ORIGINAL RESEARCH

Opinions, perceptions and attitudes toward an electronic health record system among practicing nurses

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ABSTRACT

Background: Despite worldwide expanding implementation of electronic health record (EHR) systems, healthcare professionals conducted limited number of studies to explore factors that might facilitate or jeopardize using these systems. This study underscores the impact of nurses' opinions, perceptions, and computer competencies on their attitudes toward using an EHR system.

Methods: With randomized sampling, a cross-sectional exploratory design was used. The sample consisted of 169 nurses who worked at a public teaching hospital in Oman. They completed self-administered questionnaire. Several standardized valid and reliable instruments were utilized.

Results: Seventy-four percent of our study nurses had high positive attitudes toward the EHR system. The least ranked perception scores (60.4%) were linked to perceiving that suggestions made by nurses about the system would be taken into account. Nurses who reported that the hospital sought for suggestions for customization of the system [OR: 2.54 (95% CI: 1.09, 5.88), *p* = .03], who found the system as an easy-to-use clinical information system [OR: 6.53 (95% CI: 1.72, 24.75), *p* = .01], who reported the presence of good relationship with the system's managing personnel [OR: 3.59 (95% CI: 1.13, 11.36), *p* = .03] and who reported that the system provided all needed health information [OR: 2.97 (95% CI: 1.16, 7.62), *p* = .02] were more likely to develop high positive attitudes toward the system.

Conclusions: To better develop plans to foster the EHR system's use facilitators and overcome its usage barriers by nursing professionals, more involvement of nurses in system's customization endeavors is highly suggested. When the system did not disrupt workflows, it would decrease clinical errors and expand nursing productivity. In order to maximize the utilization of the system in healthcare delivery, future research work to investigate the effect of the system on other healthcare providers and inter-professional communications is pressingly needed.

Key Words: Attitudes, Electronic health record, Nurses, Opinions, Perceptions

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1. INTRODUCTION

1.1 Background

The electronic health record (EHR) systems have been existing for several years in healthcare facilities, with increasing implementation around the globe.[1–3] EHR system, which is also called electronic medical record system and health information system, is a patient-care platform used to gather, store, process, and present organized information associated with healthcare encounters.[4,5]

The EHR systems are infused in healthcare facilities to replace traditional paper-based health record systems, with ultimate aims such as improving effective patient care through providing comprehensive yet easily accessed patient-centered digitalized health record, and sharing information across healthcare professionals to better coordinate delivered care.[3,6]

Evaluating the use of EHR systems by healthcare professionals is important as they use such systems during providing health care activities. Despite the rapid implementation of EHR systems worldwide, there is scant information about nurses' opinions, perceptions and attitudes toward these systems. Understanding their opinions, perceptions and attitudes could support in developing plans to overcome potential system use barriers, reduce clinical errors, and expand nursing productivity as well as clinical care outcomes.

1.2 Research objectives

The primary objectives of this study were: (a) to explore opinions, perceptions and attitudes of nurses regarding the use of the EHR system, (b) to assess levels of nurses' computer competencies, and (c) to determine the predictors of positive attitude toward the EHR system among nurses.

The secondary objectives were: (a) to identify which aspects of the EHR system were perceived by nurses as promoting or hindering their task performance, and (b) to explore the roles of the EHR system's managing personnel to optimize nurses' use of the system.

1.3 Literature review

It is necessary to evaluate nurses' opinions and perceptions toward the EHR system to ensure that it adequately meets clinical nursing expectations. The EHR system may affect nurses' ability to effectively and efficiently perform their roles.[1,7] That is, integration of EHR systems in the work may require nurses to change their workflow.[8] Few studies were conducted to assess the effect of using EHR systems among nurses, and some factors found to be potential facilitators and barriers for using such systems.

Evaluating the effect of using EHR systems on nurses, who comprise of the largest segment of healthcare professionals in healthcare facilities, is paramount. As the system may facilitate or hinder nurses' daily workflow patterns, findings could assist in improving the EHR system timeliness and efficiency to enhance nurses' productivity.

Previous research studies showed little and conflicting evidence on the impact of the EHR system on the time spent to record and provide direct patient care activities by nurses. Some studies found that the EHR system decreases required nursing documentation time and increases time for direct care.[2,9–11] Whereas, other studies reported no significant change on time.[1,12,13] Yet, an increase in time required for documenting nursing care was reported by two studies.[1,7] In order to support policy planning for health to achieve better quality of healthcare outcomes, work demands after using EHR systems should be evaluated as they are might be considered barriers faced by nurses when they use such healthcare technology.[4]

The EHR systems have the ability to replace traditional paper-based medical record systems.[13,14] However, as the number of screens accessed for data entry or information retrieval increases, time spent interacting with the EHR system increases. Kossman and Scheidenhelm[7] found that many factors had hindered nurses work performance during their use of the EHR system, such as interfacing with high numbers of screens and having no guidelines to improve consistency in documentation. Likewise, higher cognitive load and attention are expected from nurses when more information presented on the EHR system screen. Some nurses may report anxiety and frustration when they use the EHR system. Increased anxiety can reduce the cognitive attention of nurses, and, thus, it can increase the potential for clinical nursing errors.[15]

Attitude of nurses toward the EHR system may affect its usage level.[1,7] Positive attitude begins when the system is perceived by nurses to meet and facilitate performing nursing activities in the practice setting. Kossman and Scheidenhelm[7] reported that nurses preferred the EHR system over paper-based health record system, with some recommendations for better performance. However, they thought that the benefits of the EHR system outweighed its limitations. It is advocated that nurses should be involved in system customization to help them in performing clinical duties.[7] Rose et al.'s[15] study also showed that nurses usage of the system was significantly influenced by the degree of nursing involvement in system customization efforts. Timmons[16] in a sociological perspective study, evaluated nurses' resistance in the workplace to use the EHR system, and found that nurses' resistance had occurred once they believed that the

system did not provide benefits for them. Likewise, Samoutis et al.[17] found that the use of the EHR system had negatively affected workflow and some legal concerns were arisen.

Despite the increased utilization of EHR in healthcare settings, yet limited number of studies have assessed the nurses' opinions, perceptions and attitudes toward the EHR systems. Yet, these studies have shown little and conflicting clinical evidence. Besides, no previous studies were conducted to explore these aspects among nurses in Oman, which is a country on the southern coast of the Middle East gulf peninsula.

2. METHODS

2.1 Design
A cross-sectional exploratory design was used.

2.2 Setting and sample
Participants were recruited from a public teaching hospital located in Muscat, Oman. The hospital has 528 bed-capacity and offers a broad range of primary, secondary and tertiary healthcare, education and medical research services in Oman.

Random sampling was used to select 200 participants among 1,210 nurses (the total number of nurses who were working at the participating hospital when data collection process had started). Only 169 of the 200 nurses agreed to participate and completed a self-administered questionnaire.

Nurses were considered candidates for participation when they met the following inclusion criteria: (a) be employed in the hospital for at least 3 months (to have valid experience in using the EHR system), (b) used the EHR system to perform job duties and expectations, and (c) be able to understand/comprehend the English language. Each participant was provided 8 gigabytes USB flash drive as a token-of-appreciation for taking part of the study. Data collection took place over an eight-month period (March to October 2014).

2.3 Measurements
The self-administered questionnaire had sections about several aspects including sociodemographic, clinical, computer competencies, along with nurses' opinions, perceptions and attitudes toward the EHR system. Several standardized valid and reliable instruments were utilized.

Computer competencies were assessed using the Computer Competency Survey.[18, 19] It consists of items about specific computer competencies such as general computer knowledge (concerned about software and hardware) and documents and documentation (concerned about word processing). Each item has 3-point response options: "yes", "not sure, but likely" and "no or unlikely". Cronbach's alpha for the sub-

scales were between 0.64 and 0.89.[18, 19] Opinions about the EHR system were assessed using adopted items of an instrument developed by Su et al.[20] They were used to uncover nurses' opinions about the EHR systems when compared with traditional paper-based medical record systems, locations and numbers of computers, quality and efficiency of documentation, clinical error reduction, and enhancing patient safety quality. Each item has 4-point response options: "strongly agree", "agree", "disagree" and "strongly disagree". Cronbach's alpha for the scale was 0.98.[20]

Perceptions toward the EHR system were assessed using an instrument developed by Oroviogoicoechea et al.[21] It consists of items about three factors: (a) "Usability" factor items, which elicit responses about the ease of use and the integration of the system in daily nursing activities. (b) "Information Technology Support" factor items, which elicit responses about the relationship with the system managing personnel, relevance of changes introduced into the system to nursing, and problems with the system itself being understood by the system managing personnel. (c) "Information Characteristics" factor items, which elicit responses about content and accessibility of the health information through the system. Each item has 5-point response options: "strongly agree", "agree", "do not know", "disagree" and "strongly disagree". Cronbach's alpha for the scale was 0.93.[21] The attitude toward the EHR system was assessed using a single question "How do you describe your attitude toward the EHR system?" with a Likert scale ranging from "-5 = Negative" to "5 = Positive", with a score of ≥ 4 as a cutpoint to indicate a high level of attitude, while a score of "0" to indicate a neutral attitude.

2.4 Ethical considerations
A research committee at a public university's college of nursing, along with the research institutional review board of the participating hospital approved this study. Participants were assured that their responses would be treated confidentially and anonymously. The participation was on voluntary basis, and the participants were invited to sign consent forms.

2.5 Data management and analysis
Data were analyzed using IBM SPSS Statistics (version 25) program. The data were double-entered to verify accuracy of entered data. Means and standard deviations for continuous variables and frequencies and percentages for categorical or rank variables were calculated. Dichotomizing continuous variables at median score was used to create "high" and "low" groups.[22–24] The attitude of the nurses toward the EHR system was the dependent outcome variable.

To explore the relationship between the study variables, Pear-

son r correlation coefficient was used between parametric continuous variables, while Spearman rho correlation coefficient was used to determine the correlation with nonparametric and categorical or rank variables. Chi-square and univariate logistic regression analyses were employed. Multivariate logistic regression was used to identify independent predictors associated with high vs. low attitude toward the EHR system status. Odds ratios (OR) with 95% confidence intervals (CI) were presented. All statistical analyses were carried out using two-tailed tests and $\alpha = .05$.

3. RESULTS

3.1 Participants' characteristics

Most of the study participants were females (82.2%, n = 139) and married (82.8%, n = 140). In relation to employment title, almost ninety percent of them were staff nurses (also called registered nurses). Table 1 shows that about half of the

participants (n = 85) completed diploma/associate college education, while the remainders completed at least baccalaureate education. The participants' average age was 39.20 ($\pm$ 9.43) years. They had an average of 15.95 ($\pm$ 8.72) years in nursing profession, and an average of 5.93 ($\pm$ 2.4) years of experience with the EHR system.

As displayed in Figure 1, seventy-four percent of our study participants had high positive attitudes toward the EHR system. Gender, marital status, employment title, age, years of nursing work experience and years of experience while using the EHR system did not yield significant correlation with nurses' attitude toward the EHR system. However, significant negative correlation was observed between having a high positive attitude toward the EHR system with increasing level of academic nursing education (rho = 0.194, $p = .01$). The correlation coefficients were shown in Table 1.

Table 1. Description of participants' characteristics and their correlation coefficients with the scores of attitude toward the EHR system

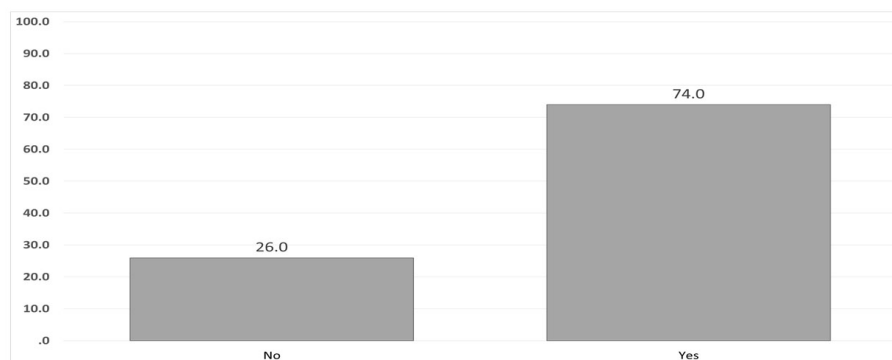| Variable	Mean	S.D.	Pearson Correlation (*r*)	*p*
Age (in years)	39.20	9.43	-.086	.26
Nursing Career Experience (in years)	15.95	8.72	.031	.68
Experience with the Current EHR System (in years)	5.93	2.40	-.028	.72
Variable	**%**	***f***	**Spearman's *rho* Correlation**	***p***
Gender				
Female	82.2	139	-.061	.43
Male	17.8	30		
Marital Status				
Married	82.8	140	.122	.11
Unmarried	17.2	29		
Employment Title				
Staff/Registered Nurse	89.3	151	-.037	.63
Charge/Administrator Nurse	10.7	18		
Nursing Educational Preparation				
Diploma/Associate	50.3	85	-.194*	.01
Baccalaureate and Above	49.7	84		

* Significant correltion was noted.

Figure 1. Percentage of participants who showed high attitude toward the EHR system

3.2 Information systems experiences

Almost ninety-four percent of the participants (n = 159) reported using the computer several times every working day. When asked about their usage of software programs other than EHR itself, 34.3% (n = 58) reported that they do not use any other software program. Other than during work, 78.7% (n = 133) reported spending 1 to 6 hours online weekly surfing the internet, yet 18.3% (n = 31) reported spending more than 6 hours. As shown in Table 2, one hundred fifty six participants (92.3%) stated owning a personal desktop or laptop computer. Among them, one hundred thirty five

(86.5%) reported that they had internet connection on their computers.

When the participants were asked if the hospital does ask for suggestions for customization or configuration to the EHR system, only 39.6% (n = 67) responded "Yes". When they were asked the latter question, a statistically significant higher proportion of the group who had high positive attitude toward the EHR system reported "Yes" compared to the low attitude group (33.1% vs. 6.5%) (χ^2 = 5.332, df = 1, p = .02).

Table 2. Descriptions and comparisons of information systems experiences by attitude group

Responding "Agree" or "Strongly Agree" to the item …	All Participants (N = 169)	Nurses with Low Attitudes (n = 44, 26%)	Nurses with High Attitudes (n = 125, 74%)	χ^2	p
	% (n)	% (n)	% (n)		
How frequent do you use the computer in your work?					
Several times per week	5.9 (10)	1.2 (2)	4.7 (8)	.201	.65
Several times per day	94.1 (159)	24.9 (42)	69.2 (117)		
Other than the EHR system, how many software programs do you use usually?					
None	34.3 (58)	10.1 (17)	24.3 (41)	.856	
1-2 programs	44.4 (75)	10.7 (18)	33.7 (57)		.84
3-4 programs	13.6 (23)	3.0 (5)	10.7 (18)		
More than 4 programs	7.7 (13)	2.4 (4)	5.3 (9)		
Do you have internet connection on your own personal desktop or laptop computer? #					
No	13.5 (21)	2.6 (4)	10.9 (17)	.656	.42
Yes	86.5 (135)	23.7 (37)	62.8 (98)		
What is the total number of hours you spend online per week (other than during the work hours)?					
None	3.0 (5)	1.2 (2)	1.8 (3)	2.608	
1-2 hours	40.2 (68)	9.5 (16)	30.8 (52)		.63
3-4 hours	24.9 (42)	8.3 (14)	16.6 (28)		
5-6 hours	13.6 (23)	3.6 (6)	10.1 (17)		
More than 6 hours	18.3 (31)	3.6 (6)	14.8 (25)		
To your knowledge, does the hospital ask for suggestions for customization or configuration to specific parts of the EHR system?					
No	60.4 (102)	19.5 (33)	40.8 (69)	5.332*	.02
Yes	39.6 (67)	6.5 (11)	33.1 (56)		

n = 156, where the others do not have personal desktop or laptop computers. * Significant difference was noted.

3.3 Opinions about using the EHR system

As shown in Table 3, most of our study participants reported positive opinions about using the EHR system. The ranked order of opinions about the EHR system showed "The EHR system helps me to write correct patient records" as being the most frequently reported opinion (99.4%, n = 168) and "The locations and numbers of computers are appropriate for users to operate the EHR system" being the least frequently reported opinion (63.9%, n = 108).

Statistically significant differences between high and low attitude groups were noted. All the nurses in the high attitude group compared with 95.5% low attitude group nurses endorsed that "The EHR system helps me to confirm a patient's history and discover potential disease than the traditional paper-based one" and "The EHR system provides me a more comprehensive medical record than the traditional paper-based one" (χ^2 = 5.75, df = 1, p = .02). About ninety-three percent of low attitude group compared with all of high

attitude group agreed that "The EHR system helps me to search for a patient's previous data easier than the traditional paper-based one" (χ^2 = 8.677, df = 1, p < .01). Also, about ninety-four percent of high attitude group nurses compared with about eighty-four percent of low attitude group nurses endorsed "The EHR system helps me to save my time in writing patient records" (χ^2 = 4.552, df = 1, p = .03).

Table 3. Descriptions and comparisons of opinions about using the EHR system by attitude group

Responding "Agree" or "Strongly Agree" to the item …	All Participants (N = 169)	Nurses with Low Attitudes (n = 44, 26%)	Nurses with High Attitudes (n = 125, 74%)	χ^2	p
	% (n)	% (n)	% (n)		
The EHR system helps me to write correct patient records.	99.4 (168)	97.7 (43)	100.0 (125)	2.858	.09
The EHR system helps me to confirm a patient's history and discover potential disease than the traditional paper-based one.	98.8 (167)	95.5 (42)	100.0 (125)	5.750*	.02
The EHR system provides me a more comprehensive medical record than the traditional paper-based one.	98.8 (167)	95.5 (42)	100.0 (125)	5.750*	.02
The interfaces of this EHR system are convenient for me to key-in (type) data into patient record.	98.8 (167)	97.7 (43)	99.2 (124)	.604	.44
The EHR system helps me to search for a patient's previous data easier than the traditional paper-based one.	98.2 (166)	93.2 (41)	100.0 (125)	8.677*	.00
The EHR system helps me to complete medical record easier than the traditional paper-based one.	97.0 (164)	95.5 (42)	97.6 (122)	.522	.47
The EHR system helps me save my time in waiting for patient records delivery when comparing with the traditional paper-based one.	97.0 (164)	97.7 (43)	96.8 (121)	.097	.75
The EHR system helps the hospital to enhance patient safety.	96.4 (163)	93.2 (41)	97.6 (122)	1.855	.17
The EHR system helps me to save my time in writing patient records.	91.7 (155)	84.1 (37)	94.4 (118)	4.552*	.03
The EHR system helps the hospital to reduce operating cost when compared with traditional paper-based one.	90.5 (153)	86.4 (38)	92.0 (115)	1.206	.27
The EHR system helps professionals to reduce medical errors in writing medical records.	89.3 (151)	86.4 (38)	90.4 (113)	.557	.46
The locations and numbers of computers are appropriate for users to operate the EHR system.	63.9 (108)	52.3 (23)	68.0 (85)	3.490	.06

 * Significant differences were noted.

3.4 Perceptions about the EHR system usage

The ranked order (most to least) for perceptions about using the EHR system showed perceiving that the data entered into the system as important for patient care, and that the system itself is integrated in nurse daily work as the top reported positive perceptions (97%, each). The least ranked perceptions scores linked to perceiving that suggestions made by the participating nurse about the system would be taken into account (60.4%).

Figure 2 displays the statistically significant differences in nurses' perceptions toward the EHR system between low and high attitude groups. Differences noted in the responses con-

cerning two perceptions about the EHR's "Usability". The high attitude group reported higher agreement than the low attitude group toward the system's ease of learning (98.4% vs. 86.4%, χ^2= 10.455, df = 1, p < .001) and the system's ease of use (96.8% vs. 79.5%, χ^2 = 13.645, df = 1, p < .001).

Four differences regarding the "Information Technology Support" factors were found. When compared with low attitude group, high attitude group more agreed that the relationship with the personnel of the department of informatics is good (94.4% vs. 79.5%, χ^2 = 8.378, df = 1, p < .001), suggestions made had been taken into account (64.8% vs. 47.7%, χ^2 = 3.964, df = 1, p < .05), response time to the introduction

of an improvement in the EHR system is adequate (79.2% vs. 59.1%, χ^2 = 6.834, df = 1, p < .01), and the changes introduced into the EHR system had importance for daily work (94.4% vs. 77.3%, χ^2 = 10.552, df = 1, p < .01).

When the participants were asked about their perceptions about the EHR system's "Information Characteristics" fac-

tors, three differences were surfaced. High attitude group were more certain about the reliability of documented data (94.4% vs. 81.8%, χ^2 = 6.370, df = 1, p = .01). They found "all the information they need" (89.6% vs. 68.2%, χ^2 = 11.121, df = 1, p < .01), and they reported that the EHR system information is always updated (85.6% vs. 63.6%, χ^2 = 9.769, df = 1, p < .001).
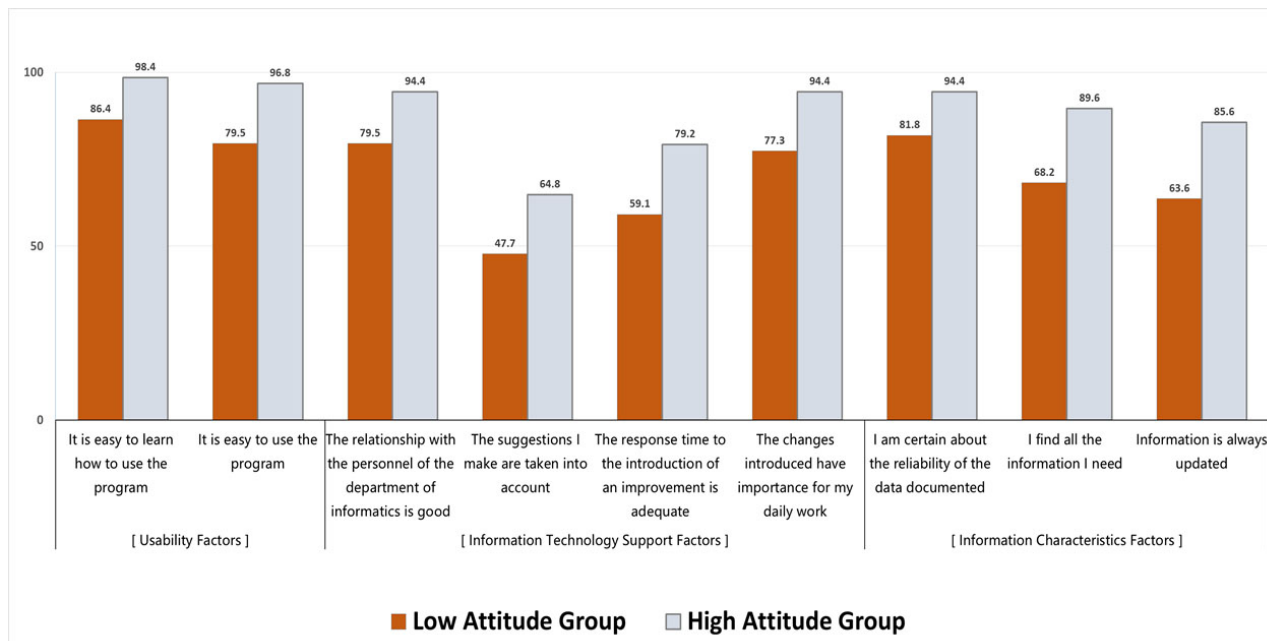

Figure 2. Significantly different perceptions toward the EHR system by attitude group

3.5 Computer competencies

When the participants were asked about general computer knowledge, they did not show the ability to perform half of the listed competencies. Table 4 shows that about ninety-five percent of the participants (n = 161) reported that they know how to use the mouse to "drag" an item on the computer screen, while only twenty-nine percent (n = 49) reported they know what a pathway is and could find a file using a pathway.

In relation to word processing computer competencies, eighty-seven percent of the participants (n = 147) reported that they know how to cut and paste a block of text, and only about twelve percent (n = 20) stated they know how to add pages into a word document. One statistically significant difference was noted between the high and low attitude groups. High attitude group more reported that they know how to cut and paste a block of text (90.4%) when compared to low attitude group (77.3%) (χ^2 = 4.953, df = 1, p = .03).

3.6 Predictors of attitude toward the EHR system

To assess the influence of study variables on nurses' attitudes toward the EHR system (as a dependent outcome variable), univariate logistic regression analyses were conducted and independent variables with scores with p < .05 were considered as candidate predictors in the subsequent multivariate analysis. Table 5 shows the multivariate logistic regression model, with four variables retained. The final model was statistically significant [χ^2 (4, N = 169) = 28.454, p < .001]. Nurses were more likely to develop high positive attitudes toward the EHR system when they: acknowledged that the hospital asked for suggestions for customization to the system [OR: 2.54 (95% CI: 1.09, 5.88), p = .03], perceived the system as easy to use [OR: 6.53 (95% CI: 1.72, 24.75), p = .01], perceived the relationship with the personnel of the department of informatics as good [OR: 3.59 (95% CI: 1.13, 11.36), p = .03], and perceived that the system helps them find the information they need [OR: 2.97 (95% CI: 1.16, 7.62), p = .02], while controlling for all other variables in the model.

Table 4. Descriptions and comparisons of computer competencies by attitude group

Responding "Yes" to the question …	All Participants (N = 169) % (n)	Nurses with Low Attitudes (n = 44, 26%) % (n)	Nurses with High Attitudes (n = 125, 74%) % (n)	χ^2	p
General Computer Knowledge					
Do you know how to use a mouse to "drag" an item?	95.3 (161)	97.7 (43)	94.4 (118)	.799	.37
Do you know what an "icon" is and what to do with it?	79.9 (135)	84.1 (37)	78.4 (98)	.656	.42
Do you know what a modem is used for?	72.8 (123)	65.9 (29)	75.2 (94)	1.418	.23
Do you know how to open up more than one program at a time in Windows and move between them?	66.9 (113)	65.9 (29)	67.2 (84)	.024	.88
Can you name one "input device" and one "output device"?	59.8 (101)	61.4 (27)	59.2 (74)	.063	.80
Do you know the acceptable form for a filename?	49.7 (84)	45.5 (20)	51.2 (64)	.430	.51
Do you know how to reboot your computer?	46.2 (78)	43.2 (19)	47.2 (59)	.211	.65
Do you know what RAM stands for and how much RAM your computer has?	40.2 (68)	40.9 (18)	40.0 (50)	.011	.92
Can you find the command line on a Windows program screen?	29.6 (50)	29.5 (13)	29.6 (37)	.000	.99
Do you know what a pathway is, and can you find a file with a pathway?	29.0 (49)	25.0 (11)	30.4 (38)	.461	.50
Documents and Documentation (Word Processing)					
Do you know how to cut and paste a block of text?	87.0 (147)	77.3 (34)	90.4 (113)	4.953*	.03
Do you know how to use a mouse to "drag" a block of text?	82.2 (139)	72.7 (32)	85.6 (107)	3.694	.055
Can you use a spell checker?	69.2 (117)	61.4 (27)	72.0 (90)	1.728	.19
Do you know what font or typeface is?	67.5 (114)	59.1 (26)	70.4 (88)	1.896	.17
Do you know how to right and left justify a document?	63.3 (107)	61.4 (27)	64.0 (80)	.097	.75
Do you know how to reset margins in your word processor?	56.8 (96)	52.3 (23)	58.4 (73)	.498	.48
Do you know how to create a page break?	44.4 (75)	40.9 (18)	45.6 (57)	.290	.59
Do you know what the clipboard does?	40.2 (68)	43.2 (19)	39.2 (49)	.215	.64
Do you know the difference between "Insert" and "Type over"?	34.9 (59)	40.9 (18)	32.8 (41)	.942	.33
Do you know how to tell your word processor to paginate?	11.8 (20)	9.1 (4)	12.8 (16)	.429	.51

* Significant difference was noted.

Table 5. Multivariate logistic regression of variables and attitude toward the EHR system as a dependent variable

Variable	B	S.E.	Sig.	Odds Ratio	95% C.I. for Odds Ratio	
					Lower	Upper
The hospital asks for suggestions for customization or configuration to specific parts of the EHR system [*Yes*]	.93	.43	.03	2.54	1.09	5.88
The EHR system is easy to use [*Yes*]	1.88	.68	.01	6.53	1.72	24.75
The relationship with the personnel of the department of informatics is good [*Yes*]	1.28	.59	.03	3.59	1.13	11.36
I find all the information I need [*Yes*]	1.09	.48	.02	2.97	1.16	7.62
Constant	-2.98	.90	.00	.05		

* Attitude toward the EHR system was coded as 0 = "Low Attitude", 1 = "High Attitude". All the variables were found as significant predictors for the attitude toward the EHR system status.

4. DISCUSSION

Regarding the opinions toward the EHR system, in line with Eley et al.'s[4] study, our findings showed that the partici-pants least agreed that the locations and numbers of comput-ers were appropriate for users to operate the EHR system's program. Therefore, it is important to avoid any ergonomic

factors that might be considered as barriers to use the EHR system by nurses as they may disrupt nursing workflow.[5, 6]

It is of note that all the nurses with high positive attitude toward the EHR system believed that it outweighs the paper-based record system in helping them to review and search for care recipients' disease history and prognosis data, and to collect comprehensive health information about care recipients. Further, they valued timesaving offered while using the EHR system. These findings are consistent with other studies.[25, 26] In a study conducted by Juliet and Sudha[25] to assess perceptions of nurses toward the EHR, they found that almost two thirds of nurses perceived that EHR use as timesaving. Similarly, nurses in Dowding et al.'s[26] study perceived the EHR system as efficient and had improved access to patient information.

The nurses who had high positive attitudes about the EHR system found it easy to use and easy to learn. In addition, they showed that reliability and findability of updated needed data through the system were influential to their positive attitudes regarding the system. Highly positive attitude and usability of the EHR system concurred when they developed such positive perceptions toward the system. Usefulness and ease of use were found to be significantly influential factors on the acceptance of EHR system by nurses.[27] Nurses agreed that the system was not only important for patient care but it was also viewed as integrated with their work routines. Successful EHR system should not disrupt workflow and routines of nurses.[4, 17] Likewise, Lambooij et al.'s[28] study had showed that quality of patient data was enhanced when the EHR system was perceived as easy to use.

In relation to the computer competencies, our study participants showed limited general computer knowledge, and stated that they may not demonstrate several word processing skills. Contemporary nursing curricula should emphasize nursing informatics content, prepare nursing students to understand basics of information technology and communication tools, and to demonstrate some skills pertinent to common applications for building and communicating documents.[29–33] The study findings highlighted that the attitude of nurses toward the EHR system was significantly influenced by their abilities to cut and paste a block of text. More work is needed to investigate the effect of low computer competencies among nurses on their interactions with the EHR system and on the quality of nursing care provided.

The correlation analysis showed that the higher academic preparation among nurses, the lower positive attitude toward the EHR system. This unique finding was perplexing. However, the level of nursing education plays a role in developing an expected "mental" clinical benefit of the EHR system.

That is, nurses with baccalaureate degrees or higher compared with other nurses with diploma/associate preparation might lower their appreciations to the digitalized functions offered through the EHR system. In addition, the correlation analysis showed that nurses with higher levels of education were older. This finding possibly implies that nurses with higher levels of education may be more resistant to the EHR system. Future qualitative studies are encouraged as they would recognize and provide the opportunity for a deeper appreciation of different human opinions and perceptions. Qualitative methods would allow for the generation of an exhaustive description of nurses' everyday experiences.[34, 35]

Similar to the findings of Rose et al.'s[15] study, higher positive attitudes were developed among our study participants who acknowledged that the EHR managing personnel had sought suggestions for customization or configuration by nurses. Further, when only about forty percent agreed that such interaction between the EHR managing personnel and nurses had occurred, EHR managing personnel are encouraged to pay more attention to the suggestions for improvement by staff nurses and nurse administrators as such tailoring in the system could improve or increase role performance of nurses. During such interactions with nurses, the EHR managing personnel would gain an understanding of workflow rules, norms, and routines; and contextualize nursing behaviors and perceptions toward of the EHR system. In addition, the interaction between the EHR managing personnel and nurses addresses the significant role for informatics in facilitating the best possible nursing care that is supported by nurses' engagement with healthcare technology while they provide technology-enabled care.[36]

5. CONCLUSIONS

This was the first study to investigate the interrelationships between opinions, perceptions, and attitudes toward the EHR system among practicing nurses in Oman. We also explored the effects of nurses' characteristics, opinions and perceptions toward the EHR system along with their computer competencies on the attitudes toward the system.

Seventy-four percent of the nurses had positive attitudes toward the EHR system. The higher the educational preparations they had, the lower the magnitude of positive attitudes they developed. Only about forty percent of the nurses acknowledged that the hospital asked for suggestions for customization to specific parts of the system, indicating the need to involve nurses in forthcoming system development activities.

Even though nurses had generally high positive opinions and perceptions about the EHR system, our findings raised

some areas for improvement. The participants raised low agreement regarding the current numbers and locations for terminal screens for users to operate the system, signifying the need to expand these technological resources so not to jeopardize the workflow of the nurses and all healthcare providers. Further, more work is suggested to revert the perception about not taking suggestions made by the nurses into tangible considerations.

On the other hand, it has been found that nurses who had acknowledged that the hospital sought suggestions for customizing the EHR system, who perceived the system as easy-to-use one and provided all the information they needed, and who perceived that the relationship with the system's managing team as good were more likely to develop highly positive attitudes toward the system.

5.1 Limitations and strengths

Our study findings are subject to recall bias due to the use of self-administering questionnaire. Yet, we randomly recruited a sample from a major public teaching hospital in Muscat, the capital of Oman, with nurses' characteristics similar to the ones existed over other Omani hospitals.

5.2 Implications and recommendations

Our study is the first in Oman to uncover nurses' opinions, perceptions and attitudes toward the EHR system. We provided rich foundational information about the impact of involving nurses in the future activities geared to modify or customize the system.

Our findings may inform educational and training policies. In order to maximize the utilization of the EHR system, a thorough assessment is needed concerning the potential effects of such limited computer competencies, which expressed by a large proportion of the participating nurses, on their use of the system. Hands-on training workshops about the system would foster the use of the system by nurses, especially

who would exhibit limited computer competencies. Within nursing curricula, nursing schools are encouraged to call for completion of courses that allow development of computer and information systems competencies, so that student nurses may interact more comfortably with the EHR systems during providing nursing care upon graduation.

We recommend evaluating the use of EHR system through qualitative studies. Qualitative research lenses may help the system's managing personnel to better understand, describe and explain nurses' interactions with the system. They also aid in developing direct understanding of nurses' workflows before and after these interactions. As a result, it facilitates the provision of EHR system customizations based on real workflow patterns. Qualitative research findings may include suggestions for more uniform or simplified workflows (or functioning patterns) for nurses if their workflows are redundant or impaired. Further, nurses may elicit and share their experiences with human-computer interactions, general expectations related to features commonly inherent in EHR systems, opinions, frustrations, and ideas for areas needing improvement.

In order to better support healthcare rendition, investigating the effect of EHR system on other healthcare providers, such as physicians, and inter-professional communications are still needed. In addition, future research endeavors are suggested to elucidate the effect of using the EHR system on patient safety and outcomes.

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CONFLICTS OF INTEREST DISCLOSURE
The authors declare that there are no conflicts of interest.

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