ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
SCHOOL OF COMMERCE

EVALUATION OF THE ELECTRONIC HEALTH RECORD (EHR) SYSTEM IN MARIE STOPES INTERNATIONAL ETHIOPIA (MSIE) MATERNAL AND CHILD HEALTH CENTERS

By Tizita Gizaw

FEBRUARY 2018

ADDIS ABABA, ETHIOPIA

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A THESIS SUBMITTED TO ADDIS ABABA UNIVERSITY SCHOOL OF GRADUATE STUDIES, COLLEGE OF COMMERCE, DEPARTMENT OF PROJECT MANAGEMENT IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF ARTS DEGREE IN PROJECT MANAGEMENT

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DECLARATION

I, the undersigned, declare that this thesis is my original work, prepared under the guidance of Dr. Mengistu Bogale. All sources of material used for the thesis have been duly acknowledged. I further confirm that the thesis has not been submitted either in part or in full to any other higher learning institutions for the purpose of earning any degree.

Name	Signature
Addis Ababa University, Addis Ababa	**February 2018**

ENDORSEMENT

This thesis has been submitted to Addis Ababa University, School of Graduate Studies for examination with my approval as a university advisor.

Dr. Mengistu Bogale _____

Advisor Signature

Addis Ababa University, Addis Ababa **February 2018**

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Dedication

I dedicate this thesis to my Parents (Gizaw & Wogay) & my husband, Tilahun for their constant support and unconditional love. I love you all dearly.

Acronyms

ANC: Antenatal Care

CAC: Comprehensive Abortion Care

EFMoH: Ethiopian Federal Ministry of Health

EHR: Electronic Health Record

EMR: Electronic Medical Record

FP: Family Planning

HIMSS: Health Information Management System Society

ICT: Information Communication Technology

IT: Information Technology

LAN: Local Area Network

MCH: Maternal and Child Health

MSI: Marie Stopes International

MSIE: Marie Stopes International Ethiopia

NGO: Non-Governmental Organization

SQL: Structured Query Language

TUTAPE: Tulane University Technical Assistance Project In Ethiopia

YTD: Year to Date

Abstract

The use of EHRs lowers medical errors by providing healthcare workers with problem solving capabilities, enhanced health information flow, and decision support through prompt access to the medical literature and best practices in medicine. The advantage of implementing EHR is more intensified in facilities where there is high volume of patients, complex work flow, frequent emergency situation and involving multiple personnel. The existing few research on EHR are addressing problems of EHR implementation. But post-implementation evaluation of the system is minimal, especially in Ethiopia. The current study will evaluate The EHR implementation effectiveness in Marie stopes International Ethiopia's Maternal and Child health Centers. A cross sectional facility based study design with a formative evaluation approach is used to assess the availability, usefulness and user satisfaction level of the EHR system implemented at Gotera (Addis Ababa), Bahir Dar and Adama MCH centers. Data was collected using structured, self-administered questionnaire from 54 participants. The collected data was entered to SPSS version 20 and cleaned. Availability of computer with EHR system installed was 98.15% and 66.67% of the respondents received training on EHR system and from participants who received training 94.83 % of them found the training adequate. Usefulness of EHR system is assessed in six departments: Inpatient, Outpatient, Pharmacy, Laboratory, Reception cashiers and MCH managers. The minimum rate of use and usefulness was from Pharmacy department (48.33%).User satisfaction with usefulness of the system is 86.56%. The result of overall EHR implementation effectiveness was 85.31% which was rated as very good. Average score of availability, usefulness and satisfaction was rated as very good. The overall EHR implementation is effectiveness was also rated as Very good. Suggested improvements regarding training and EHR Implementation in Pharmacy department should be acted upon to ensure effective utilization of the system.

Key words: Electronic health record, Availability, usefulness, satisfaction, Income

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CHAPTER ONE
INTRODUCTION

1.1 Background

The Health Information Management Systems Society's (HIMSS) define EHR as: The Electronic Health Record (EHR) is a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. Included in this information, are patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data and radiology reports. The EHR automates and streamlines the clinician's workflow. The EHR has the ability to generate a complete record of a clinical patient encounter - as well as supporting other care-related activities directly or indirectly via interface - including evidence-based decision support, quality management, and outcomes reporting [1].

Driven by the needs to facilitate clinical and administrative processes, to reduce medical errors, and to reduce healthcare costs, many healthcare institutions are deciding to implement electronic health records (EHR) systems to allow clinical information gathering and access at the point of patient care. Tools to support administrative procedures, such as billing and scheduling, are also becoming common EHR features. The use of EHR can facilitate clinical decision-making and minimize the potential for mistakes due to the inaccuracy and incompleteness of paper records [2].

The paper-based medical records are illegible, ambiguous, incomplete, unavailable, fragmented and poor in quality. Recording of patient information on papers impedes the continuity and quality of medical care offered to the patients. Additionally, paper-based systems have limited functionality; many people cannot view the same record at the same time. Patient records have been stored in papers for centuries and have consumed increasing space and notably delayed access to efficient medical care. In contrast, Electronic Medical Record (EMR) stores clinical information of each patient electronically, enables instant availability of his medical information to all providers in the healthcare chain and assist in providing coherent and consistent care [3].

In recent years, Electronic Health records have been implemented by an ever increasing number of hospitals around the world. There have, for example, been initiatives, often driven by government regulations of financial stimulations, in USA, the United Kingdom and Denmark [4].

In Ethiopia, EMR system is one of the major ICT projects among the other different initiatives like health data warehouse, Health-net, tele-education, telemedicine, human resource information system, electronic health information management system, woreda based planning system, and health integrated financial information system planned by the Ethiopian Federal Ministry of Health (EFMoH) and its partners [5].

In 2009, the Ministry of Health, with support of the Tulane University Technical Assistance Project in Ethiopia (TUTAPE), started the development and implementation of a comprehensive EMR system for hospitals called SmartCare. The system was deployed in 5 hospitals in Addis Ababa and other hospitals in regional cities. In 2013, the Ministry of Health adapted the system as a national EMR for all hospitals, and planned to scale it up to further hospitals and regions [6].

Despite the high expectations and interest in adopting and using EMR systems worldwide, its overall adoption rate is relatively low, especially in the resource-limited countries where high diseases prevalence and incidence rates are predominant. As indicated by various studies, the adoption and use of EMR systems in developing countries is in its embryonic stage for several reasons [6] [7] .

1.2 Electronic Health Recording System

The EHR solution has now been implemented in three of MSIE's four MCH centres. The solution has been implemented at all steps of the client flow in the maternity centres. The system and its screens closely model the client flow, enabling clients to be assigned to various departments as they move through the centre. Staff can also look up the status of requests, e.g. the outpatient doctor can check lab requests to ensure results are available before calling the next client in the queue.

The system is designed to be paperless, with every item of data that was formerly captured on paper forms migrated to the EHR; handwritten receipts (a government requirement) are the only formal paper-based step in the process.

The system is based in a client-server model, and consists of:

- Database server: Microsoft SQL Server
- Client Application: a remotely-installed (over LAN) client written in C#.NET
- Security: NET authentication with role-based security (configurable roles), and audit trails for read, add, edit and delete operations.

The back-end is hosted on a high-specification rack-mounted server, kept in a locked server room at each site, avoiding dependency on internet connectivity.

The system includes both built-in operational reports (developed by the supplier and integrated into the EHR itself) and a separate reporting suite (written in SQL Server Reporting Services), developed and maintained by MSIE, which can run a range of management reports.

Although a server-client model, EHR is not a web application (a Windows client is downloaded from the server and run on each computer), but this stack performs better than a web application would over a local area network, and is therefore well-suited to the MSIE maternity centres, where all rooms are connected to a LAN.

The system includes a user interface and functionality to administer key aspects of the system. However, not all elements are configurable – some aspects of the system are 'hard-wired' into the software, and any changes require software development work.

The system relies on a LAN, which is very stable and relatively cheap to maintain (but does require some degree of IT support). Because it uses a local server at each site, it does not depend in any way on the internet, a real strength given the unreliability of internet connectivity in Ethiopia. Because the system is almost entirely paperless, and has no offline working option, it depends on an uninterrupted power supply.

Figure **1**: Delivery Dashboard/Tracing delivery service, client profile, Caesarean section rate, YTD delivery

1.3 Statement of the problem

It suggested that in today's healthcare systems it is all too easy to receive the wrong medication or treatment in emergency medicine, especially when physicians do not have access to patients' documentation. The Institute of Medicine report revealed that between 44,000 and 98,000 Americans die every year because of medical errors. It is also argued that the lack of proper information in the right place and at the right time constitutes a major administrative problem in modern healthcare, and has a negative impact on the quality of healthcare services and patient outcomes [8].

The use of EHRs lowers medical errors by providing healthcare workers with problem solving capabilities, enhanced health information flow, and decision support through prompt access to the medical literature and best practices in medicine [9].Therefore, using electronic health records (EHRs) is a key component of a comprehensive strategy to improve healthcare quality and patient safety [10]. Even more, the Institute of Medicine has characterized EHRs as an essential technology for improving the safety, quality and efficiency of health care [11].

A large number of commercial and open source medical record systems already cater to the need for EMRs worldwide. The implementation and use of EMRs has become high priority for healthcare providers, organizations, and government agencies. Developers of such systems report that many of these implementations are successful, and that their services have improved tremendously after the adoption of EMRs [16].

The advantage of implementing EHRs is more intensified in facilities where there is high volume of patients, complex work flow, frequent emergency situations and involving multiple personnel. EHR is also essential to hospital leaders and administrators for improving patient safety by reducing medical errors and improving the flow of quality information.

Despite the benefit of adopting and implementing EHR, most of the projects have been recorded to have survived partially or fully at the pilot phase and have been repealed at the full implementation phase [12].

In Ethiopia, until 2014 the EHR system has been deployed in more than eleven hospitals and clinics in Diredawa , Bahirdar, Harar and Addis Ababa city administration of Ethiopia as a pilot, and the ministry of health planned to scale it up to other hospitals and regions [7].

In addition to governmental institution, many private and NGOs implemented the EHR system. MSIE is one of the NGOs which introduced EHR system in its MCH centers to manage the day to day clinical and operational activities.

User resistance was reported to be the primary hindering factor to the successful implementation of EHR. Therefore, the existing few researches on EHR are addressing problems of EHR implementation. But Post-implementation evaluation of the system for those facilities which implemented the EHR system is minimal, especially in Ethiopia. This research will focus on evaluating the impact of the implemented EHR system on the day to day activities and operations of various departments in MCH centers. This research will also tries to show if the systems meets the need of each department's work.

1.4 Significance of the study

Despite the various efforts to implement the EHR system, there is no adequate evidence on the impacts of the implemented EHR system. In order to effectively implement the EHR system in

the future, evidence on the impact of the implemented EHR system has to be studied. Therefore, this study mainly assesses the major impacts that the system has brought on the day to day activities and operations of each department in the MCH centers. This research will also tries to show if the systems meet the need of each department's work.

The study also evaluates the EHR system in order to reveal the satisfaction of users and possible improvements to the system, as well as recommend, where necessary, to ensure the successful implementation of the system, based on the information gathered.

1.5 Research Question

I. What is the rate of Availability of EHR system in terms of Training and Availability of computers with EHR system installed?

II. What is the rate of usefulness of EHR system in each department of MSIE's MCH centers?

III. What is the rate of user's satisfaction with usefulness of the EHR system?

IV. What is the rate of Implementation effectiveness in MSIE's MCH centers?

1.6 Objective of the study

1.6.1 General Objectives

To assess the implementation effectiveness of the installed EHR system at Adama, Bahir Dar and Gotera MCH centers..

1.6.2 Specific objectives

The specific objectives of the research are to:

- Evaluate the Availability of EHR system
- Evaluate the Usefulness of the EHR system.
- Evaluate Users' Satisfaction with usefulness of the EHR system

1.7 Scope and Limitation of the study

The primary limitation of our study is that it is site specific and does not have a large number of participants, especially when looking at subgroups. The study only measures Users satisfaction with usefulness of the EHR system. And also limited literatures were available to compare and discuss the findings with.

2 CHAPTER TWO
LITERATURE REVIEW

2.1 Literature Review

A study done in US ambulatory settings indicated that through the use of EHRs, productivity increases because of improved office efficiently. Another study which interviewed providers with EHR system reported that providers worked longer hours for an average of four months during the initial EHR implementation, mostly because of inefficiencies while on the "steep" part of the software learning curve and due to the onetime requirement of entering all clinical data during each patient initial visit after implementation. The study found that quality of life improved for many providers after the implementation period. Three practices benefited from seeing the same number patients in less time, taking gain as more personal time, rather than an opportunity to see more patients, providers in most practices particularly liked accessing records from home, which enables some of them to go home earlier. The providers also characterized as an improvement the ability to access records immediately while on call [13].

A study of the implementation of an EHR system in a small family practice clinic (USA) revealed that, EHR implementation had some impact on the perceived work content of clinic staff. On the contrary, the amount of time spent by physicians on patient care (about 50% of their time) did not change with the EHR implementation. The study also showed that, there were major changes in the work of clinical staff and office staff following the EHR implementation. Clinical staff spent more time in computer entry and maintaining the medical information system; office staff also spent more time in computer entry and maintaining the medical information system, and less time in distributing chart and transcription; however, these changes did not induce an increase in time spent doing tasks on their own. On the contrary, office staff spent more time in contact with nurses after the EHR implementation [2].

A literature done in Sri Lanka on acceptance and use of Electronic Medical Records evidenced that the physicians believe using EMRs will help them attain gains in job performance. The value of the Performance Expectancy construct is computed using the average of variables which relates to usefulness of the system, job-fit, productivity of the care provider and quality of service. At the same time, closely 80% of physicians agreed that the system is easy to use [3].

An evaluation of the effects of EHR in a residency's Family Medicine center in Birmingham concluded that Physicians and residents are very dissatisfied with the amount of time required for documentation using the EHR system. Further, despite a concerted effort to improve efficiency and time required for documentation between 8 and 12 months, little improvement in physician perception was experienced. Faculty, residents, and clinic staff did not observe a benefit of the EHR system to patient care. Physician and office staff saw no meaningful improvement in the coding and billing process [14].

A study done by tracking 30 ambulatory practices for 2 years after EHR implementation indicated that implementation of an EHR was associated with increased revenues but also sustained losses of productivity in ambulatory practices for at least 2 years[15].

An investigation done to assess the impact of the installation of an outpatient EHR on physician productivity and health outcome of the Lehigh valley health networks revealed that the large and persistent negative productivity shock caused by the switch to centricity physician's office in the practice sites is not, in retrospect, surprising. The new system required that physicians (many of whom had only used paper records) learn new formats for data entry that required work process adjustments. In addition, physicians were required to input new information that might not have been recorded previously; for example, new quality metrics or more complete documentation that could be shared. They were also required to input information that was previously not their data entry responsibility; for example, billing codes previously entered by coders. Finally, physicians had to adapt their work practices to integrate shared records [16].

An examination of nine hospitals that recently implemented a comprehensive electronic health record (EHR) system discovered that the EHR systems facilitate patient safety and quality improvement through: use of checklists, alerts, and predictive tools; embedded clinical guidelines that promote standardized, evidence-based practices; electronic prescribing and test-ordering that reduces errors and redundancy; and discrete data fields that foster use of performance dashboards and compliance reports. Faster, more accurate communication and streamlined processes have led to improved patient flow, fewer duplicative tests, faster responses to patient inquiries, redeployment of transcription and claims staff, more complete capture of charges, and federal incentive payments [17].

Another study on EHR revealed that financial benefits of EHRs stem from reduction in transcriptionists and saving time from searching for patient charts. The EHR also more accurately captures the services provided and as mentioned, reporting and analysis of patient records is more efficient with the EHR. Physicians are notoriously poor coders and the EHR can not only streamline the billing process, but also ensure the services provided are charged to appropriate payer. The EHR has tremendous potential to improve quality in health care and reduce medical errors. The EHR can flag drug interactions, alert a physician that a patient has poor kidney function, or remind a physician of a drug allergy. On the contrary, EHR faced major complaint quality of care and adds time to physicians to document the encounter [18].

A study on the impact of an electronic health record on nurse sensitive patient outcomes suggested that implementing an EHR has the potential to contribute to improvements in both the processes and outcomes of nursing care. However, a variety of other factors, such as organizational and cultural features and external influences, also need to be taken into account when evaluating the effect of technology such as EHR on the quality of care provided by nurses. Further research is required to improve our understanding of how technology such as EHR can be used effectively to help improve the quality of care received by patients [19].

The observations, focus groups, and survey results of four acute care units and one emergency department at the university of Virginia Medical Center suggested that nurses perceived that they generally over document. Due to faults in the EMR's interface, nurses were unnecessarily documenting information in multiple locations within the EMR, for instance when documenting removal of Foley catheters. Furthermore, whenever patients moved from one unit to another, nurses had to re-document certain patient information that had already been recorded on the other unit. In addition, nurses were required to document some information for quality metrics, which some nurses believed did not directly improve patient care [20].

An American Ophthalmological society thesis on evaluation of EHR implementation revealed that twenty-three faculty providers completed 120,490 clinical encounters during a 3-year study period. Compared to baseline clinical volume from 3 months pre-implementation, the post-implementation volume was 88% in quarter 1, 93% in year 1, 97% in year 2, and 97% in year 3.

Among all encounters, 75% were completed within 1.7 days after beginning documentation. The mean total time per patient was 6.8 minutes longer with EHR than paper (P<.01). EHR documentation involved greater reliance on textual interpretation of clinical findings, whereas paper notes used more graphical representations, and EHR notes were longer and included automatically generated text [11].

A study done by a telephone interview with 6 Community Health Centers representing a variety of staffing configurations and EHR experiences suggested that EHRs have changed nearly every aspect of providing care in Community Health Centers, from staffing decisions to workflow to quality tracking and reporting. They make certain aspects easier, such as tracking population health measures, sharing information within the Community Health Center but also introduce new burdens on providers and other staff members. It is well known that primary care practices have responded to these new realities by hiring new staff members and altering the roles of other staff members [21].

Evaluation of the effect of electronic health records adoption on patient visit volume at an academic ophthalmology department showed consistent, significant decreases in patient volume that persisted even 4 years following EHR adoption. Combined with an aging population and a growing need for ophthalmology services, a decrease in provider capacity with EHR use may mean that projected ophthalmology workforce shortages are actually being underestimated. Increases in staff, including the use of scribes to enter data and write chart notes, have been shown to improve patient flow in other specialties but represent an additional, unforeseen expense of EHR adoption [22].

The key findings from and evaluation of EHR implementation in operating room management were that there was overall worsening in intra operative documentation time following implementation of an EHR operation room management system, which eventually improved to near–paper base line levels for most procedure categories and surgical volume and overall OR staffing requirements did not change significantly after implementation, although an increase in circulating nurses persisted through the study in cataract procedures [23].

Another study also showed a decreased productivity and patient volume post implementation, but by 12 months, performance was only approximately 4 percent below pre implementation, suggesting full recovery could be achieved. Net income per physician also decreased but rebounded, suggesting little long term detriment. As intensity of services did not change significantly, the initial drop in net income was likely related to increased expenses and decreased productivity, rather than changes in case mix [24].

A Retrospective study to evaluate the impact of EHR documentation and clinical documentation specialists suggests that both did not show a statistically significant impact on case mix index [25].

Another article about the Benefits and drawbacks of electronic health record systems suggested that many averted costs associated with EHRs are the result of efficiencies created by having patient information electronically available. Some of these include increased utilization of tests, reduced staff resources devoted to patient management, reduced costs relating to supplies needed to maintain paper files, decreased transcription costs, and the costs relating to chart pulls. The use of EHRs can reduce the redundant use of tests or the need to mail hard copies of test results to different providers [26].

A survey data from forty-nine community practices in a large EHR pilot, the Massachusetts e-Health Collaborative; to project five-year returns on investment revealed that the adoption of an electronic health record system can have a markedly positive financial impact, particularly for practices that leverage the systems to increase revenue. However, the five-year return on investment was negative for the majority of practices particularly for smaller practices. Losses may have been due in part to the failure of practices to make the operational changes required to realize benefits [27].

A literature assessing the Claims of patients from four community physician practices that implemented the EHR and from about 50 comparison practices without the EHR in the same country reported that- the implementation of the EHR had a modest positive impact on the quality measure of guideline adherence for hypertension and hyperlipidemia. But no significant

impact was observed for diabetes and coronary artery disease and no measurable impact on the short term cost per episode was found [28].

A literature review of articles published between January 1998 and January 2010 suggested that when first implemented an EMR/EHR, primary-care providers should consider the potential decrease in productivity resulting from the increased time initially spent on documentation. However, this issue appears to lessen over time. Initial adoption of an EMR/EHR system requires allocation of time for learning and training. [29].

A survey of 223 primary care clinicians practicing at 26 Indian health service health centers that implemented and EHR between 2003 and 2005 reported that- of the responding clinicians, 66% felt that the EHR implementation process was positive. One third (35%) believed that the EHR improved overall quality of care with many (39%) feeling that it decreased the quality of patient-doctor interaction. One third of clinicians (34%) reported consistent use of electronic reminders and self-report that EHRs improve quality was strongly associated with increased utilization of the EHR (odds ratio 3.03, 95% confidence interval 1.05-8.8). The majority (87%) of clinicians felt that information technology could potentially improve quality of care in rural and underserved settings through the use of tools such as online information sources, telemedicine program, and EHRs [30].

Evaluation of Electronic Health Records Adoption in Egypt reported that in terms of the effectiveness of EHR in hospitals, the most common response is "EHR is adopted to increase Quality of services" which is (100%). This is followed by "EHR accelerates and improves Performance" which is (67%). Most notable was the response "time efficiency of physicians" which is 50%. With regard to the cost-effectiveness of EHR, 33% of the sample gave responses of either "strongly agree" or "somewhat agree." With regard to the necessity of promoting computerization of healthcare information in Egypt in the future, the combined responses of "strongly agree" and "somewhat agree" amounted to 50% [7].

Comprehensive Evaluation of Electronic Medical Record System Use and User Satisfaction at Five Low-Resource Setting Hospitals in Ethiopia indicated that, among the participants, 64.4% (199/309) responded to be dissatisfied with the use of the implemented EMR system. Of those

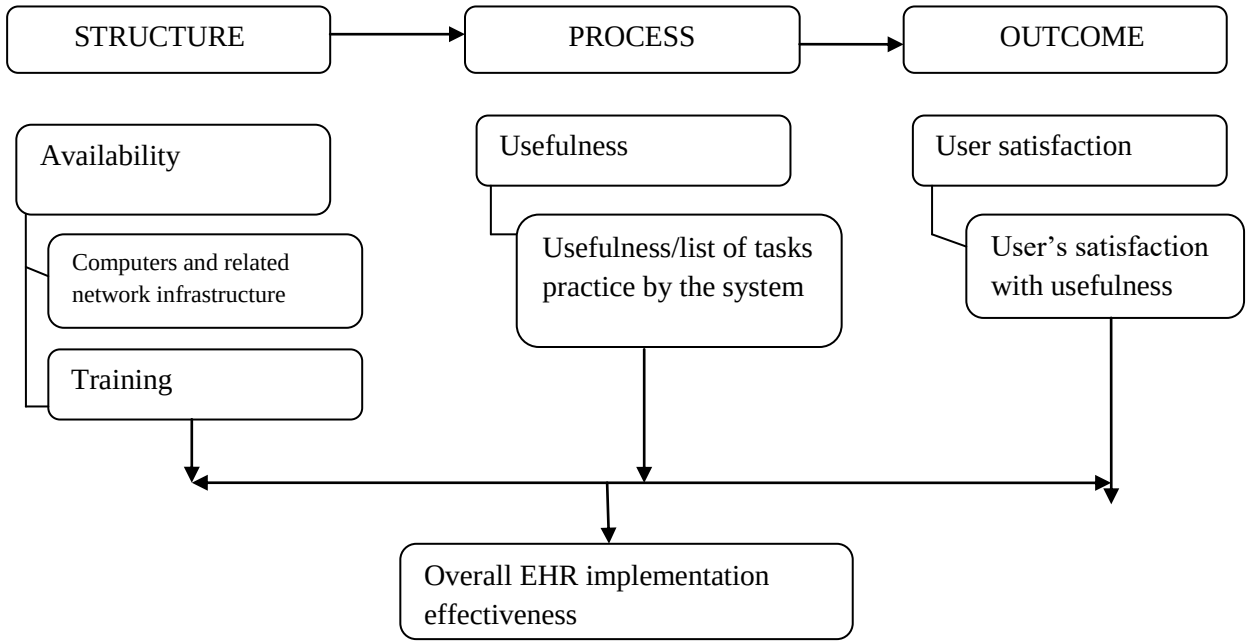
dissatisfied, 24.6% (49/199) were physicians and 52. 7% (105/199) were nurses. The participants responded with a strong disagreement towards the statements “The system helps me finish my task faster” (median=5, IQR=1) and “The system has a positive effect on quality of care” [6].

Another study done in Ethiopia suggested that Medical errors in a paper-based medical record system can sometimes be related to incomplete documentation and illegible handwriting. Although, providers may have the initial costs of implementing an electronic medical record system, the overall costs are less than those associated with the paper record. Paper medical records have higher costs due to the necessity of more personnel to manage, access, file, and maintain paper charts. With a digital record, access is virtually unlimited. Physicians can have access to test results almost immediately. Multiple departments can add clinical information to the health record without having to locate or checkout a paper medical record chart [31].

Most studies done in Ethiopia focused on factors affecting of adopting the system. This study on the other hand will evaluate Implementation effectiveness of EHR systems using three dimensions, Availability, usefulness and user’s satisfaction with usefulness of the system. The study will assess of three MCH center of MSIE, Addis Ababa , Adama and Bahir dar MCH centers.

2.2 Conceptual Framework

Figure **2**: Conceptual framework



Source: Evaluation of EMR implementation from User's perspectives in Ayder referral hospital (Modified) [33].

3 CHAPTER THREE
RESEARCH DESIGN AND METHODOLOGY

3.1 Study design

A cross sectional facility based study design with a formative evaluation approach is used to address the objective.

3.2 Study area

Marie Stopes Ethiopia (MSIE) was established in May 1990 following a bilateral agreement signed with the Ministry of Health. Marie Stopes International Ethiopia is part of the global Marie Stopes International (MSI) partnership. MSI is a UK-based global non-profit, non-governmental organization providing high-quality voluntary family planning (FP), and maternal and child health services to millions of low-income and underserved people across 37 countries.

MSIE has 24 owned and operated centers throughout the country. The centers are located in Tigray, Amhara, Oromia, SNNPR. Dire Diwa and Addis Ababa. Four of the centers are MCH centers, two in Addis Ababa, one in Bahirdar and one in Adama. EHR system is introduced in all MCH centers but this study focused on three of the MCH centers as one fails to fulfill the selection criteria.

3.3 Study population

The study population will be MCH's service providers who worked 6 months before and after the EHR implementation.

3.4 Inclusion and exclusion criteria

Inclusion criteria:

- MCH providers who worked 6 month before and after the implementation of EHR system.

Exclusion criteria:

- Providers who worked less than 6 months before and after the implementation of EHR system.

3.5 Sample size determination

Service providers working in outpatient, inpatient, laboratory, pharmacy and center managers and Receptions cashiers, who full fill the inclusion criteria, will be included in the study.

3.6 Operational definition

Availability: Preliminary activities done by the organization before allowing access and use of the EHR system.

3.7 Data collection procedures and quality assurance

Data is collected from both primary and secondary data. The primary data is obtained through structured questionnaires, interviews and observations. The secondary data is obtained from the routine clinical reporting system. The data collection process involved two stages. The first stage consisted of literature search for information on current updates on EHR system and its uses in each department of a health care facility. The second stage involved non-structure interviews of two people from each department under investigation to find out their daily tasks. The Questionnaires involved a section where the Respondents answer by ticking and a section where respondents are asked to answer by writing. Data collection took 8 weeks. The ends of period 54 questionnaires were received for analysis. During the data collection period, the participants will be well informed about the purpose of the study. Informed verbal consent will be obtained from each participant. Involvement will be fully decided by the participants. The response will be confidential.

3.8 Data management and Data analysis

Data is checked for completeness, consistency and analyzed using SPSS for windows V.20. Descriptive statistics tables and graphs will be used to describe the findings.

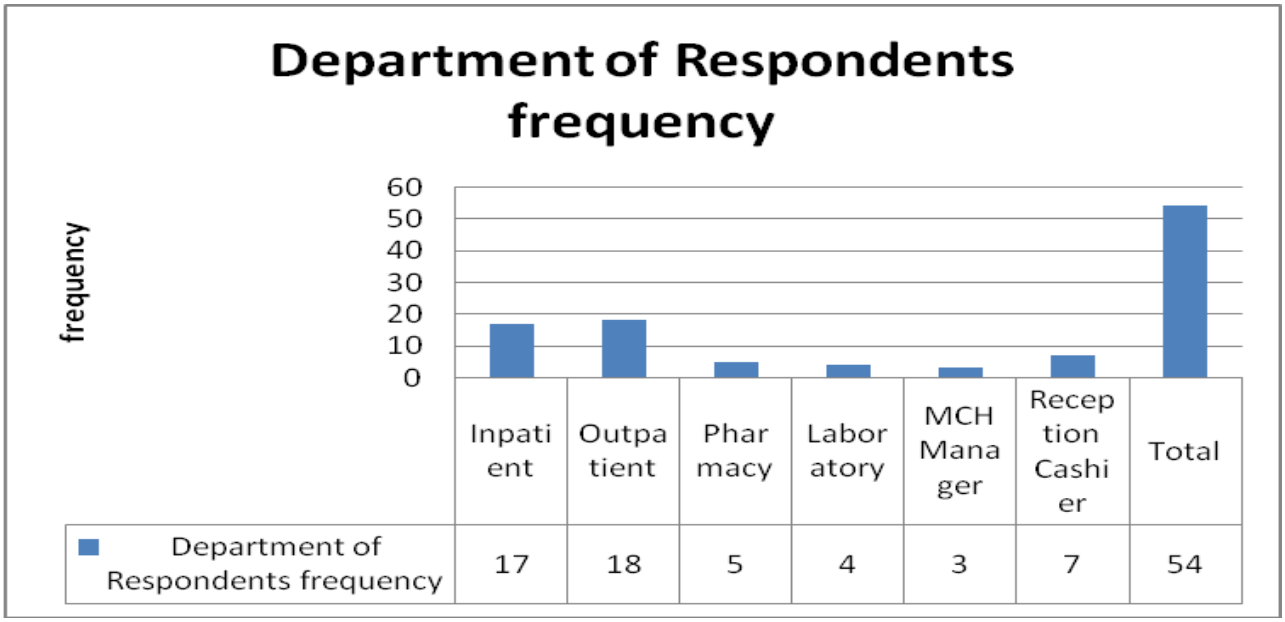
4 CHAPTER FOUR
RESULTS

4.1 Demographic data of respondents

4.1.1 Departments of Respondents

From the total 54 respondents, 17 works in Inpatient department, 18 works in Outpatient department, and 5 of them are from pharmacy, 4 are from Laboratory, 7 are reception cashiers and 3 are MCH managers.

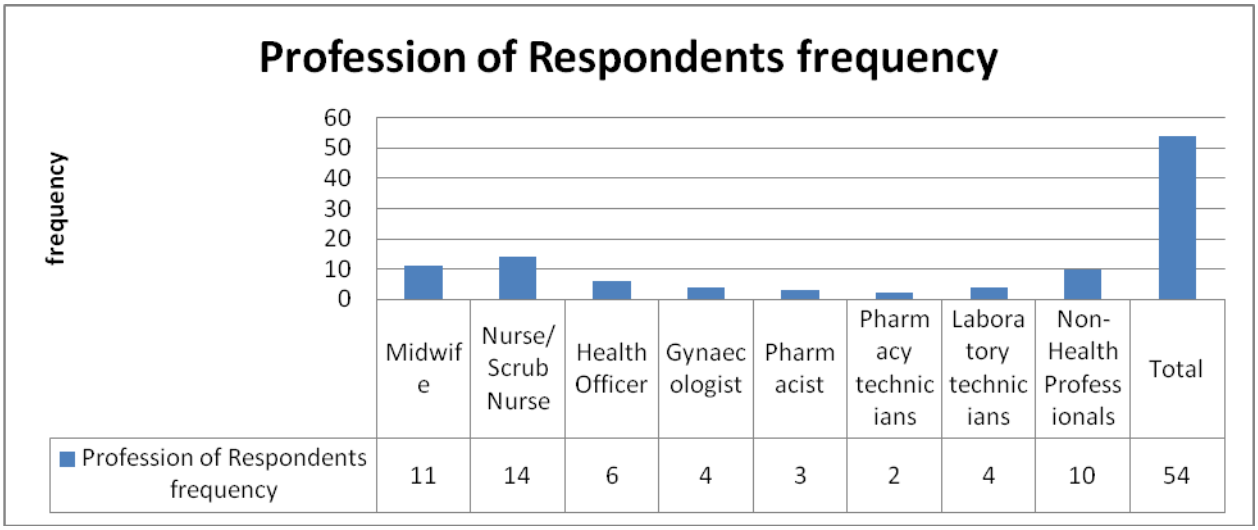
Figure **3**: Department of respondents



4.1.2 Professions of Respondents

The graph below shows the profession of respondents. It reveals that, out of the total 54 respondents, 11 of the respondents are midwives, 14 of the respondents are Nurses (both clinical and scrub nurses), 6 of the respondents are Health officers and 4 of them are Gynecologists. There are also 3 Pharmacists, 2 Pharmacy technicians and 4 Laboratory technicians. The rest 10 are non-health professionals (Accountant and Managers).

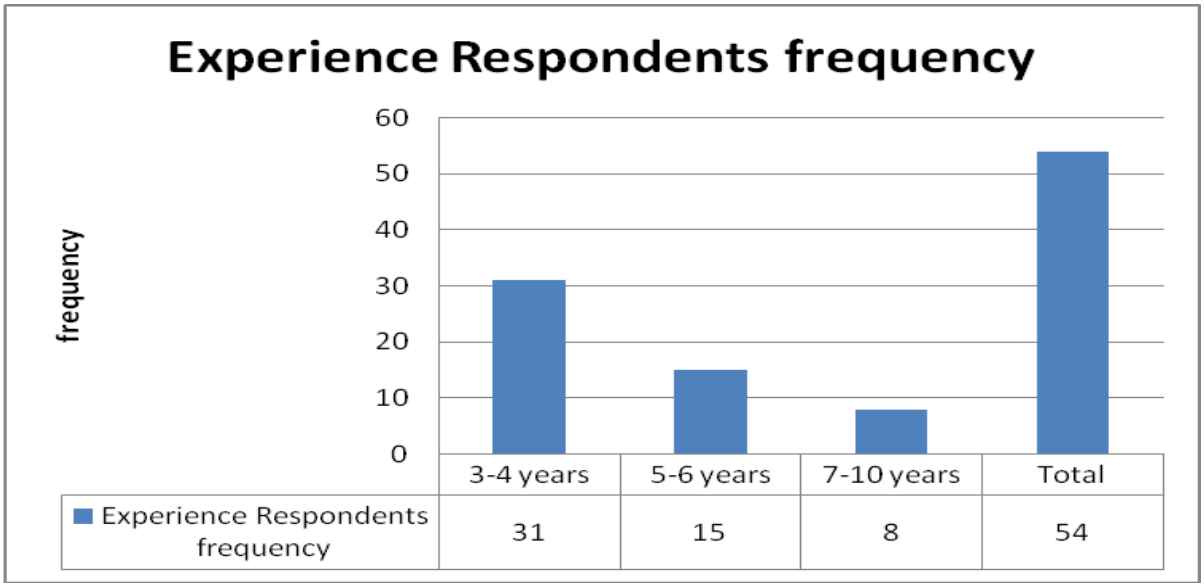
Figure **4**: Profession of respondents



4.1.3 Work Experiences of Respondents

The graph below shows experience of the respondents. It reveals that, out of the total 54 respondents, 31 of the respondents have between 3 to 4 years of experience, 15 of the respondents have between 5 to 6 years of experience. The rest 8 respondents have between 7 to 10 years of experience.

Figure **5**: Experience of respondents



4.2 Availability

Table 1: Judgment analysis matrix for the Variable Availability

Dimensions	Recommended	Indicators	Weight (%)	Judgment Criteria of each dimension and their respective indicators (%)
Availability	100%	3	13.8%	95 Excellent, 80-95 Very good, 65-80 Good, 50-64 fair, < 50 Poor
S/No	**Indicators**			
Availability 3 (13.8%)				
1	Proportion of Professionals having EHR installed computers			
2	Proportion of users received training about the EHR system			
3	Proportion of users satisfied with the adequacy of the training			

4.2.1 Availability of EHR installed computers

All the participants have Computers in their working area. Almost all of the participants 53 (98%) have computers with installed EHR system in their working area.

Table **2**: Descriptive form of availability of computer with EHR installed

Variable of Availability			Frequency (n=54)	Percentage (100%)
Availability of computer with EHR installed	Inpatient	Yes	17	100%
	Outpatient	Yes	18	100%
	Pharmacy	Yes	4	80%
		No	1	20%
	Laboratory	Yes	4	100%
	Reception cashier	Yes	7	100%
	MCH managers	Yes	3	100%
Over all Availability of computer with EHR installed		Yes	53	98.15%
		NO	1	1.85%

For the qualitative analysis, information was collected from individual suggestion and observation. All the participants were asked to give their suggestion about the implemented EHR system respect to each indicator.

Health Officer from the outpatient department suggested that "The interruption of the system due to connection failure makes our work difficult because of the lack of backup alternatives." Lack of back up alternatives is a problem shared by many from the inpatient and pharmacy department.

The reception cashier interviewed said that "The computer I'm using is old and stuck sometimes. I think my computer can't handle working 24 hours a day."

The other problem shared by many was network problem and power interruptions that made them repeat work again and again.

4.2.2 Training on EHR system

From the total respondents, 41% from the inpatient department, 72% from the outpatient department and 80% from the pharmacy department received training. 75% from Laboratory, 86% of reception cashiers and all the MCH managers received training. From all the respondents 66.67% of them received training.

Table **3**: Descriptive form of availability of training

Variable of Availability			**Frequency (n=54)**	**Percentage (100%)**
Receiving training on EHR system	Inpatient	Yes	7	41%
		No	10	59%
	Outpatient	Yes	13	72%
		No	5	28%
	Pharmacy	Yes	4	80%
		No	1	20%
	Laboratory	Yes	3	75%
		No	1	25%
	Reception cashier	Yes	6	86%
		No	1	14%
	MCH managers	Yes	3	100%
Over all receiving training on EHR system		Yes	36	66.67%
		NO	18	33.33%

4.2.3 Adequacy of training

From the respondents who received training, 85.7% from the Inpatient department and 83.3% of Reception Cashiers fond the training adequate. All EHR trained respondents from Outpatient, outpatient, pharmacy, laboratory departments and center managers found the training adequate.

Table **4**: Descriptive form of Training Adequacy

Variable of Availability	**Departments**	**V.Inadequate/Inadequate**	**Medium/Adequate/V. Adequate**
Training Adequacy	Inpatient	14.30%	85.70%
	Outpatient	0	100%
	Pharmacy	0	100%
	Laboratory	0	100%
	Reception cashier	16.70%	83.30%
	MCH managers	0	100%
Over all Adequacy of training			94.83%

If the learning or training was not sufficient, there is no effective on-going use of the system. Therefore, the factors influencing the on-going use of the system due to learning or training ware suggested by the users as follows:

Reception cashier said that “the class room training is given for all service providers at a time; it doesn’t consider our computer skill. If it wasn’t for the on job support the trainers gave us, it’s difficult for me to use the EHR.”

Service provider from the inpatient department suggested that “There is no timely training for the newly recruited staffs. They are being trained by their colleagues and I’m afraid their understanding of the EHR is not sufficient.” A nurse from the same department suggested that “There is no refreshment training especially in system updates. And our knowledge of the EHR system is restricted to our daily activities we don’t know how to manage the simplest malfunctions of the system, for everything we rely on the ICT experts. It’s better for the organization to arrange us a training in common malfunctions of the system. ”

4.2.4 Judgment for the dimension of Availability

According to the judgment criteria, the total score for the dimension of availability was 86.55%. The overall result would be judged as Very Good.

Table **5**: Judgment of the result for the dimension availability of computer access, training and adequacy of training

Dimension	**Indicator/Variable**	**Surveyed Number**	**Observation (%)**	**Weight (%)**	**Result (%)**	**Judgment**
Availability	Availability of computer with EHR installed	54	98.15	33.3	98.15	Excellent
	Receiving training on EHR system	54	66.67	33.3	66.67	Good
	Overall adequacy of training	36	94.83	33.3	94.83	V. Good
	Average of availability scores	**-**	**86.55**	**100%**	**86.55**	**V. Good**

4.3 Usefulness

Table **6**: Judgment analysis matrix for the Variable Use and Usefulness

Dimensions	**Recommended**	**Indicators**	**Weight (%)**	**Judgment Criteria of each dimension and their respective indicators (%)**
Use and Usefulness	100%	69	45.0%	>95 Excellent, 80-95 Very good, 65-80 Good, 50-64 fair, < 50 Poor
S/No	**Indicators**			
Use and Usefulness 69 (45%)				
1	The clinical tasks list in each department(EHR usefulness index)			

4.3.1 Inpatient Department

The table below reveals that, all the respondents from the inpatient department agree that the EHR system makes their daily task of admitting patients/clients, following admitted clients medical usage and monitoring consumables during procedure easier. 94.1% of the respondents agree that the implemented EHR system makes activities such as referring clients to other medical center or department, billing for consumables and following post delivery status easier as compared to the paper based system.

From all the respondents, 88.2% of them agree that the EHR system makes it easier to follow 1st & 2nd stage labor and monitoring labor using partograph. Only 77% of the respondents agree that it is easier to use EHR to monitor neonatal outcome.

Table **7**: Descriptive form of EHR system usefulness in the Inpatient Department

How has the EHR system changed the performance of the following tasks?	**Significantly more difficult**	**More difficult**	**Slightly more difficult**	**No change**	**Slightly easier**	**Easier**	**Significantly easier**	**Usefullness/ Task**
To admit patients has become	-	-	-	-	17.60%	35.30%	47.10%	100.00%
To refer clients to other Medical center/specialists/departments has become	-	-	-	5.90%	11.80%	29.40%	52.90%	94.10%
To follow admitted clients Medication usage	-	-	-	-	17.60%	41.20%	41.20%	100.00%
To monitor consumables during procedure	-	-	-	-	17.60%	47.10%	35.30%	100.00%
Billing for consumables		-	5.90%	-	23.50%	41.20%	29.40%	94.10%
To follow 1st stage labor care			5.90%	5.90%	17.60%	41.20%	29.40%	88.20%
To follow 2nd stage labor care			5.90%	5.90%	17.60%	35.30%	35.30%	88.20%
To monitor labor using partograph			5.90%	5.90%	17.60%	35.30%	35.30%	88.20%
To follow post-delivery status			5.90%		23.50%	35.30%	35.30%	94.10%
To monitor OR outcome				5.90%	17.60%	47.10%	29.40%	94.10%
To monitor Neonate outcome			11.80%	11.80%	11.80%	47.10%	17.60%	77%
Over all usefulness of EHR/Inpatient								**92.50%**

Most of the respondents also suggested that the EHR system improved their daily activities. They also said that the system adds quality to their service.

A midwife from the department suggested that “I’m very happy with the system. The best thing that the system does for me is minimizing the admittance and discharging procedure. Before the implementation discharging was one of the hectic procedures.”

Another midwife also suggested that “We can get the previous medical history easily with the system and this aids to the quality of our service.”

Though many are happy with the system, there are also some suggestions about improvements that the respondents want from the system.

Health officer suggested that “on the admission part of the system it needs to have a nursing care plan according to the standard and in post-partum follow up it needs a space to include Respiratory Rate.”

A nurse from the department suggested that “It is important to include provider name in the partograph. It is also best to include spelling correction system while inputting data.”

4.3.2 Outpatient Department

As indicated from the table below, from the 23 indicators used, all the respondents from the outpatient department agree that the implemented EHR system make it easy to perform 7 indicator tasks. The overall usefulness of the EHR system in the outpatient department is 93.97%.

The result also supported by the suggestions from the respondents. The respondents mentioned their opinion about the implemented EHR system as follows:

Health officer mentioned “The system doesn’t only save client’s time it also saves the provider’s time as well. We don’t need any facilitators /card porters client can easily be served in order using the system.”

A nurse suggested that “The best thing about the system is that it makes all information about the client easily accessible for the provider. It also made our communication within & between departments very easy.”

The respondents also gave suggestions about possible improvements for the system that can further simplify their daily activity.

Gynecologist suggested that “Some procedures are not included in the system. It is better to include major degree perineal tear repair, cervical and vaginal tear repair and secondary would closure.”

Another Gynecologist added that “Medical certificates and Antenatal care (ANC) sheet doesn’t accept Amharic phonetics; some clients need their certificates in Amharic. And also the Gynecological note doesn’t accept subjective findings.”

Table **8**: Descriptive form of EHR system usefulness in Outpatient Department

How has the EHR system changed the performance of the following tasks?	Significantly more difficult	More difficult	Slightly more difficult	No change	Slightly easier	Easier	Significantly easier	Usefulness/Task
To review the clients problems has become	-	-	5.6%	-	5.60%	16.70%	72.20%	94.50%
To seek out specific information from the clients record	-	-		-	11.10%	27.80%	61.10%	100%
To follow the results of a particular test or investigation has become	-	-	5.60%	-		44.40%	50.00%	94.40%
To obtain the results from new tests or investigation has become	-	-	5.60%	-	5.60%	33.30%	55.60%	94.50%
To enter daily notes has become	-	-	5.60%	-	11.10%	55.60%	27.80%	94.50%
To obtain information on investigation or treatment procedures has become	-	-	5.60%		11.10%	33.30%	50.00%	94.40%
To answer questions concerning general medical knowledge (E.g. Concerning treatment, symptoms, complications etc.) has become	-	-	5.60%	5.60%	22.20%	22.20%	44.40%	88.80%
To produce data reviews for specific patient groups (E.g. complication rate) has become	-	-	-	-	27.80%	16.70%	55.60%	100%
To order clinical laboratory analysis has become	-	-	-	-	27.80%	16.70%	55.60%	100%
To obtain the results from clinical laboratory analysis has become	-	-	-	5.60%	16.70%	16.70%	61.10%	94.50%
To order ultrasound investigations has become	-	-	-	-	22.20%	16.70%	61.10%	100%
To obtain results from ultrasound has become	-	-	-	-	22.20%	27.80%	50.00%	100%
To order other supplementary investigations has become	-	-	-	-	22.20%	38.90%	38.90%	100%
To obtain the results from other supplementary investigations has become	-	-	-	-	22.20%	50.00%	27.80%	100%
To refer the patients to other departments or specialists has become	-	-	11.10%	-	11.10%	38.90%	38.90%	88.90%
To order treatments directly (E.g. medicines, operations etc.)has become	-	-	-	5.60%	16.70%	27.80%	50.00%	94.50%
To write prescriptions has become	-	-	-	-	16.70%	27.80%	55.60%	100%
To complete sick-leave forms has become	-	-	5.60%	33.30%	16.70%	22.20%	22.20%	61%
To collect patient information for various medical declarations has become	-	-	5.60%	5.60%	11.10%	38.90%	38.90%	89%
To give written individual information to patients (E.g. About medications, disease status)has become	-	-	-	5.60%	11.10%	50.00%	33.30%	94%
To give written general medical information to patients has become	-	-	-	56.00%	16.70%	33.30%	44.40%	94%
To collect patient information for discharge reports has become	-	-	-		16.70%	44.40%	38.90%	100%
To check and sign typed dictations has become	-	-	-	16.70%	11.10%	38.90%	33.30%	83%
Over all usefulness of EHR/Outpatient								**93.97%**

A Nurse mentioned “The number of characters than can be written on admission and patient notes are limited, It’s better to increase.”

Another Nurse also mentioned “The space specified to take history is not enough. And when client’s come for an appointment with a new history it’s difficult to add with the previous one.”

4.3.3 Pharmacy Department

As indicated in the table below, all the respondents agree that the EHR system is useful to know available drugs in the dispensing area and for billing for medication. Whereas for activities such as implementing drug-drug or drug-Allergy interaction checks, to maintain active medication allergy list and in maintaining active medication list, all the respondents agree that the implemented EHR system has no use.

For tasks like dispensing multiple medications for the prescription, monitor drug by expiry dates and monitor controlled drug by prescription, respondents agree that the impact of EHR in simplifying these tasks is low.

Table **9**: Descriptive form of EHR usefulness in Pharmacy Department

How has the EHR system changed the performance of the following tasks?	**Significantly more difficult**	**More difficult**	**Slightly more difficult**	**No change**	**Slightly easier**	**Easier**	**Significantly easier**	**Usefulness/ Task**
To clearly read prescription	-	-	20.0%	20%	20%	-	40%	60.00%
To dispense Medication	-	-	40%	-	-	-	60%	60.00%
To dispense Multiple drug from the prescription	-	20%	20.00%	20.00%	-	-	40%	40.00%
To know available drugs in dispensing area	-	-	-	-	-	20%	80%	100.00%
Monitor Medications by expiry date	-	20%	20%	40%	-	-	20%	20.00%
Serving clients in order	-	-	-	20%	-	-	80%	80.00%
Billing for Medication	-	-	-		-	-	100%	100.00%
Implement drug-drug and drug-allergy interaction checks	-	-	60%	40%	-	-	-	0.00%
To Maintain an active medications allergy list	-	-	60%	40%	-	-	-	0.00%
To Maintain an active medications list	-	-	60%	40%	-	-	-	0.00%
To detect duplication of therapies	-	-		20%	-	20%	60%	80.00%
To monitor controlled drug prescriptions		-	20%	40%	40%	-	-	40.00%
Over all usefulness of EHR/Pharmacy								**48.33%**

The respondents from pharmacy department suggested that EHR system is not fully integrated with store. Therefore store activities such as issuing and receiving items and stock returns are done manually.

The other problem mentioned is in drug dispensing. They said when multiple drug is prescribed to a client it doesn't come in a single folder rather it gives too many list for a single client. They also suggested for the system to have an alarm system for near expiry date items.

4.3.4 Laboratory Department

All the respondents agree the EHR system simplified tasks such as receiving laboratory orders, serving clients in order and processing reference laboratory results. 75% of the respondents agree in simplified activities after the implementation of EHR, billing for service, avoiding errors in giving results and ensuring accuracy of laboratory results. The total usefulness of EHR system in laboratory is 81.25%.

Table **10**: Descriptive form of EHR usefulness in Laboratory Department

How has the EHR system changed the performance of the following tasks?	**Significantly more difficult**	**More difficult**	**Slightly more difficult**	**No change**	**Slightly easier**	**Easier**	**Significantly easier**	**Usefulness/ Task**
Receiving lab orders	-	-	-	-	-	50%	50%	100%
Serving clients in order	-	-	-	-	-	50%	50%	100%
Avoiding errors in giving results	-	-	25%	-	25%	50%	-	75%
Billing for service	-	-	25%	-	-	25%	50%	75%
Ensure accuracy of lab results	-	-	25%	-	25%	-	50%	75%
Process Reference Laboratory results	-	-	-		25%	25%	50%	100%
Process Lab packages by category of services (ANC, CAC)	-	25%	-	25%	25%	-	25%	50%
Over all usefulness of EHR/Laboratory								**81.25%**

In this study the respondents from the laboratory department gave their suggestion about possible improvements and problems as follows:

Laboratory technicians suggested "The system saves time and it makes communication between departments easy. And after the implementation of the system there is no missing of lab results."

Another laboratory technician mentioned “a Laboratory order doesn’t indicate from which department the order is sent. And the laboratory reports doesn’t show reported time and the technicians name. Another problem is when clients ask for print out, the system doesn’t allow print out without referral and when the result is printed with the referral, it cuts some section.”

4.3.5 Reception cashiers

The table below indicates that all the reception cashiers agree that implemented EHR system made their daily activity, of registering clients, finding mistakes and missing information, billing and charge capture, searching and find the exact client searching for, easy.

Table **11**: Descriptive form of EHR usefulness for Reception cashiers

How has the EHR system changed the performance of the following tasks?	**Significantly more difficult**	**More difficult**	**Slightly more difficult**	**No change**	**Slightly easier**	**Easier**	**Significantly easier**	**Usefulness/Task**
To register patient/client information	-	-	-	-	-	28.60%	71.40%	100%
Finding mistakes and missing information	-	-	-	-	-	28.60%	71.40%	100%
Billing and charge capture	-	-	-	-	-	42.90%	57.10%	100%
Searching patient file	-	-	-	-	-	28.60%	71.4%	100%
Finding the exact file searching for	-	-	-	-	-	14.30%	85.70%	100%
Over all usefulness of EHR/Reception Cashiers								**100.00%**

As indicated from the table the usefulness of the EHR system for reception cashiers is 100%. The respondents interviewed gave opinions or suggestion about the benefits of the system as follows:

Reception cashiers said “In the paper based system the hard copy file for each client were kept in a cupboard. It was difficult to reach in the top shelf. Now searching for client file is very easy we can do it using their names or phone numbers using the EHR system from our desktop.”

“The EHR system made monthly reporting very easy. Before using the system it requires as to add each service provided in the month but now the system itself generates the report.”

"The EHR system makes our job very easy especially in reconciling cash and finding client's files. The only problem we are facing is that the system has no section to handle credit system and discounts. Therefore, it is difficult to balance cash when we close."

4.3.6 MCH Managers

All the MCH managers agree the EHR system helped in simplifying the following activities: Getting a total number of clients, Getting provider level performance, Getting the number of clients/service, producing data reviews for specific patient group, to find out total cash collected daily/weekly/monthly, to show service data and in controlling fraud. The total Usefulness of the EHR system for MCH mangers is calculated to be 80.54%

Table **12**: Descriptive form of EHR usefulness for MCH Managers

How has the EHR system changed the performance of the following tasks?	**Significantly more difficult**	**More difficult**	**Slightly more difficult**	**No change**	**Slightly easier**	**Easier**	**Significantly easier**	**Usefulness/Task**
Getting a total number of clients as needed	-	-	-	-	-	33.30%	66.7%	100.00%
Getting provider level performance	-	-	-	-	33.30%	33.30%	33.30%	100.00%
Getting Number of clients/Service	-	-	-	-	33.30%	33.30%	33.30%	100.00%
Producing data reviews for specific patient groups E.g. Complication rate, diagnosis	-	-	-	-	33.30%	33.30%	33.30%	100.00%
Total cash collected daily/weekly and monthly	-	-	-	-		66.70%	33.30%	100.00%
To calculate income to cost ration	-	-	33.30%	33.30%	33.30%	-	-	33.30%
To show service trend	-	-	-	-	33.30%	66.70%	-	100.00%
Providing remote access to data	-	-	-	33.30%	33.30%	33.30%	-	66.60%
Providing live data for presentations	-	-	-	33.30%	33.30%	33.30%	-	66.60%
Controlling Fraud	-	-	-		33.30%	33.30%	33.30%	99.90%
Over all usefulness of EHR/MCH Manager								**80.53%**

MCH managers agree that EHR system is worth the time and effort required to use it. They said "They are EHR is enabling them to manage every activity of the center. The system played a great role in improving health care delivery especially in controlling fraud."

"The EHR system really simplified our daily activities but sometimes there is delay in getting support in case of malfunctions. It is also best if the reporting template matches the government's report template (HMIS)."

4.3.7 Judgment for the dimension of usefulness

According to the judgment criteria, the total score for the dimension of usefulness is 82.81%. The overall result would be judged as Very Good.

Table **13**: Judgment of the result for the dimension Usefulness

Dimension	Indicator/Variable	Surveyed Number	Observation (%)	Weight (%)	Result (%)	Judgment
	Usefulness of EHR/Inpatient department	17	92.50%	16.67	92.50%	V.Good
	Usefulness of EHR/Outpatient department	18	93.97%	16.67	93.97%	V.Good
	Usefulness of EHR/Pharmacy Department	4	48.33%	16.67	48.33%	Poor
	Usefulness of EHR/Laboratory department	4	81.25%	16.67	81.25%	V.Good
	Usefulness of EHR/Reception Cashiers	7	100.00%	16.67	100.00%	Excellent
	Usefulness of EHR/MCH Managers	3	80.83%	16.67	80.83%	V.Good
Usefulness	**Average of usefulness scores**	**-**	**82.81%**	**100%**	**82.81%**	**V.Good**

4.4 User satisfaction

Table **14**: Judgment analysis matrix for the Variable User satisfaction

Dimensions	Recommended	Indicators	Weight (%)	Judgment Criteria of each dimension and their respective indicators (%)
User satisfaction	100%	5	41.2%	>95 Excellent, 80-95 Very good, 65-80 Good, 50-64 fair, < 50 Poor
S/No	Indicators			
User satisfaction 5 (41.2%)				
1	Proportion of satisfied with usefulness/utility of EHR system.			

4.4.1 Users Satisfaction with usefulness of the system

Most of the respondents on the study opinion were agree/strongly agree with usefulness of the system. 88.12% of respondents agree the system help them for more activities of their daily work, 85.23% of the respondents agree the system help them to be more productive, 90.89% of

respondents agree with the system was useful, 88.99% of the respondents were agreeing with save their time due to use of the system and 79.57% of the respondents agree that the system meet their needs. Generally, 86.56% of the respondents were agreeing with satisfied by usefulness of the system. The detailed of users satisfaction with department of is presented in the table below.

Table **15**: Cross tabulation of Department's satisfaction with usefulness of the EHR system

Indicators of usefulness	Department of respondents	Strongly disagree/Disagree/Neither	Strongly Agree/Agree
The system help me for more activities in my daily work	Inpatient	24%	76%
	Outpatient	28%	72%
	Pharmacy	20%	80%
	Laboratory	0%	100%
	Reception Cashier	0%	100%
	MCH Manager	0%	100%
Average score		**11.88%**	**88.12%**
The system help me to be more productive	Inpatient	35.29%	64.71%
	Outpatient	33.33%	66.67%
	Pharmacy	20.00%	80.00%
	Laboratory	0.00%	100.00%
	Reception Cashier	0.00%	100.00%
	MCH Manager	0.00%	100.00%
Average Score		**14.77%**	**85.23%**
The system is useful	Inpatient	23.53%	76.47%
	Outpatient	11.11%	88.89%
	Pharmacy	20.00%	80.00%
	Laboratory	0.00%	100.00%
	Reception Cashier	0.00%	100.00%
	MCH Manager	0.00%	100.00%
Average Score		**9.11%**	**90.89%**
The system saves me time	Inpatient	29.41%	70.59%
	Outpatient	16.67%	83.33%
	Pharmacy	20.00%	80.00%
	Laboratory	0.00%	100.00%
	Reception Cashier	0.00%	100.00%
	MCH Manager	0.00%	100.00%
Average Score		**11.01%**	**88.99%**
The system meets my needs	Inpatient	29.41%	70.59%
	Outpatient	38.89%	61.11%
	Pharmacy	40.00%	60.00%
	Laboratory	0.00%	100.00%
	Reception Cashier	14.29%	85.71%
	MCH Manager	0.00%	100.00%
Average Score		**20.43%**	**79.57%**
Total satisfaction with usefulness of EHR system		**13.44%**	**86.56%**

According the judgment criteria, the total score of the dimension of user's satisfaction with usefulness of the system was 86.56%. The overall result would be judged as Very good.

4.5 Overall EHR implementation (Summary of dimensions)

The overall results of the EHR implementation effectiveness was 85.31%. Depend on the judging criteria this result was Very good. But, there are variables that scored excellent (Availability of computer with EHR installed and usefulness of EHR for Reception cashiers) and poor (Usefulness of EHR for Pharmacy department).

Table **16**: Judgment for the overall EHR implementation effectiveness

	Indicator/Variable	**Surveyed Number**	**Observation (%)**	**Weight (%)**	**Result (%)**	**Judgment**
1	Average score of Availability	54	86.55%	13.80	86.55%	V.Good
2	Average score of Usefulness of the system	54	82.81%	45.00	82.81%	V.Good
3	Average score of User satisfaction	54	86.56%	41.20	86.56%	V.Good
	Total score of EHR implementation effectiveness	54	**85.31%**	**100%**	**85.31%**	**V.Good**

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5 CHAPTER FIVE
DISCUSSION

5.1 Availability

From all the respondents 98.15% of them have computer with installed EHR system at their working area. The availability of computers with installed EHR system can be judged as Excellent. But, there are some challenges mentioned by participants. Lack of backup system, Interruption of network and power are problems mentioned by participants. A similar study done in Effia Nkwanta regional hospital found in Ghana [13] revealed that, inadequate computers to serve all the users department was a major challenge for EHR implementation. Another challenges mentioned by this study were inadequate personnel, Attitude of personnel and network switches.

A systematic literature review of empirical research on EHR implementation revealed that the importance of training is often underestimated, and inadequate training will create a barrier to EHR use. Consequently, adequate training, of appropriate quantity and quality, must be provided at the right times and locations [4]. The current study showed that 66.67% of the participants received training. Out of those participants who received training 94.83% found the training adequate. The participants also mentioned that they enjoyed the on job training than the class room training. On the other hand, participants criticized the training for not considering their computer skills. In addition, the participants mentioned that there is no refreshment training for system updates and no timely training for newly recruited staffs. A study focused on shared access to EHR also identifies a difficulty when an employee leaves the organization [32]. When one employee leaves the organization and a new employee is hired, the current employee who uses the EHR system was responsible for providing the necessary training. This setup is problematic if the old and new pharmacists did not overlap. A plan for training new collaborators and providing updates about the shared EHR system is valuable.

The current study judged the availability dimension as Very good, which is better than the result obtained from Evaluation of EMR system in Aydel Hospital (Good) [33].The reason was better preparation from the organizations' side in assessing and providing the necessary ICT equipments ahead of EHR implementation.

5.2 Usefulness

Usefulness is another dimension used in this evaluation study. Usefulness of EHR system in each department's activity was studied and judged according to the judgment criteria. All Receptionist cashiers found the EHR system useful for their daily work. All of them agree the implemented EHR system made their daily task of registering client information, finding mistakes and missing information, billing and charge capture, searching patient file and find the exact file they are searching for easier than the paper based recording system. They also mentioned that the EHR system made managing discounts and credit system a challenge as the system only allows pre entered price for all services.

From respondents of the inpatient department, 92.5% of them agree on the usefulness of the EHR system for their daily activities. All respondents agree that the implemented EHR system made their daily task of admitting clients, following admitted clients, and monitoring consumables during procedure easier as compared to the previous paper based system. More than 94% of the participants agree that it is easier to use EHR to refer clients to other medical centers/specialists, billing for consumables, to follow post-delivery status and to monitor neonate outcome. As compare to the paper based system, more than 88% of the participants agree that the EHR system made it easy to follow 1^{st} and 2^{nd} stage labor care and monitor labor using partograph. But only 77% of the respondents agree that it is easier to use EHR for monitoring neonate outcome than the previous paper based system.

Overall usefulness of EHR system in the outpatient department was measured to be 93.97%. All the participants agree that the EHR system is easy to do their daily activity of seeking out specific information from the client record, to produce data reviews for specific patient groups, ordering clinical laboratory analysis, to order and receive results from ultrasound investigation, to order and receive results from supplementary investigations. But only 61% of the respondents agree that EHR made it easy to completer sick-leave forms. As most of the participants agree that the EHR system made it easy to do their daily activities, they also suggested improvements for the system that can even facilitate their tasks. The suggestions include Adding Amharic phonetics to the system especially in writing medical certificates and increasing space specified for history taking.

Examination of the implementation of an electronic health records (EHR) system in a small family practice clinic in USA showed that Physicians spent about half of their time caring for patients in both the pre- and post-implementation studies. The EHR implementation did not affect the amount of time physicians spent with patients, but increased the amount of time spent by physicians on computer entry and decreased time spent on dictation, phone, and typing/writing/signing. For clinical staff, the main differences between the pre- and the post-EHR implementation were the following: increases in time spent on patient care, computer entry, phone and preparing, and decreases in time spent in meeting, performing lab work, and typing/writing/signing [2].

From pharmacy department, only 48.33% of them agree that EHR is useful to do their daily task. All the participants agree that the EHR system made it easy to do their daily task of billing for medication and monitoring available drugs in dispensing area. As compare to the paper based system, the respondents agree that there is no improvement in maintaining active medication allergy list, implement drug-drug and drug- allergy interaction checks and maintaining active medication allergy list. Only 40% of the respondents agree that it is slightly easier to use EHR to monitor controlled drug prescription. The majority of respondents find the EHR system has not made it easy to dispense multiple medications per prescription and monitor drugs by expiry drug, 60% and 80% respectively.

As most the respondents suggested and indicated in the quantitative data, the benefit of EHR system is not fully realized in Pharmacy department. They respondents mentioned that store related activities such as receiving and issuing medication and managing stock returns are not fully integrated with EHR system. A study conducted for the agency of healthcare research and quality to support research and policy formation in the area of EHR summarizes the role of EHR in prescribing medication. If effectively implemented, EHR system reduces the need to relay on memory alone for information required to complete a task such as medical history, allergies and formulations. It also reduces the need to mentally group compare, or analyze information such as dose calculation. The EHR system can also enhance the ability to integrate information from multiple sources to make evidence based decision (Eg. medication interaction, contraindication and effectiveness). Another role of EHR in pharmacy includes enhancing the ability to

communicate information and findings to other providers and patients (Eg. patient instructions, side effects and warnings) [34].

As all respondents from Laboratory department agreed, it is easier to use EHR system for activities such as receiving lab orders, serving clients in order and process reference laboratory results. And only have of them find the implemented EHR system makes it easier to process Lab packages by category of services. The overall usefulness of EHR system in Laboratory department is 81.25%. Though the implementation of EHR system in laboratory department is judged to be Very good, there are also some problems mentioned by respondents. As the respondents mentioned, the laboratory order doesn't indicate from which department the order is sent. And also the reports doesn't show reported time and the technicians name. This may have an impact in accountability, since it's difficult to know who sent the order and who reported the result.

The current study also measured the usefulness of EHR for MCH managers. All MCH managers found the EHR system useful for activities such as, getting client numbers as needed, getting provider level performance, getting number of clients/service, producing data reviews for specific patient groups, to get cash collect daily/weekly or monthly, to show service trend and fraud control. Whereas 66.6% of the respondents found the system doesn't make it easy to calculate income to cost ratio. Similarly, a nation-wide survey of clinical coders working in Australian Hospitals revealed that a large number of managers' responses (38%) relating to the impact of electronic health records referred to easier access to information and a better availability of information from which to assign codes. Managers believed that easier access to off-site information which is not a traditional part of the paper-based record, and better availability of information, would result in coding from EHRs being less time consuming than paper-based records. The majority of managers (82%) also stated that EHRs will improve data quality. Reasons for improved data quality included more readily available information and improved legibility of records [35].

Comparing the judgment criteria for usefulness of EHR in each department, reception cashiers are at the front with excellent. Inpatient, outpatient, Laboratory and MCH managers are next with Very good. The lowest score is Pharmacy department with Poor. The average score of use and usefulness of all departments is very good.

5.3 User Satisfaction

The other dimension measured in this study is user satisfaction. User satisfaction with EHR system in each department was measured using five indicators and judged using the judgment criteria. Total satisfaction of usefulness with EHR system is scored to be 86.56% (Very good). From the five satisfaction indicators “the system meets my needs” scored the lowest with 79.57% (Good). A study done in Egypt also measures effectiveness of EHR in hospitals, the most common response is "EHR is adopted to increase Quality of services" which is (100%). This is followed by “EHR accelerates and improves Performance” which is (67%). Most notable was the response “time efficiency of physicians” which is 50% [1] .

5.4 Implementation Effectiveness

The overall implementation effectiveness is the average score of availably, use and usefulness and user satisfaction dimensions. It is measured to be 85.3% (very good). This result is better than result of EMR evaluation done at Ayder hospital (73.5%) [33].

6 CHAPTER SIX
CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

This study was carried out in Marie Stopes Internation Ethiopia's MCH centers, in Adama, Bahir Dar and Gotera (Addis Ababa), with the principal aim of evaluating the installed EHR system. The outcome of this evaluative assessment has produced useful insight into the actual implementation of the system at its early stages and the prospect of fully implementing the electronic record system in for the whole MSIE centers. In general terms, the study reveals a fairly positive implementation of the system in the studied centers.

The current study evaluates the installed EHR system using three dimensions: availability, usefulness and user satisfaction with usefulness of the system. Availability is measured using three indicators; proportion of professionals having EHR installed computers, proportion of users received training about the EHR system and proportion users satisfied with the training. Usefulness of the study is measured in six departments; inpatient, outpatient, pharmacy, laboratory, Reception cashiers and MCH managers. User satisfaction is evaluated in each department using five indicators.

Average score for the dimension of Availability is judged to be very good. Almost all of the study participants have computers with EHR installed. But only a little more than half of the participants received training. From participants who received training, almost all find the training satisfactory. Most of the participants found the practical training was very enabling than the class room training.

Usefulness is another dimension used in the study. The overall usefulness of EHR system is judged to be very good. A significant number of participants from Inpatient, Outpatient, Laboratory, Reception Cashiers and MCH managers found the implemented EHR system useful for their daily task. But less than half of the participants from the Pharmacy department found the system useful. Participants from pharmacy department suggested that the system is not fully integrated with store system and face difficulty managing stock returns and receiving using the EHR system.

Total satisfaction with usefulness of the system is judged to be very good. Satisfaction with usefulness of the system is measured in each department by five indicators, which are; The system help me for more activities in my daily work, The system help me to be more productive, The system is useful, The system saves my time and The system meets my needs. The First four indicators scored very good in the judgment criteria. Whereas the last indicator, the system meets my needs, scored good in the judgment criteria.

Over all implementation effectiveness of the system is measured using the average score of availability, usefulness and satisfaction dimensions. It is judged to be very good.

6.2 Recommendations

The importance of adequate and timely training to staffs about the EHR system cannot be over emphasized. If the learning or training is not sufficient, there is no effective on-going use of the system. Therefore, factors and suggestion given by the study participants must be acted upon to ensure effective use of the system. As most participants suggested the practical training conducted on their duty station was very helpful. This kind of training must be continued in future training plans. Letting the current staff train the new staff about the EHR system has an impact on effective use of the system, if the current staff does not master the use of the EHR system. The organization must ensure newly recruited staffs received adequate training by EHR experts before assigning.

As the study revealed the benefit of EHR system is not fully realized in pharmacy department. Pharmacy is an important unit in health care system. Medications occupy a significant amount in any health facilities budget. As health information technology proliferates and EHRs are designed and implemented in the health care setting, it is imperative that pharmacists' workflow and information needs are met within EHRs to optimize medication therapy quality and patient outcomes.

The participants mentioned many improvements to the system. The need for improvement may be the cause for relatively low score in satisfactory indicatory "the system meets my needs." The organization must find a way of incorporating these needs.

It is also recommended that future studies evaluate the impact of EHR from the patients' perceptive. This would help reveal whether or not the intended benefits of the implemented EHRs to patients are actually realized.

From the identified limitations, it is recommended for further studies to investigate user satisfaction with other dimension of the EHR system such as context, ease to learn and ease of use.

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8 Annex A: Consent Form

The Questionnaire is for Evaluation of the Electronic Health Record (EHR) system in MSIE's MCH centers.

I am kindly requesting you to participate on this survey questionnaire which is intended to:

- Evaluate the Availability of EHR system
- Evaluate the Use and Usefulness of the EHR system.
- Evaluate Users' Satisfaction with usefulness of the EHR system
- Evaluates Implementation effectiveness of the EHR system

The information you will provide will be used as primary data for the partial fulfillment for the Award of Master of Arts Degree in Project Management. All your responses are strictly confidential and the findings of this study will be used for academic purpose only.

Please don't write your name anywhere on this questionnaire. I would like to express my heartfelt gratitude in advance for your kind participation.

9 Annex B: Questionnaires

9.1 Demographic and Availability of EHR questionnaires

1. What is your role in the clinic?

_____

2. How long have you worked in your current position?

_____

3. Do you have a computer with EHR system installed in your working area? Yes [ ] No [ ]

4. Did you receive any training on the EHR before it implementation? Yes [ ] No [ ]

5. How adequate was the training? Very adequate [ ] adequate [ ] Medium [ ] inadequate [ ] very inadequate [ ]

_____
_____
_____

9.2 Usefulness questionnaires

Comparing to previous paper based system, how has the EHR in your opinion changed the performance of the following tasks?

9.2.1 Reception Cashiers

How has the EHR system changed the performance of the following tasks	Significantly More difficult	More difficult	Slightly More difficult	No change	Slightly easier	Easier	Significantly easier
1. To register client/patient information							
2. Finding Mistakes and missing information							
3. Billing and charge capture							
4. Searching for patient file							
5. Finding the exact file searching for							

9.2.2 Pharmacy Department

How has the EHR system changed the performance of the following tasks?	Significantly more difficult	More difficult	Slightly more difficult	No change	Slightly easier	Easier	Significantly easier
1. To clearly read prescription							
2. To dispense Medication							
3. To dispense Multiple drug from the prescription							
4.To know available drugs in dispensing area							
5. Monitor Medications by expiry date							
6. Serving clients in order							
7. Billing for Medication							
8. Implement drug-drug and drug-allergy interaction checks							
9. To Maintain an active medications allergy list							
10. To Maintain an active medications list							
11. To detect duplication of therapies							
12. To monitor controlled drug prescriptions							

9.2.3 Laboratory Department

How has the EHR system changed the performance of the following tasks?	Significantly more difficult	More difficult	Slightly more difficult	No change	Slightly easier	Easier	Significantly easier
1. Receiving lab orders							
2. serving clients in order							
3. Avoiding errors in giving results							
4. Billing for service							
5. Ensure accuracy of lab results							
6. Process Reference Laboratory results							
7. Process Lab packages by category of services (ANC, CAC)							

9.2.4 Inpatient Department

How has the EHR system changed the performance of the following tasks?	Significantly more difficult	More difficult	Slightly more difficult	No change	Slightly easier	Easier	Significantly easier
1. To admit patients has become							
2. To refer clients to other Medical center/specialists/departments has become							
3. To follow admitted clients Medication usage							
4.To monitor consumables during procedure							
5. Billing for consumables							
6.To follow 1st stage labor care							
7.To follow 2nd stage labor care							
8. To monitor labor using partograph							
9. To follow post-delivery status							
10.To monitor OR outcome							
11. To monitor Neonate outcome							

9.2.5 MCH Managers

How has the EHR system changed the performance of the following tasks?	Significantly more difficult	More difficult	Slightly more difficult	No change	Slightly easier	Easier	Significantly easier
1. Getting a total number of clients as needed							
2. Getting provider level performance							
3. Number of clients/service							
4.To know available drugs in dispensing area							
5. Producing data reviews for specific patient groups eg, complication rate, diagnosis							
6.Total cash collected daily/weekly and monthly							
7. To calculate income to cost ratio							
8. To show service trends							
9. Providing remote access to Data							
10. Providing live data for presentation							
11. Controlling Fraud							

9.2.6 Outpatient Department

How has the EHR system changed the performance of the following tasks?	Significantly more difficult	More difficult	Slightly more difficult	No change	Slightly easier	Easier	Significantly easier
1.To review the clients problems has become							
2.To seek out specific information from the clients record							
3. To follow the results of a particular test or investigation has become							
4. To obtain the results from new tests or investigation has become							
5. To enter daily notes has become							
6. To obtain information on investigation or treatment procedures has become							
7. To answer questions concerning general medical knowledge (E.g. Concerning treatment, symptoms, complications etc.) has become							
8. To produce data reviews for specific patient groups (E.g. complication rate) has become							
9. To order clinical laboratory analysis has become							
10. To obtain the results from clinical laboratory analysis has become							
11. To order ultrasound investigations has become							
12. To obtain results from ultrasound has become							
13. To order other supplementary investigations has become							
14. To obtain the results from other supplementary investigations has become							
15. To refer the patients to other departments or specialists has become							
16. To order treatments directly (E.g. medicines, operations etc.)has become							
17. To write prescriptions has become							
18. To complete sick-leave forms has become							
19. To collect patient information for various medical declarations has become							
20. To give written individual information to patients (E.g. About medications, disease status)has become							
21. To give written general medical information to patients has become							
22. To collect patient information for discharge reports has become							
23. To check and sign typed dictations has become							

9.3 User satisfaction about usefulness of the EHR system

How much do you agree with the following statements about the installed EHR system? Answer by ticking in the cell

S.N	Indicator of Usefulness	Strongly disagree	Disagree	Neither	Agree	Strongly agree
1	The system help me for more activities in my daily work					
2	The system help me to be more productive					
3	The system is useful					
4	The system saves time					
5	The system meets my needs					

9.4 General Comments and feedback/Interview guide

1. What are the values added by the introduction of EHR with regard to your job?

_____
_____
_____

2. What are the problems resolved by the implementation of EHR?

_____
_____
_____

3. What challenges are still intact after the introduction of EHR?

_____
_____
_____
_____

4. What do you think are some of the challenges to the overall introduction and implementation of the EHR?

_____
_____
_____
_____

5. Which elements of the system need improvement?

_____
_____
_____
_____
_____
_____

6. Compare the working condition before and after the introduction of the EHR?

_____
_____
_____
_____
_____
_____