CONTINUING PROFESSIONAL DEVELOPMENT

Barriers to Adoption of Electronic Health Record Systems from the Perspective of Nurses
A Cross-sectional Study

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This study report aimed to investigate the barriers to implementation of electronic health record systems from the perspective of nurses. The research data comprised responses from nurses working in a university hospital. Our data collection instruments were the Participant Information Form and EHR Nurse Opinion Questionnaire, which were developed by the researchers. Data analysis was presented as summary statistics, including mean values of variables, standard deviation, frequency, and percentages. A total of 160 nurses participated in the study. The mean age of participants was 30.94 ± 0.59 years, and 77.5% were university graduates. Barriers to adoption of the electronic health record system included high number of patients (82.8%), limited time (79%), lack of knowledge and skills for effective use of the system (22.9%), lack of user-friendly interface and inability to create a common language within the team (17.8%), and attachment to the traditional method (17.2%). Although most nurses thought that the electronic health record system offered some advantages, they reported that factors such as large numbers of patients, limited time, and lack of user-friendly interface hindered its adoption. Innovative strategies should be explored to develop user-friendly designs for electronic health records and to produce solutions for nursing shortages to increase the time allocated for patient care.

KEY WORDS: Electronic health records, EHR, Opinions, Barriers, Nurse

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Nurses constitute by far the largest group in the healthcare workforce across the globe and are primary caregivers for many patients.[1–4] They are responsible for several duties, including documentation, implementation, evaluation, and coordination of patient care.[1,4–6] Designed to support and improve patient care, electronic health record (EHR) systems enable collection and storage of a patient's health information on a digital medium, and they have become an integral part of modern healthcare.[7–11] Nurses rely on EHR system for a range of procedures such as drug management, clinical monitoring, clinical decision making, as well as patient care.[12–15] Such systemized collection of health details in a digital format has a huge potential to improve the efficiency and productivity of healthcare workers, ensuring better quality, safer patient care, and reduced costs.[13,16–19] It also provides an opportunity to collect more practical data to devise better solutions and transform modern healthcare services.[1,11]

Efforts toward boosting the quality of healthcare should include integration of modern information technologies into healthcare to support safe and effective EHR implementation, and the adoption of EHR systems by health organizations has been growing rapidly.[3,20] Conventional paper-based patient charts may facilitate collection of information, yet they do not encourage creative-thinking and treatment strategies tailored for each patient and health staff needs.[3,6,21] It is essential to figure out how best to utilize and analyze such data to carry nursing interventions to a whole new level of care.[1,6,19,22,23] Nurses acknowledge the rationale for EHR and are willing to adopt this new technology and equipment[21,24]; however, such systems should afford clear advantages such as reducing nursing workload and saving time for care.[8] To achieve a wider adoption of EHR systems, further support and training on the proper use of electronic documentation are still needed.[3,21,23] Systems and practices that do not support the clinical roles of nurses may lead to resistance behavior that manifests itself as refusal to engage with the system, reluctance to invest time and criticism. To improve the quality of patient care, we first need to figure out expectations and perceptions of nurses on EHR implementation, trying to understand issues regarding its usability and challenges.[3,15,19,25,26] It is known that

identifying and eliminating the barriers to adoption of EHR can increase the visibility of nursing interventions,[27] improve patient outcomes and satisfaction, promote safe practice, and reduce costs once nurses have begun to add their valuable input to the system.[15] However, the current literature contains rather limited research into perceived barriers to implementing EHR systems by nurses, who are constantly with patients at many stages of the care. We need better insights into the ways how nurses could be encouraged to use EHR and factors that cause disengagement and then translate such insights across health organizations so that we can ensure successful EHR implementation and avoid wasting financial resources. Therefore, we conducted this study to explore the opinions of nurses on the EHR system and prevailing issues restricting the use of this system.

METHODS

The aim of this study report was to determine the perceptions of nurses regarding the barriers to implementing fully EHR systems in hospitals. In particular, we sought answers to the question "What are the barriers to implementing electronic health record systems from the perspective of nurses?" The study was conducted at a university hospital in southern Turkey between March and April 2020. The universe for the research was the nurses working as administrators, service, education, and outpatient nurses in a tertiary university hospital. The sample of the study consisted of 160 nurses who volunteered to participate in the study. This study data collection coincided with the start of the pandemic period (coronavirus [COVID-19]) in Turkey. Although approximately 680 nurses were working in the units where the study was conducted, the sample of the study consisted of less number of nurses. The reason for this is that, within the scope of preventive measures in the pandemic, the number of active nurses at the onset of the pandemic was lower owing to the decrease in hospital admissions, except for emergencies, and the administrative leave of nurses whose health conditions are at risk. Approximately one-third of the nurses constitute the sample. Our data collection instruments were the Participant Information Form and EHR Nurse Opinion Questionnaire developed by the researchers.

Participant Information Form

The form contains six questions designed by the researchers in line with the relevant literature[15,16,20,28–30] and obtains data on the demographic characteristics of the participants (age and educational level) and work-related information (department, work position, professional experience, and working hours).

Electronic Health Record Nurse Opinion Questionnaire

The questionnaire contains 11 questions designed by the researchers after a detailed review of the relevant literature[15,16,20,28–30] to assess the views of the nurses on the EHR system (ie, current state of EHR, advantages, disadvantages, and barriers). The language and content of the EHR Nurse Opinion Questionnaire were evaluated by five experts (two clinic nurses and three instructors in the Department of Nursing). The experts evaluated the necessity, clarity, and specificity of the questions. Some sentences were changed with the advice of experts, but the question was not removed. Content validity index was used to evaluate the opinions of the experts.[31] Accordingly, the experts scored each item in degrees varying from 1 to 4 (1—not appropriate, 2—slightly appropriate, 3—very appropriate, 4—most appropriate). The content index of the questionnaire was 0.97 in terms of language expression and the content index was 0.90 in terms of content suitability. The clarity of the questions in the questionnaire was tested by 10 nurses in the prestudy. The questionnaires were individually distributed to all nurses, who were asked to complete the surveys whenever convenient. One week later, the completed questionnaires were collected by the researchers.

Statistical analyses were performed using the licensed software package BM SPSS Statistics version 23 (IBM Inc, Armonk, NY, USA). The analysis of research data was presented as summary statistics, including mean values of variables, standard deviation, frequency, and percentages. Before initiation of any research protocols, a written approval was obtained from the Clinical Research Ethics Committee (approval no. 70904504/176) and permission from the chief physician of the hospital. Participation in the study was based on the principle of voluntary participation, and all nurses were informed about the precautions taken to protect their privacy and maintain confidentiality of research data.

RESULTS

The study sample consisted of 160 nurses currently working in a university hospital. A total of four incomplete questionnaires were excluded from the study. The mean age of the participants was 30.94 ± 0.59 years, and 77.5% were university graduates. Analysis of the departments where nurses worked revealed that most of the participants worked in internal medicine departments (55.4%), followed by those working in surgery clinics (21.9%). About 86.3% of the nurses worked as ward nurses, whereas 80% of them worked in day and night shifts. The length of work experience was evaluated in two categories, and the number of nurses with more than 5 years of work experience was comparable with that of those with less than 5 years of experience in the profession. The number of patients receiving daily nursing care ranged from 3 to 30 depending on the department, with a mean patient number of 13.08 (the number of patients was high) (Table 1). When participants were asked whether they

Table 1. Demographic Details of Nurse Participants (n = 160)

Variable	n	%
Age, mean ± SD (range)	30.94 ± 0.592 (21–54)	
Level of education		
High school and associate degree	20	12.5
University graduates	124	77.5
Postgraduate	16	10.0
Nursing unit		
Internal medicine	86	55.5
Surgical	34	21.9
Policlinic (outpatient)	18	11.7
Intensive care	17	10.9
Position		
Ward nurse	138	86.2
Outpatient nurse	22	13.8
Working hours		
Day shift	32	20.0
Day and night shift	128	80.0
Work experience		
1–5 y	74	48.7
≥5 y	78	51.3
Number of patients cared for, mean ± SD (range)	13.08 ± 0.480 (3–30)	

could "access the data they needed on the EHR system," only 57.5% answered yes (Table 2).

The functions of EHR commonly used by nurses, along with perceived advantages and disadvantages, are presented in Table 3. Nurses reported that they used the EHR system mostly to access the ward records (29%). Other common EHR domains that nurses reported using in routine nursing care were laboratory results (80.6%), Braden and Itaki scale (73.5%), patient identification (68.4%), patient education (66.5%), blood glucose monitoring (60.6%), pain (55.5%), and isolation (52.9%), whereas the least used segments were safety diagnosis system (20.6%), Glasgow scale (21.9%), pathology results (23.2%), blood transfusion (26.5%), fluid monitoring (29.7%), and vital signs (43.9%). The participants reported that the most important advantages of the EHR system were accessibility of test results (91.8%), availability of medical records and information (78.6%), and ability to save time (54.1%). The disadvantages included technology-related difficulties (45.6%), extended time required for entering data into the system (42.3%), lack of hardware (tablets for recording at bedside, etc) (37.6%), and increased workload (36.9) (Table 3).

The perceived barriers to implementing fully EHR systems were the high number of patients per nurse (82.8%), limited time (79%), insufficient knowledge and skills for using EHR (22.9%), lack of user-friendly interface and inability to create a common language within the team (17.8%), and at-

tachment to the traditional method (17.2%) (Table 4) (Figure 1). According to our participants, the highest priority areas for improvement should include functions like proper warnings and suggestions in case of allergies (73.4%), emergencies (72.1%), and critical laboratory values (51.9%) (Table 5).

DISCUSSION

Electronic health record systems have already shown great promise in transforming the clinical scene for nurses in many countries.[3,30] The widespread employment of EHR in health services such as patient admission, patient care, and transfer necessitates readiness to change and willingness to adapt to this technological innovation.[17,20] Nurses reluctant to engage with the EHR system cannot have access to the records entered by other healthcare professionals, which may lead to serious communication problems within the team and thus affect the quality of nursing care.[11,15]

System functionality and usability cause both positive and negative effects on nursing interventions.[3,7,19,30] In previous studies, nurses reported perceiving EHR systems positively on grounds that EHR enhanced the efficiency of data transfer between various specialties, provided easy access to legible information, allowed documentation updates in real time, and improved the quality of care and patient safety. On the other hand, the reasons for negative perceptions of EHR among nurses were reported to include poor system design, significantly increased documentation time, waste of valuable time that could be spent on direct patient care, and slow response times in cases of emergency.[7,30]

Zadvinskis et al[30] reported that the EHR system had a positive effect on the quality of patient care. Schenk and colleagues[2] observed an increase in the time spent by nurses in patient rooms and documentation after EHR but a slight decrease in care efficiency. In our study, participants specified the most important advantages of the EHR system as accessibility of test results, availability of records and information, and its ability to save time. In addition, although some participants reported that EHRs offer certain benefits such as ensuring well-planned care, providing support and electronic data flow, reducing workload, retrieving data from remote systems, screening for drug interactions, and increasing the time allocated to patients, the rate of such reports

Table 2. Nurses' Access to Information in EHR (n = 160)

Variable	n	%
Yes	92	57.5
No	8	5.0
Partially	60	37.5

Table 3. EHR Usage Areas, Advantages and Disadvantages According to Nurses (n = 160)

Variable	n	%	Cumulative %
Fields used in EHR[a]			
Ward records	137	29.0	90.7
Nursing records	124	26.2	82.1
General examination results	124	26.2	82.1
Scanning information	88	18.6	58.3
Areas used in EHR regarding nursing care[b]			
Laboratory results	125	11.6	80.6
Braden scale	114	10.5	73.5
Itaki scale	114	10.5	73.5
Patient identification	106	9.8	68.4
Patient education	103	9.5	66.5
Blood glucose monitoring	94	8.7	60.6
Pain	86	8.0	55.5
Isolation measures	82	7.6	52.9
Vital signs follow-up	68	6.3	43.9
Fluid monitoring	46	4.3	29.7
Blood transfusion	41	3.8	26.5
Pathology results	36	3.3	23.2
Glasgow scale	34	3.1	21.9
Safety diagnosis system	32	3.0	20.6
Advantages of the EHR system[c]			
Accessibility of test results	146	20.2	91.8
Quick access to medical records and information	125	17.3	78.6
Ability to save time	86	11.9	54.1
Creating planned maintenance	74	10.2	46.5
Support and electronic data flow (such as the patient's transport to another service)	73	10.1	45.9
Decrease in workload	65	9.0	40.9
Electronic data retrieval from other systems	56	7.8	35.2
Responding to drug interaction	52	7.2	32.7
Increase in the time allocated to the patient	45	6.2	28.3
Disadvantages of the EHR system[d]			
Technology-related difficulties (software and system errors etc.)	68	13.6	45.6
Extended time required for entering data into the system	63	12.6	42.3
Lack of hardware (computer)	56	11.2	37.6
Increase in workload	55	11.0	36.9
Decrease in patient time	46	9.2	30.9
Failure to ensure privacy and security	42	8.4	28.2
Ability to delete the information entered into the system	42	8.4	28.2
Ability to change the information entered into the system	41	8.2	27.5

(continues)

Table 3. EHR Usage Areas, Advantages and Disadvantages According to Nurses (n = 160), Continued

Variable	n	%	Cumulative %
Difficulty with computer use	40	8.0	26.8
Inability to use time effectively	38	7.6	25.5
Current use is difficult	10	2.0	6.7

[a]Nine missing.
[b]Five missing.
[c]One missing.
[d]Eleven missing.

represents less than half of the participants in our study. These results suggest that the EHR system needs improvements in the domain of increasing the time allocated to patient care, namely care activities.

Stevenson and colleagues[18] examined the disadvantages of the EHR system in the study where they examined the documentation of vital signs, expressed in technical (lack of technological design, difficulties in data visibility), operational (impractical), cultural, and organizational (serving the needs of strategic and managerial users, not meeting the needs of employees). Zadvinskis et al[30] reported that increased length of time for documentation and decreased time allocated to patient care were among the disadvantages of the EHR system. In this regard, our findings seem to be consistent with previous reports in the literature, as we found that the major drawbacks of the system were difficulties related to technology, extended time needed for entering records into the system, shortage of hardware, increased workload, decreased time allocated to the patient, inability to ensure privacy and security, possibility of deletion or alteration of the information entered into the system, difficulties related to computer skills, and inefficient time management.

The EHR system should be compatible with nursing activities and ways of thinking because usability is the fundamental dimension of patient safety and care.[7,30] Perceived

Table 4. Barriers to the Use of EHR Systems (n = 157)[a]

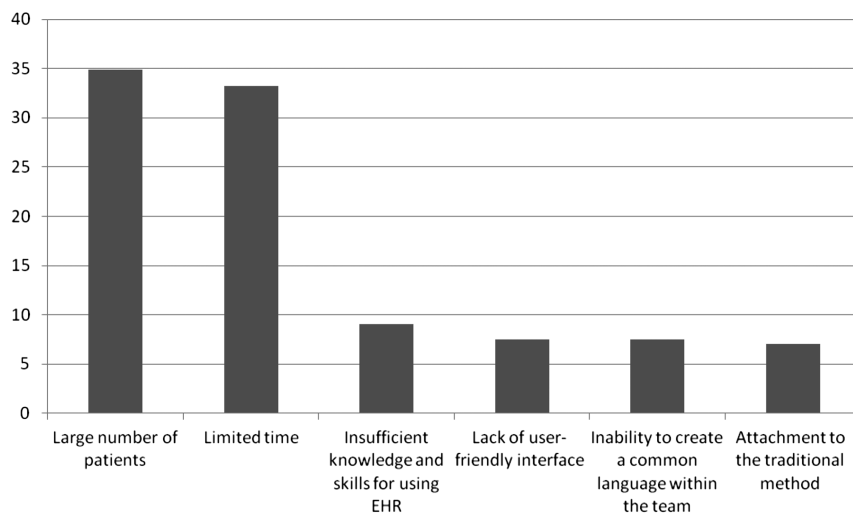| Variable	n	%	Cumulative %
High number of patients per nurse	130	34.9	82.8
Limited time	124	33.2	79.0
İnsufficient knowledge and skills for using EHR	36	9.7	22.9
Lack of user-friendly interface	28	7.5	17.8
İnability to create a common language within the team	28	7.5	17.8
Attachment to the traditional method (writing on paper, etc)	27	7.2	17.2

[a]Three missing.

FIGURE 1. Barriers to the use of EHR systems according to nurses.

usefulness plays a more important role than perceived ease of use because nurses are often willing to deal with the challenge of using technology that provides critically needed functionality.[26] In the study conducted by Gephart et al,[32] it was reported that that by enriching the EHR system with hardware and technical options, the frequency of undesirable events has decreased. In their qualitative study conducted to detect EHR adoption challenges, Sockolow et al[33] concluded that hardware issues, poor usability and functionality, lack of training, and unauthorized access to patient records were barriers to EHR adoption. They recommended that improvements in sharing information with frontline clinicians, insufficient data areas, patient safety, and documentation of nursing practice could facilitate wider adoption of EHR. Our study concluded that EHR systems should be improved by prioritizing warning and recommendations in cases of allergy, emergency, critical laboratory values, and

blood transfusion. These findings suggest that the addition of such warnings and suggestions designed for patient-specific situations may increase the functionality of the system. There is a need to improve EHR design through customization, integration, and refinement to support patient safety by identifying the frequency of experiencing undesirable consequences of EHR use. Furthermore, facilitators like easy access to up-to-date information on the system, alerts to deliver recommendations regarding patient care, improvement in clinical decision support systems, and good usability were considered to improve patient-oriented functionality.

Several studies in the literature have reported that many barriers prevent nurses from implementing the EHR system.[15,19] Essentially, such barriers are caused by three reasons, which include EHR system usability (ease of use, functionality, impact on workload), physical environment, and individual characteristics of nurses.[34] In a recent systematic

Table 5. Highest Priority Areas to Be Included in the EHR According to Nurses (n = 160)[a]

Variable	n	%	Cumulative %
Warnings and advice in case of allergies	113	15.9	73.4
Alerts and suggestions regarding emergencies	111	15.6	72.1
Critical laboratory values warnings and recommendations	80	11.2	51.9
Warnings and advice on blood transfusion	72	10.1	46.8
Easy access to up-to-date information from the system	71	10.0	46.1
Alerts and recommendations regarding patient care	68	9.6	44.2
Clinical decision support system (intervention steps according to nursing diagnoses)	62	8.7	40.3
Easy to use system	51	7.2	33.1
Performance incentives	43	6.0	27.9
Functionality for the patient (such as patients reaching the provider from the program, asking about their medication, etc)	41	5.8	26.6

[a]Six missing.

review article by Tolentino and colleagues,[15] many dimensions were mentioned on the basis of EHRs. These are functional (interruption in work flow), physical (accessibility and equipment), perceptual (lack of usefulness and difficulty of use), cognitive (workload experienced by nurses, temporary solutions developed because of the use of EHR), psychological (documentation time, satisfaction), and social (communication with the patient). In the same article, it was stated that nurses did not consider returning to the linear paper-based system as an option, despite the difficulties in using EHR. In the study of Zadvinskis et al,[30] most nurses reported experiencing frustrating issues owing to technological challenges such as software issues, power outages, and difficulties in logging in the system. In their qualitative study, Heidarizadeh et al[35] identified themes of barriers to implementing the EHR system as rationalization (need for training, insufficient number of computers, and challenges related to the security of the system) and difficulty accepting change (changes in existing practices, difficulty starting new tasks, and resistance) based on the perceptions of nurses. Moreover, according to many studies, the most important barriers to the use of EHRs are as follows: the EHR is not user-friendly[3,8,23] and makes it difficult to maintain the workflow.[7,11,15,18] Different from previous work in the literature, our participants stated that the major barriers restricting the implementation of EHR were the large numbers of patients requiring nurse care and the limited time that could be allocated for patient care. Schenk et al[2] stated that the EHR system, where computers are available in every patient room, leads to potential increases in efficiency and care behavior, although small reductions in patient education–related activities are observed. In another study, it was shown that nurses' reduced patient burden helped a lot in adapting to the EHR system.[3] In our study, the average number of patients per nurse was 13.08 patients, and because of the low number of nurses in the hospital, nurses had to take care of more patients. As the number of patients per nurse increases, time is directly limited and the time allocated to the system decreases. It seems that increasing the number of nursing personnel providing daily care for patients will increase the use of electronic records and significantly facilitate wider adoption of EHR among nurses. Finally, our results indicate that the main barriers to wider adoption of EHR systems were the lack of knowledge and skills for effective use of EHR, lack of user-friendly interface, the EHR's inability to create a mutual language within the team, and attachment to the traditional paper-based methods, which seem to be in agreement with the finding in the literature. All these reasons disrupt and hinder the nurse's work flow. In this context, if robust workflow models can be offered instead of EHRs that disrupt the current clinical workflow and technology-related difficulties can be

solved, the barriers in the use of EHRs will be reduced.[7,15,19] It is also important to take into account the perceptions of the users of the EHR. The EHR system should be acceptable to nurses to improve use and provide quality care.[6,8,23] Nurses, who are considered super users in the EHR, should be involved in the implementation, evaluation, development, and decision making of the system.[24] There is a need for continuous updating of EHR systems and for nurses to stay up-to-date on EHR use. In this study, data on the time of the pandemic, which is an extraordinary situation, are presented. In this context, for the effective and up-to-date use of EHR, nursing managers and educators should seek ways to identify faulty aspects of systems and to provide motivation for development.

LIMITATIONS

The fact that our study was conducted at a single hospital naturally reduces the generalizability of our results to a wider population. Further studies with samples from different health institutions are needed to better identify barriers to wide-scale adoption of EHR from the perspective of nurses. In addition, in our study, nurses were asked questions prepared by the researchers; the use of an internationally accepted instrument will contribute to the global discussion of the results.

CONCLUSION

To ensure successful integration of nurses into the EHR system, we should first probe into the possible barriers restricting the use of the system. Besides, adoption facilitators associated with such digital health interventions should be identified and creative solutions should be devised to overcome barriers to adoption of EHR. To that end, more participation of nurses should be ensured in efforts toward product customization with enhanced features and functions. The technological difficulties related to the system should be eliminated, addressing concerns over patient and nurse safety as the highest priority issue. Average nursing workload should also be improved by reducing nurse-to-patient ratio, along with improvements in EHR areas of high priority for nurses. Although most of the nurses appear to understand the rationale for the system and are willing to reap the benefits of EHR use, they believe that large numbers of patients, limited time, and lack of user-friendly interface constitute serious barriers to wide-scale adoption of EHR. Our findings may inform other health organizations on the possible measures before EHR implementation to diminish concerns over the quality of patient care and increase the chance of successful implementation. Healthcare managers should explore innovative strategies toward more user-friendly designs for EHR and produce policy solutions for the nursing workforce to allow more time for patient care.

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The authors and planners have disclosed that they have no financial relationships related to this article.