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Complete List of Authors:	Al Alawi, shamma; Ambulatory Healthcare services, Family medicine Al-Dhaheri, Aysha; Ambulatory Healthcare services, Family medicine Al-Baloushi, Durra; Ambulatory Healthcare services, Family medicine Al-Dhaheri, Mouza; Tawam Hospital in Affiliation with Johns Hopkins Medicine, Homecare Prinsloo, Engela; United Arab Emirates University Faculty of Medicine & Health Sciences, joint Family AND Community Medicine
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Physicians User's Satisfaction with Electronic Medical Records System in Primary Health Care Centers in Al-Ain: a qualitative study

Shamma Al Alawi[1], Aysha Al Dhaheri[1], Durra Al Baloushi[1], Mouza Al Dhaheri[2], Engela Prinsloo[3]

[1]Ambulatory Health Care Services, SEHA, Al Ain, Abu Dhabi, United Arab Emirates.
[2]Homecare Department, Tawam Hospital in Affiliation with Johns Hopkins Medicine, Al Ain; United Arab Emirates.
[3]Department of Community Medicine, Faculty of Medicine and Health Sciences UAE University, United Arab Emirates.

Correspondence to:
Durra Al Baloushi,
Ambulatory Health Care Services, SEHA, Al Ain, Abu Dhabi, United Arab Emirates.
P.O. Box 15676
Al Ain, United Arab Emirates
E-mail: d_albaloushi@hotmail.com

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Abstract

Background: The Electronic Medical records (EMR) system has a great potential to improve the quality of health care services. User's satisfaction with electronic medical records plays an important role in its implementation and subsequent use. The UAE has started to implement the EMR system in Abu-Dhabi and Al-Ain since 2008. Although measuring user's satisfaction is a necessary part of the development cycle of electronic medical record system there are lack of information and research studies in this field in United Arab Emirates.

Objectives: To explore physician's satisfaction with the EMR system, to identify and explore the main limitations of the system and finally to submit recommendations to address these limitations in primary health care centers already implementing the system in the Al Ain region, United Arab Emirates, during 2011.

Methods: A descriptive qualitative study including three semi structured focus group interviews among physicians, using open-ended questions was performed. The interviews were audiotaped, documented and transcribed verbatim. The themes were explored and analyzed in different categories.

Results: Key themes emerged from the focus groups and categorized as physician dependent factors, patient related factors and system related factors. In general, physicians were satisfied with the EMR system although some were initially facing some difficulties with implementation. Most of the participants identify the long time required to do the documentation in the system as a factor that affected their practice and communication with the patients. Many physicians were pleased about the orders and results of laboratory and radiology function and they emphasized that this was the strongest point in EMR. They were also satisfied with the electronic prescription function because it reduced errors and saved time.

Conclusion: Physician's perception of EMR appears to have both positive and negative impacts on primary care outpatient practices. Several themes emerged during this study that need to be considered to enhance the EMR system. Further studies need to be conducted amongst other health care practitioners and patients to explore their attitude and perception about the EMR system.

Strength and limitations of this study

UAE has implemented the EMR system (Cerner) in 2008 in Abu-Dhabi and Al-Ain. Ever since there is a lack of information and research studies for this area specifically to evaluate the users' satisfaction. This study focused on EMR users in primary health care settings and did not include the EMR users in hospitals.

Introduction

The Electronic medical record (EMR) is a new and promising tool for enhancing health care delivery as such; the interest in EMR systems both nationally and internationally is considerable.[1] Recent research has shown that information technologies can reduce medication errors[2], improve adherence to clinical practice guidelines[3], and improve the delivery of preventive health services[4], thereby potentially improving health outcomes for patients. [5,6]

While electronic medical users can be productive, any disparities in experience, understanding, and skills can leave team members feeling less than satisfied and not working to their full capabilities.[1] Clinicians' perception of EMR is a crucial determinant of successful use of the EMR system. United Arab Emirate, Health Authority of Abu-Dhabi (HAAD) has implemented a system developed by one of the top three Healthcare IT vendors in the US.[6] They are in existence since 1979 and have installations in many countries including USA, Canada, Australia, Saudi Arabia, Qatar, UAE, France, Spain, Singapore, Malaysia, and South America.

UAE has implemented the EMR system (Cerner) in 2008 in Abu-Dhabi and Al-Ain. Ever since there is a lack of information and research studies for this area specifically to evaluate the users' satisfaction.

This research study focused on physician User's Satisfaction with Electronic Medical Records System in Primary Health Care Centers in Al-Ain. The research findings are reported in two separate qualitative and quantitative papers. We conducted a concurrent qualitative study in the same practices selected for the quantitative project. The aim of the qualitative part was to explore the attitude and behavior of the participants, which could not be fully appreciated and interpreted by means of a questionnaire.

The use of focus group interviews is becoming increasingly popular in health care research to explore beliefs, feelings, attitudes and behavior of individuals. Focus group discussions provide information about a range of ideas and feelings of individuals about specific issues and it illuminates the differences in perspective between groups of individuals. A focus group can generate large amount of data in a relatively short time span.[7]

In this study the researchers explored users' knowledge, attitude and satisfaction with the electronic medical records system in primary health care centers in Al-Ain.

Method

Study design: This descriptive qualitative study was conducted in parallel with a quantitative study, which was reported in a separate paper. Study method: A Purposive sampling strategy was used to recruit the physicians.[8] Permission was obtained from the clinic supervisors of each hospital prior to the study. Invitation letters were distributed among the physicians in clinics where the quantitative study on the EMR system was conducted. Those who agreed to participate in the qualitative study were contacted by telephone 1–2 days before the focus group meeting. The overall focus group attendance was 70–80%. The main reason given for non-participation was lack of time. Each focus group consisted of seven to nine physicians working in the primary health care centers using the same EMR system .The authors participated in conducting the research in different ways. The third author, a family medicine resident, reviewed literature related to qualitative research, received additional training related to qualitative research methods, developed the moderators guide[8] and moderated the focus groups. The three other researchers were respectively responsible for audio taping and documenting verbal and non-verbal responses. Participants signed a consent form before the focus group session. All focus group interviews were conducted in the same primary health care center in Al Ain Medical District. To maximize ease of participation, the interviews were held after office hours at lunchtime. Each focus group consisted of a mix of males and females of different age groups and professional experience. There was no managerial representation in the focus groups, which may have inhibited group participation.

The moderator introduced herself at the beginning of the focus groups, explaining the purpose of the study and assuring confidentiality of the information shared.[8] The facilitator encouraged participation of all members in the discussions using open-ended questions focusing on: (1) initial impression about Electronic Medical Records System, (2) advantages and disadvantages of EMR, (3) patients' reaction to introduction of EMR and (4) suggestions to improve the EMR. Interview questions were reviewed as the study progressed to seek further clarifications.[9]

Semi structured group interviews were conducted on three consecutive days. Each focus group lasted for one hour. Theme saturation was approximately achieved during the second focus group and a third focus group was conducted to confirm the saturation.

Data analysis

The interviews were audiotaped and transcribed verbatim. As the interviews progressed, data was analyzed after each focus group to develop preliminary codes to identify important and new ideas emerging. Each transcript was independently reviewed and coded separately by all the researchers to establish main concepts.[1] Subsequently, each transcript was analyzed by each investigator independently to explore the themes and subthemes and then reviewed by the other investigators to compare and group the similar data. Further relations and triangulations[10] were analyzed during regular meetings. The next stage involved identifying the theme frame using the "Krueger" framework.[11]

Trustworthiness and credibility of the data

Trustworthiness of the data was enhanced by using Guba's four criteria. [12]

a) Credibility: To ensure credibility of an accurate recording of the participant responses, focus groups were audiotaped, transcribed verbatim and subjected to independent reviews and the use of more than one analyst improved the consistency or reliability of analyses. [13]

b) Transferability (generalizability): The purposeful sampling method was broad to include maximum variation in perspectives and views.

c) Dependability (reliability): Reflective appraisal of the data, evaluating the effectiveness of the process of inquiry undertaken was ensured.

d) Confirmability was achieved through independent reviews and consensus of the coding scheme by the research team.

Findings

A total of 23 physicians attended either of the three focus groups held in PHC in Al Ain Medical District. (Table 1) shows the characteristics of the focus group participants.

Table 1: Characteristics of physicians

Demographic data	FG1* (n=7)	FG2* (n=9)	FG3* (n=7)
Gender			
Male (female)	**3(4)**	**4(5)**	**2(5)**
Professional experience			
Seniors	**5**	**6**	**4**
Juniors (residents)	**2**	**3**	**3**
Nationality			
UAE	**2**	**3**	**3**
Non-UAE	**5**	**6**	**4**

FG: focus group, n= total number

Several themes emerged from the focus groups about the implementation of EMR (Table 2). The themes were categorized as physician issues, patient issues and system (Cerner) issues. . Figure 1 illustrates the influence of a "Third party", the EMR on the doctor patient interaction.

Physician dependent factors

The initial impression of physicians:

In general physicians spoke favorably about EMR system implementation e.g. *"I think that, I do believe that my first impression was so amazing"* "(excited) FG1 but all remarked that the beginning was difficult e.g. *" At the beginning, as anything when you use it for the first time, it will look complex until you get familiar to the system""(*all saying yes, yes) FG3.

Computer skills: They believed that the computer skills had a major role in understanding EMR as they mentioned that old generation physicians were slower in typing and learning new tricks. There is a difference in competency among physicians in dealing with technology e.g. *"Old generation doctors, whom I respect a lot of course, let's say there is a urine culture results, they don't know that there is a click where you can get the susceptibility"FG1 Another e.g. "if you don't know like Alt and C is copying and Alt and V is pasting, it takes for a lot of people it causes a lot of difficulties"FG2*

"for me for example if I want to explain something for the patient in anatomy, instead of drawing I will just enter the Google and the patient will be very happy: ohm, this is how it look, this is how the anatomy. And when you want to illustrate the disease process through pictures the patient will be very happy" It was also useful to provide the patient with very useful educational materials.

The training: Physicians appeared to have various opinions about the training period. Some were completely satisfied e.g. *"It was sufficient, the training was good, of course the training itself to how to deal with computer at the beginning start in a good*

way" FG3, while others were not satisfied and expressed that they were not aware of some facilities available in the EMR system e.g. *"How to order everything at the start was very clear and comprehensive in the training part but when we start on the note part the training was not sufficient, in my opinion*"(intensely saying) FG3. Some physicians suggested having individualized training sessions according to the physician needs. *"I think they should work on teaching session, according to level of each, e.g. dividing them in groups and take them step by step even if it take 10 sessions or more"*FG2.

Participants specified that IT team and super users were always available during the early time of implementation. They also suggested having regular meetings with the IT team to revaluate the physicians, answer their queries and have an updated training sessions for each system upgrade e.g. *"they make a training they have to meet the users again to evaluate them. For example, I am using the cerner and I collect questions there should be some one professional to answer me" FG3*

"*They should give us updating; now what I learn 2 years ago I am developing myself. This should be like regular because this will answer a lot of questions for me for the system" "*(repeatedly saying) FG1

Patient related outcomes

Patient-physician relationship: Physicians' perceptions about patient reaction were mixed. Initially they were unhappy because of disturbed patient doctors relationship e.g. *"It was bad but now it is improving a lot"* (head nodding) FG1 and *"The real thing is eye contact is missing"* FG2. Further more the waiting time increased due to data entry causing more frustration to the patients e.g. *"The patient upset because of waiting time "(overlap talk) FG3.*

Physicians believed that the waiting time was not caused by them but was mainly in the registration and nursing assessment e.g. *"I found that nursing assessment they have to do a lot of things"* (all agree) FG2. On the other hand they believed the benefits outweighed the waiting time issue and included beneficial issues as improved patient care, patient education and the health maintenance schedule. They stated that patient flow was initially reduced but eventually returned to the same as prior to implementation of the EMR e.g. *"the same, the same,"*FG2.

Many physicians were concerned about their patients' perception about the new technology. They felt that many patients were unhappy but indicated that few patients approved and made positive remarks to their physicians.

Physician tried to adapt some strategies to maintain the relation with their patient. Some were talking to the patients while dealing with computer so patients would not feel neglected *e.g. "ok now I am checking your results, I am checking your past file"*FG1.

Others reserved data entry to immediately after the visit e.g. *"we can put the diagnosis, then put the medication, because we can't put medication without diagnosis then put the labs then ask the patient to go and continue documentation"*FG2.

*"…the proper thing is to take full history from the patient, maintaining the good communication with the patient then turn and document"*FG3.

All physicians believed that the presence of the EMR had strong effects on the flow of the patients initially. But later returned to the prior situation.

Some of physicians used the EHR as a means for collaboration to share the screen with their patients. They showed them some pictures to illustrate and explain concerns.

System dependent factors

A summary of advantages and barriers highlighted by physicians using the EMR is discussed in the text below:

<u>The quality of documentation</u>: Physicians believed that EMR improved the quality and clarity of the documentation e.g. *"it is very helpful, very readable, better than the handwriting"* another e.g. *"previously they were usually write their own abbreviations* ***LE, RE*** *not sure what they mean is it LEFT EYE or the disease itself but now because of the system coding they tend to write""(all saying yes yes)* FG2. However some physicians described the system as complex and less informative e.g. *"if the doctor is free texting he will say the real thing and when you read it you will know what is the meaning exactly (overlapping talk) but if you tick tick, tick sometime you lose"(emotive expression? intensely saying)* FG3.

Participants in all focus groups agreed that the current EMR was designed mainly for the hospitals and not for the primary care centers e.g. *"The system was not designed*

for primary care (all agree) it is designed for hospitals this is the main issue for us"(emotive expression? intensely saying) FG3. Physicians had difficulties finding a diagnosis for some of the common conditions like skin laceration or skin abrasion seen in daily practices.

System complexity and interconnectivity: A common theme was the complexity of the system. Participants explained that they had difficulty at the beginning of implementation of the system to find the proper coding for the diagnosis. They also complained that sometimes they had to duplicate and repeat notes in several locations because there was no link, for example between the notification system and the patient notes e.g. *"Notification system, there must be a connection between Health Authority Abu Dhabi and cerner (EMR) another thing some cases...if anyone experience how to notify a case of syphilis he will hate himself (laughing). Four pages you must fulfill four (4) pages"* FG3.

Participants were very satisfied with the precompleted notes in the system. They mentioned, it helped them in saving time and was very useful in the specialty clinics. e.g. *"Definitely, it saves a lot of time"*FG1 another e.g. "*Helpful, especially in the clinics, the specialized clinics like the well baby clinic, in antenatal clinic, in chronic clinic*" FG1. They also highlighted that in the long run the review of accumulated documentation will be challenging because they mentioned that the visual scanning is impossible without highlights e.g. "*Accumulation over the year will be a problem because you cannot go through all the note to find something"*FG1.

Ordering and viewing: Many participants in the three focus groups were very pleased and satisfied with the orders and results of laboratory and radiology function. They mentioned that it is the strongest part in the EMR and the results are available on the same day e.g. *"The stronger point on cerner (EMR) is lab's and x-rays* (overlap talk)"FG3. Participants found that online orders from the Cerner tick list was are easier than the written ones. e.g. *"If you are comparing writing an order with ticking order, ticking order is easier."* FG3,

EMR viewing capability was considered to be useful information for patient management and it helped with continuity of care and following progression of many chronic diseases e.g. *"For example, if you have a patient with renal failure you can see the results (creatinine) for one year which is very useful"FG2.*

Participants believed that x-ray orders are very helpful because the radiologist has access to the history of the patient e.g. *"It was really miserable because there is no history for the doctor to read from x-ray. When I sit with the doctor the radiologist, I feel what he is feeling because there is nothing just X-ray. Okay for what? What are you thinking? What are your differential, it is nothing."* FG3.

Regarding the electronic prescription, participants were very excited since it helps a lot in reducing the errors. *"It is easy and safe also"* FG1. They indicated that the prescription refill system saved time. Participants stated that they liked the drug reference text that appeared with each medication order.

Participants were suggesting to uniform the units that are used in the system to either mg or mmol. Several participants agreed that the referral is much easier and patients could be traced and followed up through the system. Feedback about patient referral and management was a major improvement according to participants. This was difficult with the paper system before. e.g. "*Before we don't know any feedback about the patient but now I refer one patient suspecting bronchiolitis or something after one hour I can open the cerner(EMR) and I can see what they did for him*" FG1.

Some participants said that the referral and feedback system is good for the continuity of care of the patients; it enables them to have a complete picture of the progression of patient condition and what sort of further management he received after referral. e.g. "*I think referred for us as Family medicine for continuity of case is better*" FG2. Regarding the disadvantages of EMR, participants were complaining that the system was time consuming and required too much detailed documentation. e.g. *"Previously documentation was not such detail when using file. But whatever time we spent, we spent with patient, we were asking his history, examining, and writing a prescription giving him cause and the rest come but now, suppose URTI case come one or two minutes is taken to diagnose the case once the diagnosis is finished then I started with my computer so this computer is taking time and patient finished and he is just waiting and waiting till I finished so he gets upset."* FG1.

An important point that was raised in the first focus group, which was subsequently added to the discussion questions, was the confidentiality issue. All participants agreed that there was no confidentiality with the EMR system e.g.*" One of the main issues with the Cerner (EMR) is the confidentiality"* FG1.

Suggestions

One of the themes from the discussions was suggestions to improve the EMR system. Participants suggested to allow more time for the physicians and to improve the email system. They also proposed including some diagnosis in the EMR that are commonly used in the primary care setting. e.g. *"Common medical problem should be included in the diagnosis and encounter pathway should include more general complaints"* FG1.

In the second focus groups, participants suggested that the electronic document design should be simplified for use by doctors and patients in primary care.

"Electronic documentation it is so much better. No one differ about that but it must be simplified for the patient and for the physician" "(repeatedly saying) FG2.

Participants also suggested for ease of use the allergies, problem list and diagnosis should be included in the main page. Physicians wanted to have a free text to add diagnosis and not be restricted to the available EMR list e.g. "*We can't find ICD9 since one or two months it can enter as free text, now it can't I should change it. It should be applicable for change it. He was osteopenic and now osteoporosis. So I can change it I can click this and write other*" FG3.

Participants asked to have a link between HAAD records and the EMR system for the sick leave and notifications. e.g. *"Sick leave and notification. There must be a link between cerner (EMR) and HAAD at HAAD website. For sick leave it is very important as we write free text and patient coming to me and take it after 3 days go to another clinic and take another sick leave like this*" (hot emotive??? discussion) FG2.

Discussion:

This is the first published paper in the UAE to evaluate the EMR users satisfaction since the implementation. The aim of this study was to understand the attitude and knowledge of physicians about the EMR. Another goal was to identify the disadvantages and suggestions to improve the system.

The elicited physicians' perceptions about the EMR summarized in the preceding text suggested several ideas to improve the system. Physicians in all focus group were satisfied with the EMR system although some physicians were facing some

difficulties at the beginning of implementation. Most of the participants identify the long time required to do the documentation in the system as a factor that affect their practice and communication with the patients. The same results were found in a study done in Hawaii. Participants reported that CIS had reduced clinicians' productivity, primarily because of extra work such as processing laboratory result reports, entering orders and navigating through the systems.[14]

Many physicians were pleased about the orders and results of laboratory and radiology as they emphasized that this is the strongest point in EMR. They were also happy about the electronic prescription because it reduced the errors and saved time.

They believed that the computer skills had a major role in understanding EMR as they mentioned. In the review of the literature, computer literacy was a major barrier for the implementation of the EMR. [15]

There is one finding that emerged in the second focus group only as a result of the presence of a physician who was exposed to the auditing process. The investigators got the feeling that physicians perceived it as a significant issue mainly about auditing the physicians for documentation and patient confidentiality e.g. "*the medical record do regular audit and find out, for example, why the chart has been opened*".

Another e.g. "*part of annual appraisal of the physicians is the we have about eight competencies one of them is the documentation and we usually audit at least 10 to 20 task for each physician and all the important factors the presenting symptom, the history of present illness the past medical history… we do for audit and this is why the physician are keen to have a complete or as much as we can about full documentation*". Physicians had a negative perception that they have been monitored for their performance through the cerner, which created some discomfort during the session. This finding was not commonly identified in our literature review except in one study where the respondent reported? the feedback as personal criticism.[14] It may be important to ensure that during implementation of new systems, like the cerner, users should be informed about the purpose of the use of the system and also about the auditing tool and the purpose of use of audits to allay fears and negative perceptions.

The confidentiality issue was added to the moderators guide as a questions after it emerged as theme in the first focus group. Participants mentioned the loss of confidentiality in the patient's files, because anybody who has access could open any file. A new insight developed after the first focus group, and the interview questions were adapted to explore this new knowledge.[16] It was discussed until the point reached saturation similar to the situation in other studies. [15,16]

Physicians in our study reported that EMR documentation was taking long time, as there were so many clicks to perform even for short documents and simple complaints. In the review of the published literature, physicians recognized the benefits of EMR for legibility, and readily linked this to better and safer patient care outcomes. The burden and time inefficiency of data entry are seen as major disadvantages, suggesting the importance of "smarter" and more intuitive data entry interfaces and perhaps voice recognition.[17] This also emerged as subtheme in our study.

Participants continued to identify the important role of an EMR champion within their practice who encouraged EMR usage and was available to problem solve. Support and encouragement from a "champion" has been noted in the literature as crucial throughout the implementation process.[1,18] In this study participants mentioned that follow-up by super users and the IT team would be beneficial.

Participants identified the messaging system within the EMR software as practical, useful and important tool for enhancing efficiency within the team. Successful communication has been linked to increased patient safety and improved patient outcomes. [1] The physicians in all focus groups emphasized this point. They mentioned that internal communication in the clinic through the system had saved time and improve the safety of the patient.

Major barriers to implementation and adoption included computer literacy, training, and time. There was also variability regarding the influence of prior computer knowledge on perceptions of EMR implementation. While these issues have been identified in prior studies, they remain an ongoing challenge for primary health care providers. Implementation and adoption of EMRs will be most successful when protected time is available for training all EMR users. [15] In this study similar concerns were raised.

A recent review of studies on barriers to EMR implementation found that these could be broadly categorized as concerns about costs, technical issues (including lack of interconnectivity, high complexity, and lack of customizability), lack of time, psychological factors such as lack of belief in EMR, social factors such as lack of support from colleagues, and legal issues such as concerns over privacy and security.[18,19] Complexity, interconnectivity and time factors also emerged from the current study.

Limitations

The present study was limited in several ways. Firstly, the study included only physicians despite the importance of understanding nurses, pharmacists and other health care professionals' beliefs about using the EMR. Secondly the study was done only in Al-Ain district although HAAD has implemented the EMR system in Abu-Dhabi and Al-Ain. This study focused on EMR users in primary health care settings and did not include the EMR users in hospitals.

Conclusion

Clinicians' perception of EMR appears to have both positive and negative impacts on primary care outpatient practices. Several themes emerged during this study that need to be considered to enhance the EMR system. Further studies need to be done including other medical users and patients to view their attitude and perception about the EMR system.

Recommendations

A crucial next step is to select from the themes, which emerged in the study the ones that are most commonly mentioned or most important to physicians, and to formulate hypothesis about the mechanisms by which those beliefs might shape acceptance and users' behavior. Further, survey measures should be implemented in nurses, pharmacists, patients and others groups to understand their beliefs and attitudes about the EMR system. The findings which correspond with those of other studies or which are detrimental to services and can be adjusted should be communicated to authorities and IT vendors to seek solutions to improve and adjust future applications to the benefit all.

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Contributors:

All authors contributed to the concept and design of the study Dr. Durra was the moderator of the focus group. Dr. Shamma was the principle investigator and the coordinator of the study and contributed to the analysis, interpretation and preparation of the manuscripts with the input from all authors. All Authors have read and approved the final manuscript.

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Research interests

Better health care quality providing, and patient safety with relation to health care information technology.

Competing interests

The authors declare that they have no competing interest.

Ethics Approval

The proposal for this study was approved by Al Ain Medical District Human Research Ethics Committee, protocol No. SO11-3. Permission was taken from governing hospitals of each clinic before starting the study.

Table 2 : summery of themes of all focus groups

	Themes & Subthemes	Quotes
Physicians dependent factors	**1.** The initial impression about EMR system • Difficulty in use at the beginning • Training was sufficient and good	*"Still we are in the fetal state"*.FG1 *"We had a team which was always available"FG3*
	2. Past computer skills • Different users' generations with different computer skills	*"Old generation doctors, whom I respect a lot of course, let's say there is a urine culture results, they don't know that there is a click where you can get the susceptibility". FG1*
	3. The impression about the precompleted notes • Precompleted notes definitely saves time	*"Definitely, it saves a lot of time"FG2*
Patient related	**4.** Doctor – patients relationship • No eye contact • Waiting time is more • Patients are accepting the system because it is reflecting an advance modern of technology	*"Initially the patient were not happy"FG1* *"No eye contact" FG1* *"It consumes more time" FG1* *"Patient will accept this new system because it is more advance and reflect that the clinic is more advance with modern technology but giving good care"FG1*
System dependent factors	**5.** Complexity of the system • EMR complexity was at the beginning • Complexity of the system, not specialized to PHC	*"If you get use to it, yes, it become very easy"FG1* *"The system was not designed for primary care"FG3*
	6. The quality of documentation • Documentation now is readable and better than handwriting • The quality of documentation is depends on the physician them self	*"Before we should open this charts. I can't read handwriting of the doctors, now everything is easy and everything is in front of my eyes only by clicking"FG2*
	7. The process of prescription in the cerner and the current problems • Prescription is better & safe now • Allergy system decreasing the medication errors	*"Definitely much better 100%"FG1* *"Before there were so many mistakes"FG2* *"If there is allergy, decrease the error because during hand writing there was medication errors"FG1*
	8. Improvement of the orders and results with EMR • The orders and the result much organized • Fast feedback of the results	"T*he stronger point on cerner is lab's and xrays"FG3* *"Much organized"FG1* *"The results will come directly to your inbox"FG1*
	9. Referral issues with the cerner • Referral issue easy with feedback • Trace patient's appointment and print it for them	*"Before when was referring patients to the hospital we don't have any clue what happened to him"FG3* *"I can easily open the system and look for it and tell her this is your appointment"FG1*
	10. Confidentiality • No confidentiality with EMR	*"It is easy to break this confidentiality with the cerner. Any body can open the file"FG1*
	11. Disadvantages of EMR • Takes time • Important notes should be highlighted	*"Longer, even not only with doctor, from pharmacy side, from reception side"FG3* *"It is difficult to eye scan, it should be highlighted"FG1*
	12. Suggestions to improve EMR • Giving more time • Meetings and updating by Cerner people	*"Give us enough time" FG1* *"They should give us updating; now what I learn 2 yrs. ago I am developing myself"FG1*

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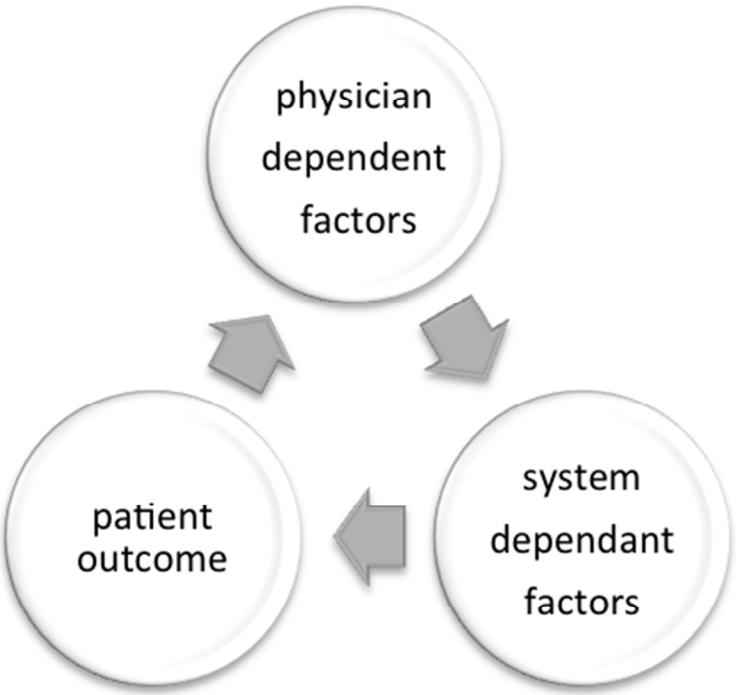

Figure1 EMR dynamics
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Physicians User's Satisfaction with Electronic Medical Records System in Primary Health Care Centers in Al-Ain: a qualitative study

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Physicians User's Satisfaction with Electronic Medical Records System in Primary Health Care Centers in Al-Ain: a qualitative study

Shamma Al Alawi[1], Aysha Al Dhaheri[1], Durra Al Baloushi[1], Mouza Al Dhaheri[2], Engela A. M. Prinsloo[3]

[1]Ambulatory Health Care Services, SEHA, Al Ain, Abu Dhabi, United Arab Emirates.
[2]Homecare Department, Tawam Hospital in Affiliation with Johns Hopkins Medicine, Al Ain; United Arab Emirates.
[3]Department of Family Medicine , College of Medicine and Health Sciences UAE University, United Arab Emirates.

Correspondence to:
Durra Al Baloushi,
Ambulatory Health Care Services, SEHA, Al Ain, Abu Dhabi, United Arab Emirates.
P.O. Box 15676
Al Ain, United Arab Emirates
E-mail: d_albaloushi@hotmail.com

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Abstract

Objectives: To explore physician's satisfaction with the Electronic Medical Records (EMR) system, to identify and explore the main limitations of the system and finally to submit recommendations to address these limitations.

Design: A descriptive qualitative study that entailed three semi structured focus group interviews was performed amongst physicians, using open-ended questions. The interviews were audiotaped, documented and transcribed verbatim. The themes were explored and analyzed in different categories.

Setting: The study was conducted in primary health care centers (PHC) in Al Ain, United Arab Emirates (UAE).

Participants: A total of 23 physicians, all using the same EMR system, attended one of three focus groups held in PHC in Al Ain Medical District. Each focus group consisted of 7-9 physicians working in PHC as family medicine specialists, residents or general practitioners.

Primary outcome measure: Physicians satisfaction with EMR System.

Results: Key themes emerged and were categorized as physician dependent, patient related and system related factors. In general, physicians were satisfied with the EMR system in spite of initially difficulties with implementation. Most participants identified that the long time required to do the documentation affected their practice and patients communication. Many physicians expressed satisfaction with the orders and results of laboratory and radiology function and they emphasized that this was the strongest point in EMR. They were also satisfied with the electronic prescription function stating that it reduced errors and saved time.

Conclusion: Physicians are satisfied with EMR and have a positive perception regarding the application of the system. Several themes emerged during this study that need to be considered to enhance the EMR system. Further studies need to be conducted amongst other health care practitioners and patients to explore their attitude and perception about the EMR.

Strength and limitations of this study

- The EMR system (Cerner) was introduced in the Emirate of Abu-Dhabi but only Al-Ain clinics were selected for the study and due to study design findings cannot be generalized.
- This being the first local study to address EMR user satisfaction adds a new user perspective.
- This study focused on primary health care physician EMR users excluding hospital users and related health care professionals.
- Method of focus-group recruitment contributed to selection bias .

Introduction

The Electronic medical record (EMR) is a new and promising tool for enhancing national and international health care delivery.[1] Recent research has shown that information technologies can reduce medication errors[2], improve adherence to clinical practice guidelines[3], and improve the delivery of preventive health services[4], thereby potentially improving health outcomes for patients. [5,6]

While electronic medical users can be productive, any disparities in experience, understanding, and skills can leave team members feeling less than satisfied and not working to their full potential.[1] Clinicians' perception of EMR is a crucial determinant of successful use of the EMR system. United Arab Emirate, Health Authority of Abu-Dhabi (HAAD) has implemented a system developed by one of the top three Healthcare IT vendors in the US.[6] They have been in existence since 1979

and have installations in many countries including USA, Canada, Australia, Saudi Arabia, Qatar, UAE, France, Spain, Singapore, Malaysia, and South America.

UAE has implemented the EMR system (Cerner) in 2008 in Abu-Dhabi and Al-Ain. Information and research studies related to user satisfaction is lacking in the local context.

This research study focused on physician User's Satisfaction with Electronic Medical Records System in Primary Health Care Centers in Al-Ain and was the first known survey done in the UAE exploring this research question.

The findings are reported in two separate papers qualitative and quantitative[7] respectively. We conducted a concurrent qualitative study in the same practices selected for the quantitative project.

The use of focus group interviews is becoming increasingly popular in health care research to explore beliefs, feelings, attitudes and behavior of individuals. Focus group discussions provide information about a range of ideas and feelings of individuals about specific issues and it illuminates the differences in perspective between groups of individuals. A focus group can generate large amount of data in a relatively short time span.[8]

In this study the researchers explored users' knowledge, attitude and satisfaction with the electronic medical records system in primary health care centers in Al-Ain.

Method

Study design: This descriptive qualitative study was conducted in parallel with a quantitative study reported separately in a paper presented at the 2nd Al Ain Family Medicine Research Day; 2012 March 3; Al Ain, UAE. [7]

. Study method: A Purposive sampling strategy was used to recruit the physicians. [9]

The study was conducted in English. Permission was obtained from the clinic supervisors of each hospital prior to the study. Invitation letters were distributed among the physicians in clinics where the quantitative study on the EMR system was conducted. The management personnel were requested to select the participants for our study. These workers were selected based on their willingness to share their experiences on EMR with us. Those who were to participate in the qualitative study were contacted by telephone 1–2 days before the focus group meeting. The physicians were not compensated for their time since most of them (physicians) were released during their shift hours. The authors contributed to different aspects of the research study.. The third author, a family medicine resident, reviewed literature related to qualitative research, received additional training related to qualitative research methods, developed the moderators guide[9] and moderated the focus groups. The three other researchers were respectively responsible for audio taping and documenting verbal and non-verbal responses. Participants signed a consent form before the focus group session. All focus group interviews were conducted in the same primary health care center.. To maximize ease of participation, the interviews were held after office hours during lunchtime. We deliberately exempted the managerial representation from our focus groups. The main reason was that we were of the opinion that their presence would cause junior colleague to feel uncomfortable preventing them from sharing their personal experiences and perceptions on their use of EMR in the work-place..

The moderator introduced herself at the beginning of the focus groups, explaining the purpose of the study and assuring confidentiality of the information shared.[9] The facilitator encouraged participation of all members in the discussions using open-

ended questions focusing on: (1) initial impression about Electronic Medical Records System, (2) advantages and disadvantages of EMR, (3) patients' reaction to introduction of EMR and (4) suggestions to improve the EMR. Interview questions were reviewed as the study progressed to seek further clarifications.[10] (See the online supplementary appendix A) for detailed focus Group Questions.

Semi structured group interviews were conducted on three consecutive days. Each focus group lasted an hour. Theme saturation was approximately achieved during the second focus group and a third focus group was conducted to confirm the saturation.

Data analysis

The interviews were audiotaped and transcribed verbatim. As the interviews progressed, data was analyzed after each focus group to develop preliminary codes to identify important and new ideas emerging. Each transcript was independently reviewed and coded separately by all the researchers to establish main concepts.[1] Subsequently, each transcript was analyzed by each investigator independently to explore the themes and subthemes and then reviewed by the other investigators to compare and group the similar data. Further relations and triangulations[11] were analyzed during regular meetings. The next stage involved identifying the theme frame using the "Krueger" framework.[12] Trustworthiness of the data was enhanced by using Guba's four criteria [13] [14]for more details (See the online supplementary appendix B)

Findings

A total of 23 physicians attended either of the three focus groups.. The overall focus group attendance was 70–80%. The main reason given for non-participation was lack of sufficient time.. Each focus group consisted of seven to nine physicians working in the primary health care centers as family medicine specialists, residents or general

practitioners using the same EMR system since 2008. The characteristics of the focus group participants are reported in Table 1.

Each focus group consisted of a mix of males and females of different age groups and professional experience.

Table 1: Characteristics of physicians

Demographic data	FG1* (n=7)	FG2* (n=9)	FG3* (n=7)
Gender			
Male (female)	**3(4)**	**4(5)**	**2(5)**
Professional experience			
Seniors	**5**	**6**	**4**
Juniors (residents)	**2**	**3**	**3**
Nationality			
UAE	**2**	**3**	**3**
Non-UAE	**5**	**6**	**4**

FG: focus group, n= total number

Several themes emerged from the focus groups about the implementation of EMR (Table 2). The main themes were categorized as physician issues, patient issues and system (Cerner) issues. These categories of main themes were arrived at through consensus during analysis of focus-group transcribes after the interviews. Participants repeatedly referred to or mentioned these themes during their discussions.

Physician dependent factors

The initial impression of physicians:

In general physicians spoke favorably about EMR system implementation e.g. *"I think that, I do believe that my first impression was so amazing"* FG1 but all remarked that the beginning was difficult e.g. *" At the beginning, as anything when you use it for the first time, it will look complex until you get familiar to the system"* FG3.

Computer skills: They believed that the computer skills had a major role in understanding EMR as they mentioned that old generation physicians were slower in typing and learning new tricks. There is a difference in competency among physicians in dealing with technology e.g. *"Old generation doctors, whom I respect a lot of*

course, let's say there is a urine culture results, they don't know that there is a click where you can get the susceptibility"FG1 Another e.g. "if you don't know like Alt and C is copying and Alt and V is pasting, (it takes) for a lot of people it causes a lot of difficulties"FG2

"for me for example if I want to explain something for the patient in anatomy, instead of drawing I will just enter the Google and the patient will be very happy: ohm, this is how it look, this is how the anatomy. And when you want to illustrate the disease process through pictures the patient will be very happy" It was also useful to provide the patient with very useful educational materials.

The training: Physicians appeared to have various opinions about the training period. Some were completely satisfied e.g. *"It was sufficient, the training was good, of course the training itself to how to deal with computer at the beginning start in a good way"* FG3, while others were not satisfied and expressed that they were not aware of some facilities available in the EMR system e.g. *"How to order everything at the start was very clear and comprehensive in the training part but when we start on the note part the training was not sufficient, in my opinion*" FG3. Some physicians suggested having individualized training sessions according to the physician needs. *"I think they should work on teaching session, according to level of each, e.g. dividing them in groups and take them step by step even if it take 10 sessions or more"* FG2.

Participants specified that IT team and super users were always available during the early time of implementation. They also suggested having regular meetings with the IT team to reevaluate the physicians, answer their queries and have an updated training sessions for each system upgrade e.g. *"they make a training they have to meet the users again to evaluate them. For example, I am using the Cerner and I collect questions there should be someone professional to answer me" FG3*

"*They should give us updating; now what I learn 2 years ago I am developing myself. This should be like regular because this will answer a lot of questions for me for the system"* FG1

Patient related outcomes

Patient-physician relationship: Physicians' perceptions about patient reaction were mixed. Initially they were unhappy because of disturbed patient doctors relationship e.g. *"It was bad but now it is improving a lot"* FG1 and *"The real thing is eye contact is missing"* FG2. Furthermore the waiting time increased due to data entry causing more frustration to the patients e.g. *"The patient upset because of waiting time"* FG3.

Physicians believed that the waiting time was not caused by them but was mainly in the registration and nursing assessment e.g. *"I found that nursing assessment they have to do a lot of things"* FG2. On the other hand they believed the benefits outweighed the waiting time issue and included beneficial issues as improved patient care, patient education and the health maintenance schedule. They stated that patient flow was initially reduced but eventually returned to the same as prior to implementation of the EMR e.g. *"the same, the same,"*FG2.

Many physicians were concerned about their patients' perception about the new technology. They felt that many patients were unhappy but indicated that few patients approved and made positive remarks to their physicians.

Physician tried to adapt some strategies to maintain the relation with their patient. Some were talking to the patients while dealing with computer so patients would not feel neglected *e.g. "ok now I am checking your results, I am checking your past file"*FG1.

Others reserved data entry to immediately after the visit e.g. *"we can put the diagnosis, then put the medication, because we can't put medication without diagnosis then put the labs then ask the patient to go and continue documentation"*FG2.

*"...the proper thing is to take full history from the patient, maintaining the good communication with the patient then turn and document"*FG3.

All physicians believed that the presence of the EMR had strong effects on the flow of the patients initially,but later returned to the prior situation.

Some of the physicians used the EHR as a means for collaboration to share the screen with their patients. They showed them some pictures to illustrate and explain concerns.

System dependent factors

A summary of advantages and barriers highlighted by physicians using the EMR is discussed in the text below:

The quality of documentation: Physicians believed that EMR improved the quality and clarity of the documentation e.g. *"it is very helpful, very readable, better than the handwriting"* another e.g. *"previously they were usually write their own abbreviations*

*"**LE", "RE"** not sure what they mean is it LEFT EYE or the disease itself but now because of the system coding they tend to write"* FG2. However some physicians described the system as complex and less informative e.g. *"if the doctor is free texting he will say the real thing and when you read it you will know what is the meaning exactly (overlapping talk) but if you tick tick, tick sometime you lose"* FG3.

Participants in all focus groups agreed that the current EMR was designed mainly for the hospitals and not for the primary care centers e.g. *"The system was not designed for primary care (all agree) it is designed for hospitals this is the main issue for us*" FG3. Physicians had difficulties finding a diagnosis for some of the common conditions like skin laceration or skin abrasion seen in daily practices.

System complexity and interconnectivity: A common theme was the complexity of the system. Participants explained that they had difficulty at the beginning of implementation of the system to find the proper coding for the diagnosis. They also complained that sometimes they had to duplicate and repeat notes in several locations because there was no link, for example between the notification system and the patient notes e.g. *"Notification system, there must be a connection between Health Authority Abu Dhabi and cerner (EMR) another thing some cases...if anyone experience how to notify a case of syphilis he will hate himself (laughing). Four pages you must fulfill four (4) pages"* FG3.

Participants were very satisfied with the pre-completed notes in the system. They mentioned, it helped them in saving time and was very useful in the specialty clinics. e.g. *"Definitely, it saves a lot of time"*FG1 another e.g. "*Helpful, especially in the clinics, the specialized clinics like the well-baby clinic, in antenatal clinic, in chronic clinic*" FG1. They also emphasized that in the long run the review of accumulated

documentation will be challenging by asserting that visual scanning is impossible without highlights e.g. "*Accumulation over the year will be a problem because you cannot go through all the note to find something"*FG1.

Ordering and viewing: Many participants in the three focus groups were very pleased and satisfied with the orders and results of laboratory and radiology function. They mentioned that it is the strongest part in the EMR and the results are available on the same day e.g. *"The stronger point on cerner (EMR) is lab's and x-rays*" FG3. Participants found that online orders from the Cerner tick list was easier than the written ones. e.g. *"If you are comparing writing an order with ticking order, ticking order is easier."* FG3.

EMR viewing capability was considered to be useful information for patient management and it helped with continuity of care and following progression of many chronic diseases e.g. *"For example, if you have a patient with renal failure you can see the results (creatinine) for one year which is very useful"FG2.*

Participants believed that x-ray orders are very helpful because the radiologist has access to the history of the patient e.g. *"It was really miserable because there is no history for the doctor to read from x-ray. When I sit with the doctor the radiologist, I feel what he is feeling because there is nothing just X-ray. Okay for what? What are you thinking? What are your differential, it is nothing."* FG3.

Regarding the electronic prescription, participants were very excited since it helps in reducing the errors. *"It is easy and safe also"* FG1. They indicated that the prescription refill system saved time. Participants stated that they liked the drug reference text that appeared with each medication order.

Participants suggested agreeing on uniformity in the use of metric units deciding on either reporting in milligram (mg) or millimol (mmol). Several participants agreed that the EMR referral is much easier and patients could be traced and followed up through the system. Feedback about patient referral and management was a major improvement according to participants. The previous paper system did not support continuity of care or feedback. . e.g. "*Before we don't know any feedback about the patient but now I refer one patient suspecting bronchiolitis or something after one hour I can open the cerner(EMR) and I can see what they did for him*" FG1.

According to some participants the referral and feedback system enhances continuity of care of the patients; it provides them with a complete picture of post referral management and progress. e.g. "*I think referred for us as Family medicine for continuity of case is better*" FG2. Regarding the disadvantages of EMR, participants were complaining that the system was time consuming and required too much detailed documentation. e.g. *"Previously documentation was not such detail when using file. But whatever time we spent, we spent with patient, we were asking his history, examining, and writing a prescription giving him cause and the rest come but now, suppose URTI case come one or two minutes is taken to diagnose the case once the diagnosis is finished then I started with my computer so this computer is taking time and patient finished and he is just waiting and waiting till I finished so he gets upset."* FG1.

An important issue that was raised in the first focus group, and subsequently added to the discussion questions, was that of confidentiality.. All participants agreed that there was no confidentiality with the EMR system e.g.*" One of the main issues with the Cerner (EMR) is the confidentiality"* FG1.

Suggestions

One of the emerging themes from the discussions was suggestion to improve the EMR system. Participants suggested to allow more time for the physicians and to improve the email system. They also proposed including some diagnosis in the EMR that are commonly used in the primary care setting. e.g. *"Common medical problem should be included in the diagnosis and encounter pathway should include more general complaints"* FG1.

In the second focus group, participants suggested that the electronic document design should be simplified for use by doctors and patients in primary care.

"Electronic documentation it is so much better. No one differ about that but it must be simplified for the patient and for the physician" FG2.

Participants also suggested that allergies, problem list and diagnosis should be included in the main page to simplify the system. Physicians wanted to have a free text to add diagnosis and not be restricted to the available EMR list e.g. "*We can't find ICD$_9$ since one or two months it can enter as free text, now it can't I should change it. It should be applicable for change it. He was osteopenic and now osteoporosis. So I can change it I can click this and write other*" FG3.

Participants requested to have a link between HAAD records and the EMR system for sick leave notes and notification of disease. e.g. *"Sick leave and notification. There must be a link between Cerner (EMR) and HAAD at HAAD website. For sick leave it is very important as we write free text and patient coming to me and take it after 3 days go to another clinic and take another sick leave like this*" FG2.

Discussion:

This is the first published paper in the UAE to evaluate the EMR users' satisfaction since the implementation. The aim of this study was to understand the attitude and knowledge of physicians about the EMR. Another goal was to identify the disadvantages and suggestions to improve the system.

The physicians' perceptions about the EMR summarized in the preceding text suggested several ideas to improve the system. Physicians in all focus groups were satisfied with the EMR system although some physicians were facing some difficulties at the beginning of implementation. Most of the participants identified the long time required to do the documentation in the system as a factor that affects their practice and communication with the patients. The same results were found in a study done in Hawaii. Participants reported that CIS had reduced clinicians' productivity, primarily because of extra work such as processing laboratory result reports, entering orders and navigating through the systems.[15]

Many physicians were pleased about the orders and results of laboratory and radiology as they emphasized that this is the strongest point in the EMR. They were also happy about the electronic prescription because it reduced errors and saved time. In a survey conducted by Robert et. al (2011), including 2,719 Family Physicians in America the respondents highlighted advantages of the EMR which were almost similar to our findings.. Their respondents stated that they were pleased with the EMR system since it was fast, easy to use, well documented, more precise and provided patient engagement tools such as the patient education resources and patients' portal.[16] However, ACP (2008), conducted a survey reporting that physician dissatisfaction with EMRs increased from 24% in 2010 to 39% in 2102. The reasons provided by the respondents for their dissatisfaction with the EMR was that the system was expensive and was not significantly reducing their workload.[17]

They mentioned that computer skills had a major effect on understanding the EMR. In the literature review, computer literacy was identified as a major barrier to the implementation of the EMR.

There was a finding that only emerged in the second focus group due to the presence of a physician who was previously exposed to the auditing process. The researchers were of the impression that physicians perceived the EMR as a significant threat when used to audit the physicians for documentation and patient confidentiality e.g. "*the medical record do regular audit and find out, for example, why the chart has been opened*".

Another e.g. "*part of annual appraisal of the physicians is the we have about eight competencies one of them is the documentation and we usually audit at least 10 to 20 task for each physician and all the important factors the presenting symptom, the history of present illness the past medical history… we do for audit and this is why the physician are keen to have a complete or as much as we can about full documentation*". Physicians had a negative perception that they were monitored for their performance through the Cerner, which created some discomfort during the session. This finding was not commonly identified in our literature review except in one study where the respondent reported the feedback as personal criticism.[15] It is important to ensure that during the implementation of a new systems, like the Cerner, users should be informed about the purpose of the use of the system and also about the auditing tool and the purpose of use of audits to allay fears and negative perceptions.

The confidentiality issue was added to the moderators guide as a focus group questions after it emerged as theme in the first focus group. Participants mentioned

the loss of confidentiality in the patient's files, because anybody who has access could open any file. A new insight developed after the first focus group, and the interview questions were adapted to explore this new knowledge. It was discussed until the point reached saturation similar to the situation in other studies. [18,19]

Physicians in our study reported that EMR documentation was time- consuming, due to many clicks that had to be performed, even for short documents and simple complaints. In the review of the published literature, physicians recognized the benefits of EMR for legibility, and readily linked this to better and safer patient care outcomes. The burden and time inefficiency of data entry are seen as major disadvantages, suggesting the importance of "smarter" and more intuitive data entry interfaces and perhaps voice recognition.[20] This also emerged as subtheme in our study.

Participants continued to identify the important role of an EMR champion within their practice who encouraged EMR usage and was available to problem solve. Support and encouragement from a "champion" has been noted in the literature as crucial throughout the implementation process.[1,21] In this study participants mentioned that follow-up by super users and the IT team would be beneficial.

Participants identified the messaging system within the EMR software as a practical, useful and important tool for enhancing efficiency within the team. Successful communication has been linked to increased patient safety and improved patient outcomes.[1] The physicians in all focus groups emphasized this point. They mentioned that internal communication in the clinic through the system had saved time and improved patient safety.

Major barriers to implementation and adoption included computer literacy, training, and time. There was also variability regarding the influence of prior computer knowledge on perceptions of EMR implementation. While these issues have been identified in prior studies, they remain an ongoing challenge for primary health care providers. Implementation and adoption of EMRs will be most successful when protected time is available to train all EMR users. [18] In this study similar concerns were raised.

A recent review of studies on barriers to EMR implementation found that these could be broadly categorized as concerns about costs, technical issues (including lack of interconnectivity, high complexity, and lack of customizability), lack of time, psychological factors such as lack of belief in EMR, social factors such as lack of support from colleagues, and legal issues such as concerns over privacy and security.[22,23] Complexity, interconnectivity and time factors also emerged from the current study.

Limitations

The present study was limited in several ways. Firstly, the study included only physicians despite the importance of understanding nurses, pharmacists and other health care professionals' beliefs about using the EMR. Secondly the study was done only in Al-Ain district although HAAD has implemented the EMR system in Abu-Dhabi and Al-Ain. This study focused on EMR users in primary health care settings and did not include the EMR users in hospitals. The application of purposive sampling strategy in the recruitment of the physicians during this study is also a limitation. Since the respondents were self-selected, it might mean that this study had many EMR enthusiasts.

Conclusion

Clinicians have a positive perception regarding the application of EMR in the primary care outpatient practices. However, several themes emerged during this study that need to be considered to enhance the EMR system. Therefore, further studies need to be done by focusing on other medical users and patients in viewing their attitude and perception about the EMR system. Adapting the system to needs and diagnosis common to the PHC setting and offering continuous training and technical support would assist in convincing apprehensive EMR users.

Recommendations

A crucial subsequent step is selecting from the themes, which emerged in the study, the themes that are most commonly mentioned or most important to physicians, and to formulate a hypothesis about the mechanisms by which these beliefs might shape acceptance and users' behavior. A , survey should be implemented on nurses, pharmacists, patients and others groups so as to understand their beliefs and attitudes about the EMR system. The findings which correspond with those of other studies or are detrimental to services and can be adjusted, should be communicated to authorities and IT vendors to seek solutions of improving and adjusting future applications to the benefit of all.

Footnotes

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Contributors:

All authors contributed to the concept and design of the study. Dr.Durra: was the moderator of the focus group. Dr. Shamma was the principle investigator and the coordinator of the study, Dr. Shamma and Aysha contributed to the analysis, interpretation and preparation of the manuscripts with the input from all authors. Dr. Prinsloo, Durra and Mouza were involved in editing the article or revising it critically for important intellectual content, All Authors have read and approved the final manuscript.

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Research interests

Better health care quality providing, and patient safety with relation to health care information technology.

Competing interests

The authors declare that they have no competing interest.

Ethics Approval The proposal for this study was approved by IRB of Al Ain Medical District Human Research Ethics Committee, protocol No. SO11-3. Permission was taken from governing hospitals of each clinic before starting the study.

Data sharing statement**:** Our qualitative data are not to be shared, as we consent patients for data confidentiality when the study was undertaken. The Quantitative study is unpublished data available from the corresponding author, Appendix A and B are available for Data Sharing, Further details of the study protocols can be requested from the corresponding author by emailing Durra Al Baloushi (d_albaloushi@hotmail.com).

Table 2: Summary of themes of all focus groups

Themes & Subthemes		Quotes
Physicians dependent factors	**1.** The initial impression about EMR system • Difficulty in use at the beginning • Training was sufficient and good	*"Still we are in the fetal state"*.FG1 *"We had a team which was always available"FG3*
	2. Past computer skills • Different users' generations with different computer skills	*"Old generation doctors, whom I respect a lot of course, let's say there is a urine culture results, they don't know that there is a click where you can get the susceptibility". FG1*
	3. The impression about the precompleted notes • Precompleted notes definitely saves time	*"Definitely, it saves a lot of time"FG2*
Patient related	**4.** Doctor – patients relationship • No eye contact • Waiting time is more • Patients are accepting the system because it is reflecting an advance modern of technology	*"Initially the patient were not happy"FG1* *"No eye contact" FG1* *"It consumes more time" FG1* *"Patient will accept this new system because it is more advance and reflect that the clinic is more advance with modern technology but giving good care"FG1*
System dependent factors	**5.** Complexity of the system • EMR complexity was at the beginning • Complexity of the system, not specialized to PHC	*"If you get use to it, yes, it become very easy"FG1* *"The system was not designed for primary care"FG3*
	6. The quality of documentation • Documentation now is readable and better than handwriting • The quality of documentation is depends on the physician them self	*"Before we should open this charts. I can't read handwriting of the doctors, now everything is easy and everything is in front of my eyes only by clicking"FG2*
	7. The process of prescription in the cerner and the current problems • Prescription is better & safe now • Allergy system decreasing the medication errors	*"Definitely much better 100%"FG1* *"Before there were so many mistakes"FG2* *"If there is allergy, decrease the error because during hand writing there was medication errors"FG1*
	8. Improvement of the orders and results with EMR • The orders and the result much organized • Fast feedback of the results	"T*he stronger point on cerner is lab's and xrays"FG3* *"Much organized"FG1* *"The results will come directly to your inbox"FG1*
	9. Referral issues with the cerner • Referral issue easy with feedback • Trace patient's appointment and print it for them	*"Before when was referring patients to the hospital we don't have any clue what happened to him"FG3* *"I can easily open the system and look for it and tell her this is your appointment"FG1*
	10. Confidentiality • No confidentiality with EMR	*"It is easy to break this confidentiality with the cerner. Any body can open the file"FG1*
	11. Disadvantages of EMR • Takes time • Important notes should be highlighted	*"Longer, even not only with doctor, from pharmacy side, from reception side"FG3* *"It is difficult to eye scan, it should be highlighted"FG1*
	12. Suggestions to improve EMR • Giving more time • Meetings and updating by Cerner people	*"Give us enough time" FG1* *"They should give us updating; now what I learn 2 yrs. ago I am developing myself"FG1*

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Physicians User's Satisfaction with Electronic Medical Records System in Primary Health Care Centers in Al-Ain: a qualitative study

Shamma Al Alawi[1], Aysha Al Dhaheri[1], Durra Al Baloushi[1], Mouza Al Dhaheri[2], Engela A. M. Prinsloo[3]

[1]Ambulatory Health Care Services, SEHA, Al Ain, Abu Dhabi, United Arab Emirates.
[2]Homecare Department, Tawam Hospital in Affiliation with Johns Hopkins Medicine, Al Ain; United Arab Emirates.
[3]Department of ~~Community~~Family Medicine~~, Faculty~~ , College of Medicine and Health Sciences UAE University, United Arab Emirates.

Correspondence to:
Durra Al Baloushi,
Ambulatory Health Care Services, SEHA, Al Ain, Abu Dhabi, United Arab Emirates.
P.O. Box 15676
Al Ain, United Arab Emirates
E-mail: d_albaloushi@hotmail.com

Keywords: Electronic medical records, Electronic health records, physician satisfaction, EMR functionalities, computerized health information

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Abstract

Objectives: To explore physician's satisfaction with the Electronic Medical Records (EMR) system, to identify and explore the main limitations of the system and finally to submit recommendations to address these limitations~~-~~.

Design: A descriptive qualitative study that entailed three semi structured focus group interviews was performed amongst ~~the~~ physicians, using open-ended questions ~~was performed.~~ The interviews were audiotaped, documented and transcribed verbatim. ~~-~~The themes were explored and analyzed in different categories.

Setting: ~~In~~The study was conducted in primary health care centers (PHC) in Al Ain, United Arab Emirates (UAE).

Participants: A total of 23 physicians, all using the same EMR system, attended ~~either~~one of ~~the~~ three focus groups held in PHC in Al Ain Medical District~~,~~. Each focus group consisted of 7-9 physicians working in PHC as family medicine specialists, residents or general practitioners ~~using the same EMR system.~~

Primary outcome measure: Physicians satisfaction with EMR System.

Results: Key themes emerged and were categorized as physician dependent, patient related~~,~~ and system related factors. In general, physicians were satisfied with the EMR system ~~although some were~~ in spite of initially ~~facing some~~ difficulties with implementation. Most ~~of the~~ participants ~~identify~~identified that the long time required to do the documentation ~~as a factor that~~ affected their practice and patients communication. Many physicians ~~were pleased about~~ expressed satisfaction with the orders and results of laboratory and radiology function and they emphasized that this was the strongest point in EMR. They were also satisfied with the electronic prescription ~~because~~function stating that it reduced errors and saved time.

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Conclusion: Physicians are satisfied with EMR and have a positive perception regarding the application of the system. Several themes emerged during this study that need to be considered to enhance the EMR system. Further studies need to be conducted amongst other health care practitioners and patients to explore their attitude and perception about the EMR.

Strength and limitations of this study

- The EMR system (Cerner) ~~is currently being used~~was introduced in the Emirate of Abu-Dhabi ~~and~~ but only Al-Ain.
- ~~There is a lack of information and research studies regarding the evaluation of~~ clinics were selected for the ~~users'~~study and due to study design findings cannot be generalized.
- This being the first local study to address EMR user satisfaction, adds a new user perspective.
- This study focused ~~only~~ on ~~EMR users in~~ primary health care ~~settings and not in hospitals~~physician EMR users excluding hospital users and related health care professionals.
- Method of focus-group recruitment contributed to selection bias .

Introduction

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~~The Electronic medical record (EMR) is a new and promising tool for enhancing national and international health care delivery.[1] Recent research has shown that information technologies can reduce medication errors[2], improve adherence to clinical practice guidelines[3], and improve the delivery of preventive health services[4], thereby potentially improving health outcomes for patients.[5,6]~~

~~While electronic medical users can be productive, any disparities in experience, understanding, and skills can leave team members feeling less than satisfied and not working to their full potential.~~The Electronic medical record (EMR) is a new and promising tool for enhancing national and international health care delivery.[1] Recent research has shown that information technologies can reduce medication errors[2], improve adherence to clinical practice guidelines[3], and improve the delivery of preventive health services[4], thereby potentially improving health outcomes for patients.[5,6]

While electronic medical users can be productive, any disparities in experience, understanding, and skills can leave team members feeling less than satisfied and not working to their full potential.[1] Clinicians' perception of EMR is a crucial determinant of successful use of the EMR system. United Arab Emirate, Health Authority of Abu-Dhabi (HAAD) has implemented a system developed by one of the top three Healthcare IT vendors in the US.[6][6] They ~~are~~have been in existence since 1979 and have installations in many countries including USA, Canada, Australia, Saudi Arabia, Qatar, UAE, France, Spain, Singapore, Malaysia, and South America.

UAE has implemented the EMR system (Cerner) in 2008 in Abu-Dhabi and Al-Ain. ~~Ever since, there lacks information~~Information and research studies ~~in this area specifically the evaluation of the users'~~related to user satisfaction~~.~~ is lacking in the local context.

This research study focused on physician User's Satisfaction with Electronic Medical Records System in Primary Health Care Centers in Al-Ain~~. The~~ and was the first known survey done in the UAE exploring this research question.

The findings are reported in two separate papers qualitative and quantitative ~~papers.~~[7] respectively. We conducted a concurrent qualitative study in the same practices selected for the quantitative project. ~~The aim of the qualitative part was to explore the attitudes of the participants regarding the EMR through the interpretation of their filled questionnaires.~~

The use of focus group interviews is becoming increasingly popular in health care research to explore beliefs, feelings, attitudes and behavior of individuals. Focus group discussions provide information about a range of ideas and feelings of individuals about specific issues and it illuminates the differences in perspective

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between groups of individuals. A focus group can generate large amount of data in a relatively short time span.[7,8]

In this study the researchers explored users' knowledge, attitude and satisfaction with the electronic medical records system in primary health care centers in Al-Ain.

Method

Study design: This descriptive qualitative study was conducted in parallel with a quantitative study. ~~The quantitative study was~~ reported separately ~~as unpublished data in~~ in a paper presented at the 2nd Al Ain Family Medicine Research Day; 2012 March 3; Al Ain, UAE.[7]

. Study method: A Purposive sampling strategy was used to recruit the physicians.[8,9] The study was conducted in English ~~language~~. Permission was obtained from the clinic supervisors of each hospital prior to the study. Invitation letters were distributed among the physicians in clinics where the quantitative study on the EMR system was conducted. ~~We had requested the~~ The management personnel were requested to select ~~for us workers~~the participants for our study. These workers were selected based on their willingness to share their experiences on EMR with us. Those who were to participate in the qualitative study were contacted by telephone 1–2 days before the focus group meeting. The physicians were not compensated for their time since most of them (physicians) ~~was~~were released during their shift hours. The authors ~~participated in conducting~~contributed to different aspects of the research ~~in different ways.~~study.. The third author, a family medicine resident, reviewed literature related to qualitative research, received additional training related to qualitative research methods, developed the moderators guide[8][9] and moderated the focus groups. The three other researchers were respectively responsible for audio taping and documenting verbal and non-verbal responses. Participants signed a consent form before the focus group session. All focus group interviews were conducted in the

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same primary health care center ~~in Al Ain Medical District.~~. To maximize ease of participation, the interviews were held after office hours ~~at~~during lunchtime. We deliberately exempted the managerial representation ~~in~~from our focus groups. The main reason ~~for this is~~was that we ~~felt~~were of the opinion that their presence would ~~make their juniors~~cause junior colleague to feel uncomfortable ~~in~~preventing them from sharing their personal experiences and perceptions on their use of EMR in ~~their healthcare.~~the work-place..

The moderator introduced herself at the beginning of the focus groups, explaining the purpose of the study and assuring confidentiality of the information shared.[~~8~~][9] The facilitator encouraged participation of all members in the discussions using open-ended questions focusing on: (1) initial impression about Electronic Medical Records System, (2) advantages and disadvantages of EMR, (3) patients' reaction to introduction of EMR and (4) suggestions to improve the EMR. Interview questions were reviewed as the study progressed to seek further clarifications.[9] ~~(See the online supplementary appendix A) for detailed focus Group Questions.~~[10] (See the online supplementary appendix A) for detailed focus Group Questions.

Semi structured group interviews were conducted on three consecutive days. Each focus group lasted ~~for one~~an hour. Theme saturation was approximately achieved during the second focus group and a third focus group was conducted to confirm the saturation.

Data analysis

The interviews were audiotaped and transcribed verbatim. As the interviews progressed, data was analyzed after each focus group to develop preliminary codes to identify important and new ideas emerging. Each transcript was independently

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reviewed and coded separately by all the researchers to establish main concepts.[~~1~~1] Subsequently, each transcript was analyzed by each investigator independently to explore the themes and subthemes and then reviewed by the other investigators to compare and group the similar data. Further relations and triangulations[~~10~~11] were analyzed during regular meetings. The next stage involved identifying the theme frame using the "Krueger" framework.[~~11~~12] Trustworthiness of the data was enhanced ~~by using Guba's four criteria.[12] **for more details** (See the online supplementary appendix B)~~

by using Guba's four criteria [13] [14] for more details (See the online supplementary appendix B)

Findings

A total of 23 physicians attended either of the three focus groups ~~held in PHC in Al Ain Medical District.~~. The overall focus group attendance was 70–80%. The main reason given for non-participation was lack of sufficient time ~~for this study.~~. Each focus group consisted of seven to nine physicians working in the primary health care centers as family medicine specialists, residents or general practitioners using the same EMR system ~~from~~since 2008~~, (Table 1) shows the~~. The characteristics of the focus group participants ~~–~~ are reported in Table 1.

Table 1: Characteristics of physicians

Demographic data	FG1* (n=7)	FG2* (n=9)	FG3* (n=7)
Gender			
Male (female)	**3(4)**	**4(5)**	**2(5)**

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Each focus group consisted of a mix of males and females of different age groups and professional experience.

Professional experience			
Seniors	**5**	**6**	**4**
Juniors (residents)	**2**	**3**	**3**
Nationality			
UAE	**2**	**3**	**3**
Non-UAE	**5**	**6**	**4**

FG: focus group, n= total number

Several themes emerged from the focus groups about the implementation of EMR (Table 2). The main themes were categorized as physician issues, patient issues and system (Cerner) issues. These categories of main themes were arrived at~~, at~~ through consensus~~,~~ during analysis of focus-group transcribes after the ~~interview because whenever the physicians talked, they could refer~~interviews. Participants repeatedly referred to or mentioned these themes~~,~~ during their discussions.

Physician dependent factors

The initial impression of physicians:

In general physicians spoke favorably about EMR system implementation e.g. *"I think that, I do believe that my first impression was so amazing"* FG1 but all remarked that the beginning was difficult e.g. *" At the beginning, as anything when you use it for the first time, it will look complex until you get familiar to the system"* FG3.

Computer skills: They believed that the computer skills had a major role in understanding EMR as they mentioned that old generation physicians were slower in typing and learning new tricks. There is a difference in competency among physicians in dealing with technology e.g. *"Old generation doctors, whom I respect a lot of course, let's say there is a urine culture results, they don't know that there is a click where you can get the susceptibility"FG1 Another e.g. "if you don't know like Alt and C is copying and Alt and V is pasting, (it takes) for a lot of people it causes a lot of difficulties"FG2*

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"for me for example if I want to explain something for the patient in anatomy, instead of drawing I will just enter the Google and the patient will be very happy: ohm, this is how it look, this is how the anatomy. And when you want to illustrate the disease process through pictures the patient will be very happy" It was also useful to provide the patient with very useful educational materials.

The training: Physicians appeared to have various opinions about the training period. Some were completely satisfied e.g. *"It was sufficient, the training was good, of course the training itself to how to deal with computer at the beginning start in a good way"* FG3, while others were not satisfied and expressed that they were not aware of some facilities available in the EMR system e.g. *"How to order everything at the start was very clear and comprehensive in the training part but when we start on the note part the training was not sufficient, in my opinion"* FG3. Some physicians suggested having individualized training sessions according to the physician needs. *"I think they should work on teaching session, according to level of each, e.g. dividing them in groups and take them step by step even if it take 10 sessions or more"* FG2.

Participants specified that IT team and super users were always available during the early time of implementation. They also suggested having regular meetings with the IT team to reevaluate the physicians, answer their queries and have an updated training sessions for each system upgrade e.g. *"they make a training they have to meet the users again to evaluate them. For example, I am using the Cerner and I collect questions there should be someone professional to answer me" FG3*

"*They should give us updating; now what I learn 2 years ago I am developing myself. This should be like regular because this will answer a lot of questions for me for the system"* FG1

Patient related outcomes

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Patient-physician relationship: Physicians' perceptions about patient reaction were mixed. Initially they were unhappy because of disturbed patient doctors relationship e.g. *"It was bad but now it is improving a lot"* FG1 and *"The real thing is eye contact is missing"* FG2. Furthermore the waiting time increased due to data entry causing more frustration to the patients e.g. *"The patient upset because of waiting time"* FG3.

Physicians believed that the waiting time was not caused by them but was mainly in the registration and nursing assessment e.g. *"I found that nursing assessment they have to do a lot of things"* FG2. On the other hand they believed the benefits outweighed the waiting time issue and included beneficial issues as improved patient care, patient education and the health maintenance schedule. They stated that patient flow was initially reduced but eventually returned to the same as prior to implementation of the EMR e.g. *"the same, the same,"* FG2.

Many physicians were concerned about their patients' perception about the new technology. They felt that many patients were unhappy but indicated that few patients approved and made positive remarks to their physicians.

Physician tried to adapt some strategies to maintain the relation with their patient. Some were talking to the patients while dealing with computer so patients would not feel neglected *e.g. "ok now I am checking your results, I am checking your past file"* FG1.

Others reserved data entry to immediately after the visit e.g. *"we can put the diagnosis, then put the medication, because we can't put medication without diagnosis then put the labs then ask the patient to go and continue documentation"* FG2.

"…the proper thing is to take full history from the patient, maintaining the good communication with the patient then turn and document" FG3.

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All physicians believed that the presence of the EMR had strong effects on the flow of the patients initially~~. But,~~ but later returned to the prior situation.

Some of ~~the~~ physicians used the EHR as a means for collaboration to share the screen with their patients. They showed them some pictures to illustrate and explain concerns.

System dependent factors

A summary of advantages and barriers highlighted by physicians using the EMR is discussed in the text below:

The quality of documentation: Physicians believed that EMR improved the quality and clarity of the documentation e.g. *"it is very helpful, very readable, better than the handwriting"* another e.g. *"previously they were usually write their own abbreviations "**LE**~~,~~", "**RE**" not sure what they mean is it LEFT EYE or the disease itself but now because of the system coding they tend to write"* FG2. However some physicians described the system as complex and less informative e.g. *"if the doctor is free texting he will say the real thing and when you read it you will know what is the meaning exactly (overlapping talk) but if you tick tick, tick sometime you lose"* FG3.

Participants in all focus groups agreed that the current EMR was designed mainly for the hospitals and not for the primary care centers e.g. *"The system was not designed for primary care (all agree) it is designed for hospitals this is the main issue for us"* FG3. Physicians had difficulties finding a diagnosis for some of the common conditions like skin laceration or skin abrasion seen in daily practices.

System complexity and interconnectivity: A common theme was the complexity of the system. Participants explained that they had difficulty at the beginning of

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implementation of the system to find the proper coding for the diagnosis. They also complained that sometimes they had to duplicate and repeat notes in several locations because there was no link, for example between the notification system and the patient notes e.g. *"Notification system, there must be a connection between Health Authority Abu Dhabi and cerner (EMR) another thing some cases...if anyone experience how to notify a case of syphilis he will hate himself (laughing). Four pages you must fulfill four (4) pages"* FG3.

Participants were very satisfied with the pre-completed notes in the system. They mentioned, it helped them in saving time and was very useful in the specialty clinics. e.g. *"Definitely, it saves a lot of time"*FG1 another e.g. "*Helpful, especially in the clinics, the specialized clinics like the well-baby clinic, in antenatal clinic, in chronic clinic*" FG1. They also ~~highlighted~~emphasized that in the long run the review of accumulated documentation will be challenging by asserting that visual scanning is impossible without highlights e.g. "*Accumulation over the year will be a problem because you cannot go through all the note to find something"*FG1.

Ordering and viewing: Many participants in the three focus groups were very pleased and satisfied with the orders and results of laboratory and radiology function. They mentioned that it is the strongest part in the EMR and the results are available on the same day e.g. *"The stronger point on cerner (EMR) is lab's and x-rays*" FG3. Participants found that online orders from the Cerner tick list was ~~are~~ easier than the written ones. e.g. *"If you are comparing writing an order with ticking order, ticking order is easier."* FG3.

EMR viewing capability was considered to be useful information for patient management and it helped with continuity of care and following progression of many

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chronic diseases e.g. *"For example, if you have a patient with renal failure you can see the results (creatinine) for one year which is very useful"FG2.*

Participants believed that x-ray orders are very helpful because the radiologist has access to the history of the patient e.g. *"It was really miserable because there is no history for the doctor to read from x-ray. When I sit with the doctor the radiologist, I feel what he is feeling because there is nothing just X-ray. Okay for what? What are you thinking? What are your differential, it is nothing."* FG3.

Regarding the electronic prescription, participants were very excited since it helps in reducing the errors. *"It is easy and safe also"* FG1. They indicated that the prescription refill system saved time. Participants stated that they liked the drug reference text that appeared with each medication order.

Participants ~~were suggesting to uniform the units that are used~~suggested agreeing on uniformity in the ~~system to~~use of metric units deciding on either reporting in milligram (mg) or millimol (mmol~~.~~). Several participants agreed that the EMR referral is much easier and patients could be traced and followed up through the system. Feedback about patient referral and management was a major improvement according to participants. ~~This was difficult with the~~The previous paper system ~~before.~~did not support continuity of care or feedback. . e.g. "*Before we don't know any feedback about the patient but now I refer one patient suspecting bronchiolitis or something after one hour I can open the cerner(EMR) and I can see what they did for him*" FG1.

~~Some~~According to some participants ~~said that~~ the referral and feedback system ~~is good for the~~enhances continuity of care of the patients; it ~~enables~~provides them ~~to have~~with a a complete picture of ~~the progression of patient condition and what sort of further~~post referral management ~~he received after referral.~~and progress. e.g. "*I think*

referred for us as Family medicine for continuity of case is better" FG2. Regarding the disadvantages of EMR, participants were complaining that the system was time consuming and required too much detailed documentation. e.g. *"Previously documentation was not such detail when using file. But whatever time we spent, we spent with patient, we were asking his history, examining, and writing a prescription giving him cause and the rest come but now, suppose URTI case come one or two minutes is taken to diagnose the case once the diagnosis is finished then I started with my computer so this computer is taking time and patient finished and he is just waiting and waiting till I finished so he gets upset."* FG1.

An important ~~point~~issue that was raised in the first focus group, ~~which was~~and subsequently added to the discussion questions, was ~~the~~that of confidentiality ~~issue.~~.. All participants agreed that there was no confidentiality with the EMR system e.g." *One of the main issues with the Cerner (EMR) is the confidentiality"* FG1.

Suggestions

One of the emerging themes from the discussions was suggestions to improve the EMR system. Participants suggested to allow more time for the physicians and to improve the email system. They also proposed including some diagnosis in the EMR that are commonly used in the primary care setting. e.g. *"Common medical problem should be included in the diagnosis and encounter pathway should include more general complaints"* FG1.

In the second focus ~~groups~~group, participants suggested that the electronic document design should be simplified for use by doctors and patients in primary care.

"Electronic documentation it is so much better. No one differ about that but it must be simplified for the patient and for the physician" FG2.

Participants also suggested ~~for ease of use the~~ that allergies, problem list and diagnosis should be included in the main page~~.~~ to simplify the system. Physicians wanted to have a free text to add diagnosis and not be restricted to the available EMR list e.g. "*We can't find ICD$_9$ since one or two months it can enter as free text, now it can't I should change it. It should be applicable for change it. He was osteopenic and now osteoporosis. So I can change it I can click this and write other*" FG3.

Participants ~~asked~~requested to have a link between HAAD records and the EMR system for ~~the~~ sick leave notes and ~~notifications.~~notification of disease. e.g. *"Sick leave and notification. There must be a link between Cerner (EMR) and HAAD at HAAD website. For sick leave it is very important as we write free text and patient coming to me and take it after 3 days go to another clinic and take another sick leave like this*" FG2.

Discussion:

This is the first published paper in the UAE to evaluate the EMR users' satisfaction since the implementation. The aim of this study was to understand the attitude and knowledge of physicians about the EMR. Another goal was to identify the disadvantages and suggestions to improve the system.

The ~~elicited~~ physicians' perceptions about the EMR summarized in the preceding text suggested several ideas to improve the system. Physicians in all focus ~~group~~groups were satisfied with the EMR system although some physicians were facing some difficulties at the beginning of implementation. Most of the participants ~~identify~~identified the long time required to do the documentation in the system as a factor that ~~affect~~affects their practice and communication with the patients. The same results were found in a study done in Hawaii. Participants reported that CIS had

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reduced clinicians' productivity, primarily because of extra work such as processing laboratory result reports, entering orders and navigating through the systems.[13 15]

Many physicians were pleased about the orders and results of laboratory and radiology as they emphasized that this is the strongest point in the EMR. They were also happy about the electronic prescription because it reduced the errors and saved time. In a survey conducted by Robert et. Alal (2011), carried a survey oninclouding 2,719 Family Physicians in America and had the respondents highlightinghighlighted advantages of the EMR which were almost similar to our respondents' findings.. Their respondents stated that they were pleased with the EMR system since it was fast, easy to use, well documented, more precise and provided patient engagement tools such as the patient education resources and patients' portal.[21 16] However, ACP (2008), carriedconducted a survey in which unearthedreporting that thephysician dissatisfaction of physicians onwith EMRs increased from 24 percent% in 2010 to 39 percent% in 2102. The reasons givenprovided by the respondents' respondents for their dissatisfaction regardingwith the EMRsEMR was that the system was expensive and was not significantly reducing their workload.[22 17]

They believedmentioned that the computer skills had a major role ineffect on understanding the EMR as they mentioned.. In the review of the literature review, computer literacy was identified as a major barrier forto the implementation of the EMR.

There is onewas a finding that only emerged in the second focus group only as a result ofdue to the presence of a physician who was previously exposed to the auditing process. The investigators gotresearchers were of the feelingimpression that physicians perceived itthe EMR as a significant issue in the auditing ofthreat when

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used to audit the physicians for documentation and patient confidentiality e.g. "*the medical record do regular audit and find out, for example, why the chart has been opened*".

Another e.g. "*part of annual appraisal of the physicians is the we have about eight competencies one of them is the documentation and we usually audit at least 10 to 20 task for each physician and all the important factors the presenting symptom, the history of present illness the past medical history… we do for audit and this is why the physician are keen to have a complete or as much as we can about full documentation*". Physicians had a negative perception that they ~~have been~~were monitored for their performance through the Cerner, which created some discomfort during the session. This finding was not commonly identified in our literature review except in one study where the respondent reported the feedback as personal criticism.[~~14~~15] It ~~may be~~is important to ensure that during the implementation of ~~the~~a new systems, like the Cerner, users should be informed about the purpose of the use of the system and also about the auditing tool and the purpose of use of audits to allay fears and negative perceptions.

The confidentiality issue was added to the moderators guide as a focus group questions after it emerged as theme in the first focus group. Participants mentioned the loss of confidentiality in the patient's files, because anybody who has access could open any file. A new insight developed after the first focus group, and the interview questions were adapted to explore this new knowledge.[~~16~~]. It was discussed until the point reached saturation similar to the situation in other studies.[~~15~~18,~~16~~19]

Physicians in our study reported that EMR documentation was ~~taking long~~ time, ~~as there were~~ consuming , due to many clicks that had to be performed, even for short

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documents and simple complaints. In the review of the published literature, physicians recognized the benefits of EMR for legibility, and readily linked this to better and safer patient care outcomes. The burden and time inefficiency of data entry are seen as major disadvantages, suggesting the importance of "smarter" and more intuitive data entry interfaces and perhaps voice recognition.[~~17~~20] This also emerged as subtheme in our study.

Participants continued to identify the important role of an EMR champion within their practice who encouraged EMR usage and was available to problem solve. Support and encouragement from a "champion" has been noted in the literature as crucial throughout the implementation process.[1,~~18~~21] In this study participants mentioned that follow-up by super users and the IT team would be beneficial.

Participants identified the messaging system within the EMR software as a practical, useful and important tool for enhancing efficiency within the team. Successful communication has been linked to increased patient safety and improved patient outcomes~~.~~[1] The physicians in all focus groups emphasized this point. They mentioned that internal communication in the clinic through the system had saved time and ~~improve the safety of the~~improved patient safety.

Major barriers to implementation and adoption included computer literacy, training, and time. There was also variability regarding the influence of prior computer knowledge on perceptions of EMR implementation. While these issues have been identified in prior studies, they remain an ongoing challenge for primary health care providers. Implementation and adoption of EMRs will be most successful when protected time is available ~~for training~~to train all EMR users.[~~15~~18] In this study similar concerns were raised.

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A recent review of studies on barriers to EMR implementation found that these could be broadly categorized as concerns about costs, technical issues (including lack of interconnectivity, high complexity, and lack of customizability), lack of time, psychological factors such as lack of belief in EMR, social factors such as lack of support from colleagues, and legal issues such as concerns over privacy and security.[18,19,22,23] Complexity, interconnectivity and time factors also emerged from the current study.

Limitations

The present study was limited in several ways. Firstly, the study included only physicians despite the importance of understanding nurses, pharmacists and other health care professionals' beliefs about using the EMR. Secondly the study was done only in Al-Ain district although HAAD has implemented the EMR system in Abu-Dhabi and Al-Ain. This study focused on EMR users in primary health care settings and did not include the EMR users in hospitals. The application of purposive sampling strategy in the recruitment of the physicians during this study is also a limitation. Since the respondents were self-selected, it might mean that this study had many EMR enthusiasts.

Conclusion

Clinicians have a positive perception regarding the application of EMR in the primary care outpatient practices. However, several themes emerged during this study that need to be considered to enhance the EMR system. Therefore, further studies need to be done by focusing on other medical users and patients in viewing their attitude and perception about the EMR system. Adapting the system to needs and diagnosis

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common to the PHC setting and offering continuous training and technical support would assist in convincing apprehensive EMR users.

Recommendations

A crucial subsequent step is selecting from the themes which emerged in the study, the themes that are most commonly mentioned or most important to physicians, and to formulate a hypothesis about the mechanisms by which these beliefs might shape acceptance and users' behavior. A ~~further~~, survey ~~measures~~ should be implemented on nurses, pharmacists, patients and others groups so as to understand their beliefs and attitudes about the EMR system. The findings which correspond with those of other studies or are detrimental to services and can be adjusted, should be communicated to authorities and IT vendors to seek solutions of improving and adjusting future applications to the benefit of all.

Footnotes

Acknowledgment

We thank the study participants for their kind cooperation and time. Thanks to all managers of clinics included in the study for their cooperation and support.

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Especial thanks to Mrs. Maria Cristina- Community Medicine Department & Dr. Latifa Al Ketbi- Department of Family Medicine

Contributors:

All authors contributed to the concept and design of the study. Dr.Durra: was the moderator of the focus group. Dr. Shamma was the principle investigator and the coordinator of the study, Dr. Shamma and Aysha contributed to the analysis,

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interpretation and preparation of the manuscripts with the input from all authors. Dr. Prinsloo, Durra and Mouza were involved in editing the article or revising it critically for important intellectual content, All Authors have read and approved the final manuscript.

Funding:

There was no funding for our study.

Research interests

Better health care quality providing, and patient safety with relation to health care information technology.

Competing interests

The authors declare that they have no competing interest.

Ethics Approval The proposal for this study was approved by IRB of Al Ain Medical District Human Research Ethics Committee, protocol No. SO11-3. Permission was taken from governing hospitals of each clinic before starting the study.

Data sharing statement: Our qualitative data are not to be shared, as we consent patients for data confidentiality when the study was undertaken. The Quantitative study is unpublished data ~~Available~~available from the corresponding ~~Author~~author, Appendix A and B are ~~Available~~available for Data Sharing, Further details of the study protocols can be requested from the corresponding author by emailing Durra Al Baloushi (d_albaloushi@hotmail.com).

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Table 2-: Summary of themes of all focus groups

	Themes & Subthemes	Quotes
Physicians dependent factors	**1.** The initial impression about EMR system • Difficulty in use at the beginning • Training was sufficient and good	*"Still we are in the fetal state"*.FG1 *"We had a team which was always available"FG3*
	2. Past computer skills • Different users' generations with different computer skills	*"Old generation doctors, whom I respect a lot of course, let's say there is a urine culture results, they don't know that there is a click where you can get the susceptibility". FG1*
	3. The impression about the precompleted notes • Precompleted notes definitely saves time	*"Definitely, it saves a lot of time"FG2*
Patient related	**4.** Doctor – patients relationship • No eye contact • Waiting time is more • Patients are accepting the system because it is reflecting an advance modern of technology	*"Initially the patient were not happy"FG1* *"No eye contact" FG1* *"It consumes more time" FG1* *"Patient will accept this new system because it is more advance and reflect that the clinic is more advance with modern technology but giving good care"FG1*
System dependent factors	**5.** Complexity of the system • EMR complexity was at the beginning • Complexity of the system, not specialized to PHC	*"If you get use to it, yes, it become very easy"FG1* *"The system was not designed for primary care"FG3*
	6. The quality of documentation • Documentation now is readable and better than handwriting • The quality of documentation is depends on the physician them self	*"Before we should open this charts. I can't read handwriting of the doctors, now everything is easy and everything is in front of my eyes only by clicking"FG2*
	7. The process of prescription in the cerner and the current problems • Prescription is better & safe now • Allergy system decreasing the medication errors	*"Definitely much better 100%"FG1* *"Before there were so many mistakes"FG2* *"If there is allergy, decrease the error because during hand writing there was medication errors"FG1*
	8. Improvement of the orders and results with EMR • The orders and the result much organized • Fast feedback of the results	*"The stronger point on cerner is lab's and xrays"FG3* *"Much organized"FG1* *"The results will come directly to your inbox"FG1*
	9. Referral issues with the cerner • Referral issue easy with feedback • Trace patient's appointment and print it for them	*"Before when was referring patients to the hospital we don't have any clue what happened to him"FG3* *"I can easily open the system and look for it and tell her this is your appointment"FG1*
	10. Confidentiality • No confidentiality with EMR	*"It is easy to break this confidentiality with the cerner. Any body can open the file"FG1*
	11. Disadvantages of EMR • Takes time • Important notes should be highlighted	*"Longer, even not only with doctor, from pharmacy side, from reception side"FG3* *"It is difficult to eye scan, it should be highlighted"FG1*
	12. Suggestions to improve EMR • Giving more time • Meetings and updating by Cerner people	*"Give us enough time" FG1* *"They should give us updating; now what I learn 2 yrs. ago I am developing myself"FG1*

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Appendix A – Focus Group Questions

1) **What is your initial impression about EMR (Electronic Medical Records System)** implementation ?
   - EMR training
   - Past computer skills
   - Complexity of the system

2) **Tell me about advantages and disadvantages of EMR ?**
   a. Advantages :
      - Quality of documentation
      - Prescription process
      - Orders and results
      - Referral issues

   b. Disadvantages :
      - Quality of documentation
      - Prescription process
      - Orders and results
      - Referral issues

3) **What have been the patients reaction to introduction of EMR ?**

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- Patient doctor relationship
- Time (waiting time)
- Patient flow in the clinic

4) What can be done to make EMR better ?

- your suggestions

5) Is there is something else you would like to add ?

Appendix B -The Guba's four criteria.

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a) Credibility: To ensure credibility of an accurate recording of the participant responses, focus groups were audiotaped, transcribed verbatim and subjected to independent reviews and the use of more than one analyst improved the consistency or reliability of analyses.

b) Transferability (generalizability): The purposeful sampling method was broad to include maximum variation in perspectives and views.

c) Dependability (reliability): Reflective appraisal of the data, evaluating the effectiveness of the process of inquiry undertaken was ensured.

d) Conformability was achieved through independent reviews and consensus of the coding scheme by the research team.

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4) **What can be done to make EMR better ?**
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5) **Is there is something else you would like to add ?**

Appendix A-The Guba's four criteria. [12]

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Physicians User's Satisfaction with Electronic Medical Records System in Primary Health Care Centers in Al-Ain: a qualitative study

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Primary Subject Heading:	Qualitative research
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Keywords:	Health informatics < BIOTECHNOLOGY & BIOINFORMATICS, EMR, Electronic health records, physician satisfaction, computerized health information

Physicians User's Satisfaction with Electronic Medical Records System in Primary Health Care Centers in Al-Ain: a qualitative study

Shamma Al Alawi[1], Aysha Al Dhaheri[1], Durra Al Baloushi[1], Mouza Al Dhaheri[2], Engela A. M. Prinsloo[3]

[1]Ambulatory Health Care Services, SEHA, Al Ain, Abu Dhabi, United Arab Emirates.
[2]Homecare Department, Tawam Hospital in Affiliation with Johns Hopkins Medicine, Al Ain; United Arab Emirates.
[3]Department of Family Medicine , College of Medicine and Health Sciences UAE University, United Arab Emirates.

Correspondence to:
Durra Al Baloushi,
Ambulatory Health Care Services, SEHA, Al Ain, Abu Dhabi, United Arab Emirates.
P.O. Box 15676
Al Ain, United Arab Emirates
E-mail: d_albaloushi@hotmail.com

Keywords: Electronic medical records, Electronic health records, physician satisfaction, EMR functionalities, computerized health information

Word count: 6582

Abstract

Objectives: To explore physician's satisfaction with the Electronic Medical Records (EMR) system, to identify and explore the main limitations of the system and finally to submit recommendations to address these limitations.

Design: A descriptive qualitative study that entailed three focus group interviews was performed amongst physicians, using open-ended questions. The interviews were audiotaped, documented and transcribed verbatim. The themes were explored and analyzed in different categories.

Setting: The study was conducted in primary health care centers (PHC) in Al Ain, United Arab Emirates (UAE).

Participants: A total of 23 physicians, all using the same EMR system, attended one of three focus groups held in PHC in Al Ain Medical District. Each focus group consisted of 7-9 physicians working in PHC as family medicine specialists, residents or general practitioners.

Primary outcome measure: Physicians satisfaction with EMR System.

Results: Key themes emerged and were categorized as physician dependent, patient related and system related factors. In general, physicians were satisfied with the EMR system in spite of initially difficulties with implementation. Most participants identified that the long time required to do the documentation affected their practice and patients communication. Many physicians expressed satisfaction with the orders and results of laboratory and radiology function and they emphasized that this was the strongest point in EMR. They were also satisfied with the electronic prescription function stating that it reduced errors and saved time.

Conclusion: Physicians are satisfied with EMR and have a positive perception regarding the application of the system. Several themes emerged during this study that need to be considered to enhance the EMR system. Further studies need to be conducted amongst other health care practitioners and patients to explore their attitude and perception about the EMR.

Strength and limitations of this study

- The EMR system (Cerner) was introduced in the Emirate of Abu-Dhabi but only Al-Ain clinics were selected for the study and due to study design findings cannot be generalized.
- This being the first local study to address EMR user satisfaction adds a new user perspective.
- This study focused on primary health care physician EMR users excluding hospital users and related health care professionals.
- Method of focus-group recruitment contributed to selection bias.

Introduction

The Electronic medical record (EMR) is a new and promising tool for enhancing national and international health care delivery.[1] Recent research has shown that information technologies can reduce medication errors[2], improve adherence to clinical practice guidelines[3], and improve the delivery of preventive health services[4], thereby potentially improving health outcomes for patients. [5,6] While electronic medical users can be productive, any disparities in experience, under-standing, and skills can leave team members feeling less than satisfied and not working to their full potential.[1] Clinicians' perception of EMR is a crucial determinant of successful use of the EMR system. United Arab Emirate, Health Authority of Abu-Dhabi (HAAD) has implemented a system developed by one of the top three Healthcare IT vendors in the US.[6] They have been in existence since 1979 and have installations in many countries including USA, Canada, Australia, Saudi Arabia, Qatar, UAE, France, Spain, Singapore, Malaysia, and South America.

UAE has implemented the EMR system (Cerner) in 2008 in Abu-Dhabi and Al-Ain. Information and research studies related to user satisfaction is lacking in the local context.

This research study focused on physician User's Satisfaction with Electronic Medical Records System in Primary Health Care Centers in Al-Ain and was the first known survey done in the UAE exploring this research question.

The findings are reported in two separate papers qualitative and quantitative respectively. We conducted a concurrent qualitative study in the same practices selected for the quantitative project.

The use of focus group interviews is becoming increasingly popular in health care research to explore beliefs, feelings, attitudes and behavior of individuals. Focus group discussions provide information about a range of ideas and feelings of individuals about specific issues and it illuminates the differences in perspective between groups of individuals. A focus group can generate large amount of data in a relatively short time span.[7]

In this study the researchers explored users' knowledge, attitude and satisfaction with the electronic medical records system in primary health care centers in Al-Ain.

Method

Study design: This descriptive qualitative study was conducted in parallel with a quantitative study reported separately in a paper presented at the 2nd Al Ain Family Medicine Research Day; 2012 March 3; Al Ain, UAE.

Study method: A Purposive sampling strategy was used to recruit the physicians. [8] The study was conducted in English. Permission was obtained from the clinic supervisors of each hospital prior to the study. Invitation letters were distributed among the physicians in clinics where the quantitative study on the EMR system was

conducted. The management personnel were requested to select the participants for our study. These workers were selected based on their willingness to share their experiences on EMR with us. Those who were to participate in the qualitative study were contacted by telephone 1–2 days before the focus group meeting. The physicians were not compensated for their time since most of them (physicians) were released during their shift hours. The authors contributed to different aspects of the research study. The third author, a family medicine resident, reviewed literature related to qualitative research, received additional training related to qualitative research methods, developed the moderators guide[8] and moderated the focus groups. The three other researchers were respectively responsible for audio taping and documenting verbal and non-verbal responses. Participants signed a consent form before the focus group session. All focus group interviews were conducted in the same primary health care center. To maximize ease of participation, the interviews were held after office hours during lunchtime. We deliberately exempted the managerial representation from our focus groups. The main reason was that we were of the opinion that their presence would cause junior colleague to feel uncomfortable preventing them from sharing their personal experiences and perceptions on their use of EMR in the work-place.

The moderator introduced herself at the beginning of the focus groups, explaining the purpose of the study and assuring confidentiality of the information shared.[8] The facilitator encouraged participation of all members in the discussions using open-ended questions and prompts focusing on: (1) initial impression about Electronic Medical Records System, (2) advantages and disadvantages of EMR, (3) patients' reaction to introduction of EMR and (4) suggestions to improve the EMR. Interview

questions were reviewed as the study progressed to seek further clarifications.[9] (See the online supplementary appendix A) for detailed focus Group Questions.

Focus group interviews were conducted on three consecutive days. Each focus group lasted an hour. Theme saturation was approximately achieved during the second focus group and a third focus group was conducted to confirm the saturation.

Data analysis

The interviews were audiotaped and transcribed verbatim. As the interviews progressed, data was analyzed after each focus group to develop preliminary codes to identify important and new ideas emerging. Each transcript was independently reviewed and coded separately by all the researchers to establish main concepts.[1] Subsequently, each transcript was analyzed by each investigator independently to explore the themes and subthemes and then reviewed by the other investigators to compare and group the similar data. Further relations and triangulations[10] were analyzed during regular meetings. The next stage involved identifying the theme frame using the "Krueger" framework.[11] Trustworthiness of the data was enhanced by using Guba's four criteria [12] [13]for more details (See the online supplementary appendix B)

Findings

A total of 23 physicians attended either of the three focus groups. The overall focus group attendance was 70–80%. The main reason given for non-participation was lack of sufficient time. Each focus group consisted of seven to nine physicians working in the primary health care centers as family medicine specialists, residents or general practitioners using the same EMR system since 2008. The characteristics of the focus group participants are reported in Table 1.

Each focus group consisted of a mix of males and females of different age groups and professional experience.

Table 1: Characteristics of physicians

Demographic data	FG1* (n=7)	FG2* (n=9)	FG3* (n=7)
Gender			
Male (female)	**3(4)**	**4(5)**	**2(5)**
Professional experience			
Seniors	**5**	**6**	**4**
Juniors (residents)	**2**	**3**	**3**
Nationality			
UAE	**2**	**3**	**3**
Non-UAE	**5**	**6**	**4**

FG: focus group, n= total number

Several themes emerged from the focus groups about the implementation of EMR (Table 2). The main themes were categorized as physician issues, patient issues and system (Cerner) issues. These categories of main themes were arrived at through consensus during analysis of focus group transcribes after the interviews. Participants repeatedly referred to or mentioned these themes during their discussions.

Physician dependent factors

The initial impression of physicians:

In general physicians spoke favorably about EMR system implementation e.g. *"I think that, I do believe that my first impression was so amazing"* FG1 but all remarked that the beginning was difficult e.g. *" At the beginning, as anything when you use it for the first time, it will look complex until you get familiar to the system"* FG3.

Computer skills: They believed that the computer skills had a major role in understanding EMR as they mentioned that old generation physicians were slower in typing and learning new tricks. There is a difference in competency among physicians in dealing with technology e.g. *"Old generation doctors, whom I respect a lot of course, let's say there is a urine culture results, they don't know that there is a click where you can get the susceptibility"FG1 Another e.g. "if you don't know like Alt and*

C is copying and Alt and V is pasting, (it takes) for a lot of people it causes a lot of difficulties"FG2

''For me for example if I want to explain something for the patient in anatomy, instead of drawing I will just enter the Google and the patient will be very happy: ohm, this is how it look, this is how the anatomy. And when you want to illustrate the disease process through pictures the patient will be very happy" It was also useful to provide the patient with very useful educational materials.

The training: Physicians appeared to have various opinions about the training period. Some were completely satisfied e.g. *"It was sufficient, the training was good, of course the training itself to how to deal with computer at the beginning start in a good way"* FG3, while others were not satisfied and expressed that they were not aware of some facilities available in the EMR system e.g. *"How to order everything at the start was very clear and comprehensive in the training part but when we start on the note part the training was not sufficient, in my opinion*" FG3. Some physicians suggested having individualized training sessions according to the physician needs. *"I think they should work on teaching session, according to level of each, e.g. dividing them in groups and take them step by step even if it take 10 sessions or more"* FG2.

Participants specified that IT team and super users were always available during the early time of implementation. They also suggested having regular meetings with the IT team to re-evaluate the physicians, answer their queries and have an updated training sessions for each system upgrade e.g. *"they make a training they have to meet the users again to evaluate them. For example, I am using the Cerner and I collect questions there should be someone professional to answer me" FG3*

"*They should give us updating; now what I learn 2 years ago I am developing myself. This should be like regular because this will answer a lot of questions for me for the system"* FG1

Patient related outcomes

Patient-physician relationship: Physicians' perceptions about patient reaction were mixed. Initially they were unhappy because of disturbed patient doctors relationship e.g. *"It was bad but now it is improving a lot"* FG1 and *"The real thing is eye contact is missing"* FG2. Furthermore the waiting time increased due to data entry causing more frustration to the patients e.g. *"The patient upset because of waiting time"* FG3.

Physicians believed that the waiting time was not caused by them but was mainly in the registration and nursing assessment e.g. *"I found that nursing assessment they have to do a lot of things"* FG2. On the other hand they believed the benefits outweighed the waiting time issue and included beneficial issues as improved patient care, patient education and the health maintenance schedule. They stated that patient flow was initially reduced but eventually returned to the same as prior to implementation of the EMR e.g. *"the same, the same"*FG2.

Many physicians were concerned about their patients' perception about the new technology. They felt that many patients were unhappy but indicated that few patients approved and made positive remarks to their physicians.

Physician tried to adapt some strategies to maintain the relation with their patient. Some were talking to the patients while dealing with computer so patients would not feel neglected *e.g. "ok now I am checking your results, I am checking your past file"* FG1.

Others reserved data entry to immediately after the visit e.g. *"we can put the diagnosis, then put the medication, because we can't put medication without diagnosis then put the labs then ask the patient to go and continue documentation"* FG2.

"…The proper thing is to take full history from the patient, maintaining the good communication with the patient then turn and document'' FG3.

All physicians believed that the presence of the EMR had strong effects on the flow of the patients initially, but later returned to the prior situation.

Some of the physicians used the EHR as a means for collaboration to share the screen with their patients. They showed them some pictures to illustrate and explain concerns.

System dependent factors

A summary of advantages and barriers highlighted by physicians using the EMR is discussed in the text below:

The quality of documentation: Physicians believed that EMR improved the quality and clarity of the documentation e.g. *"it is very helpful, very readable, better than the handwriting"* another e.g. *"previously they were usually write their own abbreviations*

*"**LE", "RE"** not sure what they mean is it LEFT EYE or the disease itself but now because of the system coding they tend to write"* FG2. However some physicians described the system as complex and less informative e.g. *"if the doctor is free texting he will say the real thing and when you read it you will know what is the meaning exactly (overlapping talk) but if you tick tick, tick sometime you lose"* FG3.

Participants in all focus groups agreed that the current EMR was designed mainly for the hospitals and not for the primary care centers e.g. *"The system was not designed for primary care (all agree) it is designed for hospitals this is the main issue for us*" FG3. Physicians had difficulties finding a diagnosis for some of the common conditions like skin laceration or skin abrasion seen in daily practices.

System complexity and interconnectivity: A common theme was the complexity of the system. Participants explained that they had difficulty at the beginning of implementation of the system to find the proper coding for the diagnosis. They also complained that sometimes they had to duplicate and repeat notes in several locations because there was no link, for example between the notification system and the patient notes e.g. *"Notification system, there must be a connection between Health Authority Abu Dhabi and cerner (EMR) another thing some cases...if anyone experience how to notify a case of syphilis he will hate himself (laughing). Four pages you must fulfill four (4) pages"* FG3.

Participants were very satisfied with the pre-completed notes in the system. They mentioned, it helped them in saving time and was very useful in the specialty clinics. e.g. *"Definitely, it saves a lot of time"* FG1 another e.g. "*Helpful, especially in the clinics, the specialized clinics like the well-baby clinic, in antenatal clinic, in chronic clinic*" FG1. They also emphasized that in the long run the review of accumulated

documentation will be challenging by asserting that visual scanning is impossible without highlights e.g. "*Accumulation over the year will be a problem because you cannot go through all the note to find something"* FG1.

Ordering and viewing: Many participants in the three focus groups were very pleased and satisfied with the orders and results of laboratory and radiology function. They mentioned that it is the strongest part in the EMR and the results are available on the same day e.g. *"The stronger point on cerner (EMR) is lab's and x-rays*" FG3. Participants found that online orders from the Cerner tick list was easier than the written ones. e.g. *"If you are comparing writing an order with ticking order, ticking order is easier"* FG3.

EMR viewing capability was considered to be useful information for patient management and it helped with continuity of care and following progression of many chronic diseases e.g. *"For example, if you have a patient with renal failure you can see the results (creatinine) for one year which is very useful" FG2.*

Participants believed that x-ray orders are very helpful because the radiologist has access to the history of the patient e.g. *"It was really miserable because there is no history for the doctor to read from x-ray. When I sit with the doctor the radiologist, I feel what he is feeling because there is nothing just X-ray. Okay for what? What are you thinking? What are your differential, it is nothing"* FG3.

Regarding the electronic prescription, participants were very excited since it helps in reducing the errors. *"It is easy and safe also"* FG1. They indicated that the prescription refill system saved time. Participants stated that they liked the drug reference text that appeared with each medication order.

Participants suggested agreeing on uniformity in the use of metric units deciding on either reporting in milligram (mg) or millimol (mmol). Several participants agreed that the EMR referral is much easier and patients could be traced and followed up through the system. Feedback about patient referral and management was a major improvement according to participants. The previous paper system did not support continuity of care or feedback. e.g. "*Before we don't know any feedback about the patient but now I refer one patient suspecting bronchiolitis or something after one hour I can open the cerner(EMR) and I can see what they did for him*" FG1.

According to some participants the referral and feedback system enhances continuity of care of the patients; it provides them with a complete picture of post referral management and progress. e.g. "*I think referred for us as Family medicine for continuity of case is better*" FG2. Regarding the disadvantages of EMR, participants were complaining that the system was time consuming and required too much detailed documentation. e.g. *"Previously documentation was not such detail when using file. But whatever time we spent, we spent with patient, we were asking his history, examining, and writing a prescription giving him cause and the rest come but now, suppose URTI case come one or two minutes is taken to diagnose the case once the diagnosis is finished then I started with my computer so this computer is taking time and patient finished and he is just waiting and waiting till I finished so he gets upset"* FG1.

An important issue that was raised in the first focus group, and subsequently added to the discussion questions, was that of confidentiality. All participants agreed that there was no confidentiality with the EMR system. e.g.*" One of the main issues with the Cerner (EMR) is the confidentiality"* FG1.

Suggestions

One of the emerging themes from the discussions was suggestion to improve the EMR system. Participants suggested to allow more time for the physicians and to improve the email system. They also proposed including some diagnosis in the EMR that are commonly used in the primary care setting. e.g. *"Common medical problem should be included in the diagnosis and encounter pathway should include more general complaints"* FG1.

In the second focus group, participants suggested that the electronic document design should be simplified for use by doctors and patients in primary care.

"Electronic documentation it is so much better. No one differ about that but it must be simplified for the patient and for the physician" FG2.

Participants also suggested that allergies, problem list and diagnosis should be included in the main page to simplify the system. Physicians wanted to have a free text to add diagnosis and not be restricted to the available EMR list. e.g. "*We can't find ICD$_9$ since one or two months it can enter as free text, now it can't I should change it. It should be applicable for change it. He was osteopenic and now osteoporosis. So I can change it I can click this and write other*" FG3.

Participants requested to have a link between HAAD records and the EMR system for sick leave notes and notification of disease. e.g. *"Sick leave and notification. There must be a link between Cerner (EMR) and HAAD at HAAD website. For sick leave it is very important as we write free text and patient coming to me and take it after 3 days go to another clinic and take another sick leave like this*" FG2.

Discussion

This is the first published paper in the UAE to evaluate the EMR users' satisfaction since the implementation. The aim of this study was to understand the attitude and knowledge of physicians about the EMR. Another goal was to identify the disadvantages and suggestions to improve the system.

The physicians' perceptions about the EMR summarized in the preceding text suggested several ideas to improve the system. Physicians in all focus groups were satisfied with the EMR system although some physicians were facing some difficulties at the beginning of implementation. Most of the participants identified the long time required to do the documentation in the system as a factor that affects their practice and communication with the patients. The same results were found in a study done in Hawaii. Participants reported that CIS had reduced clinicians' productivity, primarily because of extra work such as processing laboratory result reports, entering orders and navigating through the systems.[14]

Many physicians were pleased about the orders and results of laboratory and radiology as they emphasized that this is the strongest point in the EMR. They were also happy about the electronic prescription because it reduced errors and saved time. In a survey conducted by Robert et. al (2011), including 2,719 Family Physicians in America the respondents highlighted advantages of the EMR which were almost similar to our findings. Their respondents stated that they were pleased with the EMR system since it was fast, easy to use, well documented, more precise and provided patient engagement tools such as the patient education resources and patients' portal.[15] However, ACP (2008), conducted a survey reporting that physician dissatisfaction with EMRs increased from 24% in 2010 to 39% in 2102. The reasons provided by the respondents for their dissatisfaction with the EMR was that the system was expensive and was not significantly reducing their workload. [16]

They mentioned that computer skills had a major effect on understanding the EMR. In the literature review, computer literacy was identified as a major barrier to the implementation of the EMR.

There was a finding that only emerged in the second focus group due to the presence of a physician who was previously exposed to the auditing process. The researchers were of the impression that physicians perceived the EMR as a significant threat when used to audit the physicians for documentation and patient confidentiality. e.g. "*the medical record do regular audit and find out, for example, why the chart has been opened*".

Another e.g. "*part of annual appraisal of the physicians is the (audio unclear) we have about eight competencies one of them is the documentation and we usually audit at least 10 to 20 task for each physician and all the important factors the presenting*

symptom, the history of present illness the past medical history… we do for audit and this is why the physician are keen to have a complete or as much as we can about full documentation". Physicians had a negative perception that they were monitored for their performance through the Cerner, which created some discomfort during the session. This finding was not commonly identified in our literature review except in one study where the respondent reported the feedback as personal criticism.[15] It is important to ensure that during the implementation of a new systems, like the Cerner, users should be informed about the purpose of the use of the system and also about the auditing tool and the purpose of use of audits to allay fears and negative perceptions.

The confidentiality issue was added to the moderators guide as a focus group questions after it emerged as theme in the first focus group. Participants mentioned the loss of confidentiality in the patient's files, because anybody who has access could open any file. A new insight developed after the first focus group, and the interview questions were adapted to explore this new knowledge. It was discussed until the point reached saturation similar to the situation in other studies. [17,18]

Physicians in our study reported that EMR documentation was time- consuming, due to many clicks that had to be performed, even for short documents and simple complaints. In the review of the published literature, physicians recognized the benefits of EMR for legibility, and readily linked this to better and safer patient care outcomes. The burden and time inefficiency of data entry are seen as major disadvantages, suggesting the importance of “smarter” and more intuitive data entry interfaces and perhaps voice recognition.[19] This also emerged as subtheme in our study.

Participants continued to identify the important role of an EMR champion within their practice who encouraged EMR usage and was available to problem solve. Support and encouragement from a "champion" has been noted in the literature as crucial throughout the implementation process.[1,20] In this study participants mentioned that follow-up by super users and the IT team would be beneficial.

Participants identified the messaging system within the EMR software as a practical, useful and important tool for enhancing efficiency within the team. Successful communication has been linked to increased patient safety and improved patient outcomes.[1] The physicians in all focus groups emphasized this point. They mentioned that internal communication in the clinic through the system had saved time and improved patient safety.

Major barriers to implementation and adoption included computer literacy, training, and time. There was also variability regarding the influence of prior computer knowledge on perceptions of EMR implementation. While these issues have been identified in prior studies, they remain an ongoing challenge for primary health care providers. Implementation and adoption of EMRs will be most successful when protected time is available to train all EMR users. [17] In this study similar concerns were raised.

A recent review of studies on barriers to EMR implementation found that these could be broadly categorized as concerns about costs, technical issues (including lack of interconnectivity, high complexity, and lack of customizability), lack of time, psychological factors such as lack of belief in EMR, social factors such as lack of support from colleagues, and legal issues such as concerns over privacy and security.

[21,22] Complexity, interconnectivity and time factors also emerged from the current study.

Limitations

The present study was limited in several ways. Firstly, the study included only physicians despite the importance of understanding nurses, pharmacists and other health care professionals' beliefs about using the EMR. Secondly the study was done only in Al-Ain district although HAAD has implemented the EMR system in Abu-Dhabi and Al-Ain. This study focused on EMR users in primary health care settings and did not include the EMR users in hospitals. The application of purposive sampling strategy in the recruitment of the physicians during this study is also a limitation. Since the respondents were self-selected, it might mean that this study had many EMR enthusiasts.

Conclusion

Clinicians have a positive perception regarding the application of EMR in the primary care outpatient practices. However, several themes emerged during this study that need to be considered to enhance the EMR system. Therefore, further studies need to be done by focusing on other medical users and patients in viewing their attitude and perception about the EMR system. Adapting the system to needs and diagnosis common to the PHC setting and offering continuous training and technical support would assist in convincing apprehensive EMR users.

Recommendations

A crucial subsequent step is selecting from the themes, which emerged in the study, the themes that are most commonly mentioned or most important to physicians, and to

formulate a hypothesis about the mechanisms by which these beliefs might shape acceptance and users' behavior. A follow-up survey should be implemented on nurses, pharmacists, patients and others groups so as to understand their beliefs and attitudes about the EMR system. The findings which correspond with those of other studies or refer to issues that have a negative impact on services and can be rectified should be communicated to authorities and IT vendors to seek solutions to improve and adjust future applications.

Footnotes

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Contributors:

All authors contributed to the concept and design of the study. Dr. Durra was the moderator of the focus group. Dr. Shamma was the principle investigator and the coordinator of the study, Dr. Shamma and Dr. Aysha contributed to the analysis, interpretation and preparation of the manuscripts with the input from all authors. Dr. Prinsloo, Durra and Mouza were involved in editing the article or revising it critically for important intellectual content, all authors have read and approved the final manuscript.

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Research interests

Better health care quality providing, and patient safety with relation to health care information technology.

Competing interests: None declared

Ethics Approval: The proposal for this study was approved by IRB of Al Ain Medical District Human Research Ethics Committee, protocol No. SO11-3. Permission was taken from governing hospitals of each clinic before starting the study.

Data sharing statement: Our qualitative data are not to be shared, as we consent patients for data confidentiality when the study was undertaken. The Quantitative study is unpublished data available from the corresponding author, Appendix A and B are available for Data Sharing, Further details of the study protocols can be requested from the corresponding author by emailing Durra Al Baloushi (d_albaloushi@hotmail.com).

Table 2: Summary of themes of all focus groups

Themes & Subthemes		Quotes
Physicians dependent factors	**1.** The initial impression about EMR system • Difficulty in use at the beginning • Training was sufficient and good	*"Still we are in the fetal state"*.FG1 *"We had a team which was always available"FG3*
	2. Past computer skills • Different users' generations with different computer skills	*"Old generation doctors, whom I respect a lot of course, let's say there is a urine culture results, they don't know that there is a click where you can get the susceptibility". FG1*
	3. The impression about the precompleted notes • Precompleted notes definitely saves time	*"Definitely, it saves a lot of time"FG2*
Patient related	**4.** Doctor – patients relationship • No eye contact • Waiting time is more • Patients are accepting the system because it is reflecting an advance modern of technology	*"Initially the patient were not happy"FG1* *"No eye contact" FG1* *"It consumes more time" FG1* *"Patient will accept this new system because it is more advance and reflect that the clinic is more advance with modern technology but giving good care"FG1*
System dependent factors	**5.** Complexity of the system • EMR complexity was at the beginning • Complexity of the system, not specialized to PHC	*"If you get use to it, yes, it become very easy"FG1* *"The system was not designed for primary care"FG3*
	6. The quality of documentation • Documentation now is readable and better than handwriting • The quality of documentation is depends on the physician them self	*"Before we should open this charts. I can't read handwriting of the doctors, now everything is easy and everything is in front of my eyes only by clicking"FG2*
	7. The process of prescription in the cerner and the current problems • Prescription is better & safe now • Allergy system decreasing the medication errors	*"Definitely much better 100%"FG1* *"Before there were so many mistakes"FG2* *"If there is allergy, decrease the error because during hand writing there was medication errors"FG1*
	8. Improvement of the orders and results with EMR • The orders and the result much organized • Fast feedback of the results	"T*he stronger point on cerner is lab's and xrays"FG3* *"Much organized"FG1* *"The results will come directly to your inbox"FG1*
	9. Referral issues with the cerner • Referral issue easy with feedback • Trace patient's appointment and print it for them	*"Before when was referring patients to the hospital we don't have any clue what happened to him"FG3* *"I can easily open the system and look for it and tell her this is your appointment"FG1*
	10. Confidentiality • No confidentiality with EMR	*"It is easy to break this confidentiality with the cerner. Any body can open the file"FG1*
	11. Disadvantages of EMR • Takes time • Important notes should be highlighted	*"Longer, even not only with doctor, from pharmacy side, from reception side"FG3* *"It is difficult to eye scan, it should be highlighted"FG1*
	12. Suggestions to improve EMR • Giving more time • Meetings and updating by Cerner people	*"Give us enough time" FG1* *"They should give us updating; now what I learn 2 yrs. ago I am developing myself"FG1*

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Physicians User's Satisfaction with Electronic Medical Records System in Primary Health Care Centers in Al-Ain: a qualitative study

Shamma Al Alawi[1], Aysha Al Dhaheri[1], Durra Al Baloushi[1], Mouza Al Dhaheri[2], Engela A. M. Prinsloo[3]

[1]Ambulatory Health Care Services, SEHA, Al Ain, Abu Dhabi, United Arab Emirates.
[2]Homecare Department, Tawam Hospital in Affiliation with Johns Hopkins Medicine, Al Ain; United Arab Emirates.
[3]Department of ~~Community~~Family Medicine~~, Faculty~~ , College of Medicine and Health Sciences UAE University, United Arab Emirates.

Correspondence to:
Durra Al Baloushi,
Ambulatory Health Care Services, SEHA, Al Ain, Abu Dhabi, United Arab Emirates.
P.O. Box 15676
Al Ain, United Arab Emirates
E-mail: d_albaloushi@hotmail.com

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Abstract

Objectives: To explore physician's satisfaction with the Electronic Medical Records (EMR) system, to identify and explore the main limitations of the system and finally to submit recommendations to address these limitations~~-~~.

Design: A descriptive qualitative study that entailed three ~~semi structured~~ focus group interviews was performed amongst ~~the~~ physicians, using open-ended questions ~~was performed.~~ The interviews were audiotaped, documented and transcribed verbatim. ~~-~~The themes were explored and analyzed in different categories.

Setting: ~~In~~The study was conducted in primary health care centers (PHC) in Al Ain, United Arab Emirates (UAE).

Participants: A total of 23 physicians, all using the same EMR system, attended ~~either~~one of ~~the~~ three focus groups held in PHC in Al Ain Medical District~~,~~. Each focus group consisted of 7-9 physicians working in PHC as family medicine specialists, residents or general practitioners ~~using the same EMR system.~~

Primary outcome measure: Physicians satisfaction with EMR System.

Results: Key themes emerged and were categorized as physician dependent, patient related~~,~~ and system related factors. In general, physicians were satisfied with the EMR system ~~although some were~~ in spite of initially ~~facing some~~ difficulties with implementation. Most ~~of the~~ participants ~~identify~~identified that the long time required to do the documentation ~~as a factor that~~ affected their practice and patients communication. Many physicians ~~were pleased about~~ expressed satisfaction with the orders and results of laboratory and radiology function and they emphasized that this was the strongest point in EMR. They were also satisfied with the electronic prescription ~~because~~function stating that it reduced errors and saved time.

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Conclusion: Physicians are satisfied with EMR and have a positive perception regarding the application of the system. Several themes emerged during this study that need to be considered to enhance the EMR system. Further studies need to be conducted amongst other health care practitioners and patients to explore their attitude and perception about the EMR.

Strength and limitations of this study

- The EMR system (Cerner) ~~is currently being used~~was introduced in the Emirate of Abu-Dhabi ~~and~~ but only Al-Ain.
- ~~There is a lack of information and research studies regarding the evaluation of~~ clinics were selected for the ~~users'~~study and due to study design findings cannot be generalized.
- This being the first local study to address EMR user satisfaction, adds a new user perspective.
- This study focused ~~only~~ on ~~EMR users in~~ primary health care ~~settings and not in hospitals~~physician EMR users excluding hospital users and related health care professionals.
- Method of focus-group recruitment contributed to selection bias .

Introduction

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~~The Electronic medical record (EMR) is a new and promising tool for enhancing national and international health care delivery.[1] Recent research has shown that information technologies can reduce medication errors[2], improve adherence to clinical practice guidelines[3], and improve the delivery of preventive health services[4], thereby potentially improving health outcomes for patients.[5,6]~~

~~While electronic medical users can be productive, any disparities in experience, understanding, and skills can leave team members feeling less than satisfied and not working to their full potential.~~The Electronic medical record (EMR) is a new and promising tool for enhancing national and international health care delivery.[1] Recent research has shown that information technologies can reduce medication errors[2], improve adherence to clinical practice guidelines[3], and improve the delivery of preventive health services[4], thereby potentially improving health outcomes for patients.[5,6]

While electronic medical users can be productive, any disparities in experience, understanding, and skills can leave team members feeling less than satisfied and not working to their full potential.[1] Clinicians' perception of EMR is a crucial determinant of successful use of the EMR system. United Arab Emirate, Health Authority of Abu-Dhabi (HAAD) has implemented a system developed by one of the top three Healthcare IT vendors in the US.[6][6] They ~~are~~have been in existence since 1979 and have installations in many countries including USA, Canada, Australia, Saudi Arabia, Qatar, UAE, France, Spain, Singapore, Malaysia, and South America.

UAE has implemented the EMR system (Cerner) in 2008 in Abu-Dhabi and Al-Ain. ~~Ever since, there lacks information~~Information and research studies ~~in this area specifically the evaluation of the users'~~related to user satisfaction~~.~~ is lacking in the local context.

This research study focused on physician User's Satisfaction with Electronic Medical Records System in Primary Health Care Centers in Al-Ain~~.~~ ~~The~~ and was the first known survey done in the UAE exploring this research question.

The findings are reported in two separate papers qualitative and quantitative ~~papers.~~[7] respectively. We conducted a concurrent qualitative study in the same practices selected for the quantitative project. ~~The aim of the qualitative part was to explore the attitudes of the participants regarding the EMR through the interpretation of their filled questionnaires.~~

The use of focus group interviews is becoming increasingly popular in health care research to explore beliefs, feelings, attitudes and behavior of individuals. Focus group discussions provide information about a range of ideas and feelings of individuals about specific issues and it illuminates the differences in perspective

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between groups of individuals. A focus group can generate large amount of data in a relatively short time span.[7,8]

In this study the researchers explored users' knowledge, attitude and satisfaction with the electronic medical records system in primary health care centers in Al-Ain.

Method

Study design: This descriptive qualitative study was conducted in parallel with a quantitative study. ~~The quantitative study was~~ reported separately ~~as unpublished data~~ in a paper presented at the 2nd Al Ain Family Medicine Research Day; 2012 March 3; Al Ain, UAE.[7]

. Study method: A Purposive sampling strategy was used to recruit the physicians.[8,9] The study was conducted in English ~~language~~. Permission was obtained from the clinic supervisors of each hospital prior to the study. Invitation letters were distributed among the physicians in clinics where the quantitative study on the EMR system was conducted. ~~We had requested the~~ The management personnel were requested to select ~~for us workers~~the participants for our study. These workers were selected based on their willingness to share their experiences on EMR with us. Those who were to participate in the qualitative study were contacted by telephone 1–2 days before the focus group meeting. The physicians were not compensated for their time since most of them (physicians) ~~was~~were released during their shift hours. The authors ~~participated in conducting~~contributed to different aspects of the research ~~in different ways.~~study.. The third author, a family medicine resident, reviewed literature related to qualitative research, received additional training related to qualitative research methods, developed the moderators guide[8][9] and moderated the focus groups. The three other researchers were respectively responsible for audio taping and documenting verbal and non-verbal responses. Participants signed a consent form before the focus group session. All focus group interviews were conducted in the

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same primary health care center ~~in Al Ain Medical District.~~. To maximize ease of participation, the interviews were held after office hours ~~at~~during lunchtime. We deliberately exempted the managerial representation ~~in~~from our focus groups. The main reason ~~for this is~~was that we ~~felt~~were of the opinion that their presence would ~~make their juniors~~cause junior colleague to feel uncomfortable ~~in~~preventing them from sharing their personal experiences and perceptions on their use of EMR in ~~their healthcare.~~the work-place..

The moderator introduced herself at the beginning of the focus groups, explaining the purpose of the study and assuring confidentiality of the information shared.[~~8~~][9] The facilitator encouraged participation of all members in the discussions using open-ended questions and prompts focusing on: (1) initial impression about Electronic Medical Records System, (2) advantages and disadvantages of EMR, (3) patients' reaction to introduction of EMR and (4) suggestions to improve the EMR. Interview questions were reviewed as the study progressed to seek further clarifications.[9] ~~(See the online supplementary appendix A) for detailed focus Group Questions.~~[10] (See the online supplementary appendix A) for detailed focus Group Questions.

~~Semi structured group~~ Group interviews were conducted on three consecutive days. Each focus group lasted ~~for one~~an hour. Theme saturation was approximately achieved during the second focus group and a third focus group was conducted to confirm the saturation.

Data analysis

The interviews were audiotaped and transcribed verbatim. As the interviews progressed, data was analyzed after each focus group to develop preliminary codes to identify important and new ideas emerging. Each transcript was independently

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reviewed and coded separately by all the researchers to establish main concepts.[1][1] Subsequently, each transcript was analyzed by each investigator independently to explore the themes and subthemes and then reviewed by the other investigators to compare and group the similar data. Further relations and triangulations[10][11] were analyzed during regular meetings. The next stage involved identifying the theme frame using the "Krueger" framework.[11][12] Trustworthiness of the data was enhanced by using Guba's four criteria.[12] **for more details** (See the online supplementary appendix B)

by using Guba's four criteria [13] [14]for more details ((See the online supplementary appendix B)

Findings

A total of 23 physicians attended either of the three focus groups held in PHC in Al Ain Medical District.. The overall focus group attendance was 70–80%. The main reason given for non-participation was lack of sufficient time for this study.. Each focus group consisted of seven to nine physicians working in the primary health care centers as family medicine specialists, residents or general practitioners using the same EMR system fromsince 2008, (Table 1) shows the. The characteristics of the focus group participants are reported in Table 1.

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Table 1: Characteristics of physicians

Demographic data	FG1* (n=7)	FG2* (n=9)	FG3* (n=7)
Gender			
Male (female)	**3(4)**	**4(5)**	**2(5)**

Each focus group consisted of a mix of males and females of different age groups and professional experience.

Professional experience			
Seniors	**5**	**6**	**4**
Juniors (residents)	**2**	**3**	**3**
Nationality			
UAE	**2**	**3**	**3**
Non-UAE	**5**	**6**	**4**

FG: focus group, n= total number

Several themes emerged from the focus groups about the implementation of EMR (Table 2). The main themes were categorized as physician issues, patient issues and system (Cerner) issues. These categories of main themes were arrived at~~, at~~ through consensus~~,~~ during analysis of focus-group transcribes after the ~~interview because whenever the physicians talked, they could refer~~interviews. Participants repeatedly referred to or mentioned these themes~~,~~ during their discussions.

Physician dependent factors

The initial impression of physicians:

In general physicians spoke favorably about EMR system implementation e.g. *"I think that, I do believe that my first impression was so amazing"* FG1 but all remarked that the beginning was difficult e.g. *" At the beginning, as anything when you use it for the first time, it will look complex until you get familiar to the system"* FG3.

Computer skills: They believed that the computer skills had a major role in understanding EMR as they mentioned that old generation physicians were slower in typing and learning new tricks. There is a difference in competency among physicians in dealing with technology e.g. *"Old generation doctors, whom I respect a lot of course, let's say there is a urine culture results, they don't know that there is a click where you can get the susceptibility"FG1 Another e.g. "if you don't know like Alt and C is copying and Alt and V is pasting, (it takes) for a lot of people it causes a lot of difficulties"FG2*

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"for me for example if I want to explain something for the patient in anatomy, instead of drawing I will just enter the Google and the patient will be very happy: ohm, this is how it look, this is how the anatomy. And when you want to illustrate the disease process through pictures the patient will be very happy" It was also useful to provide the patient with very useful educational materials.

The training: Physicians appeared to have various opinions about the training period. Some were completely satisfied e.g. *"It was sufficient, the training was good, of course the training itself to how to deal with computer at the beginning start in a good way"* FG3, while others were not satisfied and expressed that they were not aware of some facilities available in the EMR system e.g. *"How to order everything at the start was very clear and comprehensive in the training part but when we start on the note part the training was not sufficient, in my opinion"* FG3. Some physicians suggested having individualized training sessions according to the physician needs. *"I think they should work on teaching session, according to level of each, e.g. dividing them in groups and take them step by step even if it take 10 sessions or more"* FG2.

Participants specified that IT team and super users were always available during the early time of implementation. They also suggested having regular meetings with the IT team to reevaluate the physicians, answer their queries and have an updated training sessions for each system upgrade e.g. *"they make a training they have to meet the users again to evaluate them. For example, I am using the Cerner and I collect questions there should be someone professional to answer me" FG3*

"*They should give us updating; now what I learn 2 years ago I am developing myself. This should be like regular because this will answer a lot of questions for me for the system"* FG1

Patient related outcomes

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Patient-physician relationship: Physicians' perceptions about patient reaction were mixed. Initially they were unhappy because of disturbed patient doctors relationship e.g. *"It was bad but now it is improving a lot"* FG1 and *"The real thing is eye contact is missing"* FG2. Furthermore the waiting time increased due to data entry causing more frustration to the patients e.g. *"The patient upset because of waiting time"* FG3.

Physicians believed that the waiting time was not caused by them but was mainly in the registration and nursing assessment e.g. *"I found that nursing assessment they have to do a lot of things"* FG2. On the other hand they believed the benefits outweighed the waiting time issue and included beneficial issues as improved patient care, patient education and the health maintenance schedule. They stated that patient flow was initially reduced but eventually returned to the same as prior to implementation of the EMR e.g. *"the same, the same,"* FG2.

Many physicians were concerned about their patients' perception about the new technology. They felt that many patients were unhappy but indicated that few patients approved and made positive remarks to their physicians.

Physician tried to adapt some strategies to maintain the relation with their patient. Some were talking to the patients while dealing with computer so patients would not feel neglected *e.g. "ok now I am checking your results, I am checking your past file"* FG1.

Others reserved data entry to immediately after the visit e.g. *"we can put the diagnosis, then put the medication, because we can't put medication without diagnosis then put the labs then ask the patient to go and continue documentation"* FG2.

"…the proper thing is to take full history from the patient, maintaining the good communication with the patient then turn and document" FG3.

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All physicians believed that the presence of the EMR had strong effects on the flow of the patients initially ~~But~~ but later returned to the prior situation.

Some of ~~the~~ physicians used the EHR as a means for collaboration to share the screen with their patients. They showed them some pictures to illustrate and explain concerns.

System dependent factors

A summary of advantages and barriers highlighted by physicians using the EMR is discussed in the text below:

The quality of documentation: Physicians believed that EMR improved the quality and clarity of the documentation e.g. *"it is very helpful, very readable, better than the handwriting"* another e.g. *"previously they were usually write their own abbreviations "**LE**~~,~~", "**RE**" not sure what they mean is it LEFT EYE or the disease itself but now because of the system coding they tend to write"* FG2. However some physicians described the system as complex and less informative e.g. *"if the doctor is free texting he will say the real thing and when you read it you will know what is the meaning exactly (overlapping talk) but if you tick tick, tick sometime you lose"* FG3.

Participants in all focus groups agreed that the current EMR was designed mainly for the hospitals and not for the primary care centers e.g. *"The system was not designed for primary care (all agree) it is designed for hospitals this is the main issue for us"* FG3. Physicians had difficulties finding a diagnosis for some of the common conditions like skin laceration or skin abrasion seen in daily practices.

System complexity and interconnectivity: A common theme was the complexity of the system. Participants explained that they had difficulty at the beginning of

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implementation of the system to find the proper coding for the diagnosis. They also complained that sometimes they had to duplicate and repeat notes in several locations because there was no link, for example between the notification system and the patient notes e.g. *"Notification system, there must be a connection between Health Authority Abu Dhabi and cerner (EMR) another thing some cases...if anyone experience how to notify a case of syphilis he will hate himself (laughing). Four pages you must fulfill four (4) pages"* FG3.

Participants were very satisfied with the pre-completed notes in the system. They mentioned, it helped them in saving time and was very useful in the specialty clinics. e.g. *"Definitely, it saves a lot of time"*FG1 another e.g. "*Helpful, especially in the clinics, the specialized clinics like the well-baby clinic, in antenatal clinic, in chronic clinic*" FG1. They also ~~highlighted~~emphasized that in the long run the review of accumulated documentation will be challenging by asserting that visual scanning is impossible without highlights e.g. "*Accumulation over the year will be a problem because you cannot go through all the note to find something"*FG1.

Ordering and viewing: Many participants in the three focus groups were very pleased and satisfied with the orders and results of laboratory and radiology function. They mentioned that it is the strongest part in the EMR and the results are available on the same day e.g. *"The stronger point on cerner (EMR) is lab's and x-rays*" FG3. Participants found that online orders from the Cerner tick list was ~~are~~ easier than the written ones. e.g. *"If you are comparing writing an order with ticking order, ticking order is easier."* FG3.

EMR viewing capability was considered to be useful information for patient management and it helped with continuity of care and following progression of many

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chronic diseases e.g. *"For example, if you have a patient with renal failure you can see the results (creatinine) for one year which is very useful"FG2.*

Participants believed that x-ray orders are very helpful because the radiologist has access to the history of the patient e.g. *"It was really miserable because there is no history for the doctor to read from x-ray. When I sit with the doctor the radiologist, I feel what he is feeling because there is nothing just X-ray. Okay for what? What are you thinking? What are your differential, it is nothing."* FG3.

Regarding the electronic prescription, participants were very excited since it helps in reducing the errors. *"It is easy and safe also"* FG1. They indicated that the prescription refill system saved time. Participants stated that they liked the drug reference text that appeared with each medication order.

Participants ~~were suggesting to uniform the units that are used~~suggested agreeing on uniformity in the ~~system to~~use of metric units deciding on either reporting in milligram (mg) or millimol (mmol~~.~~). Several participants agreed that the EMR referral is much easier and patients could be traced and followed up through the system. Feedback about patient referral and management was a major improvement according to participants. ~~This was difficult with the~~The previous paper system ~~before.~~did not support continuity of care or feedback. . e.g. "*Before we don't know any feedback about the patient but now I refer one patient suspecting bronchiolitis or something after one hour I can open the cerner(EMR) and I can see what they did for him*" FG1.

~~Some~~According to some participants ~~said that~~ the referral and feedback system ~~is good for the~~enhances continuity of care of the patients; it ~~enables~~provides them ~~to have~~with a a complete picture of ~~the progression of patient condition and what sort of further~~post referral management ~~he received after referral.~~and progress. e.g. "*I think*

referred for us as Family medicine for continuity of case is better" FG2. Regarding the disadvantages of EMR, participants were complaining that the system was time consuming and required too much detailed documentation. e.g. *"Previously documentation was not such detail when using file. But whatever time we spent, we spent with patient, we were asking his history, examining, and writing a prescription giving him cause and the rest come but now, suppose URTI case come one or two minutes is taken to diagnose the case once the diagnosis is finished then I started with my computer so this computer is taking time and patient finished and he is just waiting and waiting till I finished so he gets upset."* FG1.

An important ~~point~~issue that was raised in the first focus group, ~~which was~~and subsequently added to the discussion questions, was ~~the~~that of confidentiality ~~issue.~~.. All participants agreed that there was no confidentiality with the EMR system e.g." *One of the main issues with the Cerner (EMR) is the confidentiality"* FG1.

Suggestions

One of the emerging themes from the discussions was suggestions to improve the EMR system. Participants suggested to allow more time for the physicians and to improve the email system. They also proposed including some diagnosis in the EMR that are commonly used in the primary care setting. e.g. *"Common medical problem should be included in the diagnosis and encounter pathway should include more general complaints"* FG1.

In the second focus ~~groups~~group, participants suggested that the electronic document design should be simplified for use by doctors and patients in primary care.

"Electronic documentation it is so much better. No one differ about that but it must be simplified for the patient and for the physician" FG2.

Participants also suggested ~~for ease of use the~~ that allergies, problem list and diagnosis should be included in the main page~~.~~ to simplify the system. Physicians wanted to have a free text to add diagnosis and not be restricted to the available EMR list e.g. "*We can't find ICD$_9$ since one or two months it can enter as free text, now it can't I should change it. It should be applicable for change it. He was osteopenic and now osteoporosis. So I can change it I can click this and write other*" FG3.

Participants ~~asked~~requested to have a link between HAAD records and the EMR system for ~~the~~ sick leave notes and ~~notifications.~~notification of disease. e.g. *"Sick leave and notification. There must be a link between Cerner (EMR) and HAAD at HAAD website. For sick leave it is very important as we write free text and patient coming to me and take it after 3 days go to another clinic and take another sick leave like this*" FG2.

Discussion:

This is the first published paper in the UAE to evaluate the EMR users' satisfaction since the implementation. The aim of this study was to understand the attitude and knowledge of physicians about the EMR. Another goal was to identify the disadvantages and suggestions to improve the system.

The ~~elicited~~ physicians' perceptions about the EMR summarized in the preceding text suggested several ideas to improve the system. Physicians in all focus ~~group~~groups were satisfied with the EMR system although some physicians were facing some difficulties at the beginning of implementation. Most of the participants ~~identify~~identified the long time required to do the documentation in the system as a factor that ~~affect~~affects their practice and communication with the patients. The same results were found in a study done in Hawaii. Participants reported that CIS had

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reduced clinicians' productivity, primarily because of extra work such as processing laboratory result reports, entering orders and navigating through the systems.[13 15]

Many physicians were pleased about the orders and results of laboratory and radiology as they emphasized that this is the strongest point in the EMR. They were also happy about the electronic prescription because it reduced the errors and saved time. In a survey conducted by Robert et. Alal (2011), carried a survey onincluding 2,719 Family Physicians in America and had the respondents highlightinghighlighted advantages of the EMR which were almost similar to our respondents' findings.. Their respondents stated that they were pleased with the EMR system since it was fast, easy to use, well documented, more precise and provided patient engagement tools such as the patient education resources and patients' portal.[21 16] However, ACP (2008), carriedconducted a survey in which unearthedreporting that thephysician dissatisfaction of physicians onwith EMRs increased from 24 percent% in 2010 to 39 percent% in 2102. The reasons givenprovided by the respondents' respondents for their dissatisfaction regardingwith the EMRsEMR was that the system was expensive and was not significantly reducing their workload.[22 17]

They believedmentioned that the computer skills had a major role ineffect on understanding the EMR as they mentioned.. In the review of the literature review, computer literacy was identified as a major barrier forto the implementation of the EMR.

There is onewas a finding that only emerged in the second focus group only as a result ofdue to the presence of a physician who was previously exposed to the auditing process. The investigators gotresearchers were of the feelingimpression that physicians perceived itthe EMR as a significant issue in the auditing ofthreat when

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used to audit the physicians for documentation and patient confidentiality e.g. "*the medical record do regular audit and find out, for example, why the chart has been opened*".

Another e.g. "*part of annual appraisal of the physicians is the we have about eight competencies one of them is the documentation and we usually audit at least 10 to 20 task for each physician and all the important factors the presenting symptom, the history of present illness the past medical history… we do for audit and this is why the physician are keen to have a complete or as much as we can about full documentation*". Physicians had a negative perception that they ~~have been~~were monitored for their performance through the Cerner, which created some discomfort during the session. This finding was not commonly identified in our literature review except in one study where the respondent reported the feedback as personal criticism.[~~14~~15] It ~~may be~~is important to ensure that during the implementation of ~~the~~a new systems, like the Cerner, users should be informed about the purpose of the use of the system and also about the auditing tool and the purpose of use of audits to allay fears and negative perceptions.

The confidentiality issue was added to the moderators guide as a focus group questions after it emerged as theme in the first focus group. Participants mentioned the loss of confidentiality in the patient's files, because anybody who has access could open any file. A new insight developed after the first focus group, and the interview questions were adapted to explore this new knowledge.[~~16~~]. It was discussed until the point reached saturation similar to the situation in other studies.[~~15~~18,~~16~~19]

Physicians in our study reported that EMR documentation was ~~taking long~~ time, ~~as there were~~ consuming , due to many clicks that had to be performed, even for short

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documents and simple complaints. In the review of the published literature, physicians recognized the benefits of EMR for legibility, and readily linked this to better and safer patient care outcomes. The burden and time inefficiency of data entry are seen as major disadvantages, suggesting the importance of "smarter" and more intuitive data entry interfaces and perhaps voice recognition.[~~17~~20] This also emerged as subtheme in our study.

Participants continued to identify the important role of an EMR champion within their practice who encouraged EMR usage and was available to problem solve. Support and encouragement from a "champion" has been noted in the literature as crucial throughout the implementation process.[1,~~18~~21] In this study participants mentioned that follow-up by super users and the IT team would be beneficial.

Participants identified the messaging system within the EMR software as a practical, useful and important tool for enhancing efficiency within the team. Successful communication has been linked to increased patient safety and improved patient outcomes~~.~~[1] The physicians in all focus groups emphasized this point. They mentioned that internal communication in the clinic through the system had saved time and ~~improve the safety of the~~improved patient safety.

Major barriers to implementation and adoption included computer literacy, training, and time. There was also variability regarding the influence of prior computer knowledge on perceptions of EMR implementation. While these issues have been identified in prior studies, they remain an ongoing challenge for primary health care providers. Implementation and adoption of EMRs will be most successful when protected time is available ~~for training~~to train all EMR users.[~~15~~18] In this study similar concerns were raised.

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A recent review of studies on barriers to EMR implementation found that these could be broadly categorized as concerns about costs, technical issues (including lack of interconnectivity, high complexity, and lack of customizability), lack of time, psychological factors such as lack of belief in EMR, social factors such as lack of support from colleagues, and legal issues such as concerns over privacy and security.[18,19,22,23] Complexity, interconnectivity and time factors also emerged from the current study.

Limitations

The present study was limited in several ways. Firstly, the study included only physicians despite the importance of understanding nurses, pharmacists and other health care professionals' beliefs about using the EMR. Secondly the study was done only in Al-Ain district although HAAD has implemented the EMR system in Abu-Dhabi and Al-Ain. This study focused on EMR users in primary health care settings and did not include the EMR users in hospitals. The application of purposive sampling strategy in the recruitment of the physicians during this study is also a limitation. Since the respondents were self-selected, it might mean that this study had many EMR enthusiasts.

Conclusion

Clinicians have a positive perception regarding the application of EMR in the primary care outpatient practices. However, several themes emerged during this study that need to be considered to enhance the EMR system. Therefore, further studies need to be done by focusing on other medical users and patients in viewing their attitude and perception about the EMR system. Adapting the system to needs and diagnosis

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common to the PHC setting and offering continuous training and technical support would assist in convincing apprehensive EMR users.

Recommendations

A crucial subsequent step is selecting from the themes which emerged in the study, the themes that are most commonly mentioned or most important to physicians, and to formulate a hypothesis about the mechanisms by which these beliefs might shape acceptance and users' behavior. A ~~further~~ follow up survey ~~measures~~ should be implemented on nurses, pharmacists, patients and others groups so as to understand their beliefs and attitudes about the EMR system. The findings which correspond with those of other studies or refer to issues that have a negative impact on ~~are detrimental to~~ services and can be rectified ~~adjusted~~, should be communicated to authorities and IT vendors to seek solutions ~~of~~ to ~~improving~~ improve and adjust~~ing~~ future applications ~~to the benefit of all.~~

Footnotes

Acknowledgment

We thank the study participants for their kind cooperation and time. Thanks to all managers of clinics included in the study for their cooperation and support.

We would like to thank all people who were involved in the process of our research.

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Contributors:

All authors contributed to the concept and design of the study. Dr.Durra: was the moderator of the focus group. Dr. Shamma was the principle investigator and the

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coordinator of the study, Dr. Shamma and Dr. Aysha contributed to the analysis, interpretation and preparation of the manuscripts with the input from all authors. Dr. Prinsloo, Durra and Mouza were involved in editing the article or revising it critically for important intellectual content, All aAuthors have read and approved the final manuscript.

Funding:

There was no funding for our study.

Research interests

Better health care quality providing, and patient safety with relation to health care information technology.

Competing interests

The authors declare that they have no competing interest.

Ethics Approval The proposal for this study was approved by IRB of Al Ain Medical District Human Research Ethics Committee, protocol No. SO11-3. Permission was taken from governing hospitals of each clinic before starting the study.

Data sharing statement: Our qualitative data are not to be shared, as we consent patients for data confidentiality when the study was undertaken. The Quantitative study is unpublished data ~~Available~~available from the corresponding ~~Author~~author, Appendix A and B are ~~Available~~available for Data Sharing, Further details of the study protocols can be requested from the corresponding author by emailing Durra Al Baloushi (d_albaloushi@hotmail.com).

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Table 2-: Summary of themes of all focus groups

	Themes & Subthemes	Quotes
Physicians dependent factors	**1.** The initial impression about EMR system • Difficulty in use at the beginning • Training was sufficient and good	*"Still we are in the fetal state"*.FG1 *"We had a team which was always available"FG3*
	2. Past computer skills • Different users' generations with different computer skills	*"Old generation doctors, whom I respect a lot of course, let's say there is a urine culture results, they don't know that there is a click where you can get the susceptibility". FG1*
	3. The impression about the precompleted notes • Precompleted notes definitely saves time	*"Definitely, it saves a lot of time"FG2*
Patient related	**4.** Doctor – patients relationship • No eye contact • Waiting time is more • Patients are accepting the system because it is reflecting an advance modern of technology	*"Initially the patient were not happy"FG1* *"No eye contact" FG1* *"It consumes more time" FG1* *"Patient will accept this new system because it is more advance and reflect that the clinic is more advance with modern technology but giving good care"FG1*
System dependent factors	**5.** Complexity of the system • EMR complexity was at the beginning • Complexity of the system, not specialized to PHC	*"If you get use to it, yes, it become very easy"FG1* *"The system was not designed for primary care"FG3*
	6. The quality of documentation • Documentation now is readable and better than handwriting • The quality of documentation is depends on the physician them self	*"Before we should open this charts. I can't read handwriting of the doctors, now everything is easy and everything is in front of my eyes only by clicking"FG2*
	7. The process of prescription in the cerner and the current problems • Prescription is better & safe now • Allergy system decreasing the medication errors	*"Definitely much better 100%"FG1* *"Before there were so many mistakes"FG2* *"If there is allergy, decrease the error because during hand writing there was medication errors"FG1*
	8. Improvement of the orders and results with EMR • The orders and the result much organized • Fast feedback of the results	*"The stronger point on cerner is lab's and xrays"FG3* *"Much organized"FG1* *"The results will come directly to your inbox"FG1*
	9. Referral issues with the cerner • Referral issue easy with feedback • Trace patient's appointment and print it for them	*"Before when was referring patients to the hospital we don't have any clue what happened to him"FG3* *"I can easily open the system and look for it and tell her this is your appointment"FG1*
	10. Confidentiality • No confidentiality with EMR	*"It is easy to break this confidentiality with the cerner. Any body can open the file"FG1*
	11. Disadvantages of EMR • Takes time • Important notes should be highlighted	*"Longer, even not only with doctor, from pharmacy side, from reception side"FG3* *"It is difficult to eye scan, it should be highlighted"FG1*
	12. Suggestions to improve EMR • Giving more time • Meetings and updating by Cerner people	*"Give us enough time" FG1* *"They should give us updating; now what I learn 2 yrs. ago I am developing myself"FG1*

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Appendix A – Focus Group Questions

1) **What is your initial impression about EMR (Electronic Medical Records System)** implementation ?
   - EMR training
   - Past computer skills
   - Complexity of the system

2) **Tell me about advantages and disadvantages of EMR ?**
   a. Advantages :
      - Quality of documentation
      - Prescription process
      - Orders and results
      - Referral issues

   b. Disadvantages :
      - Quality of documentation
      - Prescription process
      - Orders and results
      - Referral issues

3) **What have been the patients reaction to introduction of EMR ?**

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- Patient doctor relationship
- Time (waiting time)
- Patient flow in the clinic

4) **What can be done to make EMR better ?**
   - your suggestions

5) **Is there is something else you would like to add ?**

Appendix B -The Guba's four criteria.

a) Credibility: To ensure credibility of an accurate recording of the participant responses, focus groups were audiotaped, transcribed verbatim and subjected to independent reviews and the use of more than one analyst improved the consistency or reliability of analyses.

b) Transferability (generalizability): The purposeful sampling method was broad to include maximum variation in perspectives and views.

c) Dependability (reliability): Reflective appraisal of the data, evaluating the effectiveness of the process of inquiry undertaken was ensured.

d) Conformability was achieved through independent reviews and consensus of the coding scheme by the research team.

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STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy
		(*e*) Describe any sensitivity analyses

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time
		Case-control study—Report numbers in each exposure category, or summary measures of exposure
		Cross-sectional study—Report numbers of outcome events or summary measures
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.