Addis Ababa University

College of medicine and health sciences

Comprehensive Assessment of the Electronic Medical Record System at Tikur Anbessa Specialized Hospital

BY

Abiot Yaregal (MD)

December 2021

Addis Ababa, Ethiopia

Comprehensive Assessment of the Electronic Medical Record System at Tikur Anbessa Specialized Hospital

Researcher: Abiot Yaregal (MD)
Advisor: Dr. Desalew Mekonnen (MD, Consultant Internist, Cardiologist)

A thesis submitted to department of internal medicine, college of medicine and health sciences, Addis Ababa University in partial fulfillment of specialty certificate in internal medicine

December 2021
Addis Ababa, Ethiopia

Declaration

I, Abiot Yaregal, declare that the thesis entitled, "Comprehensive Evaluation of the Electronic Medical Record System at Tikur Anbessa Specialized Hospital" is the result of my original work with guidance and supervision from my advisor which is detailed in the acknowledgement part. All the data collection and data analysis were undertaken by me; and I am responsible for this study's summary, conclusions and recommendations. I seriously declare that this thesis has not been submitted for the award of any academic degree or diploma in any university.

This thesis has been submitted in partial fulfillment of the requirements for specialty certificate in internal medicine at Addis Abeba University. Brief quotations from this thesis are allowed without special permission, provided that accurate acknowledgement of the source is made. In all other instances, however, permission must be obtained from the author.

Name: Abiot Yaregal
Signature: _____
Date of Submission: _____
Place: Addis Abeba University: Addis Abeba, Ethiopia

Approval of thesis submission

I hereby certify that I have read this thesis prepared under my direction and recommend that it can be accepted as fulfilling the thesis requirement.

Name of Thesis Advisor	Signature	Date
_____	_____	_____
Name of Department Head	Signature	Date
_____	_____	_____

Acknowledgment

I am grateful to the Almighty God for making me think and work on this invaluable title. My gratitude goes to my advisor Dr. Desalew Mekonnen, internist and consultant cardiologist, for his exemplary guidance and valuable feedbacks. The help from Mr. Hailu, head of the information technology, is beyond expected.

My gratitude also extends to Miss Engida, quality officer, who is trying to make this research feasible and to be continued as a quality improvement project.

List of tables

List of figures

Abbreviations

EHAQ: Ethiopian Hospital Alliance for Quality
EHRIG: Ethiopian Hospital Reform Implementation Guidelines
EHR: Electronic Health Record
EMR: Electronic Medical Records
IRB: Institutional Review Board
IT: Information Technology
KAP: Knowledge, Attitude & Practice
MOH: Ministry Of Health
OCR: Optical Character Recognition
QI: Quality Improvement
SPSS: Statistical Package for Social Science
TASH: Tikur Anbesa Specialized Hospital

Table of contents

ABSTRACT

Background: Related to its bundles of advantages there is a worldwide trend toward paperless medical recording to avert the drawbacks of the paper based system. However, there is limitation in the adoption, expansion and modernization of Electronic Medical record (EMR) system in Ethiopia. There is also scarcity of data assessing the utilization of EMR in Ethiopia.

Objective: The objective of this study and Quality Improvement (QI) project is to assess the quality of the EMR system used in TASH, to assess Knowledge, Attitude & Practice (KAP) of health professionals toward EMR and determinant factors for EMR improvement.

Methods: A quantitative hospital based cross sectional descriptive study was conducted to assess KAP of health professionals while quality of EMR software was assessed using a checklist. Descriptive statistical methods were applied to analyze the KAP data.

Results: Study participants were all degree and above, mainly males (63.6 %), physicians (76.54 %) and from department of internal medicine (67.7%). Most own personal computer (98.8%) and had adequate EMR knowledge (74.7%) and preferred using EMR than paper based record system (87.7%). Seventy (43.2%) had EMR experience at other government hospital. Fifty percent of the participants claimed TASH EMR did not contain all necessary functions and majority (70.4% for Doctor iCare) agreed on the need to improve TASH EMR system though EMR satisfaction was generally good (87.1% for Doctor iCare). Orientation by colleagues and work exposure were the main sources of EMR knowledge; only 10% participants got training. Majority agreed on hospital leaders (76.5%) and financial constraints (72.3%) as primary barriers for EMR expansion and improvement.

Conclusion: Knowledge, attitude and practice of the end users are better. The interest to use EMR as compared to paper based recording is rewarding. EMR can be better implemented at TASH with better engagement of the hospital leaders and financial support.

Key words: Electronic medical record, Medical records, TASH

CHAPTER ONE: Introduction

1.1 Background

Electronic Medical Record (EMR) system is an electronic record of health-related information on an individual that can be created, gathered, managed, and consulted by authorized clinicians and staff within one health care organization. There is a worldwide trend toward paperless medical recording to avert the drawbacks of the paper based system. Electronic medical record has irrefutably transformed healthcare from papers, files, charts, and hand scribbling into digital data that can be backed up and stored securely. EMR is certainly no longer a luxury it seemed to be when it was first introduced. It is rather a vital component to any modern medical practice. Today, it's fairly safe to say you can't stay or plan to be in medicine without an EMR. ;

An appropriately designed EMR system has numerous advantages.

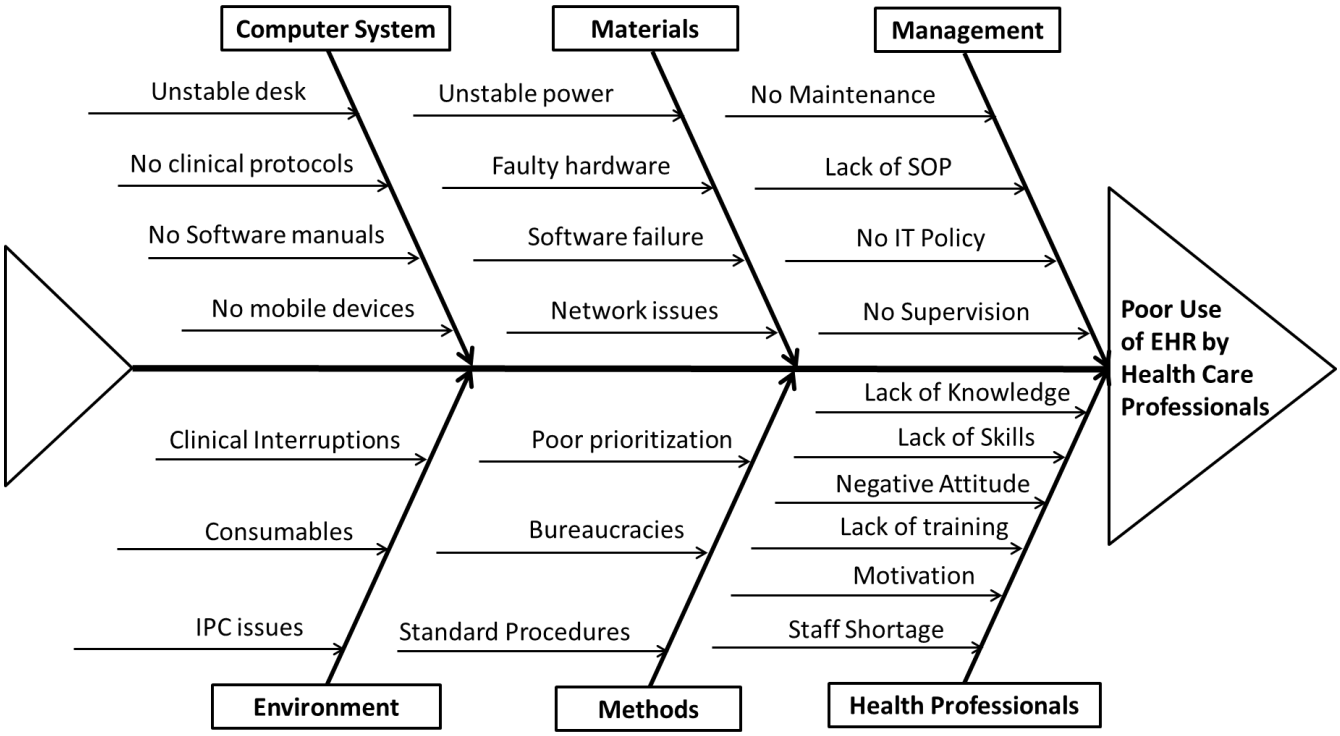
Enables to have patient information at fingertips while anywhere in the world.
Supports evidence-based decision making & promotes use of guidelines.
Increases coordination & communication between different healthcare providers.
Reduces costs of healthcare.
Reduces medical errors and many more.

So EMR is an absolute must to deliver health care services with optimum quality.
Despite these benefits and most health professionals generally believe technology is very good, many EMR systems which are technically sound for developers and healthcare managers face resistance from users due to many reasons.

Developing countries, including Ethiopia, are many steps back in the adoption, expansion and modernization of EMR system. The EMR system used currently in Tikur Anbessa Specialized Hospital is developed by ICare Company. It is a continually developing software and amenable to modification as the programmers are in close relation with the hospital. So the aim of this research and QI project is to assess KAP of staffs toward the EMR and in depth assessment of quality of the program (software) for a better betterment.

1.2 Statement of the problem

Figure 1.1 Fishbone analyses to causes of poor EHR (EMR)



Globally more than 50% of electronic medical record projects failed before reaching their target [1], whilst numerous health facilities have tried to implement with a very low success rate [2]. Therefore critical research/assessment of the EMR software and enabling factors must be done before initiation or expansion of an EMR. In Ethiopia only very few government hospitals use EMR and the EMR systems in use are different.

1.3 Significance of the study

Many health researchers are done focusing on a single problem the results of which are applicable to a small portion of the patient pool or not at all. Comparably investing on an EMR is a move toward quality health service, addressing the health needs of all patients and making the work of service providers satisfactory. Well-designed EMR systems are also the bases for researches and quality improvement projects. Only limited studies are done regarding EMR systems in Ethiopia. Even these few studies are remote & mainly focus on describing the usage pattern of the EMR systems, user satisfactions and associated factors. No EMR study that deeply analyses these factors and how could they be solved using the EMR software or other ways. Health care workers know each detail of their work but cannot change it into software while programmers know how to change an activity into software but do not know each detail of the wide varieties of clinical activities.

By assessing the gaps observed in the utilization of an EMR and quality of the EMR in addressing these gaps, this study/QI project will be a prototype in proposing a document that dictates the real mind map and wishes of health care workers turned into a computer software; “if I were a programmer, I will do it like this”. The document developed will be like a script written and directed by the will of health care workers to be acted into EMR software by programmers; hence a great input to quality health service.

1.4 Objective

1.4.1 General objective

Assessment of Knowledge, Attitude and Practice of Health Care Workers
Assessment of the EMR software quality

1.4.2 Specific objectives

To assess users’ knowledge of EMR system
To assess users’ satisfaction of EMR system
To investigate barriers in EMR utilization and expansion
To assess quality of the currently used EMR system
To propose document for EMR software improvement and impose modifications

CHAPTER TWO: Literature Review

Ethiopia began implementing EMR system or smart care software since 2007/2008 with the help of Tulane University [5] but the adoption and utilization rate is still insignificant [4, 5]. Facilities that started to use the EMR system were unable to sustain it [4, 5]. A cross-sectional study conducted in 2014 in Ayder Referral Hospital, Northern Ethiopia, to assess attitude towards and use of electronic medical record showed that 43.3% of the 428 study participants had unfavorable attitude towards EMR system use despite a significant majority were computer literate (74.3%), had computer access (57.5%) and use the EMR (71.0%) [3]. This and similar studies indicate that focus is given mainly to the material aspects during EMR program installation while the attitude and willingness of healthcare providers toward EMR system utilization including quality of the EMR software and post launching follow ups are largely ignored.

A study conducted on 2015 at Five Low-Resource Setting Hospitals in Ethiopia to assess the usage pattern, user satisfaction level, and determinants of health professionals' satisfaction towards a comprehensive EMR system with 406 study subjects showed that among those who use the EMR 61.4% (190/309) reported over all **dissatisfaction** (physicians were more dissatisfied) and 64.4% (199/309) believed that the EMR had no positive impact on the quality of care. The participants indicated an agreement with the system and information quality but strongly disagreed with the service quality [7]

Contrary to these, a recent cross-sectional study conducted in 2019 in four healthcare facilities of Bahir Dar city, North West Ethiopia, to assess the willingness to use an EMR system showed that 85.9% of the 616 study participants were willing to use the EMR system [6] though less optimal promoting factors; sufficient computer skill (58.3%), using computer for EMR (65.3%) and computer access (78.6%)

In most of the literatures I reviewed quality of the EMR is not directly included among the variables used to assess KAP of professionals toward EMR system. Even though it is difficult to assess an information system it is a must as there are varieties of EMR programs with different quality.

CHAPTER THREE: Methodology

3.1 Study setting and period

The study was conducted in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. Tikur Anbessa Specialized Hospital is the largest tertiary referral hospital in Ethiopia. It is also the main teaching hospital for the College of Health Sciences, Addis Ababa University.

The hospital began to use EMR system developed by ICare Company since March 3, 2018.

It also uses radiology softwares with annual subscription. The current software in use which was developed initially by ICare Company is now transferred to ministry of science and technology. The study was conducted from 2021/10/23 to 2021/12/04.

3.2 Study design

Hospital based cross sectional study.

3.3 Source and study population

The source population comprised all health care work forces working at TASH.

The study population was all health care work forces who used EMR systems.

3.4 Eligibility criteria

3.4.1 Inclusion Criteria

Health care workers who are working at TASH for more than three months and used EMR systems in the last 2 months.

3.4.2 Exclusion criteria

Health care workers who came for detachment from other universities.

3.5 Sample size determination

This is primarily a quality improvement project with concomitant target of conducting an appropriate research to have a better preliminary data. So sample size was determined using the following formula for a cross sectional study.

$$n = \frac{Z^2 * p*(1-p)}{e^2}$$ Where;

n = required sample size

e = margin of error= 5%

Z = critical value for normal distribution at 95% confidence interval = 1.96 ($\alpha = 0.05$).

P = Proportion = 60% taking mean of EMR satisfaction results from 3 different studies done in Ethiopia.

Substituting the variables into the equation
$n = 1.96^2 \times 0.6(1-0.6)/(0.05)^2 = 369$. But, since the size of the source population is less than 10,000 (estimated around 1000) the sample size was corrected to 270.

$$\text{Corrected sample size} = \frac{n}{1+((n-1)/N)}$$

But questionnaire was filled by only 162 persons. Though low, it is enough for a facility based QI project.

3.6 Sampling techniques

Simple random sampling technique was used.

3.7 Study variables

3.7.1 Outcome variable

EMR satisfaction

3.7.2 Explanatory variables

Socio demographic variables: Age, Sex, Literacy level, Profession, Work experience
Computer skill
EMR training
EMR knowledge
Prior EMR experience: at private &/or government hospitals
EMR software quality

3.7.3 Operational definition

EMR (electronic medical record) refers to any computer software used to document, see and/or generate any patient data and facilitate the care given.

3.8 Study tools and data collection

Being QI project, questionnaire & checklist were used. Questionnaire to assess KAP was prepared in reference to similar questionnaires used by other studies with further modification and addition of relevant issues. Checklist to assess EMR software quality was prepared taking consideration of:
Job descriptions of study subjects

National key performance indicators
National Health Service guidelines like EHRIG & EHAQ
EMR documents: articles, books etc.
Other EMRs systems
Individual (researcher's) work experiences while using the EMR system
Registries and different formats used in each unit
The six dimensions of health care quality: safe, effective, efficient, patient-centered, timely, and equitable.
The eight core functions of EMR system: result management, health information and data, order entry/management, decision support, electronic communication and conductivity, patient support, administrative processes, reporting & population health management.

A telegram group was created and nearly 500 members added to it. So the questionnaire was sent to study participants in Google document formant via telegram as a group and individually for majority. Team and unit leaders were contacted physically and with phone to enroll colleagues in their team. Unfortunately, despite made available to hundreds, only 165 filled the questionnaire. Three responses were cancelled for not fulfilling eligibility criteria.

3.9 Data Quality control

The questionnaire was discussed with members of the TASH quality team and advisor. Pretest was done with 10 individuals not included in the study. Being filled online using Google document format, mandatory and restriction checks were applied to majority of the questions. Proper categorization and coding was done before data entry into SPSS.

3.10 Data processing and analysis

Data collected using Google document was exported to excel. After appropriate coding was done it was exported to IBM SPSS version 26 followed by checkup of consistency and completeness using logic checks and exploratory data analysis before running the actual statistical analysis. Statistical parameters were described using text, tables and, graphs. Being an input to a QI project, lower number of study participants and majority are physicians from two departments, only descriptive analysis was done.

3.11 Ethical considerations

Ethical approval was granted by Addis Ababa University, college of health sciences, school of medicine Institutional Review Board (IRB). First page of the questionnaire

contains the consent form stating to decline from the outset & to leave the study at any time if not volunteer. Nothing revealing about participants identity (name, ID, telephone number or email) was collected. This study holds no feasible risk for the participant.

3.12 Dissemination of research findings

After the research is completed, results will be presented in person to responsible bodies from MOH, TASH and the Hospital's QI team. Then the hospital's QI bureau will be responsible to set action plans and do follow up assessments.

CHAPTER FOUR: Results

4.1 Baseline characteristics

As shown *Table 4.1*, a total of 162 participants were involved among whom majority (63.6%, 103/162) were males. The mean age of participants was 31.15 ± 3.99 years, the majority (87%) being between 26 and 35 years. While 52.5% (85/162) participants have degree the rest (47.5%, 77/162) were master and above[1]. Majority of the participants were physicians (76.54%, 124/162) followed by clinical nurses (12.3%, 20/162). Besides their primary profession, 38.27% (62/162) participants had added responsibilities. Among the physicians, majority were from internal medicine (67.7%) and neurology (16.9%) with higher number of residents (85%) than specialists (15%). Among resident physicians, number of participants in decreasing order was from third year (39.6%), second year (35.8%) and first year (21.7%). Mean of participants' work experience at TASH and total were 4.3 ± 3.94 and 6.5 ± 4.58 years respectively.

[1] Master and above looks to be over chosen because it seems many physicians took their medical degree as master equivalent

Table 4.1 Baseline characteristics of HCWs involved in EMR system assessment, TASH, 2021 (N = 162)

		Frequency	Percent	Valid Percent
Sex	Male	103	63.6%	63.6%
	Female	59	36.4%	36.4%
Profession	Resident physician	107	66.0%	66.0%
	Clinical nurse	20	12.3%	12.3%
	Specialist physician	19	11.7%	11.7%
	Laboratory technologist	5	3.1%	3.1%
	Midwife	4	2.5%	2.5%
	Pharmacist	3	1.9%	1.9%
	Other	4	2.5%	2.5%
Added responsibility	Consultant	14	8.6%	8.6%
	Instructor	11	6.8%	6.8%
	Department head	6	3.7%	3.7%
	Team or unit leader	31	19.1%	19.1%
Department for physicians (N = 124)	Internal medicine	84	51.9%	67.7%
	Neurology	21	13.0%	16.9%
	Surgery	9	5.6%	7.3%
	Emergency medicine	4	2.5%	3.2%
	Oncology	2	1.2%	1.6%
	Anesthesia	1	0.6%	0.8%
	Family medicine	1	0.6%	0.8%
	Pediatrics	1	0.6%	0.8%
	Radiology	1	0.6%	0.8%
Year of residency for residents (N = 106)	First	23	14.2%	21.7%
	Second	38	23.5%	35.8%
	Third	42	25.9%	39.6%
	Fourth	1	0.6%	0.9%
	Fifth	2	1.2%	1.9%
Level of education	Degree	85	52.5%	52.5%
	Master and above	77	47.5%	47.5%
Age (years): Mean $\pm$ Standard deviation			31.15 $\pm$ 3.99	
Work experience at TASH (years): Mean $\pm$ Standard deviation			4.3 $\pm$ 3.94	
Total work experience (years): Mean $\pm$ Standard deviation			6.5 $\pm$ 4.58	

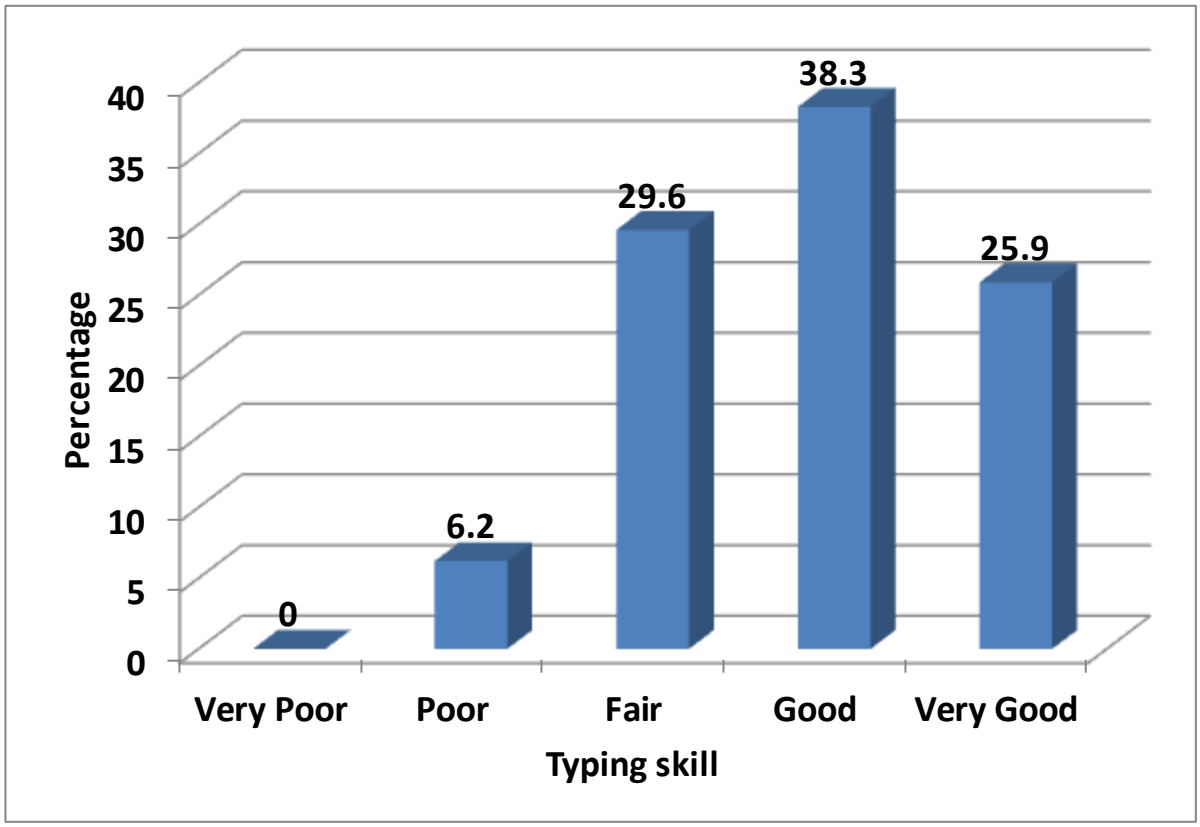
4.2 Computer possession, usage, knowledge source and skills

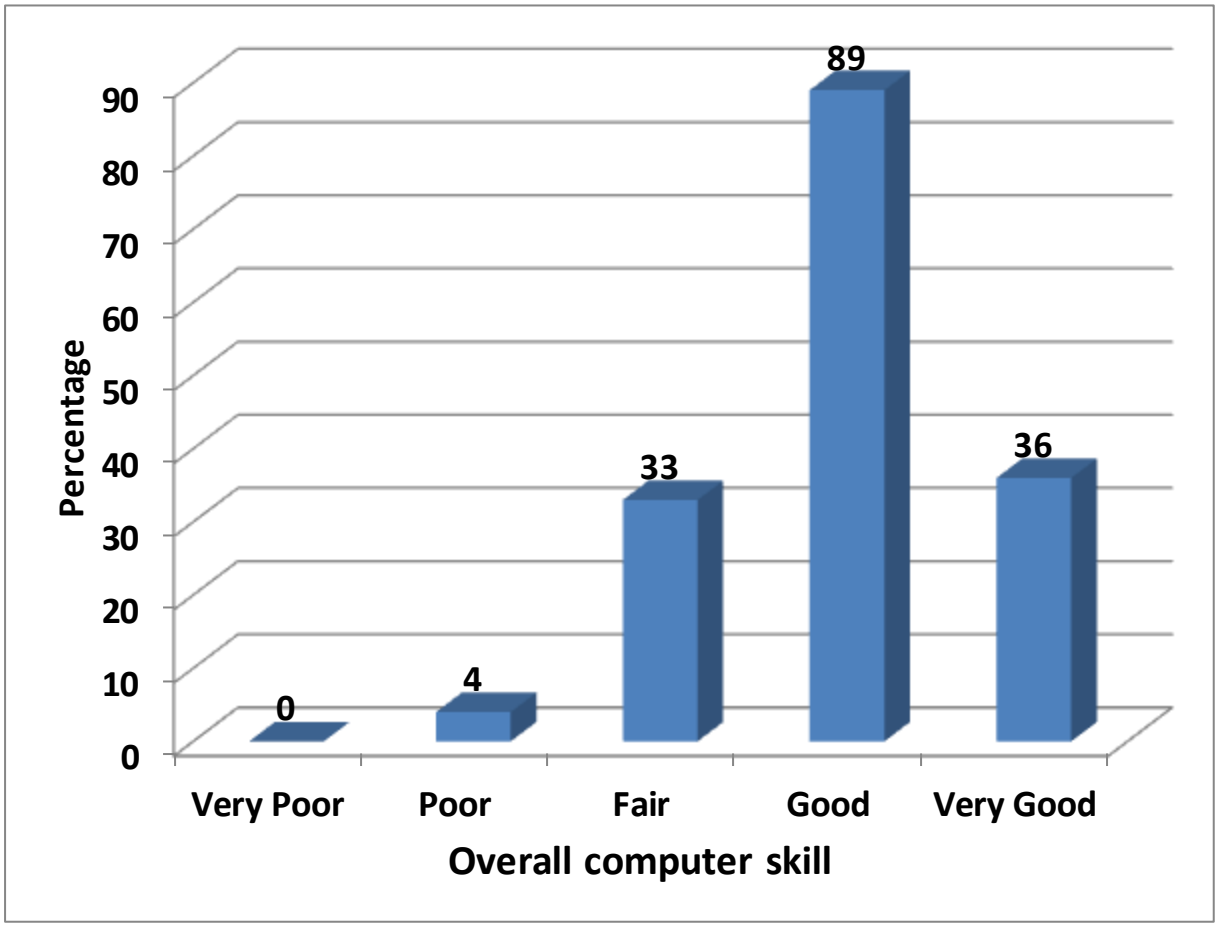
Nearly all participants do have computers both at home (98.8%) and work place (92.0%) and use them routinely. Typing skill which is the most relevant skill in electronic medical recording was fair and above in 93.8% respondents (fair = 29.6%). Nearly all participants (97.5%) had overall computer skill of fair and above (very good + good = 77%).

Table 4.2 Computer possession, usage, knowledge source and skills in the EMR system assessment study participants, TASH, 2021 (N = 162)

Computer possession & usage			Have computer at home					98.8%
			Have computer at work place					92.0%
			Use computer at home or work place					98.1%
Source of computer knowledge			At school or formal training					30.9%
			Experience with time at home					51.9%
			Experience with time at work place					17.3%
Computer skills								
Skill level (Likert scale)		Microsoft Word	Power Point	Excel	Browsing internet	Managing patient data	**Typing**	**Overall computer skill**
Very Good (5)		45.7%	49.4%	17.3%	56.2%	39.5%	25.9%	22.2%
Good (4)		37.0%	34.6%	32.1%	29.6%	42.0%	38.3%	54.9%
Fair (3)		16.7%	13.0%	38.9%	13.0%	16.0%	29.6%	20.4%
Poor (2)		0.6%	3.1%	11.7%	1.2%	1.9%	6.2%	2.5%
Very Poor (1)		0.0%	0.0%	0.0%	0.0%	0.6%	0.0%	0.0%
Median		4	4	3	5	4	4	4
Mode		5	5	3	5	4	4	4
IQR		1	1	1	1	1	2	0
Percentiles	25	4	4	3	4	4	3	4
	50	4	4	3	5	4	4	4
	75	5	5	4	5	5	5	4

Figure 4.2 Typing and overall computer skill of EMR system assessment study participants, TASH, 2021 (N = 162)





4.3 EMR knowledge and Knowledge sources

As shown in table 4.3 EMR knowledge was assessed in three different ways. While 74.7% responded "Yes" for having adequate EMR knowledge the rest 25.3% responded "No". With a 5 label Likert scale (1 - very poor to 5 - very good), 47.5% and 33.3% participants responded to have 'good' & 'very good' overall knowledge of EMR system respectively (Median 4, IQR 1). Detailed assessment of agreement on eleven functions of EMR system using a 5 label Likert scale (1 strongly disagree to 5 strongly agree) also showed comparable responses with mode of 4 in 9 of the 11 functions. While significant minority were 'neutral' to role of EMR system in health education & disease prevention (26.5%), clinical decision making (19.8%), reducing medical errors (18.5%), generating different reports (17.9%), drug stock management (14.8%) and minimizing health cost (13.6%), greater than 90% respondents agreed on the rest of EMR functions. The most common sources of EMR knowledge were "through work exposure (72.8%)' and 'orientation by responsible or assigned persons (49.4%)'. Formal training & Internet were mentioned as primary sources of EMR knowledge by 9.9% & 11.1% of the respondents respectively.

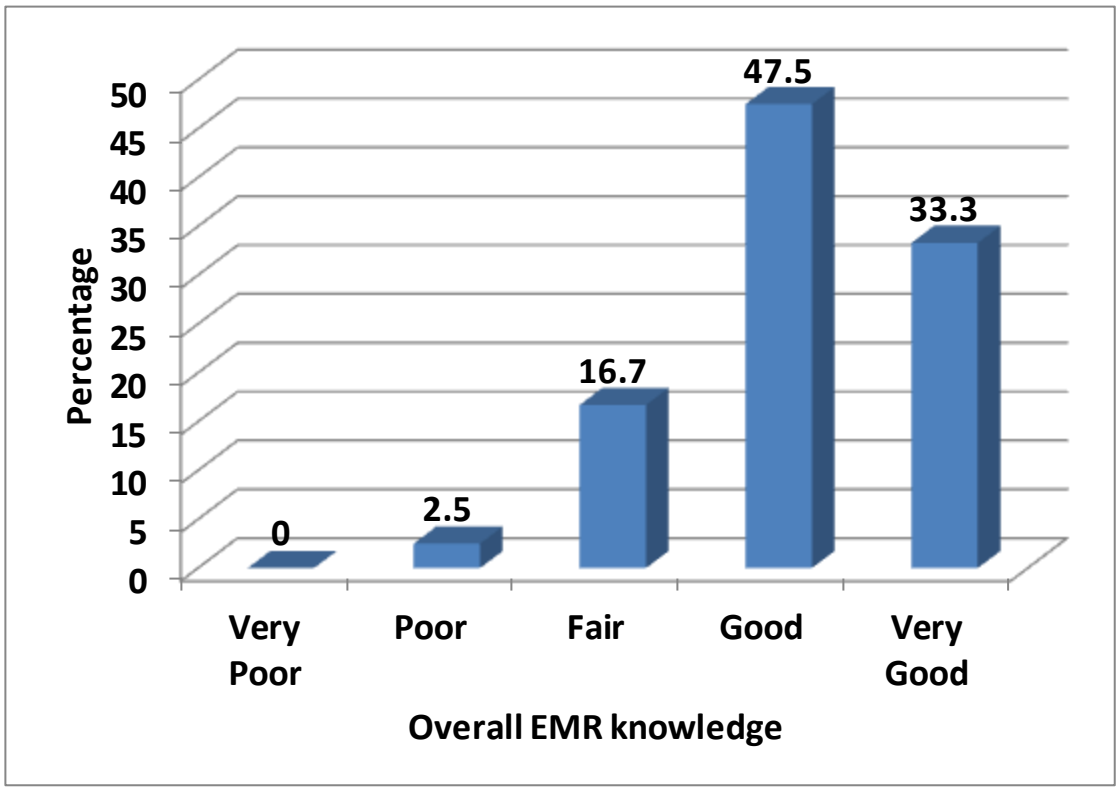
Table 4.3 EMR knowledge level and source of EMR knowledge in EMR system assessment study participants, TASH, 2021 (N = 162)

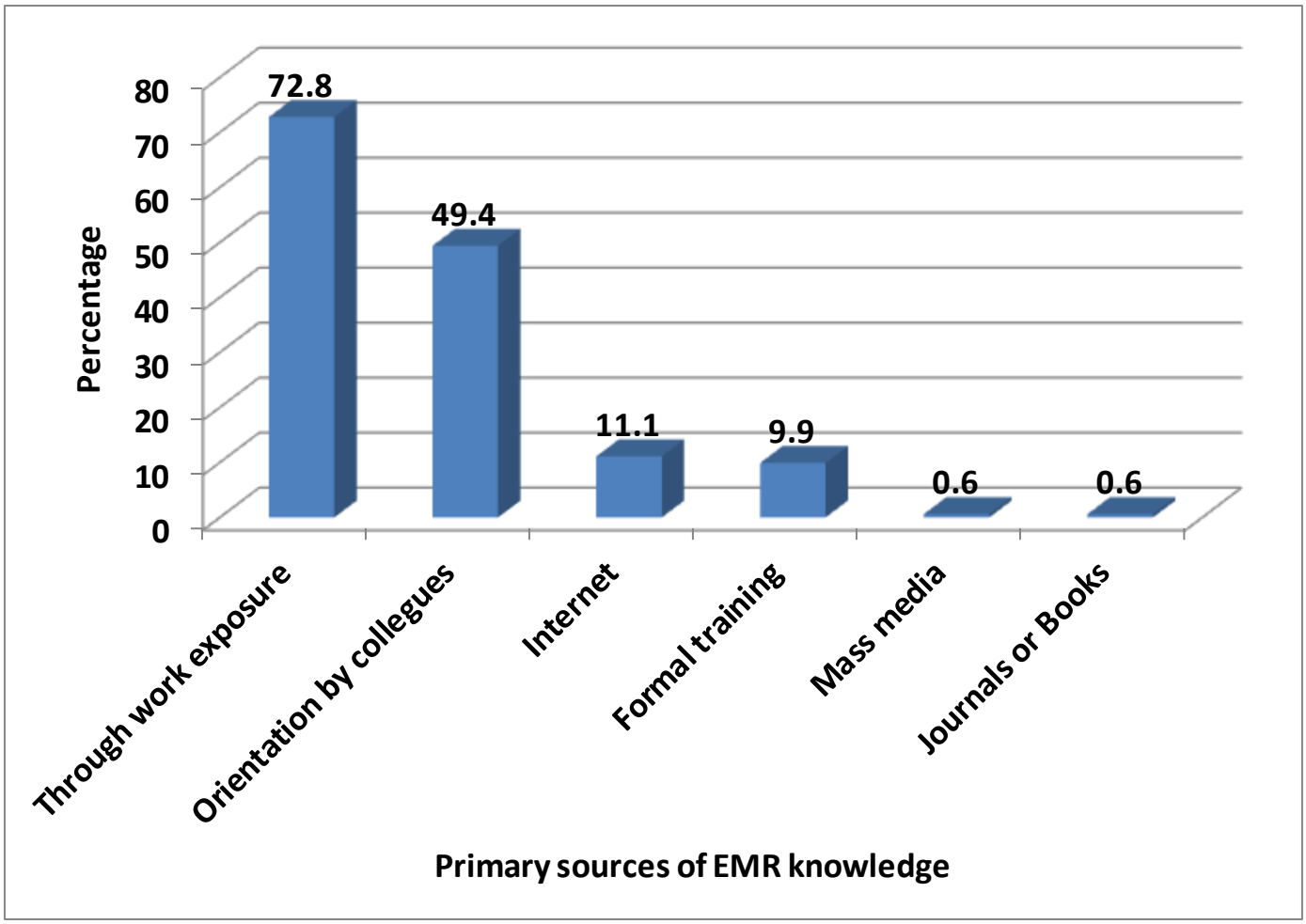
Detailed EMR knowledge assessment											
Level of agreement (Likert scale)	Improve electronic communications and connectivity	Helps in health education & disease prevention	Reduce medical errors	Help in clinical decision making	Generate different reports	Help in drug stock management	Minimize health cost	Improve data quality	Increase work performance	Improve patient care	Help in clinical research
Strongly Agree (5)	50.6%	24.7v	32.1%	31.5%	43.8%	38.3%	48.1%	49.4%	47.5%	49.4%	61.7%
Agree (4)	42.6%	47.5%	43.8%	46.9%	30.9%	45.7%	36.4%	39.5%	43.8%	43.2%	30.9%
Neutral (3)	6.2%	26.5%	18.5%	19.8%	17.9%	14.8%	13.6%	7.4%	5.6%	6.2%	4.9%
Disagree (2)	0.6%	1.2%	4.9%	0.6%	6.2%	0.6%	0.6%	2.5%	2.5%	0.6%	1.2%
Strongly Disagree (1)	0.0%	0.0%	0.6%	1.2%	1.2%	0.6%	1.2%	1.2%	0.6%	0.6%	1.2%
Median	5	4	4	4	4	4	4	4	4	4	5
Mode	5	4	4	4	5	4	5	5	5	5	5
IQR	3	1	1	1	2	1	1	1	1	1	1

Overall EMR knowledge (Likert scale)								**Adequate EMR knowledge**		
Very Good (5)	Good (4)	Fair (3)	Poor (2)	Very Poor (1)	Median	Mode	IQR		Yes	No
33.3%	47.5%	16.7%	2.5%	0.0%	4	4	1		74.7%	25.3%

Sources of EMR knowledge; multiple responses set	Through work exposure	Orientation by colleagues	Internet	Formal training	Mass media	Journals or Books
	72.8%	49.4%	11.1%	9.9%	0.6%	0.6%

Figure 4.3 EMR knowledge status and source of knowledge in EMR system assessment study participants, TASH, 2021 (N = 162)





4.4 Medical record usage and satisfaction pattern

As shown in table 4.4a despite the EMR system was used more commonly (57.4%), 42.6% of respondents reported using the paper based recording either more commonly (18.5%) or equally (24.1%) with the EMR system. Among the EMR systems Doctor iCare was the most commonly used (92.0%). Nearly two third of the respondents also used Medweb (70.4%), LIS iCare (63.0%) and RadiAnt (62.3%). Comparison of paper based medical recording with TASH EMR and a standard EMR using different parameters showed preference to the EMR systems by great majority of the respondents in all aspects. Though not higher than EMR system, compared to other comparison parameters paper based recording get relatively higher preference by few respondents for "**Less time consumption (25.9%), better patient data completeness (18.5%), easy & comfortable for use (17.3%) and better patient data privacy (15.4%)**". Overall preference of usage was given to TASH EMR (87.7%) and standard EMR (92.6%) than paper based medical record. Assessment for **level of satisfaction** and **need of improvement** (*Table 4.4b*) for the four commonly used EMR systems showed greatest satisfaction for Doctor iCare (strongly satisfied + satisfied = 87.1%). Satisfaction was also high for other EMR softwares (MedWeb, RadiAnt, LIS iCare) but significant percent of participants were neutral (25.3%-31.5%). Despite greatest satisfaction was for Doctor iCare, the need for improvement was also for it (strongly Agree + Agree = 70.4%). For the other EMR systems the majority of the respondents were 'neutral' (42.0% - 45.7%). Among those who had EMR experience outside TASH, 91.6% and 66.7% responded quality of TASH EMR system was similar or above compared to EMR system of other government and private hospitals respectively. Fifty percent (81/162) participants voted 'No' for the question 'TASH EMR provides all functions' (listed under section 4.7)

Table 4.4a Medical record usage pattern and comparison by EMR system assessment study participants, TASH, 2021 (N = 162)

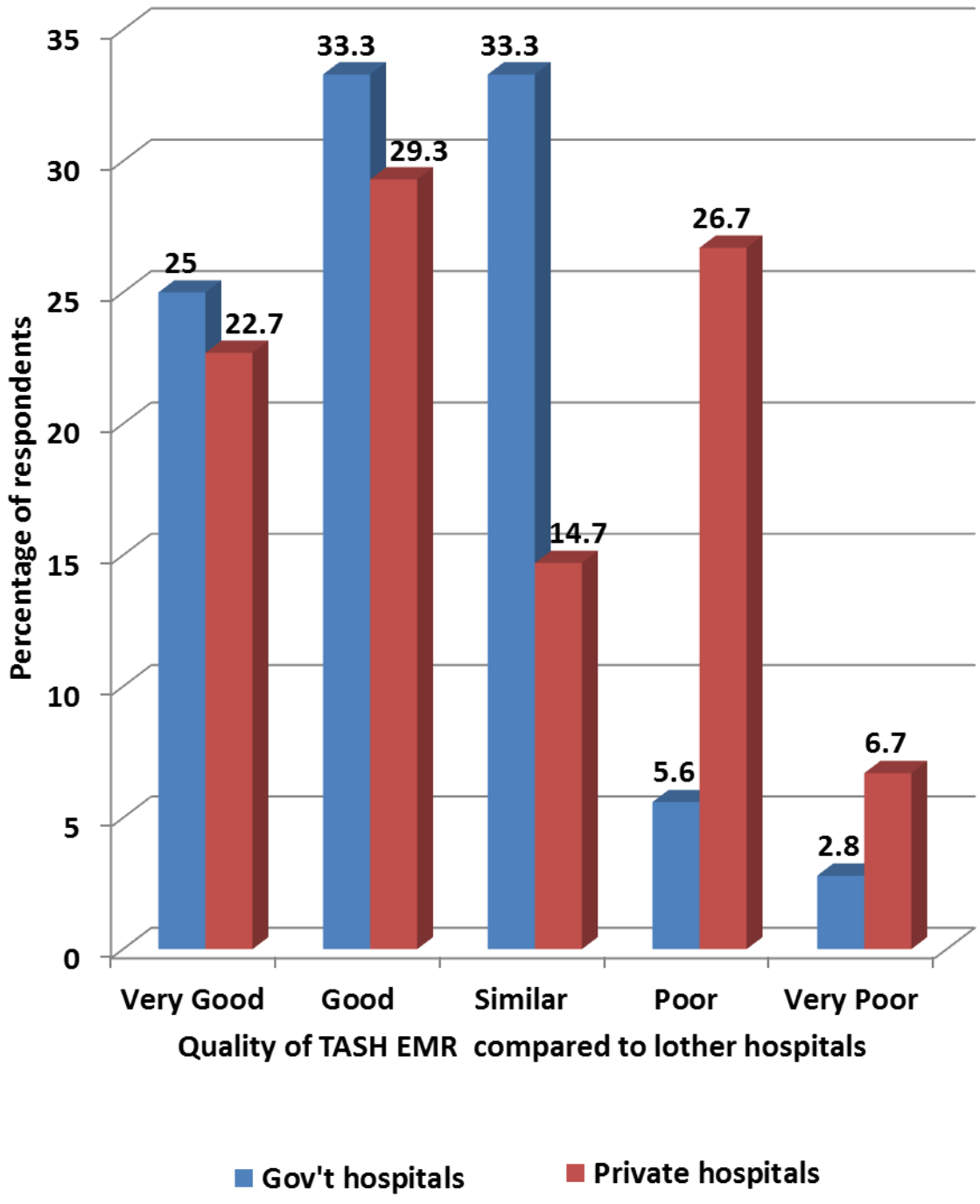
Medical record usage pattern								
More used medical record	EMR system: 57.4%			Paper based recording: 18.5%		Almost equally used: 24.1%		
Routinely used EMR systems	Doctor iCare	Medweb	LIS iCare	RadiAnt	Laboratory iCare		PMIS iCare	Other EMRs
	92.0%	70.4%	63.0%	62.3%	19.8%		3.7%	1.9%
Medical record comparisons	Paper based medical record versus TASH EMR				Paper based record versus Standard EMR			
	Paper based system	TASH EMR system#	Both are similar	I do not know	Paper based system	Standard EMR System#	Both are similar	I do not know
Less time consuming	25.9%	65.4%	8.0%	0.6%	26.5%	67.3%	4.3%	1.9%
Decrease work burden	8.6%	85.8%	4.9%	0.6%	6.8%	88.9%	3.7%	0.6%
Easy & comfortable to use	17.3%	74.7%	8.0%	0%	11.7%	83.3%	4.3%	0.6%
Decrease medical errors	8.6%	69.8%	14.2%	7.4%	6.2%	79.0%	6.8%	8.0%
Efficient (decrease wastage)	2.5%	94.4%	1.2%	1.9%	1.2%	96.9%	1.2%	0.6%
Effective (evidence based service)	1.9%	83.3%	9.3%	5.6%	4.3%	87.0%	5.6%	3.1%
Better patient data accuracy	5.6%	81.5%	12.3%	0.6%	7.4%	81.5%	9.9%	1.2%
Better patient data completeness	18.5%	68.5%	12.3%	0.6%	9.3%	80.9%	7.4%	2.5%
Better patient data privacy	15.4%	70.4%	9.9%	4.3%	10.5%	78.4%	6.8%	4.3%
Better patient satisfaction	8.6%	51.9%	17.9%	21.6%	6.8%	65.4%	11.1%	16.7%
Better staff satisfaction	4.9%%	70.4%	13.0%	11.7%	3.7%	75.3%	9.3%	11.7%
Better quality of health service	1.9	85.8%	9.9%	2.5%	1.9%	89.5%	4.3%	4.3%
Mean of responses	**9.97%**	**75.16%**	**10.08%**	**4.78%**	**8.03%**	**81.12%**	**6.23%**	**4.63%**
Medical record preference	**5.6%**	**87.7%**	**6.2%**	**0.6%**	**3.1%**	**92.6%**	**3.7%**	**0.6%**
#Look the indirect comparison between TASH EMR and Standard EMR								

Table 4.4b EMR system satisfaction and quality comparison by EMR system assessment study participants, TASH, 2021 (N = 162)

EMR systems; Satisfaction & Need of improvement									
Satisfaction (Likert scale)	Doctor iCare	MedWeb	RadiAnt	LIS iCare	**Need improvement** (Likert scale)	Doctor iCare	MedWeb	RadiAnt	LIS iCare
Strongly Satisfied (5)	27.2%	21.6%	22.2%	16.7%	Strongly Agree (5)	32.1%	21.0%	18.5%	19.8%
Satisfied (4)	59.9%	48.1%	42.0%	48.1%	Agree (4)	38.3%	29.6%	33.3%	26.5%
Neutral (3)	8.6%	25.3%	29.6%	31.5%	Neutral (3)	24.7%	43.2%	42.0%	45.7%
Dissatisfied (2)	3.7%	3.7%	4.3%	3.1%	Disagree (2)	4.9%	5.6%	4.3%	6.2%
Strongly Dissatisfied (1)	0.6%	1.2%	1.9%	0.6%	Strongly Disagree (1)	0.0%	0.6%	1.9%	1.9%
Median	4	4	4	4	Median	4	4	3	4
Mode	4	4	4	4	Mode	4	3	3	3
IQR	1	1	1	1	IQR	2	1	1	1

EMR experience outside TASH and relative quality									
EMR experience outside TASH	Quality of TASH EMR compared to	Very Good	Good	Similar	Poor	Very Poor	Median	Mode	IQR
Government hospitals: 19.8% (32/162)	Other government hospital's EMR (N = 36)	25.0%	33.3%	33.3%	5.6%	2.8%	4	3	2
Private hospitals: 43.2% (70/162)	Private hospital's EMR (N = 75)	22.7%	29.3%	14.7%	26.7%	6.7%	4	4	3

Figure 4.4 Comparison of TASH EMR with other hospitals by EMR system assessment study participants, TASH, 2021 (N = 162)



4.5 EMR failure, Hospital's support & Barriers to EMR system

Duration EMR fails per day was estimated below 10 minutes and 10 to 30 minutes by 54.3% and 32.7% participants respectively. Majority agreed on internet network problem (79.6%), power cut down (58.6%), hardware problems (47.5%) and system /software problem (39.5%) as causes of failure. While 37.0% participants respond 'easily found', 54.9% claimed finding IT technicians was not easy. Majority of respondents agreed on all mentioned possible barriers to EMR expansion and improvement but highest response rates went to hospital management or leaders (strongly agree + agree = 76.5%) and poor economic capacity (strongly agree + agree = 72.3%); table 4.5. Only 38.3% of the participants responded good or very good for Hospital's support on the EMR system.

Table 4.5 Response rate to barriers to EMR expansion and improvement by EMR system assessment study participants, TASH, 2021 (N = 162)

Response (Likert scale)	Hospital management or leaders	Poor economic capacity	Unit (work area) leaders	End users (health care workers)
Strongly Agree (5)	39.5%	38.3%	24.7%	19.8%
Agree (4)	37.0%	34.0%	40.1%	38.9%
Neutral (3)	21.0%	19.1%	27.2%	31.5%
Disagree (2)	1.9%	4.3%	5.6%	7.4%
Strongly Disagree (1)	0.6%	4.3%	2.5%	2.5%
Median	4	4	4	4
Mode	5	5	4	4
IQD	1	2	1	1

4.6 TASH EMR software system quality

The EMR system software quality and functionality was assessed using a checklist in reference to what an **ideal** EMR software could looks like. Results are displayed by putting 'v' for fulfilled and 'X' for unfulfilled criteria. This is one of the major objectives of this research (QI project); see Annex 4.

4.7 Suggestions given about TASH EMR system

No way to cancel or edit one's own previous notes (if errors have occurred); at least there should be some time gap in order to edit.
No IT police for data security.
Allows unauthorized login and activity by any person in Doctors icare.
No enough computers especially at wards and their quality is poor.
Not interlinked well (integration of different functions).
Not well interconnected between different faculties.
Radiology and laboratory service should be in the same platform.
Lab result mismatch occurs between lab and doctor iCare.
Laboratory results cannot be copied and pasted from lab report to patient history.
Do not display serial investigation results graphically.
Not suitable for use in the wards.
Not started in some departments.
No emergency evaluation note entry on doctor iCare.
Cannot upload important things like images or videos.
Contains insufficient variables.
Lacks the details of standard EMR for a wider use.
Not adequately designed for all staffs and activities.
Not a web based system.
It does not allow searching patients by their name when they lost iCare ID (unless it is for privacy purpose).
Do not generate/filter patient list or report based on diagnosis.
Do not generate diseases classification properly, not standardized, and did not have dash board or analysis features.
Do not clearly show medication availability at stock.
Since documentation is not properly filled it's difficult to retrieve patients' data, so the EMR need to have data entry cross checks and mandatory options.
Some options should be mandatory; example diagnosis.
It has no function to label a patient already screened and known to be HIV positive.
There should be data on ward bed occupancy/availability so that liaisons will not have to manually count beds every day
We are doing reports and some activities both in hard copy and EMR.
Difficult to link patient data from PSRC to pediatric causality.
Not integrated with other health institution regarding referral.
Patients pay repeatedly because it does not track payment status.
Medical device management not included.

It lacks the following laboratory and imaging requests:
CT scan and MRI request
FNAC & Biopsy
Genexpert
Culture
Body fluid analysis
Blood film
Troponin
Echocardiography
Electrocardiography
Ultrasound

It lacks the following:

Inpatient format: it only functions for lab request and prescription
History and physical exam formats
Daily vital sign for inpatient
Admission orders/Order sheet
Progress note
Discharge summary
Consultation form
Referral sheet
Operation & procedure note sheet
Nursing services including foot care and retinal screening
Transfusion
HMIS logbook/registry
Partograph, labor follow up sheet & newborn registry
Turnaround time and specimen transaction

Barriers to EMR expansion and improvement

Poor involvement of medical staff in the design of EMR
Poor communication between the stakeholders at every level of care
Limited computer knowledge and skill of users
Resource limitation; no enough computers especially in the ED
Priority not given
Lack of owner ship (the hospital, the IT professionals, the EMR developers)
Lack of staff training
Lack of software consultant engagement
Computers get damaged and not maintained timely

Some EMR infrastructure could be installed properly in the walls and floor, so that it won't be damaged by water during cleaning.
Not well organized in company level

Special suggestions

Participant A: There should be a way to use EMR for medical device management, not only for patient data management.

Participant B: I really have a lot of disagreements with your questionnaire. Don't you know what the EMR has? Why are you asking here? Anyways, it probably has less than 20% of what is needed.

Participant C: Out of my love for this hospital, I will be taking this time to write proper comments. Before anything, it is good that you are trying to do this QI. Unfortunately; your methodology has a lot of flaws. Your questions are too much, and many of the questions should not have been directed to end users.
My comments are based on my experience at private hospital EMRs, Yekatit 12 Hospital EMR, and EMRs I saw in the USA and Kenya.
EMR is a well-developed and known technology. But it is highly complex. The problems with TASH iCare are countless. One, they should not have 'reinvented the wheel'. If the developers could have seen some of the EMRs developed by Ethiopians [like Primecare] or abroad, they would have known that what they are doing is absolutely garbage.
Over last four years, they couldn't complete it. It still lacks tons of components. It should have been done by experts, not by beginners, as i heard that is the case for TASH iCare.
The developers should set deadline to finish the whole component. It has to finished, and they should leave the hospital. Making the hospital dependent on them is a big liability.
Developers should have consultation with users, and deliver improvements rapidly.
I strongly advise developers to just GO AND VISIT, Yerkatit 12 hospital, Addis Hiwot hospital and Teklehaimanot hospital. They will then know that, their work is not even close to 25%.
The components for lab and imaging should be altogether. They should not be separate.

CHAPTER FIVE: Conclusions and Recommendations

Because EMR knowledge & satisfaction are high, staffs will be in support than against expansion & improvement of EMR system.

Though adequate satisfaction, participants know TASH EMR limitations compared to a standard EMR and majority agree on improving its quality.

But, because level of satisfaction is good, preference should be given to expanding than modernizing the EMR system if there is economic or other limitation to do both.

There should be inpatient EMR service with appropriate modification of the software.

Lack of training is a major gap for not utilizing TASH EMR to its best quality.

Low dedication of hospital leaders and low budget are the great barriers to EMR expansion and improvement.

Overall, as many participants agreed, TASH EMR lacks many functions & formats and has poor interoperability between different functions which mandate improving it to an optimum quality.

Because good insights are obtained from participants, the study needs to be continued to assess KAP and collect more suggestions from less involved departments (Gyni Obs, Pediatrics, Surgery, Oncology, Radiology, ENT, Dermatology, Pathology, Pharmacy and Laboratory) including nurses & midwives.

References

1. Ward, R. (2013). The application of technology acceptance and diffusion of innovation models in healthcare informatics. Health Policy and Technology, 2(4), 222-228. https://doi.org/10.1016/j.hlpt.2013.07.002.
2. HASANAIN, R. A., & COOPER, H. (2014). Solutions to Overcome Technical and Social Barriers to Electronic Health Records Implementation in Saudi Public and Private Hospitals. *Journal of Health Informatics in Developing Countries*, *8*(1). Retrieved from https://www.jhidc.org/index.php/jhidc/article/view/116
3. G. Yehualashet, M. Asemahagn, and B. Tilahun, "The attitude towards and use of electronic medical record system by health professionals at a referral hospital in Northern Ethiopia: cross-sectional study," *Journal of Health Informatics in Africa*, vol. 3, no. 1, pp. 19–29, 2015.View at: Publisher Site | Google Scholar
4. B. Tilahun and F. Fritz, "Comprehensive evaluation of electronic medical record system use and user satisfaction at five low-resource setting hospitals in Ethiopia," *JMIR Medical Informatics*, vol. 3, no. 2, p. e22, 2015.View at: Publisher Site | Google Scholar
5. D. Alemayehu, "Investigating electro medical record (smart cares software) implementation in a healthcare facility," *A a guiding framework for Adama hospital Hospital medical Medical College, [M.S. thesis]*, Addis Ababa University, 2015.View at: Google Scholar
6. B. Berihun, D. Debalkie, and G.Sitotaw (2020). Willingness to Use Electronic Medical Record (EMR) System in Healthcare Facilities of Bahir Dar City, Northwest Ethiopia. *BioMed Research International, 2020*. https://doi.org/10.1155/2020/3827328
7. Tilahun B, Fritz F. Comprehensive evaluation of electronic medical record system use and user satisfaction at five low-resource setting hospitals in ethiopia. JMIR Med Inform. 2015 May 25;3(2):e22. doi:10.2196/medinform.4106

Annexes

Annex 1: Assurance of principal investigator

My name is Abiot Yaregal. I am the researcher. I put my signature below to confirm that I take over the responsibility for the scientific, ethical & technical conducts of the research project & for provision of the progress reports for all stakeholders of the research project.

Signature: _____ Date: _____

Contact Addresses
Phone number: +251 912812130
Email: abiotya@gmail.com
TASH, Addis Abeba, Ethiopia

Annex 2: Information and Consent sheet

Information sheet

The aim of this study is to propose electronic medical record (EMR) software based on the interest of the health care professionals. So please give further suggestions you have though not asked; mention the question number and write it on the free paper attached at the end. The result of the study will be submitted to MOH, Tikur Abnessa Hospital admins and Quality office. So your genuine responses and further explanations are too much invaluable.
Whenever you encounter the word electronic medical record (EMR) think of the all softwares that you use to enter, see and/or generate patient data.

You have full right to participate or never participate in the study. The information you give will be used only for the purpose of this study confidentially.
Thank you for your participation and do not forget to return the questionnaire!
Call me with 0912812130 or mail at abiotya@gmail.com for any question or comment.

Consent form

I, the undersigned, have read the information in the information sheet and understood the purpose and significance of the study. So I agree to participate in the research voluntarily with the hope of contributing to the effort to improve the electronic medical record system.

Signature _____ Date _____

Annex 3: Questionnaire English version

Comprehensive Evaluation of EMR (Electronic Medical Record) System at TASH

PART ONE: Socio-Demographic Data

101. Sex
    1. Male
    2. Female

102. Age in years: _____

103. What is your profession? If you say other please mention it.
    1. Specialist physician
    2. Resident physician
    3. General practitioner
    4. Clinical nurse
    5. Midwife
    6. Pharmacist
    7. Laboratory technologist/technician
    8. Other:_____

104. If you are a physician what is your department? _____

105. If you are a resident physician, your year of residency
    1. First
    2. Second
    3. Third
    4. Fourth
    5. Fifth

106. What is your education level related to health?

    Note: Master degree is a postgraduate (second or further) degree in a specific subject but below doctorate or PhD.
    1. Diploma
    2. Degree
    3. Master or above

107. Regular or formal responsibilities at TASH other than your primary profession; check all that applies; if you say other please mention it.
    1. Consultant
    2. Instructor
    3. Department head
    4. Team or unit leader

5. None
6. Other: _____

108. What is your current specific working unit? _____

109. What is your approximate work experience in years in this hospital? If < 1 year, please add the word month: _____

110. What is your approximate year of total work experience in health institutions serving patients? If < 1 year, please add the word month: _____

PART TWO: Computer Skill

201. Do you have computer at home (at least for 03 months)?

1. Yes
2. No

202. Do you have computer at your work area?

1. Yes
2. No

203. Do you use computer at home or work area?

1. Yes
2. No

204. How would you rate your skill in the following computer tasks?

	Very Good	Good	Fair	Poor	Very Poor
Microsoft word					
Microsoft power point					
Microsoft Excel					
Browsing the internet					
Managing patient data					
Typing skill					
Overall computer skills					

205. How did you PRIMARILY learn to use any of the above computer tasks?

1. At school or formal training
2. Experience with time at home
3. Experience with time at work place

206. Do you feel comfortable while using computer?

1. Yes
2. No

207. If you say No, why? _____

PART THREE: Knowledge, Attitude & Practice of Electronic Medical Records (EMR)

***Note**: When we say EMR (electronic medical record) it refers to any computer software that you use to document, see and/or generate any patient data and facilitate the care you give.*

301. Which EMR systems you use routinely? Check all that apply; mention the name if you choose "Other"

1. Doctor iCare
2. Medweb
3. LIS iCare
4. Laboratory iCare
5. PMIS iCare
6. RadiAnt
7. Other _____

302. Do you have adequate knowledge about EMR?

1. Yes
2. No

303. How much do you agree with the following about EMR?

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Increase work performance					
Help in clinical decision making					
Improve quality of patient care					
Minimize cost of health care					
Reduces medical errors Helps in health education & disease prevention					
Help in drug stock management					
Improve electronic communications and connectivity between care providers, between facilities & with patients					
Generate different reports					
Provide high data quality					
Help in clinical research					

304. How do you rate your overall EMR knowledge?

1. Very Good
2. Good
3. Fair
4. Poor
5. Very Poor

305. What was your MAJOR source of knowledge about EMR? Choose maximum 3

1. Formal training
2. Orientation by responsible/assigned person Mass media
3. Internet
4. Journals or Books
5. Through work exposure

306. If you say training, when did you get the training?

1. Before starting using it
2. Within first month after starting using it
3. Within second month after starting using it
4. Within third month after starting using it
5. After third month of starting using it

307. How useful was the training in giving knowledge about EMR and preparing you to use it?

1. Very useful
2. Useful
3. Fair
4. Not useful

308. If not trained yet, why?

1. Not invited
2. Invited but not attended it
3. If invited but not attended it, why? _____

309. What type of medical records you use in your current work area?

1. EMR only
2. Paper based only
3. Both

310. Which one you use MORE COMMONLY to do your primary or major activities?

1. EMR system
2. Paper based recording
3. Almost equally used

311. If you use paper, list examples of tasks you do on paper and mention the reasons in bracket using the letter codes A, B, C, and/or D. (use back of the paper)

A - Not found in the EMR

B - Easily done on paper than EMR

C - Cannot easily access the EMR system due to computer shortage, poor network or other reasons.

D - Other reasons

312. During your work time in a day how long the EMR system fails to work in average?

1. < 10 minutes
2. 10 to 30 minutes
3. > 30 minutes

313. What are the causes of failure? Check all that apply; Mention reasons if you choose other.

1. Internet network problem
2. System/software problem
3. Power cut down
4. Hardware problems (computer, cables etc.)
5. I do not know
6. Other: _____

314. How easily you find IT technicians whenever you need help regarding the EMR system?

1. Easily found
2. Not easily found
3. Could not found
4. Have not needed their help yet

315. How much support you get from the hospital in using EMR system?

1. Very Good
2. Good
3. Fair
4. Poor
5. Very Poor

316. Do you have experience (at least 3 months) of EMR use in other GOVERNMENT hospital within the past two years?

1. Yes
2. No

317. If yes, quality of the EMR in Tikur Anbessa hospital compared to that hospital EMR is

1. Very Good
2. Good
3. Similar
4. Poor
5. Very Poor

318. Do you have experience (at least 3 months) of EMR use in PRIVATE hospitals in the last two years?

1. Yes
2. No

319. If yes, quality of the EMR in this hospital compared to the EMR of private hospital is

1. Very Good
2. Good
3. Similar
4. Poor
5. Very Poor

320. If you ever had prepared patient data reports, how much our EMR was helpful in generating and preparing these data and reports?

1. I have not prepared/No such responsibility
2. Much helpful
3. Less helpful
4. Not helpful

321. Comparison between a paper based medical record and EMR system you use at TASH.

	Paper based system	EMR system used at TASH	Both are similar	I do not know
Which is less time consuming?				
Which decreases work burden?				
Which is more easy & comfortable to use?				
Which decrease medical error				
Which is efficient (decreases wastage)				
Which is effective (evidence based service)				
Patient data is more accurate with				
Patient data is more complete with				
Patient data privacy is better with				
Patient satisfaction is better with				
Staff satisfaction is better with				
Quality of health service is better with				
Generally you prefer to use				

322. Comparison between a paper based medical record and a STANDARD or well prepared EMR system.

	Paper based system	Standard EMR	Both are similar	I do not know
Which is less time consuming?				
Which decreases work burden?				
Which is more easy & comfortable to use?				
Which decrease medical error				
Which is efficient (decreases wastage)				
Which is effective (evidence based service)				
Patient data is more accurate with				
Patient data is more complete with				
Patient data privacy is better with				
Patient satisfaction is better with				
Staff satisfaction is better with				
Quality of health service is better with				
Generally you prefer to use				

323. The current EMR you use at TASH provides all functions you expect

1. Yes
2. No

324. If you say No, mention functions it fails to provide you. Use paper back

325. The following EMR softwares need improvement.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Doctor iCare					
LIS iCare					
MedWeb					
RadiAnt					

326. How much you are satisfied with the following softwares we use?

	Strongly Satisfied	Satisfied	Neutral	Dissatisfied	Strongly Dissatisfied
Doctor iCare					
LIS iCare					
MedWeb					
RadiAnt					

327. Were you involved in a survey or staff preparation before initiation of the current EMR system (the ICare)?

1. I came after start of the EMR
2. Yes
3. No

328. Which of these do you think are the barriers not to expand and improve the EMR system we use?

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Poor commitment of the hospital leaders					
Poor commitment of the unit (work area) leaders					
Poor commitment of end users (health care workers)					
Poor economic capacity					

329. Write down other barriers. Use paper back

330. Write down any suggestion and attach it with this questionnaire

THANK YOU FOR YOUR PARTICIPATION!

Annex 4 Checklist used for EMR quality check

	Fulfilled criteria are marked "√" and unfulfilled by "X". NB: this is an **ideal** checklist.
	INFORMATION TECHNOLOGY
√	1. There is dedicated annual budget to run/expand the EMR system
x	2. There is dedicated team dealing about the EMR with regular meetings
	3. Staffs are trained about the EMR using the following means
X	Formal training
X	Prepared CD/DVD
X	Demo, User guide or Help on the software[2]
X	4. The system identify trained and non-trained users
X	5. The EMR software auto updates when version is changed
X	6. The EMR has an expandable medical dictionary (expandable – auto detects most commonly used words and add them to dictionary)
X	7. It has short cuts to save time[3]
	8. The EMR supports the following
X	A. Camera – taking photo using the computer or camera connected to it
X	B. Scanning
X	C. OCR – to extract text from images or scanned documents
X	D. Drawing board
X	E. Voice input (voice to text conversion)
X	F. Wireless connection
√	9. The EMR filter evaluations by specific unit. e.g. filter OPD follow up notes by cardiac clinic only
X	10. The EMR notifies if patients are enrolled in clinical trials
X	11. There is search bar to find a specific word from patient document
X	12. The EMR system tracks (measures) activities of staffs like attendance, customers served and send monthly feedback to the staff and coordinators
X	13. The EMR contains directory of health facilities & health related institutions (apart from the referral directory, this helps in communication)
X	14. How much EMR softwares are in use? If more than one EMR softwares are they optimally interoperable?
X	15. The EMR system has exhaustive inter & intra operability; like[4]

[2] Demo/user manual/help –helps to support training gaps or until formal training given; should be specific depending on the user.

[3] E.g. shift + L, Shift + P, Shift + R to go to laboratory, pathology & radiology results

[4] Extensive inter & intra operability enables to fill information simultaneously in all necessary sections with fewer mouse clicks, keystrokes, and overall physical touching.

	• Most recent vital signs filled by nurses will be automatically filled to VS under - physical examination, patient summary, patient handover format, Discharge summary, Referral forms etc. • Most recent diagnosis will be automatically filled to patient summary, discharge summary, referral form, cardex, medication administration sheet etc. • Physician order moves automatically to the cardex
	EDITING AND PRINTING
X	1. EMR enables editing patient assessment notes, lab & rad requests, and prescriptions after submitted until a limited time period
X	2. It has Microsoft word tools like changing font, capitalization, bullets, etc.
X	3. Copy & paste of previous patient assessment note to current note is possible
√	4. Patient data (physician's note, certificates, results etc.) can be printed
X	5. Printed files bear header and footer showing institution's name & date
	ACCESSIBILITY AND SECURITY
X	1. The EMR is accessible at any place over the internet[5]
X	2. EMR is accessible with individual devices like PC, tablet & Smart cell phones
X	3. There is an IT policy or HIPAA manual security rule [6]
X	4. When the EMR system is down, there is policy to continue activities
X	5. There is data backup (recovery plan) in case the system crashes irreversibly
X	6. The EMR system auto saves unfinished work in case of power break and retrieves it for finishing.
√	7. It does not allow weak password (e.g. password below 8 digits and not alphanumeric)
X	8. It allows changing user name and password
√	9. It has user expiry date
X	10. It automatically block a user inactive beyond certain days
X	11. It logout automatically if users stay inactive for some hours.
X	12. It prevents access to activities or data out of user's job description or privilege
COMMENTS AND FEEDBACKS	
X	1. The EMR has comment/feedback portal accessible to any user
X	2. It is possible to give comment or feedback to:
	A. Software developer: this helps in improving the software

[5] Accessing EMR anywhere with any device enables physicians to know admitted patients well & helps patient data at tip of hand during round or other times.

[6] The HIPAA security rule establishes national standards to protect individuals' electronic personal health information that is created, received, used, or maintained by a covered entity.

	B. Individuals
	C. Specific work units
	D. Departments
	E. Hospital
X	3. Feedback to a unit, department or hospital is seen by/linked to accounts of heads.
X	4. Feedback given to "X" goes up automatically to sequential responsible bodies depending on the organogram.
X	5. The EMR system gives automatic feedbacks to users: E.g. ✓ Attendance: You were late 30 minutes on 1-5-13 ✓ You were logged but inactive for > 01 hour; please log out to keep privacy when not around. ✓ Likely you were misconducting on date & time: you used these harsh and unfriendly words Alawklihim, Ayagebagnim etc. so the system needs to have audio recorder, language identifier and voice to text translator
X	6. Feedbacks can be sent anonymously or name mentioned depending on choice.
X	7. Any user can check feedback given to him or her
	APPOINTMENT
√	1. There is appointment system
X	2. The calendar supports both Ethiopian & Gregorian calendars
X	3. The calendar suggests months, weeks and days with less appointed patients
X	4. The calendar notifies if patient has appointment by other units
X	5. The calendar blackens (make inactive) holidays, weekend, and non-clinic days
	BLOOD BANK AND TRANSFUSION SERVICES
X	1. The EMR supports the blood bank services
X	2. The system contain the following in appropriate formats
X	A. Blood transfusion protocol
X	B. Blood group and cross match request
X	C. Blood transfusion request
X	D. Blood transfusion consent? Printable?
X	E. Registries
X	3. It displays the hospital blood product information (type of product, number, and expiry date) with cross reference to the hospital's consumption data filled at national or regional blood banks
X	4. It generate the following reports

X	A. How much collected from national or regional blood bank
X	B. How much taken to (used by) patients
X	C. How much returned
X	D. How much discarded
X	E. How much is useless from the outset
X	F. Utilization rate by department and unit
X	G. Request rate by nurses, interns' residents, seniors.
X	H. Cross match to transfusion ratio
X	I. Taken to patient side to transfusion discrepancy
	COMMUNICATION
X	1. The EMR software has a means to call or communicate IT technicians[7].
X	2. The EMR system contains profile of all staffs[8]
X	3. It shows name & tel. number of who prescribed, ordered, requested, dispensed etc.[9]
X	4. It has chat or message box to disseminate message to all or selected users (as if telecom sends message to its customers)
X	5. It allows communication between the following
X	A. Care providers/units within the facility: inter & intradepartmental consultations
X	B. Care providers and patients
X	C. Different facilities e.g. with the referring & referral hospitals
X	D. Patient & patient
X	E. Facility and respective health bureaus e.g. for reports
X	6. It allows Telemedicine & Virtual clinic
X	7. There are portal to post and see consultations (inter & intradepartmental consultations) with notification and urgency level. Notification of an urgent consultation may blink RED.
X	8. The EMR generates monthly report of "Consultant Delay Time" in units with level of urgency.
EMERGENCY	
X	1. The EMR shows list of admissions decided
X	2. It generates the following data (e.g. for monthly report)
X	A. Total number of patients seen (linked from OPD, come with referral, come

[7] There should be "call IT person" button and the IT person get notification about it and the computer calling.

[8] The profile must include name, photo, profession, added responsibility. It must be accessible & searchable by any user. E.g. searching profile of nurses at ICU. Knowing staffs by name face and responsibility enables good communication and quality service.

[9] In case there is a need for further information person can be called with this number and patient will not get exhausted going here and there.

	without referral)
X	B. Patient outcomes (Admitted, Died, Discharged, Disappeared)
X	C. Total number of beds, standard to actual bed number ratio & Bed occupancy rate.
X	D. Average waiting time for physician evaluation (computer registered time difference between Emergency triage & physician evaluations)
X	E. Average waiting time for triaging (e.g. for patients linked from OPD, computer registered time difference between OPD and Emergency triage evaluations)
X	F. Average length of emergency stay in days
X	G. Emergency stay > 24 hours in percent
X	H. Time between emergency admission time to admit to ward decision
X	I. Time between admit to ward decision to ward admission
	FINANCE
√	1. Patients are differentiated as: paying, credit, insured
X	2. There is exhaustive list of services (coded) with price
X	3. The EMR system generates payment bill for the patient
X	4. Requested service will be inactive unless patient pays (bill given)
X	5. The EMR system generates total revenue collected from lab, radiology, card etc.
X	6. Price is shown to ordering staffs (E.g. cost of lab, imaging, drug, procedure etc.)[10]
HIT/HMIS	
	The EMR generate the following data
√	1. Number of patients seen in a day, a month etc. divided in units
X	2. Number of patients with disease "X" classified with age, sex, address, month etc.
X	3. Most common diseases of the month (like top 10, top 20) and their frequency (distinguishes New vs Repeat/Follow Up patients)
INFORMATION DESK & HELP	
X	1. The EMR system includes information desk service[11]
X	2. The information desk includes information about
X	A. Staffs
X	B. Admitted patients address
X	C. Service areas

[10] This helps the care provider to discuss with patient and prioritize if economically unfit and to give answer if patient asks cost for decision.

[11] So that everybody can give information to patients and get any information for self.

X	D. OPD schedules: of Internal medicine, surgery etc.
X	E. Other service schedules e.g. days of echo, endoscopy etc.
X	3. It has a "Help" button to get information not in the information desk list. E.g. you can post "Anyone who knows a private which does hip replacement surgery? Is the radiotherapy working" to get information.
	LABORATORY
	1. The following found in the EMR system
X	A. Laboratory standard operating procedures (SOPs)
X	B. Laboratory request formats with appropriate information (printable)
X	C. Brief protocols on sample collection for a specific test
√	2. Laboratory test menu is arranged in an easy to find way
X	3. All tests are requested via the EMR system
X	4. Lab test items are searchable. E.g. creatinine will appear when typing creat…
X	5. The system notifies currently unavailable tests. So physician will print lab request to avoid unnecessary queue at laboratory for non-existing tests.
X	6. It notifies double lab requests[12]
X	7. It allows consequent or corollary test orders. E.g. ordering TFT like this. TSH, if abnormal, FT4 & FT3. This avoids unnecessary cost and other risks.
X	8. Lab test results can be searched to see trend over time
X	9. This trend can be exported to history or progress note
X	10. All tests have updated reference range
X	11. Turn Around Time (TAT) is set for all tests
X	12. Lab result reports allow copy and paste to required destination like progress note
X	13. Lab results can be exported to history or progress note and can be edited
X	14. There is notification for ready results • This helps the logged user to have instantaneous know how on results, not to forget requests and aware of requests by peers
X	15. The system notifies alarming results e.g. very low hemoglobin, Positive MTB (what if the patient is outpatient?)
X	16. There is a comment writing box if lab technician has remark
X	17. There is activity reminder. E.g. sample "X" is not processed yet/passed its TAT.
X	18. When patient is appointed on Monday to come with investigation; system reminds "This patient is to come on Friday for investigation"

[12] Notification of previous lab request must show planned date of result: asap, any time before next visit, on next appointment date (mention)

X	19.The EMR generate the following data
	A. TAT of specific tests & comparison with the standard
X	B. Most commonly ordered tests like top 10
X	C. Test unavailability rate (number of lab request copies given by lab persons & physicians) and which tests.
X	D. Monthly activities like how many CBC, OFT etc.
	LIAISON
X	• **About patient admission**
X	1. Admission and discharge protocols are uploaded[13]
X	2. The EMR blocks admission not approved by liaison[14]
X	3. It notifies and shows list of patients (at ED or OPD) decided to be admitted and date of decision.
X	4. It shows list of elective admissions and procedures with priority level[15].
X	5. It generates waiting time for elective admissions.
X	6. The EMR generates (in graph, table etc.) number of admissions and admitted patient outcomes in month, unit, sex, disease etc. ✓ Admitted patient outcomes include the following a. Discharged improved b. Discharged unimproved (home care) c. Discharged unimproved (palliation, poor prognosis) d. Discharged against medical advice e. Disappeared f. Referred g. Died ✓ So these outcomes must be included in the discharge format and interlinked
	• **About bed management**
X	7. The system auto fills free bed data and notifies.
X	8. The system shows reserved beds and auto delete it if not occupied for some days.
X	9. It generates total number of beds, standard to actual bed number ratio, bed occupancy rate & average length of stay by month, department & specific ward.
	• **About referral service**

[13] Relevant staffs must know these protocols; so, if included it will be easily accessible, and easily updatable.
[14] If liaison (admission officer) does not click "admit" patient account accessed via ward logging will be inactive
[15] This includes any patient who is sent home because of unavailability of bed, skilled manpower or instrument. Besides fair service delivery this helps to create registries like Cardiac Registry. So there must be "Elective Admission" button on physicians'

X	10. A referral protocol is uploaded.
X	11. There is an exhaustive referral service directory.
X	12. The directory lists out the major clinical services and searchable; E.g. when you type "MDR TB" and click search system lists out all facilities providing this service.
X	13. The directory shows distance of facilities from referring facility and patient address • So patient will be referred to the nearest facility
X	14. There is referral register; interlinked with liaisons referral decision
X	15. There is referral out notification when physicians write a referral.
X	16. There is referral in notification when liaisons somewhere request referral.
X	17. Printing referral paper and putting a seal is possible only by liaison officer. • So every referral will pass through liaison
X	18. The EMR has portal to enter and see referral feedbacks including notifications.
X	19. The feedbacks written are automatically linked to health facilities email.
X	20. Feedbacks given to a specific health facility can be filtered out.
X	21. It generates number of referral in & outs in month, unit, disease etc.
NURSING WARD	
X	1. The EMR contains all nursing formats: appropriate and interlinked.
X	A. Nursing care plan/assessment
X	B. Medication administration
X	C. Vital sign sheet
X	D. Fluid balance sheet
X	E. Cardex
X	F. Nursing progress note
X	2. It prevents signing on medication sheet before and after the set time
X	3. Automatically calculate fluid balance[16]
X	4. It generates patient summary[17] and handover notes with further modification.
X	5. Notifies unseen physician order and new (coming) admission.
X	6. When nurses click unseen order system must document "seen by XX" under the order
X	7. It provides nursing drug information of common drugs: storage, dose & administration

[16] Fluid balance = make the system to calculate PO & IV fluid + fluid for medication + Blood – UOP – Drain output – GI output – Dialysis output - insensible loss

[17] Patient summary for nurses may include: Diagnosis, condition, diet/feeding, medications, non-medication order, and hand over notice/attention.

X	8. Has nurse to physician communication button with notification of unseen chats
X	9. Has activity (medication administration, wound care, feeding, taking vital signs etc.) reminder or notification when a certain set time passed.
X	10. The EMR system records & reports "activity X is not done" if a certain set time passed
X	11. The EMR generates the following monthly data.
X	A. PICT performance rate
X	B. Number and % of new bed sore
X	C. Number & % of activities not done timely and activities not done at all
X	D. Admitted patient outcomes
OPD	
X	1. The EMR enables calculating OPD waiting time.
PATHOLOGY	
X	1. Pathology test request formats are found with appropriate information • Cytology, FNAC, biopsy, Bone marrow aspiration/biopsy etc. requests
X	2. All investigations are requested via the EMR system
X	3. Pathology test menu is arranged in an easy to find way
X	4. Pathology test items are searchable.
X	5. The system notifies currently unavailable tests. So physician will print request to avoid unnecessary queue at pathology for non-existing tests.
X	6. There is notification for ready results • This helps the logged user to have instantaneous know how on results, not to forget requests and aware of requests by peers
X	7. Turn Around Time (TAT) is set for all tests
X	8. Pathology result reports allow copy and paste
X	9. Pathology results can be exported to history or progress note and can be edited
X	10. There is activity reminder. E.g. sample "X" is not processed yet/passed its TAT.
X	11. The EMR generate the following data
X	A. TAT of specific tests & comparison with the standard
X	B. Most commonly ordered tests like top 10
X	C. Test unavailability rate (number of request copies given by patho persons & physicians) and which tests.
X	D. Monthly activities like how many FNAC, Cytology, Biopsy etc.
PATIENT PORTAL OR PATIENT VERSION --- NO PATIENT PORTAL AT ALL	
	1. There is a patient portal or version

	2. It has language options
	3. Patients can edit their own demographics: age, Sex, occupation, Ethnicity, Address (region, telephone) etc.
	4. Patients can book appointments online
	5. Patients can request modifying their appointment
	6. Patients can send relevant data (e.g. lab results) and request drug refills.
	7. It allows online prescription so that patient can buy drugs anywhere.
	8. It reminds/notifies patients about appointment dates, lab orders etc.
	9. It provides health promotion reminders. Like stop smoking, get screened for diabetes etc. depending on the clinical conditions and risk factors.
	10. It provide printable health education materials & patient's drug information
	11. It generate patient's medical summary
	12. Patients can ask question to doctors
	13. Patients can give feedback
	14. Patients can find and communicate with patients having similar disease
	15. It has important service directories like Ambulance number, Hospital phone etc.
	16. Patients can electronically send their online medical record to a third party
PHARMACY	
	1. The EMR system display the following drug information
X	A. Strength, formulation & cost for ordering physicians
X	B. Non available drugs
X	C. Expired & near expiry drugs
X	D. Newly arrived drugs
X	2. It auto fills diagnosis when writing prescription
X	3. It helps the dispenser in pill / drug counting (the system takes consideration of amount dispensed on previous visit)[18]
X	4. It has drug-drug & drug-food interaction checker and notification

[18] Advantages:

•It saves time for the dispenser and decreases pill /strip counting error

•Avoids unnecessary accumulation of drugs at home

•Patients will not be get confused (patients take the same drug twice if they are different in color/preparation or strength: from the unfinished previous drug and from the current)

•Patients will not take for or physicians will not prescribe for other patients using one patient MRN (e.g. using free MRN for the non-free patient)

- ✓ To enable pill counting feed the system – drug strength, number of tabs per strip and frequency and duration of order – then system considers remained amount from previous and will calculate number of tablets/strips needed.
- ✓ To prevent patient confusion with previous & current drugs; system will show the dispenser:
- How many tabs are left from the previous.
- Batch number (brand & strength) of the previous: so he can dispense this same drug again if available; if not, advise patient not to get confused with the previous.

X	5. It prevent dispensing drug for a duration beyond their expiry date
X	6. The EMR helps prescribing narcotics while rules are and risks are addressed. • Not finding narcotic prescription paper is an obstacle.
X	7. It allow transcription without modification
X	8. Notifies about compounded preparations
X	9. It shows unavailable drugs. So physician will print prescription to avoid unnecessary queue at pharmacy for non-existing drug.
X	10. System notifies "not generic or not in the hospitals drug list" when physician writes a drug not in the inventory/formulary list; and save it under "not on the list drugs".
X	11. It displays the following information before prescribing & dispensing: Age, weight, allergies, pregnancy & breast feeding status, renal & liver status.
X	12. It prevents or notifies double prescription[19]
X	13. It has drug inventory and stock calculator (color coded)
	14. It generates the following data
X	A. List of drugs patient is taking currently
X	B. Monthly drug unavailability rate (number of transcriptions at pharmacy and prescriptions printed by physicians) and which drugs
X	C. Most commonly prescribed drugs (top 10, top 20)
X	D. Expired drugs; which and percent
X	E. Not on the list (not in the inventory) drugs: This helps to expand/suggest formulary list & to add brand drugs if necessary.
PHYSICIANS	
X	1. The EMR system interface or layout is appropriate for the unit selected. Example; anthropometry & immunization included for pediatrics, ANC & previous pregnancy history for Gyne Obs etc.
	2. There are appropriate and interlinked formats used or filled by physicians
X	A. Admission & discharge format
X	B. History sheet
X	C. Progress note
X	D. Certificates: birth, death, medical, vaccination, sick leave etc.
X	E. Referral & Referral feedback formats
X	F. Other formats: Procedure note, hand over format with a remark/attention section

[19] Notification of previous prescription must show dose, frequency, unit and amount left. E.g. he is left with 20 days dose of enalapril 10 mg po daily prescribed by cardiac unit.

X	3. It has all spaces/sections in the appropriate patient assessment order: Chief complaint, previous admission, HPI, Past history, Family history, ROS, PE, Initial diagnosis, Investigation plan, Investigation results, Final diagnosis, Treatment, Remark
X	4. It prevents going to next section without filling the preceding
X	5. It generates course of drug treatment for admitted patients (start date, missed doses, dose change, time discontinued).
X	6. It has sections to fill important health information (Blood group, CD4 count, Pace maker, immunization, Permanent contraceptives etc.) and health risk factors (alcohol, Khat, drug use, smoking, lifestyle etc.)
X	7. These health information and health risk factors can be updated any time.
X	8. It has headings for treatment orders: new, added & revised order
X	9. It prevents more than three sequential added &/or new orders; it automatically revises and notify to edit and approve it.
X	10. There is "Refill & edit" under prescription. This helps to save time & not to miss drugs.
X	11. It generates investigation summary
RADIOLOGY	
X	1. Radiology test menu is arranged in an easy to find way
X	2. Radiology test items are searchable.
X	3. There are appropriate test ordering/requesting formats[20]
X	4. All investigations are requested via the EMR system
X	5. Test requests can be seen sorted in order of urgency
X	6. The system notifies currently unavailable radiologic tests. So physician will print radiologic test request to avoid unnecessary queue at radiology for non-existing tests.
X	7. It notifies double test requests[21]
X	8. It allows consequent or corollary test orders
X	9. There is notification for ready results • This helps the logged user to have instantaneous know how on results, not to forget requests and aware of requests by peers
X	10. Turn Around Time (TAT) is set for all tests
X	11. Radiologic result reports allow copy and paste

[20] Radiology request formats: clinic, physician, date, patient MRN and summary, Priority (cold, urgent, emergent), appointed on (asap, on date____)

[21] Notification of previous radiologic test request must show planned date of result: asap, any time before next visit, on next appointment date (mention)

X	12. Results can be exported to history or progress note and can be edited
X	13. The system notifies alarming test results
X	14. There is activity reminder. E.g. CXR of "patient X" is not commented yet/passed its TAT.
X	15. The EMR generate the following data; Circle all which are correct
X	A. Monthly TAT report of specific radiologic tests & comparison with the standard
	B. Investigation unavailability rate (number of rad request copies given by rad persons & physicians) and which tests.
X	C. Monthly activities like how many CXR, CT scan, MRI, Ultrasound etc.
REGISTRATION/ CARD ROOM	
X	1. There is an extensive searchable occupation list to choose among; > 1 possible
X	2. There is an extensive religion list to choose among
X	3. Age is auto updating
X	4. There is another section of Age, Sex, occupation, Ethnicity, Marital status, Address (region, telephone) to be filled by the physician[22]

[22] These are filled primarily by the card room receptionists but mistakes are common resulting false result of risk calculations done by the EMR system using these variables. So there should be a section of these variables to be filled by physicians and the system uses it. Notification will be sent to receptionists when there is discrepancy with that of the physicians