



Organizational and health professional readiness for the implementation of electronic medical record system: an implication for the current EMR implementation in northwest Ethiopia

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ABSTRACT

Objective The WHO developed a manual outlining the preliminary organizational and health professionals' readiness to implement electronic medical records (EMR). On the other hand, the readiness assessment in Ethiopia only includes the evaluation of health professionals, leaving out organisational readiness components. As a result, this research aimed to determine health professionals' and organizational readiness to implement EMR at a specialized teaching hospital.

Methods An institutional-based cross-sectional study design was conducted among 423 health professionals and 54 managers. Self-administered and pretested questionnaires were used to collect data. Binary logistic regression analysis was used to identify factors associated with health professionals' readiness for EMR implementation. An OR with a 95% CI and $p < 0.05$ was used to determine the strength of the association and the statistical significance, respectively.

Results In this study, 53.7% management capacity, 33.3% finance and budget capacity, 42.6% operational capacity, 37.0% technology capability and 53.7% organisational alignment among the five dimensions evaluated to assess an organisation's readiness to implement an EMR system. Of 411 health professionals in this study, 173 (42.1%) with (95% CI 37.3% to 46.8%) were ready to implement an EMR system at the hospital. Sex (AOR 2.69, 95% CI 1.73 to 4.18), basic computer training (AOR 1.59, 95% CI 1.02 to 2.46), knowledge of EMR (AOR 1.88, 95% CI 1.19 to 2.97) and attitudes towards EMR (AOR 1.65, 95% CI 1.05 to 2.59) were significantly associated with health professionals' readiness towards EMR system implementation.

Conclusions Findings showed that most dimensions of organizational readiness for EMR implementation were below 50%. This study also revealed a lower level of EMR implementation readiness among health professionals compared with previous research studies' results. To improve organisational readiness to implement an electronic medical record system, a

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The readiness assessment in Ethiopia includes only the evaluation of health professionals, leaving out organisational readiness, which is a cornerstone to successfully implementing electronic medical record (EMR) systems. As readiness is a multidimensional and multilevel construct, it should consist of individual and organisational dimensions.

WHAT THIS STUDY ADDS

⇒ This study is a comprehensive assessment of the organisational and health professionals' readiness for EMR implementation at a Specialised Teaching Hospital in Northwest Ethiopia. This study is unique in that it evaluates organisational readiness for adopting EMRs in addition to health professionals' readiness.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The study's findings will enable implementers and health managers to identify gaps and provide a baseline understanding of the organisational and professional readiness levels before launching a costly implementation.

focus on management capability, financial and budget capability, operational capability, technical capability and organisational alignment was crucial. Likewise, having basic computer training, giving special attention to female health professionals and improving health professionals' knowledge of and attitudes towards EMR could help improve the readiness level of health professionals for implementing an EMR system.

INTRODUCTION

Healthcare systems worldwide are implementing ICT to improve access to healthcare

and the effectiveness and efficiency of health systems.¹ Electronic medical record (EMR) systems are used in many countries' healthcare systems. An EMR is a computer-based system that collects and stores a person's medical information.²⁻³ EMR systems can collect longitudinal data from patients, retrieve patient history and provide doctors with access to evidence-based decision-making tools. EMR systems are used for patient registration, medication and drug prescriptions, pharmaceutical activity record keeping, laboratory results and all patient healthcare information during each visit.^{4,5}

The WHO developed a manual outlining the preliminary organisational and health professional readiness for implementing an EMR system.⁶ According to the WHO outline, successful implementation and maintenance of EMR result from the organisation's and end users' predetermined readiness.⁶ Globally, more than half of EMR projects face sustainability issues. Especially in low-income and middle-income countries, the adoption of EMR systems is far lower than expected. Evidence shows that only 35% of lower-middle-income and 15% of low-income countries have implemented national electronic health record systems.⁷ A factor contributing to the low adoption rate of EMR systems is that implementers in low-income and middle-income countries fail to properly assess organisational and staff readiness for EMR system implementation and use.⁸ Before implementing EMRs, it is critical to understand the medical community's managerial readiness and digital literacy. This is because once the implementer is aware of the problems, everyone can work together to keep the implementation moving forward.

In developed countries, evidence reported the assessment of organisational^{9,10} and healthcare provider readiness to adopt EMR.¹¹⁻¹³ On the other hand, there is a lack of preimplementation assessment in low-income countries, particularly in sub-Saharan Africa, which has been blamed for the failure of those EMR implementation projects. Evidence suggested that low-income nations did not conduct organisational or health professional readiness evaluations before implementing the EMR, and that no efforts were made to ensure the implementation's effectiveness.¹⁴ Furthermore, the readiness assessment in this setting includes only the evaluation of health professionals, leaving out organisational readiness, which is a cornerstone to successfully implementing EMR systems.¹⁵⁻¹⁷ As readiness is a multidimensional and multilevel construct, it should consist of individual and organisational dimensions. Organisational readiness is a well-known factor influencing EMR implementation success. The areas of focus for organisational readiness for implementing EMR are management capacity, finance and budget capacity, operational capacity, technology capacity and organisational alignment.¹⁸

In Ethiopia, studies have been conducted to assess the readiness of health professionals for EMR adoption.¹⁹⁻²¹ Sociodemographic characteristics, knowledge, attitude and practice of health professionals on EMR, computer

training, and computer literacy determine the readiness of health professionals.²⁰⁻²³

In the past many years, Ethiopia has made efforts to implement EMR systems at various public health facilities. However, the implementation efforts have been unsuccessful in all but a few health facilities. In recent years, however, Ethiopia has made remarkable achievements in the implementation of health information systems, including the District Health Information System, Electronic Community Health Information System, Electronic Logistics Management Information System, Electronic Public Health Emergency Management System and EMR system.²⁴

Currently, the Ministry of Health is facilitating and supporting the implementation of EMR systems that meet the Ethiopian Electronic Health Record (EHR) standard. One of the EMR systems deployed in various public health facilities in Ethiopia, including the University of Gondar Comprehensive and Specialised Hospital, is the Bahmni system. The system is a global open EMR tool that provides end-to-end automation of health facility services.²⁵

Understanding the readiness level could help to identify gaps and take remedial actions before and during EMR system implementation. Therefore, this research aimed to determine health professionals' and organisational readiness to implement EMR at the University of Gondar specialised hospital. The findings of this study will provide implementers and health managers with baseline information about organisational and health professional readiness levels before launching a costly implementation.

METHODS

Study design and setting

A cross-sectional study was conducted among health professionals and managers at the University of Gondar Comprehensive Specialised Hospital (UoG-CSH) from 2 June 2022 to 25 June 2022. The UoG-CSH is one of the biggest Hospitals in the Northern part of Ethiopia. It is located in Gondar town, which is 750 km away from Addis Ababa. The hospital is the only tertiary-level teaching hospital in the Amhara region.²⁶ The UoG-CSH has nearly 1520 healthcare professionals and more than 20 departments to treat an average of 1000 patients daily.

Eligibility criteria

The study includes all health professionals and managers from the UoG-CSH who are available during the data collection period. However, health professionals and managers with less than 6 months of experience were excluded from this study. This is because newly hired health professionals may not be familiar with the healthcare delivery system or EMRs.

Sample size determination

The sample size for health professionals' readiness was calculated using a single population proportion formula with the following assumptions: The prevalence of EMR readiness in southwestern Ethiopia was around 50%,²¹ with a 95% confidence level, a 5% margin of error and a 10% non-response rate. Finally, a minimum sample size of 423 was obtained. However, all 54 middle and top-level managers, such as department heads, team leaders, hospital directors, unit leaders and contact persons, were considered for the organisational readiness assessment.

Sampling procedure

We used stratified random sampling based on departments to assess health professionals' readiness towards EMR system implementation. Proportional allocation of the sample was done to each department based on the number of healthcare professionals. Finally, each department's study participants were chosen using a computer-generated simple random sampling process. All 54 middle and high level managers at the University of Gondar specialised and teaching hospital were considered in assessing organisational readiness components. The UoG-CSH has 20 department heads, 14 team leaders, 2 directors, 10 unit leaders and 8 contact persons.

Study variables

This study's dependent variable is the organisational and health professionals' readiness level to implement EMR. The questionnaires used to assess organisational and health professional readiness were developed using a review of related literature.^{18–20 27} The independent variables in this study were sociodemographic characteristics, technology and related organisational factors, knowledge of EMR and attitude towards EMR.

Operational definition

Organizational readiness to implement EMR

In this study, 29 items were used to assess organisational readiness for EMR implementation with management capacity (4 items), finance and budget capacity (4 items), operational capacity (4 items), technology capacity (9 items) and organisational alignment (8 items).¹⁸ Organisational readiness to implement EMR was assessed by using a 3-point Likert scale ('Highly prepared' (score 3), moderately prepared (score 2) and 'not yet prepared' (score 1)).¹⁸

The item scores for each organisational readiness component were added and divided by the number of items to create a composite variable ranging from scores 1 to 3 for the data analysis.^{28–30} As a result, two or more final scores (highly prepared, moderately prepared) were labelled as 'Ready to implement an EMR system'. In contrast, the final score of one (not yet prepared) was categorised as 'not ready to implement an EMR system'.^{30 31}

Health professional readiness to implement EMR

In this study, eight items of yes/no question type were used to assess health professionals' core and engagement

readiness.^{20 27} A study participant with a 50% or higher score on core readiness and engagement readiness questions is considered core and engagement ready, respectively.^{19 20} The union between core and engagement readiness is the overall readiness.²⁷ If a health professional has both engagement and core readiness, they are considered to have an overall readiness.^{19 20}

Knowledge towards EMR

Study participants who scored 50% on knowledge questions or higher were categorised as having good knowledge, and those who scored less than average were categorised as having limited knowledge.²⁰

Attitude towards EMR

Study participants who scored 50% on attitude questions or higher were categorised as having a good/favourable attitude, and those who scored less than 50% were categorised as having a poor/unfavourable attitude.²⁰

Data collection tool and quality control

Structured and self-administered questionnaires written in English were used to collect the necessary data. A review of related literature was conducted to develop the questionnaires that were used in this study.^{18 20 27} Twelve data collectors with experience in health IT disseminated the Google Forms-created questionnaires under the guidance of two public health informatics professionals with master's degrees. Data collectors and supervisors were trained for 2 days to eliminate ambiguity. A pretest was conducted among 50 health professionals at the Gondar town health centre, located outside of the study area, to standardise and ensure the validity of the questionnaires. We modified the data collection tools following the findings from the pretest. The internal consistency of each dimension of the data collection tool was evaluated using the pretest results' Cronbach's alpha scores. Cronbach's alpha values for overall readiness (0.84), attitude towards EMRs (0.81) and knowledge of EMRs (0.76), all fell within the acceptable range.

Data processing and analysis

The questionnaires were designed using Google Forms, which is a tool used to create and analyse surveys. Then, the data were exported to SPSS V.25 for further analysis. Binary logistic regression analyses examined the relationship between the outcome and independent variables. In the bivariate regression analysis, variables with a $p < 0.2$ were considered potential candidates for the multivariate regression analysis to assess their adjusted impacts on the dependent variables. An OR with a 95% CI and p value was calculated to determine the strength of association and statistical significance. The Hosmer and Lemeshow test was used to evaluate the model's fitness, and results showed that it was well fitted with $p > 5\%$ (ie, $p = 0.387$).

Table 1 Sociodemographic characteristics of the participants

Sociodemographic variables	Category	Frequency	Percentage
Sex	Male	240	58.4
	Female	171	41.6
Age (mean±SD)	30.3+4.89		
Profession	Doctors	89	21.7
	Nurse	161	39.2
	Pharmacy	18	4.4
	Midwifery	51	12.4
	Laboratory	32	7.8
	Public health	21	5.1
	Others*	39	9.4
Educational level	Bachelor's degree and below	337	82.0
	Masters' degree and above	74	18.0
Working experience (mean and SD)	7.0±6.41		
Computer access	No	113	27.5
	Yes	298	72.5
Internet access	No	79	19.2
	Yes	332	80.8
Computer training	No	195	47.7
	Yes	216	52.3

*Others include psychiatry, physiotherapy, optometry, anaesthesia, radiology assistant

RESULTS

Sociodemographic characteristics

A total of 411 health professionals participated in the individual readiness assessment with a 97% response rate. The average age of the respondents was 30.3 years (SD+4.8), with a minimum and maximum age of 21 and 60 years, respectively. Of the 411 participants, the majority were men (58.4%) and nurses (39.2%) by profession. The majority of the respondents, 337 (82.0%), had a bachelor's degree and below educational status, and an average of (7±6.4) years of work experience.

Most participants, 298 (72.5%) and 332 (80.8%) have access to a computer and the internet, respectively. However, only 221 (53.8%) of the participants had access to computers at work. Of the participants, 215 (52.3%) had received basic computer training (table 1).

Organisational readiness to implement EMR

The organisational readiness assessment involved 54 managers. Management capability, financial and budget capability, operational capability, technical capability, and organisational alignment were considered to assess how prepared an organisation was to implement an EMR

system. Of the 54 managers participating in the study, 29 (53.7%) said management capacity was ensured to implement the EMR system. Most managers, 36 (66.7%), thought that the financial and budgetary infrastructure was not yet ready to implement EMR.

Furthermore, only 23 (42.6%) of the hospital's managers thought there was an operational capacity to implement EMR. Only 20 (37.0%) of the managers who participated in the study claimed that there is sufficient technology to implement an EMR system. Only 29 (53.7%) participants said that the organisation's alignment for implementing an EMR system was ensured (table 2).

Knowledge and attitude of health professionals towards EMR

The result of the individual readiness assessment indicated that 267 (65.0%) of participants had good knowledge of EMR. Similarly, 270 (65.7%) participants had a favourable attitude towards EMR systems (figure 1).

Health professionals' readiness for the implementation of EMR

Of all the participants in this study (411), 173 (42.1%) of them had overall readiness for the implementation of an EMR system with (95 CI 37.3% to 46.8%), while 230 (56.0%) and 196 (47.7%) had core and engagement readiness, respectively (figure 2).

Factors associated with health professionals' readiness for the implementation of an EMR system

Both bivariable and multivariable logistic regression analysis showed that sex, basic computer training, knowledge of EMR, and attitude towards EMR were the significant factors associated with health professionals' readiness to implement an EMR system (table 3).

The multivariable logistic regression analysis showed that males were 2.69 times more likely to be ready (AOR 2.69, 95% CI 1.73 to 4.18) for implementing an EMR system than females. Participants who received basic computer training were 1.59 times more likely to be ready (AOR 1.59, 95% CI 1.02 to 2.46) for implementing an EMR system than those without basic computer training. Furthermore, participants with good knowledge of EMR were 1.88 times more likely to be ready (AOR 1.88, 95% CI 1.19 to 2.97) for the implementation of an EMR system when compared with those with poor knowledge. Similarly, health professionals with favourable attitudes towards EMRs were 1.65 times more likely to be ready (AOR 1.65, 95% CI 1.05 to 2.59) for implementing an EMR system compared with those with unfavourable attitudes (table 3).

DISCUSSION

Five dimensions were used to evaluate how prepared the University of Gondar Comprehensive and Specialised Hospital was to implement an EMR system: management capability, finance, and budget capability, operational capability, technology capability, and organisational

Table 2 Organisational readiness for the implementation of EMRs

Organisational readiness components	Not prepared (%)	Prepared (%)
Management capacity for the implementation of EMR	25 (46.3)	29 (53.7)
Finance and budget capacity for the implementation of EMR	36 (66.7)	18 (33.3)
Operational capacity for the implementation of EMR	31 (57.4)	23 (42.6)
Technology capacity for the implementation of EMR	34 (63.0)	20 (37.0)
Organisational alignment for the implementation of EMR	25 (46.3)	29 (53.7)

EMR, electronic medical record.

alignment. Only 53.7% of the managers believed that the hospital was ready to implement an EMR system in terms of management capacity. To implement an EMR system effectively, the healthcare system needs to build its managerial infrastructure.³² The management system needed to be ready in order to take the initiative and implement an EMR system at the specialised teaching hospitals in Northwest Ethiopia. The operational capability to execute an EMR system and the financial and budgetary infrastructure were the other elements of the organisational readiness to implement an EMR system. More than two-thirds of respondents (66.7%) in this study claimed that the financial and budgetary infrastructure was not yet ready to deploy an EMR system. This shows that the healthcare system should consider financial expenses when implementing an EMR. Costs for system development, modification, end-user training, maintenance and support shall be planned for EMR system implementation. The responsible body shall also consider the availability of technical employees, medical professionals and system analysts to make the EMRs operationally feasible and long-lasting.

Moreover, organisational alignment and technological readiness should be considered to prepare the organisation for implementing an EMR system.¹⁸ According to our findings, only 37% of respondents claimed that EMR implementation is possible with current technology. It is strongly advised that each health professional have access to computers and other technological tools to continue using EMRs and ensure their adoption. This is because allowing two or more health professionals to use the same login to work on the same computer violates patient confidentiality and privacy. Concerning individual readiness,

230 (56.0%) health professionals showed core readiness for EMR implementation, while 196 (47.7%) showed engagement readiness. Overall, 173 (42.1%) health professionals were ready for EMR implementation. The overall readiness for health professionals was lower in this study when compared with other research conducted in Northern Ethiopia,^{19 20} but it was higher than in the Sidama region in Southern Ethiopia.³³ The high level of readiness is shown in the previous studies because the studies were conducted in hospitals which planned to implement an EMR system for only the medical record unit.^{19 20} As a result, there is a gap in the previous study's evaluation of the full impact of EMR adoption in service units other than those that handle medical records. The readiness level could decline if medical professionals stop using EMRs. An additional source of support for this funding comes from a recent evaluation in southern Ethiopia.³³ This suggested that to implement EMRs, the current healthcare system in Ethiopia needs to enhance organisational and health professional readiness.

In this study, males were 2.69 times more likely to be ready to implement EMRs than females. This may be because women in Ethiopia tend to carry out more household duties and family responsibilities than men. The results of earlier investigations conducted in Ethiopia also confirm this conclusion.²⁰ This suggested that more work needs to be done to improve the readiness of female health professionals to implement EMRs. Enforcing factors like training and including female health professionals in the implementation process could help to increase their readiness. This study also found that healthcare professionals who had received basic computer training were 1.59 times more likely to be ready to implement EMRs than

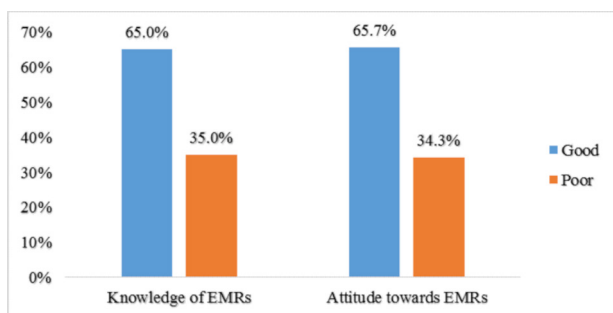
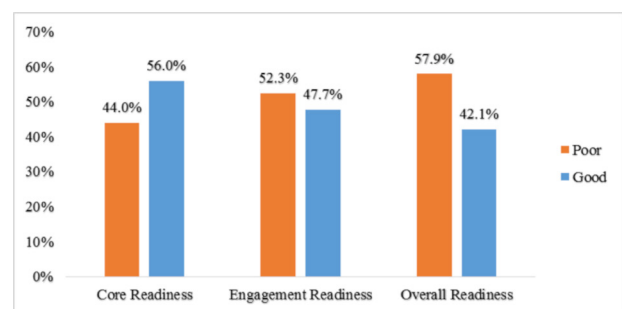

Figure 1 Knowledge and attitude of health professionals towards EMR. EMR, electronic medical record.

Figure 2 Health professionals' readiness to implement EMRs. EMRs, electronic medical records.

Table 3 Factors associated with health professionals' readiness for the implementation of an EMR system

Variables		Readiness		COR (95% CI)	AOR (95% CI)
		Ready (%)	Not ready (%)		
Sex	Male	124 (30.2)	116 (28.2)	2.66 (1.75 to 4.03)	2.69 (1.73 to 4.18)*
	Female	49 (11.9)	122 (29.7)	1	1
Age	30.3+4.89			1.04 (0.99 to 1.08)	1.02 (0.98 to 1.07)
Education level	Master's and above	40 (9.7)	34 (8.3)	1.80 (1.08 to 2.99)	1.33 (0.76 to 2.33)
	Degree and below	133 (32.4)	204 (49.6)	1	1
Computer access	Yes	132 (32.1)	166 (40.4)	1.39 (0.89 to 2.18)	1.30 (0.78 to 2.18)
	No	41 (10.0)	72 (17.5)	1	1
Internet access	Yes	144 (35.0)	188 (45.7)	1.32 (0.79 to 2.19)	1.01 (0.56 to 1.82)
	No	29 (7.1)	50 (12.2)	1	1
Computer training	Yes	106 (25.8)	110 (26.8)	1.84 (1.23 to 2.74)	1.59 (1.02 to 2.46)*
	No	67 (16.3)	128 (31.1)	1	1
EMR Knowledge	Good	128 (31.1)	139 (33.8)	2.02 (1.32 to 3.10)	1.88 (1.19 to 2.97)*
	Poor	45 (10.9)	99 (24.1)	1	1
Attitude towards EMR	Favourable	125 (30.4)	145 (35.3)	1.67 (1.09 to 2.54)	1.65 (1.05 to 2.59)*
	Unfavourable	48 (11.7)	93 (22.6)	1	1

*p<0.05
AOR, adjusted odds ratio; COR, crude odds ratio; EMR, electronic medical record.

their counterparts. This finding is supported by previous research that showed that basic ICT and other pertinent health information technology training could enhance the readiness of healthcare staff for adopting EMRs.¹⁹ To implement EMR successfully, the responsible body should improve the basic computer skills of healthcare professionals. For health professionals to easily understand EMR, end-user training should guarantee they have at least a basic degree of digital capabilities.

Health workers with good knowledge of EMRs were 1.88 times more likely to be ready to implement EMRs than those with poor knowledge. This conclusion is supported by research studies conducted in various regions of Ethiopia.^{19 20 33} This may be because health professionals with good EMR knowledge may better comprehend the EMR modules and benefits, which can boost readiness for EMR implementation.

Furthermore, health professionals with a favourable attitude towards EMRs were 1.65 times more likely to be ready to implement EMRs than those with unfavourable attitudes. Evidence from previous research studies suggested that readiness to implement EMRs was positively associated with attitudes about EMRs.^{1 13 34} This may be because people with favourable attitudes regarding EMRs are likely to use the system and have a favourable opinion. As a result, implementing the implemented EMRs will be successful and sustainable.

IMPLICATIONS FOR PRACTICE AND RESEARCH

The findings of the study have implications for the EMR implementation now underway in a specialised teaching

hospital in northwest Ethiopia. This study is unique in that it evaluates organisational readiness for adopting EMRs in addition to health professionals' readiness. Understanding organisational and health professional readiness levels may help to spot any shortcomings in the current EMR deployment at the University of Gondar specialised hospital. If we know the implementation challenges, we can take corrective action before and during the installation of the EMR system.

CONCLUSION AND RECOMMENDATION

The University of Gondar hospital is not ready to implement an EMR system as the scores for most of the dimensions for organisational readiness were below 50%. This study also revealed a lower level of EMR implementation readiness among healthcare workers when compared with earlier studies. It was recommended to develop basic computer training materials, give special attention to female health professionals, and improve health professionals' knowledge of and attitudes towards EMRs to increase the readiness of health professionals to implement EMRs in the implementation sites.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

The study has certain limitations, one being the chance of recall biases because it was self-administered. Further research is required to ascertain the exact EMR implementation status at the implementation site. Additionally, evaluating the efficacy of various interventions to implement EMR successfully was another work for researchers.

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