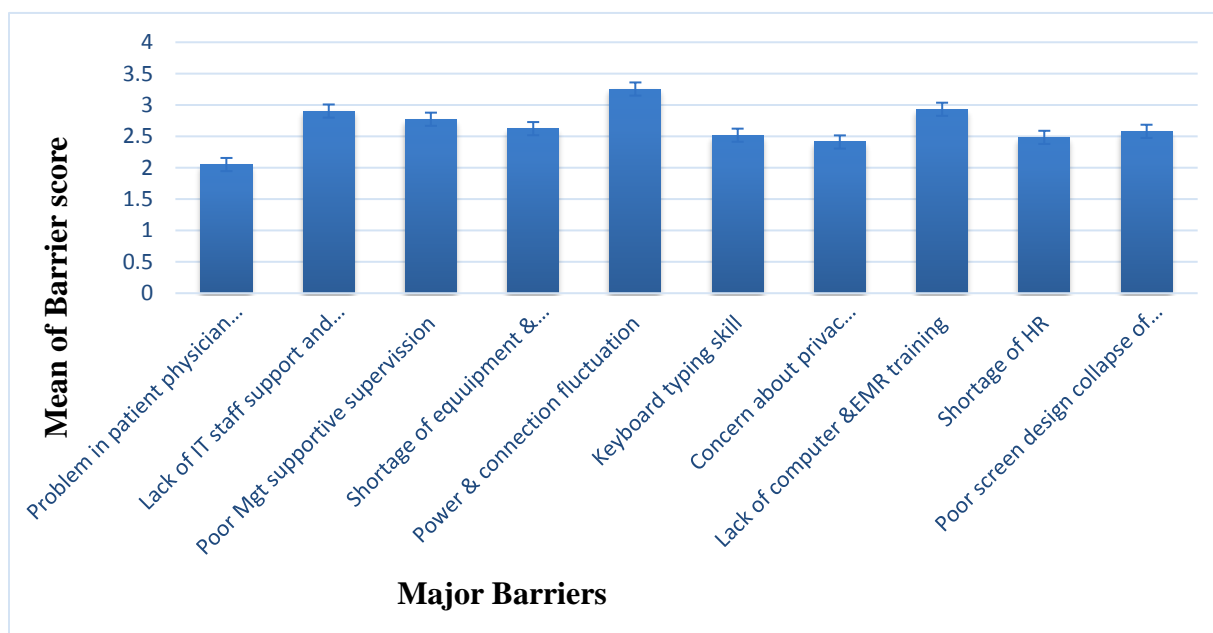


Figure 5. Major barriers perceived by health care professionals towards the utilization of EMR in Addis Ababa health facilities, October 2020

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

5.10.1. Technical barriers

This sub-theme describes common technical barriers to implement EMR raised by key informants. This includes IT staff support and capable EMR administrator, the experience of health care professionals towards using computers and EMR, and a lack of timely maintenance and support. Among the most commonly cited technical barriers from the key informants, the absence of timely maintenance and support, non-user-friendly EMR template, and physician's keyboard typing speed were mentioned as the common challenges to the full utilization of EMR. The skill and experience of health care providers to basic computer applications and EMR was also a challenge to use EMR. Improper integration of the EMR system with the new District Health Information System (DHIS) and the non-availability of some diseases classification lists in the EMR software were mentioned as technical barriers to the EMR utilization.

A senior nurse from one private hospital stated;

“...I am spending a lot of time writing patient history and physical examination findings on a non-properly specified template. The writing template is like writing on a word. It needs to be modified in short templates to be filled easily. 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 other issue raised by key informants was the frequent collapse of computers and the absence of timely maintenance from the ICT departments. They mentioned that capable EMR administrative was not available in three government-owned health facilities. One government health center EMR is out of functioning due to a shortage of human resources that can maintain computers, the system, and power sources. The head of the institution raised that;

“...We have no trained EMR administrator. There is a shortage of human resources who can administrate the EMR software and maintain the available automatic generator. Even if a large automatic generator is available in the facility, due to a shortage of manpower, the machine is not functional. Experts are needed to fix problems with the EMR system as well as to add and regularly update the EMR software. HIT professionals are not available in the market.” (KII R4)

The EMR system in one government-owned teaching hospital is not supporting the learning-teaching process, as explained by key informants. In this teaching hospital, the EMR system was not implemented in pediatrics, obstetrics & gynecology, MRI & CT-Scan and cancer treatment centers. This non-inclusive implementation of EMR creates a gap in reading and interpreting results by resident clinicians, as well as confirmatory pathologic findings after major surgeries due to partial implementation of the system.

5.10.2. Interoperability of the system

Interoperability signifies the ability of the system to work in all departments in an integrated manner. The major problem mentioned was the system not being properly integrated with the laboratory machines, printers and digital national reporting tools like DHIS2 and National Classification of Disease (NCOD). An example mentioned was a chemistry lab result and the CBC result is printed out in the machine and again the result is manually entered into the EMR system laboratory request template, which is an additional burden to laboratory staff. In one government hospital, time delay in receiving laboratory results was mentioned as a major system interoperability problem. They raise that the “Time bomb” in the system was creating the gap and recommend time bomb should not be allowed while the EMR system is implemented in health care institutions, which creates a significant barrier for continuity of care and sustainability of services.

5.10.3. Organizational and administrative barriers.

5.10.3.1. Administrative support and sustainability of the system

A gap in administrative support to the overall implementation of EMR was mentioned by key informants. The common challenge was non-institutionalizing the system. As mentioned by one EMR administrator, during the first phase of EMR implementation, the head of the hospital was giving special emphasis to digitalize the institution but later on when he leaves the hospital; the system completely collapses. The same problem was reported from other institutions. In between the exchange of directors: the system has stopped functioning for about two years.

One medical doctor added that;

“The hospital administration has no strict procedures it is loose....as an institution ...I don’t thinkeven the hospital seems without a leader there is no problem in using this term the institution needs to be properly managed. There should also 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 now it’s good, and it has to be implemented in all departments.” (KII R12)

From the key informants, the reason why they are not using the existing EMR system was due to the absence of enforcement to use the system. The other major challenge was in maintaining the sustainability of the system due to the phase-out of EMR developers. Among the assessed health facilities three were supported by TUTAPE, but currently, the agent is phased-out and one institution EMR is collapsing and the other has completely changed the system. They raised that it is due to a gap in knowledge transfer and the absence of a binding agreement between the vendor and the health facility.

In addition to the above-mentioned problem, the non-functionality of the system in all departments was a challenge for better internal referral and coordination of care. One medical doctor complained that the system is not inclusive for all departments. In pediatric, oncology, and obstetric wards, the system is not functional they use the traditional paper-based record system. This creates an on and off the working environment and also reduces the quality of care.

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. This is a serious issue that needs government concern otherwise it is a wastage of resources and adding additional burden to our health care professionals.” (KII R1).

The other barrier at the organization level mentioned by key informants was the unavailability of guidelines, SOP, and policy even at the national level. Furthermore, one key informant said that the EMR system has to be included in the educational curriculum to create a good opportunity to adapt the system when they are assigned to work. The absence of basic computer and EMR refreshment training was also mentioned by key informants.

5.10.3.2. Power and connection fluctuation

Power and connection fluctuation was a commonly cited barrier to the full utilization of the EMR system. Private health facilities have no identified gap related to power fluctuation, but they claim that slow computer startup time even after one minute of power interruption is a challenge. Government health facilities raise the concern of power fluctuation. In one government health center, no human resource was available to manipulate the existing generator.

5.10.3.3. Shortage of human resource, equipment, and supplies

The shortage of computers, power cables and server was mentioned in government health facilities. Poor support from the RHB and MOH was also mentioned as a gap. The shortage of HIT professionals and equipment was a challenge for government health facilities. The country’s largest tertiary hospital has no its own EMR administrator to maintain the functionality of the system. In one government health center, the facility medical director said that because of the absence of EMR admin, they can’t add or update laboratory requests and drug prescription templates. One key informant responded,

“We have a shortage of computers, especially 24/7 working computers in an emergency, pharmacy and laboratory departments needs to be replaced. The other major challenge is we have a shortage of human resources to maintain computers and other equipment. The other enormous problem was the server. The server was out of function. When the previous server was burned it takes about four months for the MOH and RHB to provide a functional server.” (KII R 1)

5.10.4. Behavioral constraints

This theme mainly describes a user’s perception, acceptance and resistance towards the EMR system. Resistance and poor adaptation during the first phase of EMR implementation were reported from all facilities, but after a long period of use, they prefer to use the EMR system. One key informant raised physician’s reluctance to use the EMR system;

“...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).

They mentioned that when power and internet fluctuation is frequent health care professionals regret to use the EMR system. Some individuals are also reported to have “computer phobia”. The other behavioral determinant was related to patient-physician interaction and customers also request paper-based prescriptions due to unfamiliarity with the electronic system.

5.10.5. Financial barriers

Financial determinants were described from the perspective of the cost of equipment and ongoing maintenance costs. 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 was supported by NGO. 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).

5.10.6. Legal barriers

Legal barriers that hinder the use of the EMR system are the absence of clear policy and guidelines to order narcotic and psychotropic medications and mobile devices that force health care professionals to use paper-based records. In one private hospital, one key informant mentioned that MOH prevents them to use paperless EMR due to the fear that the EMR system might be collapsed without proper backup devices. The other major legal issue mentioned was the available EMR system has no data encryption features to maintain the security of patient information. Some institutions provide a role-based password for each health care professional and supportive staff, but some institutions use a personal password that is not role-based. Another constraint was the absence of clear guideline 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 was not integrated into the EMR system not to expose ART patient information, and they use traditional paper-based records. The other legal barrier raised was related to the human resource procurement process. One key informant used the term;

“Even if IT professionals are available in the market, human resource hiring procedure and guideline has some restrictions on the payment. No one is willing to work with us with the mentioned salary scale.” KII R4.

5.11. Factors associated with the use of EMR

5.11.1. Bivariate analysis of factors associated with the use of EMR.

From the binary logistic regression model, being a private health facility was 6.99 times [COR=6.99 (95% CI 3.47-14.06)] more likely to use EMR than public health facilities. Respondents who have a favorable attitude toward EMR were 2.21 times (COR=2.21, 95% CI=1.40-3.49) more to use the EMR system. However, individuals aged 35 years and above were 58.6% (COR=0.414, 95% CI=0.211-0.817) less likely to use EMR than individuals in the age group between 23-28 years. Nurses were also 65.2% (COR=0.348, 95% CI=0.157-0.772) less likely to use EMR than other health care professionals. Other factors such as access to basic computer and EMR training, ease of using EMR, receive technical support, prefer EMR and support the overall implementation of EMR in the health facility have a positive association with utilization of EMR. Factors such as sex, marital status, and level of education do not have a significant association with the use of EMR (Annex 1, Table 7).

5.11.2. Multivariable analysis of factors associated with the use of EMR.

From a multivariable logistic regression model, being a pharmacist was 9.61 (AOR=9.61, 95% CI=1.97-46.8) times more likely to use EMR than other professionals. Having a user-friendly EMR interface increases the utilization of EMR by 2.85 (AOR=2.85, 95% CI=1.56-5.22) and the utilization of EMR in private health facilities was 7.17 times (AOR=7.17, 95% CI=3.189-16.15) more likely than in public health facilities. Individuals with favorable attitudes (AOR=2.30, 95% CI=1.26-4.19) and have access to EMR training (AOR=3.22, 95% CI=1.57-6.63) were positively associated with the utilization of EMR. Individuals aged 35 and above were 63.4% (AOR=0.36, 95% CI=0.143-0.94) less likely to use EMR records than individuals in the age group between 23-28 years. The result was statistically significant at P-value < 0.05 (Table 6).

Table 6. 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(70.68)	39(29.32)	1.00	1.00
29-34	124(72.09)	48(27.91)	1.072(0.65-1.768)	1.006(0.539-1.876)
35+	24(50.0)	24(50.0)	0.414(0.211-0.817) *	0.366(0.143-0.939) *
Profession				
General practitioner	32(78.05)	9(21.95)	1.00	1.00
Health officer	26(70.27)	11(29.73)	0.665(0.239-1.847)	1.250(0.377-4.146)
Nurse & midwifery	99(55.31)	80(44.69)	0.348(0.157-0.772) *	0.495(0.194-1.264)
Pharmacist	33(91.67)	3(8.33)	3.094(0.767-12.473)	9.609(1.973-46.79) *
Laboratory	30(78.95)	8(21.05)	1.055(0.36-3.089)	1.370(0.385-4.864)
Type of health facility				
Public	143(58.61)	101(41.39)	1	1.00
Private	99(90.83)	10(9.17)	6.99(3.478-14.059) *	7.167(3.180-16.152) *
User-friendly EMR interface				
Yes	179(74.90)	60(25.10)	2.415(1.508-3.868) *	2.849(1.555-5.223) *
No	63(55.26)	51(44.74)	1	1.00
Attitude to EMR				
Favorable attitude	154(75.86)	49(24.14)	2.21(1.401-3.497) *	2.298(1.260-4.192) *
Unfavorable attitude	88(58.67)	62(41.33)	1	1.00
Access to basic EMR training				
Yes	93(86.92)	14(13.08)	4.324(2.332-8.017) *	3.225(1.569-6.630) *
No	149(60.57)	97(39.43)	1	1.00

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

CHAPTER 6: DISCUSSION

This study was conducted to assess the utilization of EMR and determine factors that hinder the utilization of the system among health care providers currently employed in both private and public health facilities. To better understand and assess the situation, a mixed study design with a concurrent triangulation analysis approach was used by involving 353 frontline health care providers who have used the system for at least six months and 12 key informants working in selected health facilities. All selected health facilities have adopted a system of EMR, but their level of functionality and use varies from one facility to another.

In this study, the overall utilization of EMR by health care providers was 68.5% during the actual date of data collection. Compared with the finding of other studies, the utilization of EMR in our study was consistent with a study from Dire Dawa hospital (67.7%)(36) but higher than the study conducted in the West Oromia Region (42%)(57), Gondar (31.7%)(15). The finding was lower than in the study conducted Ayder referral hospital (87.6%)(35). The higher level of utilization in the latter hospital could be due to the hospitals was pilot EMR implementation hospitals and extended time variation between implementation and assessment of utilization in our study setting. The other likely explanation may be due to the decline in the usage of EMR in public hospitals because of the phase-out of vendors that introduce the system to the facilities in our study setting. The low utilization in the former hospitals may be due to power fluctuation gaps in regions and the reported absence of stand by generators.

In our study, the basic EMR components used by health care providers were “to order and display laboratory results followed by e-prescribing and history and physical examination finding documentation.” A consistent result was reported from a study conducted in the western part of the Oromia and Tigray region(35,57). The least basic component of EMR utilized was the clinical decision support feature (18.5%) and the exchange of feedback this may be due to individuals being unaware of these functionalities. This finding was supported from key informant interview that, the clinical decision support feature was not functioning and all EMR software have no scanning capacity. This may be due to the fact that the non-inclusive implementation of EMR in the majority of assessed health facilities.

From the multivariable analysis of factors affecting the use of EMR, individuals aged 35 and above were less likely to use EMR than individuals aged 23-28. The finding was supported by a finding from in a study conducted in Ethiopia (52) and systematic review conducted in primary care physicians, in which young primary care physicians were more likely to use EMR than older physicians(58). This may be explained by the fact that young age groups are closer to new technologies than aged ones, which signifies the importance of refreshment and on-job training for aged health care professionals. However, being a pharmacist was more likely to use EMR than others. This may be due to pharmacists being forced to use computers for

better dispensary and auditing purposes.

The other significant factor associated with the use of EMR was health care providers from a private hospital was more likely to use the EMR than the public hospitals. This level of disagreement may be due to the level of enforcement being available in each health facility and limited accountability in public hospitals than the private ones, this finding implies that the importance of enforcing health care providers to use EMR.

Among the factors associated with the use of EMR, having EMR training was also significantly associated with the use of the EMR system. In this study, only 30.3% of health care professionals have received basic EMR training. In a study conducted in Gondar university referral hospital, 64% of health care providers have received EMR training(15). The inconsistency may be related to a high number of nurses in our study, it might be difficult to train all professionals in tertiary hospitals.

The other factor positively associated with the use of EMR was the attitude of health care providers towards EMR. About 57.51% of health care providers have a favorable attitude towards EMR. But a significant number of health care providers were having an unfavorable attitude towards the system. A similar result was reported in the study from the northern part of the country 56.1% and 54.6% were having a good attitude towards EMR in Gondar and Ayder referral hospitals, respectively(51,52) 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%)(34,36,50). Facilities with a user-friendly EMR interface was also significantly associated with the use of the EMR system. Around 67.7% of health care providers perceived that the EMR system is user friendly, which is consistent with a study finding from Jeddah Saudi Arabia(10). A similar finding reported that EMR training, the attitude of health care providers, and user-friendly interface were significantly associated with the use of EMR systems in a study from Dire Dawa, Malawi, Saudi Arabia, and Tehran hospitals(10,34,36,50).

However, factors such as ease of using EMR, preference, and staff dissatisfaction were not associated with the use of the EMR system. In this study, the mean level of ease of using EMR from a scale of 1-5 in our study was 3.14 which is consistent with a study conducted in California in which the ease of using EMR was 3.5(59). In our study, 53.6% of professionals raised that EMR is easy to use than previous routines. The majority of respondents (81.6%) prefer EMR over paper-based record the result was consistent with a study conducted in the Northern part of the country (76.4)(52) but higher than a study in Ayder hospital in which 67.9% of health care providers prefer paper than the EMR system(15) the variation in the result may be explained by the long-term user experience and inclusiveness of private health facilities in our study.

In a previous study conducted in Saudi Arabia(10), 81% of health care providers found out that EMR was easier than the paper-based record in reviewing patient information, and 82.2% mentioned EMR was easier in retrieving data and another finding in Ethiopia(35) signifies 79.2% respondents reported that the EMR system was easy and easier when they use it to follow the result of a particular test, 76.9% responded the system was easy and easier to order clinical laboratory, 81.5% of the respondents were reported as the system was easy and easier when using it to obtain a result of laboratory analysis. The result was in line with our study finding.

The finding of this study signifies that a significant proportion of health care providers (45.9%) were dissatisfied with the EMR system. The major dissatisfying factor for the problem was mainly the non-inconclusive implementation of the EMR system, power and connection fluctuation, shortage of training, and the double burden of work doing parallel in both paper and EMR system. The study finding was higher than a study conducted in Ayder referral hospital(15) but better than in a study conducted in five low resource setting hospitals in Ethiopia(35). The variation may be explained by the frequent collapse of computers and the non-availability of vendors that provide technical support and power and connection fluctuation in our study context.

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”(32). This is in line with our study finding in which the first ranked barrier by the respondents was power and connection fluctuation, followed by a shortage of EMR training.

In a study from Ghana and Kenya(29,49), the major barrier was the shortage of technicians and capable EMR administrators to program and maintain the EMR system, shortage of computers and scanners. The result was consistent with the finding from our study in which the most significant factors that hinder the implementation of EMR was found to be a shortage of equipment and absence of competent EMR administrator to maintain EMR system and stand by power sources. Basic computer and EMR training and poor commitment from the facility administrators were also major cited barriers to use the EMR system. The other major issue perhaps the most significant barrier mentioned was related to transient vendors that introduce the system to the respective health facilities and a problem in the knowledge transfer from the implementing organization and health facilities that result in the collapse of the EMR system. On the contrary, in a systematic review conducted in the USA, the most commonly cited barrier was the cost of implementation(60). The variation may be due to the EMR was implemented by NGOs in our study setting. Another barrier mentioned by key informants was technical barriers related to keyboard typing speed as

well as the frequent collapse of the system. Additionally, the other problem identified was a shortage of human resource that is capable of maintaining and updating EMR software and power sources. A similar finding was reported in a systematic review conducted to assess barriers to EMR implementation(38,61). Besides this, a lack of support from the regional health bureau and MOH in providing required equipment, mainly power sources, computers and servers were mentioned as barriers in our study. Another study found out that strong administrative and physician leadership is required to investigate all the potential risks for medical error, system failure, and legal responsibility in implementing EMR sustainably(62). Regarding the basic behavioral determinants, health care professional's resistance to the EMR system during the beginning of EMR implementation was mentioned. The finding was consistent with the study reported in Nigerian hospitals(63).

Improper integration of EMR system with the new DHIS, national classification of disease, and laboratory machines were also mentioned as significant barriers. This could be due to the unavailability of capable EMR administrator and ICT professionals. This may create redundancy of work and misreport of data. A similar challenge was reported in a study conducted in Tanzania, data was first written in paper-based HMIS reporting books and then re-entered into the DHIS2 and it was found to be error-prone. The non-institutionalization of the EMR system was also a common factor that hinders the sustainability of the system that needs greater attention to the sustainability of the system.

The other major challenge reported was the absence of clear EMR guidelines at the facility and even at the national level. An additional barrier that was raised was legal issues related to the full utilization of the EMR system. Restrictions in prescribing narcotic and psychotropic medications were mentioned as an example. The gaps were because of the absence of clear and cut guidelines and policy in using the EMR system. In a study conducted in Saudi Arabia hospitals among other barriers lack policies/ procedures that govern EMR on the hospital level and lack of laws or legislation that govern EMR on the national level and how the EMR system is easily accessed/disclosed were reported to be significant barriers to the utilization of EMR(64). The other legal barrier raised by key informants was the concern about the confidentiality and security of patient information. Most of the health facilities were using a personal password which was shared across departments and not role-based that raises the concern for confidentiality and security of patient information. No facility was using any advanced security systems such as data encryption systems. Similar findings conducted in Ethiopia by Binyam et al. strongly asserted this condition(65). Scholars recommend data encryption technologies needs to be used for information security, but encryption alone is not recommended as a sufficient solution as a security measure, but its use is highly recommended when data is transmitted over public networks(1)

6.1. Strength and limitation of the study

6.1.1. Strength.

As a strength, this study uses a mixed study design by involving front line health workers and key informants to better understand and determine barriers to EMR utilization and the response rate was also very high. The study also incorporates both private and public health facilities to better understand the challenge of implementing EMR.

6.1.2. Limitation.

This study did not assess the patient perspective on the implementation of EMR. The nature of the study by itself doesn't assess the cause-and-effect relationship of basic factors that impede the utilization of EMR. Due to the current COVID-19 pandemic, it was difficult to interview and acquire detailed information from higher administrators of hospitals.

CHAPTER 7: CONCLUSION

In conclusion, EMR utilization in our study was good. However, the overall utilization of EMR was lower than the previous studies. Even if a system of EMR is implemented in health facilities, the system is fragmented and patient information documentation was mainly combined use. The use of basic EMR functionalities was found to be low, mainly used to order and display laboratory investigations. The clinical decision support feature was not used by health care professionals in both private and public health facilities. The study finding suggests that access to basic EMR training, the attitude of health care providers and the EMR interface were affecting the use of EMR. Additionally, the study found out that system interoperability problem, power and connection fluctuation as barriers to EMR utilization.

The study ascertained the absence of clear EMR guidelines at the facility and even at the national level. Utilization of EMR was hindered by regulations from the MOH, frequent exchange of directors and concern about the confidentiality and security of patient information. No facility was using any advanced security systems such as data encryption technologies.

CHAPTER 8: RECOMMENDATION

Based on the finding of the study, we suggest the following recommendations.

1. **FMOH:** The ministry should set clear policies and guidelines on how to use EMR and paper documentation system in parallel and when to use paperless EMR. Besides this, when the EMR system is implemented, it is recommended to have a strong binding agreement and clear phase-out strategy when the responsibility of system implementation is given for transient vendors. In collaboration with the ministry of education, we recommend including EMR introductory course for all health care professionals that will create a favorable environment for easy adaptation of the system when they are assigned to practical work and train health information technology professionals to meet the human resource demand.
2. **RHB:** The regional health bureaus should provide basic technical support for the maintenance of EMR and power sources, provide equipment, and it should facilitate basic computer and EMR training for health care providers.
3. **For health facilities:** Each health facility should provide refreshment training and make the EMR system more user friendly for effective use of the system. The system should be implemented in all departments inclusively for better coordination of care and to reduce patient burdens. Besides, enforcement in using the system and developing its working guideline is recommended.
4. **For researchers:** This research assesses only the existing utilization status and its major barriers but it doesn't assess the data quality when compared with the paper-based record, patients view on the EMR, and main legal issues such as patient information security and confidentiality maintenance features are recommended to be properly assessed.

CHAPTER 9: REFERENCES

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ANNEXES

Annex 1. Bivariate Analysis of factors associated with the use of EMR

Table 7. Bivariate Analysis of factors associated with the use of EMR in Addis Ababa health facilities in October 2020 (n=353).

Characteristics	Utilize EMR		COR (95%CI)
	Yes Frequency (%)	No Frequency (%)	
Sex			
Male	101(64.33)	56(35.67)	1.00
Female	141(71.94)	55(28.06)	1.42(0.905-2.232)
Level of education			
Diploma	17(77.27)	5(22.73)	1.00
Degree	169(65.0)	91(35)	0.546(0.195-1.529)
Masters +	56(78.87)	15(21.13)	1.098(0.348-3.462)
Marital status			
Single	109(65.66)	57(34.34)	1.00
Married	129(70.49)	54(29.51)	1.249(0.796-1.961)
Divorced	4(100)	0(0.00)	-
Age of Respondent			
23-28	94(70.68)	39(29.32)	1
29-34	124(72.09)	48(27.91)	1.072(0.65-1.768)
35+	24(50.0)	24(50.0)	0.414(0.211-0.817) *
Profession			
GP	32(78.05)	9(21.95)	1.00
Health Officer	26(70.27)	11(29.73)	0.665(0.239-1.847)
Nurse& midwifery	99(55.31)	80(44.69)	0.348(0.157-0.772) *
Pharmacist	33(91.67)	3(8.33)	3.094(0.767-12.473)
Laboratory	30(78.95)	8(21.05)	1.055(0.36-3.089)
Type of health facility			
Public	143(58.61)	101(41.39)	1
Private	99(90.83)	10(9.17)	6.99(3.478-14.059) *
User-friendly EMR interface			
Yes	179(74.90)	60(25.10)	2.415(1.508-3.868) *
No	63(55.26)	51(44.74)	1
Prefer EMR over the paper			
Yes	206(71.53)	82(28.47)	2.024(1.165-3.515) *
No	36(55.38)	29(44.62)	1
Support overall implementation			
Yes	232(71.38)	93(28.62)	4.49(1.998-10.09) *
No	10(35.71)	18(64.29)	1
Satisfaction to EMR			
Yes	147(76.96)	44(23.04)	2.36(1.488-3.731) *
No	95(58.64)	67(41.36)	1
The attitude of HCW to EMR			
Favorable attitude	154(75.86)	49(24.14)	2.21(1.401-3.497) *

Unfavorable attitude	88(58.67)	62(41.33)	1
Ease of use			
Easy to use	148(78.72)	40(21.28)	2.794(1.75-4.452) *
Not easy to use	94(56.97)	71(43.03)	1
Access to basic computer training			
Yes	96(83.48)	19(16.52)	3.183(1.824-5.557) *
No	146(61.34)	92(38.66)	1
Access to basic EMR training			
Yes	93(86.92)	14(13.08)	4.324(2.332-8.017) *
No	149(60.57)	97(39.43)	1
I receive technical support			
Yes	121(81.76)	27(18.24)	3.111(1.884-5.137) *
No	121(59.02)	84(40.98)	1
Satisfied with the support			
Yes	115(82.14)	25(17.86)	3.114(1.867-5.196) *
No	127(59.62)	86(40.38)	1
Access to EMR guideline/policy			
Yes	82(81.19)	19(18.81)	2.481(1.415-4.349) *
No	160(63.49)	92(36.51)	1
Administrative support			
Yes	116(85.93)	19(14.07)	4.458(2.560-7.762) *
No	126(57.80)	92(42.20)	1.00
Project plan communicated			
Yes	115(83.33)	23(16.67)	3.465(2.052-5.849) *
No	127(59.07)	88(40.93)	1.00

*Significant at $p < 0.05$; COR-Crude Odds Ratio; CI-Confidence Interval; HCW-Health Care Professional.

Annex 2: Screenshot of EMR templates taken from health facilities

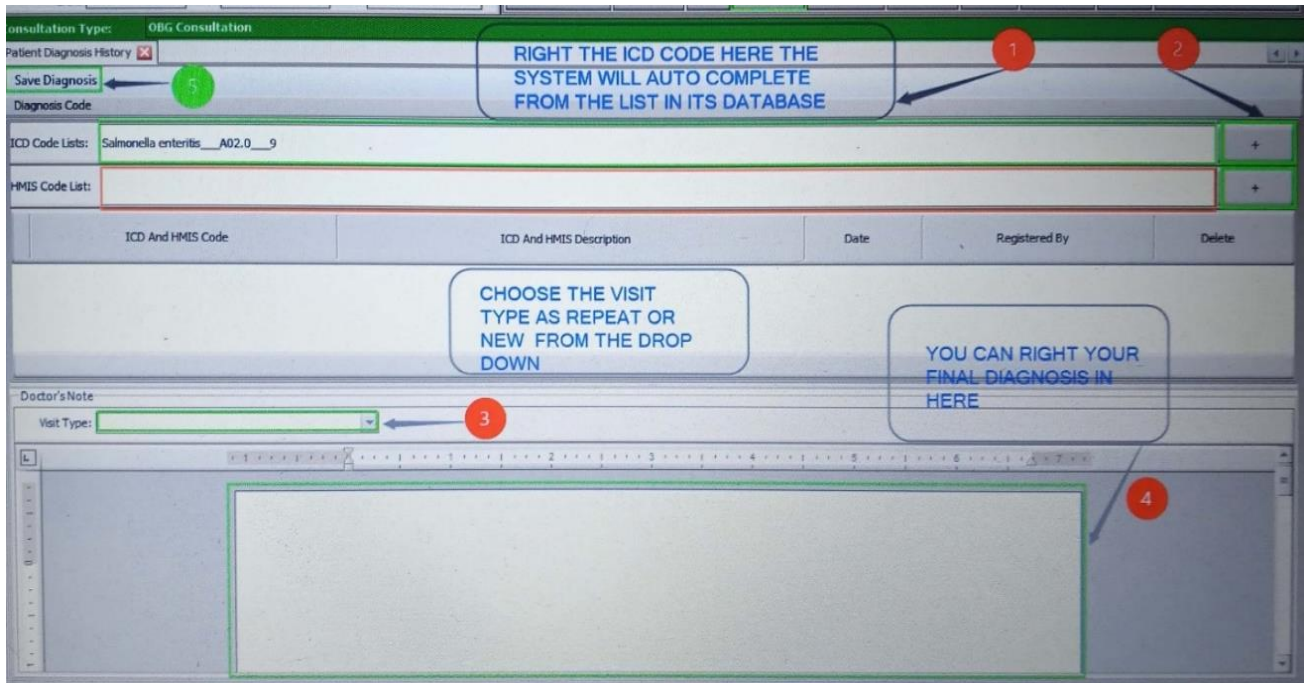


Figure 6. Diagram showing non-user-friendly template raised by key informants at Kadisco general hospital, October 2020.

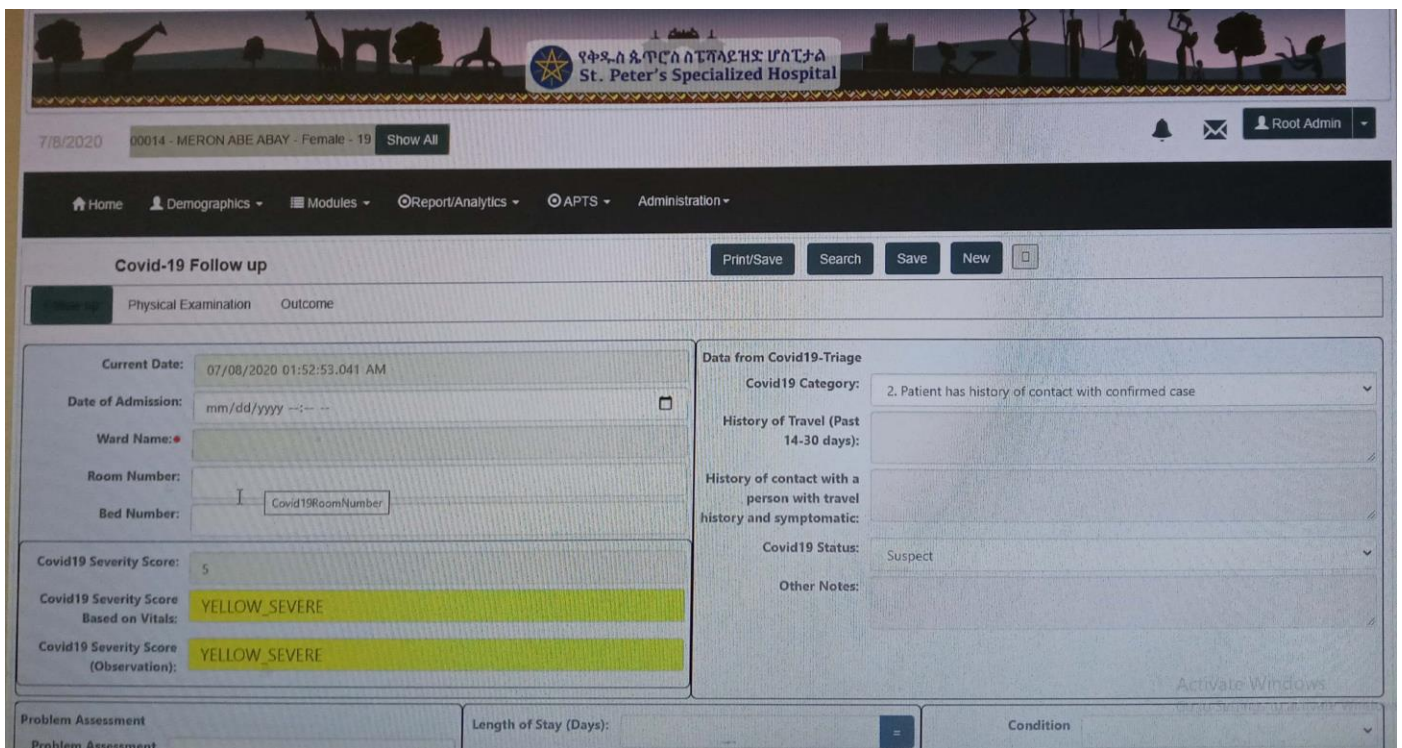


Figure 6.COVID-19 follow-up template taken from St. Peter hospital, Addis Ababa, October 2020.

Annex 3. Qualitative data code-book

Table 8. Code-book for qualitative data analysis of user experience and barriers to EMR utilization at health facilities October 2020.

No	Category	Codes	Description
1	Use and usefulness	<p>1.1. Information use</p> <p>1.2. Timesaving capacity</p> <p>1.3. Contagious disease transmission reduction.</p> <p>1.4. Triageing</p> <p>1.5 Ease of retrieving patient information</p> <p>1.6. Facilitation of referral system.</p> <p>1.7. Clinical decision support system.</p> <p>1.8. Error reduction</p> <p>1.9. Cost of service.</p>	<p>Refers to using data generated from EMR for decision making and planning. Decision making could be for resource allocation strategy for departments per their needs or performance.</p> <p>Refers to another advantage or feature of EMR in which helps in determining the standard TAT for services and helps improve the waiting time of patients.</p> <p>Refers to the advantage or feature of EMR which reduces the transmission of infectious disease such as COVID-19, Hepatitis, which can be transmitted via indirect contact when using a paper-based system</p> <p>Refers to the advantage or feature of EMR which helps in the prioritization of patients according to their cases</p> <p>Refers to the advantage or feature of EMR which reduces the time to track down a patient card using a unique MRI number.</p> <p>Refers to the advantage or feature of EMR which helps manage referred patients and monitor the ambulance schedule as well</p> <p>Refers to advantage or feature of EMR which helps in decisions drug-dose, drug-drug interaction, alert for abnormal vital signs finding</p> <p>Refers to the advantage of EMR to reduce medical errors caused by ineligible and unclear writings that increase the quality of work</p> <p>Refers to the helpful property of EMR to minimize the cost of paper pull chart printing costs and cost-related with other publication costs.</p>

- 1.10. Quality of care.** Refers to the improved quality of care after implementation of the EMR
- 1.11. Financial billing system.** Refers to the advantage of EMR that helps the patients deposit their money and subtract from their balance according to the services they get.
- 1.12. Report quality** Describes the improvement of reports after EMR implementation

2. Barriers		
2.1. Organizational barriers.	2.1.1. Shortage of equipment and supplies.	Describe the inadequacy of equipment's required for EMR including computers, power and connection cables, servers, UPS and standby generators
	2.1.2. Shortage of human resource	Describes shortage of maintenance personnel for the computers, generators, EMR software or other equipment, it's also mentioned to describe the lack of HIT and other health care professional professionals which was required to use EMR system.
	2.1.3. Availability of training	Refers to the availability of on-job and periodic training on EMR which was given to health professionals
	2.1.4. Sustainability of service.	Refers to the continuity of care during irrespective of other barriers, such as during unreliable power supply, the exchange between directors and HIT staff. Continuity of EMR in collaborating with other stakeholders such as the ministry of technology and innovation instead of just relying on foreign NGO's.
	2.1.5. Power and connectivity	It is a barrier due to the unavailability of alternative power sources such as UPS or standby generator
	2.1.6. Enforcement.	Refers to the existence of enforcement procedures that obliges physicians to use EMR mandatorily.
	2.1.7 Policy/SOP	Unavailability of written policy or guideline at either facility or national/federal level for that guide the implementation and use of EMR and use of mobile devices for EMR

	2.1.8. Ongoing costs.	Mentioned to describe the running costs of EMR spent for maintenance and update of EMR system
	2.1.9. Vendor Support	Refers to the periodic support and maintenance by the service provider who introduced EMR and its challenge due to the phasing out vendors
2.2. Technology related barriers.	2.2.1. System Interoperability.	Refers to challenges such as integrating the EMR system with the current DHIS 2, NCOD, printers and department EMRS as well us laboratory machines.
	2.2.2. Complexity of the templates.	Refers to the slow and non-user friendly EMR template writing features experienced by some types of EMR software's (e.g. Brisk)
	2.2.3. Missed EMR core components.	Describes 12 basic components of EMR which are not functional.
2.3. Technical Barriers.	2.3.1 RHB/MOH support	Refers to a lack of support from the regional health bureau
	2.3.2. Time to maintain software.	Refers to the lag from the dysfunctionality of the EMR till the ICT department fixes the problem
	2.3.3. Work burden	Refers to the challenge of burdening or tiring health professionals by using both paper-based and EMR based.
	2.3.4. Physician computer experience and typing skill.	Refers to spending a lot of time writing patient history and physical examination findings on the EMR template which could be due to unfriendly system or the health care professionals keyboard typing skills
	2.3.5. Patient-physician interaction	Refers to the complaints raised by patients of not getting the full attention of their physicians when the physician's writing on the EMR
	2.3.6. Ability to add and update template.	Refers to the inability to add and update the system due to the
	2.3.7. Reporting challenge	Refers to the challenge in reporting disease based on the new classification system (NCoD) using EMR based system since the system was designed using the ICD-10 classification

	2.3.9. Patient complaint.	Refers to unaware patients about how the EMR financial billing system works, new patients refuse to deposit money before treatment additionally the non-returning the money creates a quarrel between patients and HCW
2.4. Behavioral factors.	2.4.1. Perceived uncertainty about EMR.	Refers to the perception of HCW that the EMR will “fail” and that it’s not guaranteed 100%.
	2.4.2. fear of technology	Refers to the fear of technology due to poor computer skill, lack of experience or due to computer phobia
	2.4.3. Professional resistance.	Refers to Health professional’s initial reaction when the EMR was implemented at first, at another instance, it means adaptation problems to the EMR and using both the paper-based and EMR based system by some health facilities despite the training
2.5. Legal Barriers.	2.5.1. New reporting procedure.	Refers to problems related to the regional health bureau enforcement of the new DHIS2 when the health facilities weren’t prepared for it
	2.5.2. Medico-legal issues.	Refers to the challenges that may be occurred by misbehaving health professionals towards misusing EMR by disposing or removing patient information
	2.5.3. Patient information security and confidentiality.	Refers to the concern about ensuring of patient’s information via personal passwords for the staff which are frequently updated and authenticated and availability of advanced information security technologies
	2.5.4. Regulations from MOH/RHB	Refers to the absence of clear legal rules that allow health facilities to use EMR and interfering the use of a full EMR system because of uncertainty about the system Refers to the threat posed to continue EMR based system since the company that started EMR has phased out and unavailability of local organizations.

3	3.1. Recommend ed solutions	3.1.1. Integration with standard treatment guideline	Solution to integration primary health care treatment guideline with the EMR system.
		3.1.2. Previous paper charts.	Refers to the solution to tackle the space problem by scanning and integrating previous patient cards in to EMR system.
		3.1.3. Educational curriculum	Refers to a recommendation given by HCW to consider incorporating EMR in to education curriculum to help employees adapt the EMR system.
		3.1.4. Mobile device	Refers to include any means to use easily accessible mobile devices are if practicable.

Annex 4. Study Information Sheet and Consent Form

Name of Principal Investigator: - Gebretsadik Keleb

Name of Organization: - Addis Ababa University

Name of Sponsor: -Doris Duke Charitable Foundation (DDCF) and Addis Ababa University

My name is G/Tsadik Keleb. I am a second-year Master of Public Health student at Addis Ababa University, School of Public Health. I am doing my master's thesis on barriers to use electronic medical record among health care professionals in Addis Ababa city administration. As you know, the electronic medical record has been implemented in the country since 2002. However, it is not progressing as expected. To address such a gap, I am highly interested to conduct this research to identify major barriers and associated factors to use the electronic medical record in selected hospitals and health centers. This research will help the hospital, health bureau and Federal Ministry of Health at large to identify major barriers to use electronic medical record, which will help to address and implement this program at large at the national level. Your name will never be mentioned, and the information provided here will not be disclosed to anyone unless it is for its intended purpose and there is no any harm introduced to you. If you want to stop the interview, you can stop at any time. The purpose of the study, ethical issues and its significance has been approved by the college of health science ethical review board. You are being invited to take part in this research because we feel that your experience as a senior professional can contribute much to our understanding and knowledge of electronic medical record. For any question, please call.

Gebretsadik Keleb- Phone number-0918604336 Email- keleb82@gmail.com

If you are volunteer to take part in my study, please put your signature here.

1. Datesignature
2. Data collector name signature.....

Thank you for participating in my survey!

Annex 5. Quantitative Questionnaire

Identification				Remark
Code no				
Interviewer name				
Date of visit				If the respondent not available
Name of health facility				
Part one: General Socio-Demographic characteristics				
S. no	Questions	Option	Skip	
101.	Age of respondent in completed years			
102.	Sex	Male.....1 Female...2		
103.	Level of education	Diploma1 Degree.....2 Masters.....3 PhD.....4 Specialty.....5 Subspecialty.....6 Other 999		
104.	Marital status	Single.....1 Married2 Divorced.....3 Widowed.....4		
105.	Profession	GP.....1 Specialist2 Health officer...3 Nurse.....4 Pharmacist.....5 Laboratory.....6 Midwifery.....7		
106.	Position in the hospital			
107.	Work experience	0-2 years.....1 2-5 years2 5-10 years.....3 >10 years.....4		
108.	Nationality	Ethiopian.....1 Non-Ethiopian...2		
Part Two: Functionality of EMR, Experience and skill towards EMR				
201.	Does the organization have a system of EMR?	Yes-----1 No-----2		

202.	Do you currently use Electronic Medical Record?	yes1 no.....2		
203.	What is the main device you use for Electronic Medical Record?	Laptop computer....1 Desktop.....2 Tablet3 Mobile4		
204.	For how long have you been using EMR?			
For which one of the following activities, you use Electronic Medical Record?				
	A. To document HPI and physical examination findings	Yes-----1 No-----2		
	B. To order laboratory requests?	Yes-----1 No-----2		
	C. To view laboratory results?	Yes-----1 No-----2		
	D. To order radiologic results?	Yes-----1 No-----2		
	E. To view radiologic results?	Yes-----1 No-----2		
	F. For e-prescribing (drug prescription and dispensing)?	Yes-----1 No-----2		
	G. For patient scheduling?	Yes-----1 No-----2		
	H. For a financial program or billing system?	Yes-----1 No-----2		
	I. For a patient referral to other departments?	Yes-----1 No-----2		
	J. For reporting to HMIS, facility manager or others?	Yes-----1 No-----2		
205.	Is the EMR interface user friendly?	Yes-----1 No-----2		
206.	Do you use the EMR decision support features to guide patient management (e.g. drug allergy notifications and warnings)?	Yes-----1 No-----2		
207.	Do you have personal access control (authenticated password?)	Yes-----1 No-----2		
208.	Does the reporting location (HMIS, EMR admin) submit any feedback electronically?	Yes1 No.....2		
209.	Do you prefer EMR rather than paper-based record?	Yes-----1 No-----2		
210.	Do you support overall EMR implementation?	Yes-----1 No-----2		
211.	Which one is commonly used for medical record in your organization?	Paper only.....1 EMR only.....2 Combined use.....3		

212.	If you say combined use when do you prefer using EMR than paper-based record?	_____			
213.	Overall, are you satisfied with the electronic health record system?	Yes-----1			
214.	If you are dissatisfied what makes you dissatisfied with the EMR?	_____			
Part Three: Question from 301 to 312 are listed to assess the ease of using EMR. Please indicate the ease of EMR in the following tasks.					

		Does not apply to me	Very difficult	Somewhat difficult	Somewhat at easy	Very easy
301.	Obtain and review patient information and data	1	2	3	4	5
302.	Prevent adverse events, (e.g., drug-drug interaction, drug-allergy interaction)	1	2	3	4	5
303.	To review trends in lab values.	1	2	3	4	5
304.	Manage chronic disease conditions for my patients	1	2	3	4	5
305.	Manage orders	1	2	3	4	5
306.	Analyse outcomes of care	1	2	3	4	5
307.	Retrieve patient information easily.	1	2	3	4	5
308.	Access the EHR from offsite locations	1	2	3	4	5
309.	Enhance the continuity of care my organization can provide	1	2	3	4	5
310.	Communicate with my colleagues to coordinate care	1	2	3	4	5

Part Four: Training and related issues towards Electronic Medical Record. The following questions are developed to assess training about EMR. Please check the box according to your level of agreement.

		Strongly disagree	Disagree	Neutral	Agree	Strongly agree
401.	I have access to ongoing training on how to use a computer.	1	2	3	4	5
402.	I have access to training on how to use EMR	1	2	3	4	5
403.	The training I received was relevant to how I should use the system.	1	2	3	4	5
404.	I receive technical support whenever I need it	1	2	3	4	5
405.	I am satisfied with the support I have received in using this EMR	1	2	3	4	5

406. When this EMR system is down, we have policies and procedures to allow the clinic to continue to see patients	1	2	3	4	5
407. The EMR screens respond to my actions instantly	1	2	3	4	5
408. Lab results appear in this EMR in a timely fashion.	1	2	3	4	5
409. The project plan was adequately communicated to us during implementation	1	2	3	4	5
410. The administration of our facility was supportive during implementation	1	2	3	4	5
411. Adequate resources were committed to the implementation	1	2	3	4	5
412. Has improved communication with other health service providers (e.g. pharmacists).	1	2	3	4	5
413. Has facilitated me to exchange care strategies with co-workers.	1	2	3	4	5
414. Has facilitated the identification of trends and patterns.	1	2	3	4	5
415. Has facilitated the development of care plans.	1	2	3	4	5
416. Gives me useful reminders that help me to identify the change of care needs for a resident on time	1	2	3	4	5

Part Five: Attitude and perception of health care providers towards EMR

The questions below are developed to assess the attitude of health professionals towards EMR please select and encircle on the corresponding box based on your level of agreement

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
501. EMR increase practice productivity (i.e. Patients/ day)	1	2	3	4	5
502. EMR improve quality of work practice (i.e., work-life)	1	2	3	4	5
503. EMR improve quality of care	1	2	3	4	5
504. EMR reduces hard work	1	2	3	4	5
505. EMR need more time for training	1	2	3	4	5
506. EMR benefits outweigh the costs	1	2	3	4	5
507. EMR impacts the cost of service	1	2	3	4	5
508. EMR improve the confidentiality of patient information	1	2	3	4	5
509. EMR increases patient acceptance	1	2	3	4	5
510. EMR decreases waiting time for patients	1	2	3	4	5

511. EMR is more complex than paper-based record	1	2	3	4	5
512. EMR improves interaction with colleagues	1	2	3	4	5
513. EMR improves clinicians' access to up-to-date knowledge	1	2	3	4	5
514. EMR helps in avoiding errors	1	2	3	4	5
515. EMR should be implemented at large	1	2	3	4	5

Part six: Major barriers to the implementation of Electronic Medical Record

Below are major barriers to the implementation and sustainability of EMR please rate according to the degree of severity of the problem and put "X" mark on the corresponding box

NB: 1=least severe problem 5=the most severe problem

Factor	Rank					Remark
	1	2	3	4	5	
601. The problem in proper patient-physician interaction						
602. Lack of supportive IT staff and capable EMR administrator						
603. Poor management supportive supervision						
604. Lack of equipment and supplies(e.g. Computers)						
605. Power and system connection fluctuation						
606.The problem in keyboard typing skill (e.g. Speed)						
607. Concern about privacy and confidentiality of patient information						
608. Absence of computer and EMR training						
609. Shortage of human resource						
610. Poor computer screen design or frequent collapse of computers						
611. Please mention other factors that you think are major barriers to full implementation of EMR. (You can describe your answer in Amharic).						

_____.						

Thank you very much for completing the questionnaire!

Annex 6. Key-Informant Interview Guide

4.1. Interview guide for the health care professional key informants.

1. How is Electronic Medical Record operating in your hospital/health center?
2. When do you prefer to use Electronic Medical Record rather than paper-based record?
3. What additional features are missing in your organization EMR?
4. Do the health care providers refuse the use of Electronic Medical Record? Why?
5. Can you talk about your experience with the medication alert system in the EMR? Was that helpful?
6. Do the organizations that introduce EMR system provide periodic maintenance and support?
7. What are the major factors/barriers to implementation and use of Electronic Medical Record?
8. Does the hospital have standard EMR implementation guideline like SOP and enforced laws?
9. What are the security features of the EHR system? Does the system provide EHR security rights by password?
10. Do you use EMR for informed decision making and planning?
11. What strategies did you use to improve the use and progress of Electronic Medical Record in your hospital/health center?
12. What do you suggest workable solutions or recommendations solve the above problems?

4.2. Interview guide for EMR Administrators and managers key informants.

1. Has the EMR project been a success or a failure or some combination? Describe where you have realized success and where it is deemed a failure.
2. What is the product name of Electronic Medical Record you use in your organization?
3. Do you know any product name in your experience for Electronic Medical Record?
4. What additional features are missing in your organization EMR?
5. Does the organization have an adequate budget for Electronic Medical Record?
6. Do the health care providers refuse the use of Electronic Medical Record? Why?
7. What are the major barriers raised by health care providers to use EMR?
8. Has the desired impact of EMR been realized? When do you expect to realize the full impact??
9. If mobile devices such as smartphones, iPads, etc. are used for a medical record of data? Does the organization have a policy in place regarding the use of mobile devices?
10. Do the organizations that introduce EMR system provide periodic maintenance and support?
11. What are the major factors/barriers to implementation and use of Electronic Medical Record at organization level?
12. Is there any functionality missing in the software?
13. Does the EHR lend itself to a paperless operation? If not, does the EHR allow the capability to scan reports?
14. Is the facility able to revise its documentation screens/templates, or is this assigned to a vendor technician?
15. Does the hospital have standard EMR implementation guideline like SOP and enforced laws in place for continuity of care?
16. What strategies did you used to improve the use and progress of Electronic Medical Record in your hospital/health center?
17. What do you suggest workable solutions to solve the above problems?