

Research Article

Nurses' Perception and Satisfaction Toward Electronic Medical Record System

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Abstract

AIM: This study aims to assess the perception and satisfaction of nurses toward the electronic medical record system in a teaching hospital.**METHOD:** A cross-sectional study was conducted among 350 nurses in a teaching hospital via a self-administered questionnaire between May to October 2019. Descriptive analysis, independent t-test, analysis of variance, and hierarchical multiple regression were used to analyze the data using Statistical Package for Social Sciences software version 25. In addition, a The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) was used as guide in reporting the results of this study.**RESULTS:** Almost all the nurses (98%, $n=343$) had a positive perception toward the electronic medical record system, though their perceptions significantly differ across work units, computer or laptop ownership, and daily time spent on the system (all $p < .05$). Nurses who had received training reported better satisfaction with the system.**CONCLUSION:** Among the issues highlighted by the participants that warrant attention were system development and connectivity. This study, therefore, emphasizes the involvement of nursing personnel in system development to ensure an appropriate approach for nursing care delivery.**Keywords:** Electronic medical record, nurses, perception, satisfaction

Introduction

Electronic Medical Record (EMR) system is the digital equivalent of paper records or charts in a hospital, typically containing patients' general health information, management, and treatment plan (Babale et al., 2021). It has been reported that the implementation of the EMR system can improve patients' outcomes, quality of care, and safety by improving management, reducing medication errors, minimizing unnecessary investigations, and enhancing communication and interactions between patients and their primary and secondary care providers (Menachemi & Collum, 2011).

The EMR system has been implemented at almost every modern hospital worldwide. Compared to other healthcare workers, nurses are among the foremost users of the system in their daily work practice (Holtz & Krein, 2011). A study conducted in Oman (Raddaha et al., 2018) found that using an EMR system significantly reduced the time it took nurses to complete patient documentation. This benefit is attributed to the system's ability to give nurses more time to meet the needs of patients with direct care (Tipping et al., 2010). The EMR system is also a more secure way to safeguard patients from any medical error, as their data are linked; in contrast, one patient's paper-based data can easily be exchanged with that of another patient (Ang,

2019). Additionally, a study among 1437 nurses in the United States (Walker-Czyz, 2016) discovered that the adoption of the EMR system improves the quality of nursing care and is influenced by nurses' perception and attitude toward accepting the system (Lambooi et al., 2017).

Nevertheless, several concerning issues have been encountered in the usage of the EMR system in the clinical setting, such as its relatively high-cost consumption, especially in terms of setup costs, additional hardware costs, and maintenance costs (Ang, 2019). Apart from that, in the initial stage of EMR system adoption, there may be barriers for healthcare workers who are unfamiliar with the system and lack technical support (Paré et al., 2014). The usage of the system could also contribute to ethical and legal implications for nurses, owing to the potential for more errors and malpractice liability (Troxel, 2015). For instance, the copy-and-paste practice for repetitive information, such as vital signs documentation (Balestra, 2017), might produce an unreliable treatment plan for patients, leading to the system users' indictment in malpractice cases (Rashbaum, 2012).

It is noteworthy that though the Hospital Information System has been assimilated in Malaysia since 1999, the system is still not fully utilized in all healthcare centers and remains under development in some (Sulaiman & Wickramasinghe, 2014).

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Nurses, who play the main role in patient care management, are expected to apply the new system in their work practices to enhance the patient care process. Therefore, the adaptation of these technologically advanced skills into their daily work practice could cause difficulties for nurses, thereby impacting their nursing care delivery (Fiato, 2012). Considering that the successful application of a system depends on the acceptance and satisfaction of its main users (Khalifa & Alswailem, 2015), it is important to assess this phenomenon from the Malaysian nurses' perspective. It is believed that the findings will aid the development of strategies that better the acceptance and usage of the system among nurses. Therefore, this study aimed to assess the perception and satisfaction of nurses toward the EMR system.

Research Questions

1. What is the perception and satisfaction level of nurses toward the EMR system?
2. What are the factors related to the perception and satisfaction level of nurses toward the EMR system?

Method

Study Design

A cross-sectional study design was used in this study. The study adheres to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist in reporting this study findings (Supplementary Table 1).

Sample

Data were collected among registered nurses with at least 1 year of experience in using the EMR system at a large tertiary hospital in Kuala Lumpur, Malaysia, from June to October 2019. The hospital is equipped with a capacity of 760 beds and 420 registered nurses working on 3-shift rotations. The nurses in this study were recruited from medical, surgical, and pediatric wards. Ward selection was based on the diversity of the nurses' characteristics and the nature of work. The hospital had implemented the EMR system since 2013 in stages and possessed the necessary facilities for electronic documentation activities; however, information on the effectiveness of the system and feedback from end users like nursing personnel was not available, particularly regarding the feasibility of and satisfaction with the EMR system's implementation.

In this study, a sample size of 326 nurses has been determined as adequate using the OpenEpi software with a 5% acceptable margin of error and a 95% confidence level. After adding 20% to account for the attrition rate, 390 nurses were invited to participate in this study voluntarily using the consecutive sampling method.

However, 90% of the invited nurses participated in the study and the study was carried out with 350 nurses.

Data Collection Tools

This study used a 50-item questionnaire, adapted from the previous study with minor modifications and permission of the original authors, to assess nurses' perceptions and satisfaction

with the EMR systems (Raddaha et al., 2018). The questionnaire consisted of three sections: (i) nurses' demographic (11 items), (ii) perception of nurses toward the EMR system (32 items), and (iii) satisfaction of nurses with the EMR system (7 items). Nurses' background data included gender, age, years of experience in nursing, type of ward, level of nursing education, marital status, computer competencies, training, and daily time spent on the EMR system.

The perception of nurses toward the EMR system was rated on a 4-point Likert scale with the markers "1—strongly disagree," "2—disagree," "3—agree," and "4—strongly agree." Negative statements were reversed scored during the analysis. Therefore, the total scores ranged from 32 to 128 and were categorized into positive (total score of 81 and above) and negative (total score of 80 and below) for better interpretation.

The satisfaction of nurses with the EMR system was assessed using the same 4-point Likert scale as in the second section. The total scores ranged from 7 to 28 and were categorized into high (total score of 18 and above) and low (total score of 17 and below) for interpretation purposes.

The instrument was translated from English to Malay by linguistic experts in accordance with the World Health Organization's guidelines (World Health Organization, 2016). Minor modifications were made to the sentence structure based on the experts' comments during the validation process to ensure cross-cultural adaptation to the local community. A pilot study was conducted among 38 nurses, who were excluded from the actual study, and the results showed good internal consistency with Cronbach's alpha values of 0.845 for perception and 0.890 for satisfaction toward the EMR system.

Data Collection

Data were collected by using self-administered questionnaires distributed to nurses who met the predetermined inclusion criteria. The purpose of the study was explained briefly to them, and they were assured of their anonymity as well as the voluntary nature of their participation. A consent form was signed by nurses who agreed to participate in the survey. The nurses returned the completed questionnaire to the researcher in a sealed folder within 1–2 weeks. The softcopy of the data was kept in a secured software program and encrypted with a password that was only accessible by the researchers.

Statistical Analysis

All the collected data were analyzed descriptively using Statistical Package for Social Sciences (IBM SPSS Corp., Armonk, NY, USA) version 25. Descriptive statistics were used to evaluate frequencies, percentages, means, and standard deviations (SDs). The scores of nurses' perception of and satisfaction with the EMR system were normally distributed; accordingly, an independent t-test, analysis of variance (ANOVA), and post hoc test were used to determine associations between variables. The relationship between nurses' perception of and satisfaction with the EMR system was assessed through Pearson's correlation coefficient and multivariate hierarchical regression analyses. A *p* value of less than .05 was considered significant.

Ethical Considerations

The ethical approval for this study was obtained from the Medical Research Ethics Committee of University Malaya Medical Centre, Malaysia (Date: May 3, 2019, MRECID. NO: 201935-7194), and permission was granted by the Nursing Director before the data collection procedure. In addition, this study conforms to the provisions of the Declaration of Helsinki and the Caldicott Principle, whereby all participants gave informed consent for the study, and their anonymity was preserved.

Results

Participants' Demographics

A total of 350 questionnaires were returned with complete answers, yielding a response rate of 90%. This study was predominantly participated in by married ($n=213$, 60.8%) and female ($n=324$, 92.6%) nurses. The mean age of the nurses was 29.58 ($SD=4.31$), and the majority of them were between 26 and 32 years old ($n=151$, 43.2%). Almost half ($n=160$, 45.7%) of the nurses were working in surgical wards and had less than 5 years of nursing experience ($n=163$, 46.6%), and most of them had diploma in nursing education ($n=278$, 79.4%). Additionally, more than half had been exposed to the nursing informatics course ($n=194$, 55.4%), while a similar number stated that they had never received formal EMR training during their service in the hospital ($n=192$, 54.9%). Most of the nurses owned a personal computer or laptop ($n=242$, 69.1%) and reported spending more than 4 hours a day on the EMR system ($n=216$, 61.7%) (Table 1).

Nurses' Perception of and Satisfaction With the Electronic Medical Record System

This study discovered that most nurses have a positive perception toward the EMR system ($n=343$, 98%) with a mean score of 95.23 ($SD=8.95$; range=78-128). Almost all the nurses agreed with the system's usefulness, clear and comprehensible features, and easy accessibility to patient health records (Table 2). Nevertheless, approximately two-thirds ($n=232$, 66.3%) of the nurses claimed that the scattering of records has a poor system interface and requires multiple windows, making the documentation complex and delaying patient care delivery. In terms of nurses' satisfaction level with the EMR system, more than two-thirds ($n=248$, 70.9%) are moderately satisfied, with a mean score of 18.93 ($SD=3.06$; range=11-28). Table 3 shows the item analysis for the satisfaction domain. A vast majority of nurses claimed that they are satisfied with the availability of reliable technical support ($n=298$, 85.1%), feel comfortable using the EMR system ($n=331$, 94.6%), and are pleased with the timing of notices on EMR system upgrades ($n=266$, 76%). However, approximately half of the nurses reported dissatisfaction with the system's performance speed ($n=155$, 44.3%) and outage duration ($n=185$, 52.8%).

Nurses' Perception of and Satisfaction With the Electronic Medical Record System by Demographic Characteristics

The results in Table 3 indicate that nurses who own personal computers or laptops have a significantly more positive perception toward the EMR system ($M=95.98$, $SD=10.248$) compared to those who do not, $t(240.304)=-2.166$, $p=.03$. Meanwhile,

the ANOVA test found that nurses' perception toward the EMR system significantly differs across the type of the ward, whereby the nurses' perception score shows an increasing trend from the pediatric ward ($M=92.22$, $SD=7.833$) to the medical ward ($M=95.38$, $SD=9.876$) and surgical ward ($M=96.43$, $SD=10.316$), in that order, $F(2, 347)=4.326$, $p<.05$. The ANOVA test also revealed a statistically significant difference in nurses' perception toward the EMR system according to the daily time spent on the system, $F(2, 347)=6.149$, $p=.002$. Post hoc analysis using the Tukey post hoc test discovered that nurses who spend less than 2 hours a day ($M=98.04$, $SD=10.213$) have a better perception of the EMR system compared to those who spend 3-4 hours ($M=92.38$, $SD=7.882$) or more than 4 hours ($M=95.83$, $SD=10.222$) on the system per day.

Meanwhile, nurses' satisfaction level with the EMR system was also found to vary significantly by their Internet connection, training, and type of ward, as shown in Table 3. Nurses who face Internet connection problems were generally more dissatisfied with the EMR system ($M=18.48$, $SD=3.00$) compared to those with proper access to the Internet ($M=19.30$, $SD=3.07$), $t(348)=-2.511$, $p<.05$. In addition, a statistically significant difference in satisfaction was found with regard to EMR system training, $t(341.78)=-4.133$, $p<.001$. Lastly, the satisfaction score was lower among nurses from the medical ward ($M=18.39$, $SD=3.30$) but increased among those from the pediatric ward ($M=19.20$, $SD=2.85$) and surgical ward ($M=19.24$, $SD=2.90$), $F(2, 347)=3.056$, $p<.05$.

Relationship Between Nurses' Perception of and Satisfaction With the Electronic Medical Record System

The analysis results revealed a significant and moderate positive relationship between perception and satisfaction, $r=.495$, $p<.001$. This indicates that the satisfaction of nurses increases as their perception of the EMR system becomes more positive. Further analysis using multivariate hierarchical regression (Table 4) was done with the enter method to predict nurses' perception of the EMR system after controlling for variables identified as potential covariates in the multivariate analysis at an alpha level of 0.25. The result noted that the nurses' selected sociodemographic variables [type of ward (medical ward as reference group), internet connection, computer/laptop ownership, time spent on EMR (< 1 hour as reference group) and EMR training] in Model 1 significantly contributed to the regression model, $R^2=0.078$, $F(4, 345)=7.247$, $p<.001$, which accounted for 7.8% of the variation in satisfaction with the EMR system. The addition of the perception variable to the prediction of satisfaction with the EMR system (Model 2) led to a statistically significant increase in R^2 to 0.306, $F(5, 344)=30.327$, $p<.001$, explaining an additional 29.6% of the variation in satisfaction with the EMR system.

All the selected variables (Model 1) were found to be significant predictors of nurses' satisfaction with the EMR system, whereby the score increased by 0.936, 0.659, and 1.334 points for the type of ward, Internet connection, and EMR training, respectively. Furthermore, the regression coefficient ($B=0.152$) in Model 2 indicated an increment of 0.152 points in the average satisfaction score based on nurses' perception of the EMR system after controlling for the selected variables.

Table 1.
Items Analysis on Perception of Nurses Toward EMR System (N = 350)

Items	Disagree (Strongly Disagree, Disagree) n (%)	Agree (Agree, Strongly Agree) n (%)	Mean	SD
Perception on EMR system			26.24	3.45
1. The EMR system is useful.	5 (1.4)	345 (98.6)		
2. Easy to access patient records using the EMR system.	2 (0.6)	348 (99.5)		
3. Information from the system is accurate.	13 (3.7)	337 (96.3)		
4. Easy to understand the information from the system.	2 (0.6)	348 (99.5)		
5. The patient record is displayed in a structured format.	13 (3.7)	337 (96.3)		
6. I can retrieve information from EMR system easily.	21 (6.0)	329 (94.0)		
7. Easy to record patient data through EMR system.	26 (7.4)	324 (92.6)		
8. Easy to visualize and read patient records through EMR system.	13 (3.7)	337 (96.3)		
Perception on complexity of EMR system			13.77	1.70
9. I feel confident following the direction presented in EMR system.	25 (7.2)	325 (92.9)		
10. I find it difficult to understand the technical aspects of EMR system applications (e.g., instruction and key).*	137 (39.1)	213 (60.8)		
11. I can keep up with the rapid changes in EMR system.	41 (11.7)	309 (88.3)		
12. The scattering of records in the system causes delay in patient care delivery.*	232 (66.3)	118 (33.7)		
13. It is confusing to follow the sequence of data from the screens.*	131 (37.5)	219 (62.5)		
Perception on impact or benefit of EMR system on patient care			15.90	2.30
14. There are incidents of missing of patient records or data.*	165 (47.1)	185 (52.9)		
15. EMR system improves the quality of patient care.	33 (9.5)	317 (90.6)		
16. Patient information is more confidential with EMR system than manual records.	99 (28.3)	251 (71.7)		
17. Manual records are easy to store and retrieve than EMR system.*	116 (33.1)	234 (66.9)		
18. EMR system reduces the issues of accountability.	168 (48.0)	182 (52.0)		
19. Multiple layers of pages making the documentation complex.*	211 (60.2)	139 (39.7)		
Perception on impact of EMR system on personal work			12.05	1.75
20. With the EMR system, I am able to finish my work much faster.	86 (24.6)	264 (75.4)		
21. I spent less time on documentation with EMR system.	132 (37.7)	218 (62.3)		
22. I am able to follow patient progress better with EMR system.	17 (4.9)	333 (95.2)		
Perception on usefulness			15.06	2.36
23. EMR system reduces a lot of paper works.	9 (2.6)	341 (97.4)		
24. EMR system usage can reduce medication and other errors.	136 (38.9)	214 (61.2)		
25. EMR system usage improves efficiency and productivity.	34 (9.7)	316 (90.3)		
26. EMR system usage improves quality of decision-making.	42 (12.0)	308 (88.0)		
27. Patient information and lab results can be retrieved or accessed in a timely manner.	17 (4.9)	333 (95.1)		
28. Communication with other healthcare teams is easier with EMR	42 (12.0)	308 (88.0)		
Perception on training needs			12.19	1.78
29. EMR system should be made compulsory for patient management.	29 (8.3)	321 (91.8)		
30. The EMR system is easy to learn.	19 (5.4)	331 (94.6)		
31. I am familiarized with the EMR system.	10 (2.9)	340 (97.1)		
32. I received adequate training on how to use EMR system.	111 (31.7)	239 (68.3)		

Note: EMR=Electronic medical record.
Negative statement—the above analysis after reverse scored.

Table 2.
Items Analysis on Satisfaction of Nurses With EMR System (N=350)

Items	Disagree (Strongly Disagree, Disagree) n (%)	Agree (Agree, Strongly Agree) n (%)	Mean	SD
Satisfaction toward EMR system			18.93	3.06
1. I am happy with the system performance speed.	155 (44.3)	195 (55.8)		
2. I feel comfortable to use the EMR system.	19 (5.4)	331 (94.6)		
3. I am satisfied with the adequate number of computers/laptops provided in my unit to access the EMR system.	207 (59.2)	143 (40.8)		
4. The system outage duration is acceptable.	185 (52.8)	165 (47.1)		
5. I am satisfied with the technical support (IT experts) available for EMR system.	52 (14.9)	298 (85.1)		
6. I am satisfied with the timing of notice given regarding upgrading of EMR system.	284 (24.0)	266 (76.0)		
7. Overall, I am satisfied with the EMR system.	31 (8.9)	319 (91.1)		

Note: EMR=Electronic medical record.

Discussion

The sample of nurses in this study was female-dominated, reflecting the nature of the nursing profession in Malaysia. This is similar to a study conducted in Saudi Arabia (Aldosari et al., 2018), given the gender stereotypes related to caring and nurturing in the nursing industry (Hardie, 2015). Meanwhile, only 20% of the nurses in this study have obtained an advanced diploma in various disciplines such as critical care, emergency, midwifery, nephro-urology, and pediatric nursing. The demographic characteristics of nurses in Malaysia may differ from the qualifications of nurses in other countries. Registered nurses were required to complete either a Diploma in Nursing (3-year program) or a Bachelor of Nursing Science (4-year program). The former allows students to pursue nursing studies right after completing secondary school education, while the latter requires a pre-university program. Therefore, most nurses usually held a diploma for the minimum educational criterion required by the Malaysia Nursing Association to obtain a practicing license (Sowtali, 2019).

Almost half of the nurses had less than 5 years of working experience, presumably due to rapid nursing staff turnover (Kahouei et al., 2014). Likewise, it was revealed that most nurses had limited EMR system experience, basic computer literacy, and nursing informatics training. This deficiency needs attention as it may affect their competency with the system when providing nursing care (Tipping et al., 2010). This study further found that more than 60% of the nurses spent over 4 hours daily on the EMR system, in contrast to an average of 3 hours per day spent by nurses in the United States (Higgins et al., 2017) for documentation, review, and medication preparation activities.

The Perception of Nurses Toward the Electronic Medical Record System

The current study revealed that nurses positively perceive the EMR system, which has also been observed in a previous study (Jaber et al., 2021). Despite this finding, some nurses reported a negative perception toward the system, presumably due to

their lack of knowledge and distrust in the EMR system's usage (Alturki, 2017). In addition, a substantial majority of nurses in this study claimed that the scattering of records in the system causes delays in patient care delivery, whereas manual records are easy to store and retrieve compared to the EMR system.

Likewise, a study conducted among nurses working in a 2032-bed hospital in India (Jathanna, 2017) also reported negative perceptions toward the EMR system due to tedious documentation through multiple tabs or web pages and a lack of several nursing-focused aspects in the system. Therefore, it is important to involve nursing personnel in the development and redesign of the EMR system to improve the efficiency of nursing documentation and thus provide better nursing plans for patients (Daly, 2015). Moreover, almost half of the nurses in this study agreed that there were incidents of missing patient records or data due to poor data backup during electrical breakdowns, which echoes previous findings in India (Jathanna, 2017). These problems are barriers to technology acceptance among nurses, leading to their negative perception (Alsohime et al., 2019).

An interesting finding is that most nurses agreed that EMR system usage can reduce medication and other errors as well as enhance the quality of clinical care provided to patients, which is consistent with the existing literature (Sharikh et al., 2020). Also, the EMR system was found to be able to tackle issues of misinterpretation of doctors' handwriting (Ditya & Adisasmitho, 2019) and delayed medication administration (Durham et al., 2016) that arise from traditional paper-based documentation. This study also reported a high agreement rate pertaining to the better confidentiality of patient information with the EMR system compared to manual records. A review on privacy challenges in the EMR system discussed several efforts to ensure better health information security by complying with the Personal Data Protection Act 2010 and the Private Healthcare Facilities and Services Act 1998 (Rahim et al., 2014). This includes secure workstations, password requirements for all users, and controlled access to the system exclusively for staff with ID to prevent access by unauthorized persons.

Table 3.
Nurses' Perception and Satisfaction Toward EMR System According to Demographic Characteristics (N=350)

Demographic	n	Perception ($\bar{x} \pm SD$)	Statistical Value	p	Satisfaction ($\bar{x} \pm SD$)	Statistical Value	p
Gender			-1.558 ^t	.131		1.817 ^t	.070
Female	324	94.98 ± 9.556			19.02 ± 3.03		
Male	26	98.88 ± 12.491			17.88 ± 3.24		
Year of experience			1.915 ^a	.149		.078 ^a	.925
5 and less	163	94.65 ± 10.058			18.91 ± 3.19		
6–10	116	96.72 ± 9.450			19.02 ± 3.02		
Above 10	71	94.32 ± 9.811			18.85 ± 2.84		
Ward			4.326 ^a	.014*		3.056 ^a	.048*
Medical	125	95.38 ± 9.876			18.39 ± 3.30		
Surgical	160	96.43 ± 10.316			19.24 ± 2.90		
Pediatric	65	92.22 ± 7.833			19.20 ± 2.85		
Age (in years)			.223 ^a	.800		.740 ^a	.478
25 and less	130	95.19 ± 10.682			19.18 ± 3.07		
26–32	151	95.61 ± 9.475			18.84 ± 3.29		
33 and above	69	94.67 ± 9.022			18.67 ± 2.47		
Nursing education level			1.749 ^t	.083		1.953 ^t	.052
Diploma	278	95.69 ± 10.143			19.09 ± 3.16		
Advanced diploma	72	93.65 ± 8.414			18.31 ± 2.57		
Marital status			.169 ^a	0.845		1.331 ^a	0.266
Single	134	95.34 ± 9.586			19.27 ± 2.80		
Married	213	95.27 ± 10.037			18.72 ± 3.21		
Divorced/widowed	3	92.00 ± 8.660			19.00 ± 1.73		
Computer or laptop			-2.166 ^t	.031*			
No	108	93.68 ± 8.678			18.67 ± 2.88	-1.081 ^t	0.281
Yes	242	95.98 ± 10.248			19.05 ± 3.13		
Internet connection			-.629 ^t	.530		-2.511 ^t	.013*
No	159	94.91 ± 9.838			18.48 ± 3.00		
Yes	191	95.57 ± 9.850			19.30 ± 3.07		
Computer training			2.360 ^a	.053		1.001 ^a	.407
No	42	95.12 ± 9.534			18.8 ± 2.91		
Yes, learning while in school	194	95.27 ± 9.529			19.06 ± 2.99		
Yes, learning by attending formal computer training	47	96.23 ± 11.362			19.17 ± 3.66		
Yes, learning while on-the-job	49	92.55 ± 9.813			18.14 ± 3.23		
Yes, self-learning using resources	18	100.50 ± 7.868			19.17 ± 1.50		
EMR training			-1.472 ^t	.142		-4.133 ^t	.001*
No	192	94.57 ± 10.377			18.35 ± 3.39		
Yes	158	96.12 ± 9.095			19.64 ± 2.43		
Daily time spent on EMR			6.149 ^a	.002*		1.997 ^a	.137
2 hours and less	47	98.04 ± 10.213			19.70 ± 3.09		
3–4 hours	87	92.38 ± 7.882			18.61 ± 2.53		
More than 4 hours	216	95.83 ± 10.222			18.89 ± 3.23		

Note: EMR= Electronic medical record; ANOVA= analysis of variance.

*p < .05= significant; ^tAnalyzed based on independent t-test; ^aAnalyzed based on one-way ANOVA.

Table 4.
Multiple regression analysis on nurses' satisfactions towards the EMR system (N=350)

Variables	Model 1				Model 2				
	B	SE B	β	p	B	SE B	β	p	
(Constant)	17.425	.339		.0001**	3.168	1.372		.0001**	
Type of ward									
Surgical vs. Medical	.936	.357	.152	.020*	.756	.311	.123	.028*	
Pediatric vs. Medical	.631	.456	.080	.062	1.144	.399	.145	.043*	
Internet connection	.659	.321	.107	.018*	.543	.279	.088	.024*	
EMR training	1.334	.321	.217	.0001**	1.048	.280	.171	.0001**	
Perception					.152	.014	.487	.078	
F	7.247			.0001**	30.327			.0001*	
R ²	.078				.306				
ΔF	7.247				113.218				
ΔR^2	.067				.296				

a. Note: N=350, B=regression coefficient; SE B=standard error; β =beta coefficient; ΔF =adjusted F. ΔR^2 =adjusted R²; *p < .05; **p < .001.
 b. Dependent variable: Nurses' perception towards EMR system (Model 1), Nurses' satisfaction towards EMR system (Model 2).
 c. Predictor: type of ward, computer/laptop ownership, time spent on EMR system (Model 1), type of ward, internet connection, EMR training (Model 2).
 d. Note: Type of ward was represented as two dummy variables with medical ward serving as the reference group.
 e. Note: Daily time spent on the EMR system was represented as three dummy variables with < 1 hour serving as the reference group.

The Satisfaction of Nurses With the Electronic Medical Record System

This study found that nurses were satisfied with the EMR system, which corresponds with the finding of a study in Turkey by Top and Gider (2012), where the nurses who were satisfied with the system had received adequate training and perceived that their productivity had greatly improved. Most of the nurses in this study also appeared satisfied with the system's performance speed, as patient information could be updated effectively and systematically, and a better treatment plan could be executed for patients (Zaheer & Sayed, 2014). However, some nurses in this study expressed low satisfaction with the availability of technological devices (e.g., computer or laptop), which is considered one of the most important factors to motivate nurses' engagement with the EMR system (Top & Gider, 2012). Additionally, the cost of devices and lack of funds for healthcare have also been major issues in the development and implementation of the EMR system (Top & Gider, 2012), which should be overcome with effective planning and budgeting.

Associations Between the Perception and Satisfaction of Nurses Toward the Electronic Medical Record System by Demographic Characteristics

This study noted a significant difference between nurses' perceptions toward and satisfaction with the EMR system according to their type of ward, whereby those from the surgical department reported better perception and satisfaction scores. However, a study in Iran (Kahouei et al., 2014) found that the type of ward does not affect nurses' perception toward the system, though it affects their satisfaction. This difference is expected due to the varied intensity of nursing work by the nature of the ward and its respective patient care management (Ahn et al., 2006).

The results also showed that nurses who own a computer or laptop perceive the EMR system more positively because they are more familiar with technology navigation. Indeed, to encourage effective electronic documentation, nurses should demonstrate basic familiarity with the use of computers as well as basic competence with computer software applications and electronic communication tools for creating and sharing professional documents (Raddaha, 2017). The satisfaction level was also found to significantly differ according to nurses' EMR training experience and Internet connection, which are considered important factors in improving nurses' perception and satisfaction toward the system (Longhurst et al., 2019). However, both variables were not shown to impact the nurses' perception score.

Lastly, the study revealed that nurses who spend less than 2 hours a day using the EMR system tend to have a higher perception of it. It can be assumed that nurses who spend shorter periods on the EMR system have good levels of computer literacy, productivity, and time management (Kahouei et al., 2014). Nonetheless, the association between time spent and satisfaction should be explored further for a more reasonable explanation.

Relationship Between Nurses' Perception of and Satisfaction With the Electronic Medical Record System

A significant positive relationship was established between nurses' perception and satisfaction toward the EMR system in this study. This finding is supported by a previous study in Saudi Arabia (Khalifa & Alswailem, 2015), which suggested a strong positive relationship between the technology acceptance model factors of perceived usefulness and perceived ease of use. The study also revealed that EMR system usage, quality, and user satisfaction are likely significantly correlated (Top & Gider, 2012). Despite the positive perception of the EMR

system's usefulness, benefits for patient care, and favorable impact on nurses' work, nurses seem to be generally dissatisfied with the inadequate access to computers or laptops in the ward unit, the unacceptable duration of system outages, and the short notice of system upgrades.

Study Limitations

Several limitations have been identified in this study. Due to its cross-sectional design, it is not possible to ascertain the temporal relationship between the explanatory variables and the outcome variable. In addition, the EMR system is evolving, and some of the issues and concerns raised here may be temporary and change from time to time. Moreover, the study sample only involved nurses from one teaching hospital; therefore, the findings of the study may not be generalizable to the entire nurse population. The structured questionnaire with close-ended questions could further pose a constraint in this study.

Conclusion and Recommendations

Overall, nurses' perception of the EMR system is positive, explaining more than 30% of the variance in satisfaction with the EMR system in this study. This finding highlighted that it is imperative to ensure nurses' expectations are met with regard to the system. The findings indicate that nurses' perceptions differ based on their daily time spent on the system, while their satisfaction improves with EMR training. Thus, the EMR system should be revised to reduce the time spent on documentation to facilitate more time for patient care. Time-saving measures can include easy charting and data entry features such as checkboxes, dropdowns, and copy-and-paste.

Other than that, training nursing staff on the components of the EMR system is encouraged to maximize their utilization of the EMR system, especially for users who have not attended any computer and information technology courses. The number of computers and laptops available should be increased as well based on the staffing ratio. These improvements may be costly but could engender substantial benefits in work performance. Furthermore, it is recommended to involve nurses in the informatics team to consider their suggestions and feedback when customizing and modifying the EMR system. The EMR system implementation teams should also involve nurses in system evaluation and remodeling. Collecting feedback from nurses regarding the system will make their work easier and support their provision of quality care for patients.

From the education perspective, nursing schools are advised to incorporate general computer and information technology courses in their curriculum so that nursing students will be able to use the EMR system comfortably when performing nursing care upon graduation. Looking ahead, it is necessary to explore the perception and satisfaction of healthcare providers other than nurses in the EMR system context. Future research is also suggested to explain the effects of EMR system usage on nursing work as well as patient safety and outcomes, apart from the potential effects of limited computer literacy on quality nursing care.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of University Malaya Medical Centre, Malaysia (Date: May 3, 2019, MRECID.NO: 201935-7194).

Informed Consent: Written informed consent was obtained from all participants who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – V.R., A.K.; Design – V.R., A.K.; Supervision – V.R.; Resources – A.K.; Materials – A.K.; Data Collection and/or Processing – A.K.; Analysis and/or Interpretation – V.R., A.K., W.N.F.W.N.; Literature Search – A.K., W.N.F.W.N.; Writing Manuscript – W.N.F.W.N.; Critical Review – V.R., C.C.C., K.R.

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Supplementary Table 1.

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

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

(Continued)

Supplementary Table 1.

STROBE Statement—checklist of items that should be included in reports of observational studies. (Continued)

	Item No.	Recommendation	Page No.	Relevant text from manuscript
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	5–6	
		(b) Indicate number of participants with missing data for each variable of interest	N/A	
		(c) <i>Cohort study</i> —Summarise follow-up time (eg, average and total amount)	N/A	
Outcome data	15*	<i>Cohort study</i> —Report numbers of outcome events or summary measures over time		
		<i>Case-control study</i> —Report numbers in each exposure category, or summary measures of exposure		
		<i>Cross-sectional study</i> —Report numbers of outcome events or summary measures	6–9	
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	N/A	
		(b) Report category boundaries when continuous variables were categorized	6 & 7	
		(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	8–9	
Discussion				
Key results	18	Summarise key results with reference to study objectives	9–13	
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	13	
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	9=13	
Generalisability	21	Discuss the generalisability (external validity) of the study results	13	<i>Under limitation</i>
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	Title page	

*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.