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Nurses' Attitude for Using Barcode Medication Administration System in a Developing Country

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Abstract. Medication errors are common in healthcare settings. To prevent these errors, use of modern technology is suggested. Improvement of medication administration system particularly at the time of drug administration is mandated in Iran. Barcode medication administration (BCMA) systems are useful in this regard. This study was conducted to assess nurses' attitude for the use of BCMA systems. To this end, 283 randomly selected nurses working in teaching hospitals were surveyed using a five point Likert scale questionnaire. The most positive attitudes were related to the role of BCMA in reducing medication errors (4.02±0.8), improving performance (3.8±0.99), productivity (3.8±0.97) and making patient care easier (3.83±0.9). Only 9.9 percent of nurses did not like to use the technology. There was no significant difference between nurses in terms of their age, experience, education, and hospitals. In conclusion, **n**urses' attitude about BCMA was in a relatively good level. However, there is a need to train nurses for the use of this technology.

Keywords. Barcode medication administration system, Medication errors, Medication systems, Nurses, Readiness assessment

1. Introduction

Patient safety is one of the most important aspects of healthcare quality [1]. One of the critical aspects of healthcare services is the medication administration process. Medication errors are among the most frequent and important patient safety threats. Medication errors are the eighth leading cause of death in America [2] and may occur in each of the medication process steps including prescription medication, transcription of physician's orders, drug dispensing, administering the drugs to patients or controlling the drug effects [3]. A study in Iran showed that nurses spend more than 40 percent of their working time on giving drugs to patients, so maintaining safety and preventing medication errors in the medication administration process is of special importance [4]. A study has shown that medication errors for every nurse have been 19.5 cases per nurse on average within three months [5].

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The use of barcode medication administration system (BCMA) is suggested for improving patient safety in terms of medication errors [6, 7]. BCMA controls "five rights" related to medication administration, including the right patient, the right drug, the right time, the right route and the right dose [8]. One study about this technology have shown improvement in medication errors caused by incorrect drug prescription (75%), patient misidentification (93%) and drug misidentification (62%) [9]. Other studies have also shown the effectiveness of this technology for reducing medication errors [10].

The US Food and Drug Administration obliged the use of medication bar-coded labels and predicted that many medication errors will be prevented with this obligation [11]. According to the "Iranian Evaluation Guide of Clinical Governance" published by the Ministry of Health, hospitals should identify patients with at least two identifications. Another standard in this regard, is establishment of a medication administration system particularly at the time of drug administration [12]. Therefore, BCMA is a good technology for these standards.

Despite the benefits, adoption and acceptance of users are important. From previous studies, it was found that one of the main causes of system failure is the lack of participation and readiness of users [13]. Nurses have an important role in implementing health information technologies [14], especially BCMA, because they are the main users of BCMA. No studies have addressed the attitude of nurses to implement and use of this technology in Iran, therefore, this study was conducted with the aim of assessing the nurses' attitude in teaching hospitals in Iran.

2. Method

Three hundred nurses from seven teaching hospitals affiliated with Iran University of Medical Sciences (IUMS), Tehran, Iran were invited randomly in 2016 to participate in the study. The sample size for each hospital was determined based on the number of nurses in each hospital. Finally 283 nurses (94%) participated.

We used a questionnaire with eight questions in the form of five-point Likert scale. This study was conducted before implementation of BCMA technology to explore nurse attitude for future use. Therefore, the part 1 of the questionnaire was devoted to introduction of BCMA. In this part, we described the technology and related workflows to enable nurses to perceive the technology and its effects on their workflows. Attitude questions were designed based on several different studies [15, 16]. Content validity of the questionnaire was approved by 11 faculty members of the fields of nursing, health information management, medical informatics and a number of nurses working in hospitals (out of the sample). Reliability was assessed using Cronbach's alpha coefficient, so that 30 nurses out of the sample completed the questionnaire before the main study ($a = 0.752$). We distributed the questionnaires among the nurses and collected the completed ones several days after distribution. The Ethics Committee of IUMS approved this study.

We scored the responses as follows: 1 for completely disagreed to 5 for completely agreed. Negative questions were scored inversely. The data were analyzed using descriptive (frequency, percentage and mean) and inferential statistics (non-parametric tests after checking the normality of data using Kolmogorov-Smirnov test) using SPSS 20. We classified score as weak (<25% of score), moderate (25-50% of score), relatively good (50-75% of score) and good (>75% of score).

Table 1. Nurses' attitude towards using BCMA

Statements	Completely agreed	Agreed	So- So	disagreed	Completely disagreed	Mean± SD
It improves job performance.	67(23.7)	143(50.5)	35(12.4)	30(10.6)	7(2.5)	3.8±0.99
It increases my productivity.	66(23.3)	138(48.8)	45(15.9)	28(9.9)	6(2.1)	3.8±0.97
It enhances effectiveness in job.	61(21.6)	141(49.8)	47(16.6)	29(10.2)	5(1.8)	3.79±0.95
It is fast to use in my job.	53(18.7)	153(54.1)	34(12)	36(12.7)	6(2.1)	3.75±0.97
It reduces medication errors.	78(27.6)	158(55.8)	26(9.2)	18(6.4)	3(1.1)	4.02±0.84
It makes caring for patients easier.	59(20.8)	152(53.7)	39(13.8)	29(10.2)	3(1.1)	3.83±0.91
I do not want BCMA change the way I work.	27(9.5)	61(21.6)	69(24.4)	101(35.7)	25(8.8)	3.1±1.1
I would like to use this system.	77(27.2)	140(49.5)	34(12)	20(7.1)	8(2.8)	3.92±0.97

3. Results

Among the participants, 85.9% of nurses were female. The mean and standard deviation (SD) of nurses' age were 32.3±6.5 years and their average working experience was 7.7±5.9 years. Most of them had a bachelor degree (94.3%) and 147 of them participated from general hospitals. Among them, 75.6% had participated in patient safety courses and 36% of them had courses or workshops about application of IT for patient safety.

According to Table 1, the most positive attitude of nurses was about reducing medication errors (4.02 ± 0.8), improving job performance (3.8 ± 0.9), improving productivity (3.8 ± 0.97) and making patient care easier (3.83 ± 0.9). 9.9 percent of the nurses did not like to use BCMA technology. The lowest score was for nurses' reluctance to changing their workflow using the technology. The average total score (30 ± 5.9 from 40) showed that overall attitude of nurses was relatively good (75% of possible score). According to the table 2, nurses in general and specialized hospitals have similar attitude. The results also showed that the most positive attitude in general and specialized hospitals was related to the reduction of medication errors using BCMA and tendency to use the system. Comparing between the two hospital groups showed that there was only a significant difference between nurses' attitude towards the speed of performing tasks using the system (p=0.007).

Table 2. Nurses' attitude in general and specialized hospitals towards using BCMA

Statements	General	Specialized	P-value
Bar coding system improves job performance.	3.9 ±0.9	3.78±1	0.415
Bar coding system increases productivity.	3.88±0.9	3.74±1	0.279
Bar coding system enhances effectiveness in job.	3.83±0.9	3.75±0.9	0.434
Bar coding system is fast to use in my job.	3.9 ±0.8	3.59±1	0.009
Bar coding system reduces medication errors.	4.05±0.8	4 ±0.9	0.804
Bar coding system makes caring for patients easier.	3.86±0.84	3.8 ±0.9	0.777
Overall, I don't want the BCMA change the way I currently work.	3.14±1.1	3.11±1.2	0.755
I would like to use this system.	3.98±0.9	3.87±0.9	0.212
Total score	**30.4±5.7**	**29.6±6.2**	**0.144**

4. Discussion

Ackerman et al argue that understanding human factors and its relations to technology and in fact, the socio-technical nature of health information technologies is a prerequisite of successful implementation of a technology in health settings [17]. Based on the studies, users' perception is an influential factor for technology acceptance [18]. Other researchers introduce technology support and end users' perception as the effective factors for BCMA implementation [19]. In this regard, we found that nurses' attitudes were at a relatively good level and also there were no statistical differences between nurses' attitude in general and specialized hospitals and their demographic and experience did not affect on their attitude.

A study showed that two effective factors in BCMA acceptance by users are "understanding the profitability" and "ease of use" [20]. The present study showed that nurses have a good understanding about the usefulness of BCMA and believed that BCMA is suitable to reduce errors and improve performance and effectiveness. Studies showed that improvement is observed in medication errors using BCMA [9, 10]. Another study found that application of information technology increases nurses' productivity and using the technology may save nurses' time for patient care [21]. Our nurses have such an attitude about their productivity using BCMA. Other studies in other countries showed that nurses have a good attitude towards using BCMA [22,15]. These studies have similar findings to our results.

Minda found that the time required for documentation by computers is considerably less than the time needed for manual documentation [23]. Our study showed that nurses have a positive attitude but they are concerned about the speed of the technology, because some nurses believed that the steps of nursing and patient care processes are increased after using BCMA. Holden showed that nurses need a lot of support and training to accept this technology [15], we observed that in the majority of hospitals there were no suitable training courses for this technology. Hostgaard showed that the use of specific training will accelerate the pace of acceptance and will finally create a positive outlook in nurses [24]. Mary et al. have emphasized on nurses' training about BCMA using different modes such as guidelines, and tutorials [25]. Previous Iranian studies showed that nurses considered training about the technology very important [14]. In addition, other Iranian studies have evaluated the level of computer skills of nurses, which indicates the appropriate skills of nurses [26]. Therefore, we believe that the nurses need to be more trained about the BCMA and its processes to better understand the effect of this technology on their workflows in order to decrease this concern about the speed of the technology.

We have some limitations that should be considered. First, Iranian studies are in early steps of implementing patient safety programs and using technologies for patient safety. The barcode technology has not been implemented in this country for medication administration; however, barcodes are currently used for other processes such as admission. Therefore, the findings may not reflect the real attitude of nurses. However, we believe that investigating nurses' attitude before implementing a new technology is also important to predict future use of the technology. Additionally, although our questions were based on technology acceptance theories, we did not apply these theories to investigate effective factors on nurses' attitude. Applying such theories provide more useful information for implementing the BCMA. In a bigger follow-up study, we are currently conducting such investigation. In addition, although we have a large sample

size, they were from seven teaching hospitals. Therefore, our findings may not be generalizable to the country.

In conclusion, nurses play a key role in the successful implementation of BCMA and we concluded that nurses have a positive view of this technology and tend to use it. Therefore, hospitals in Iran may develop plan to implement and use the BCMA technology, because this technology seems acceptable for nurses. However, implementing this technology requires funds, training and also organizational readiness. In addition, other main users such as pharmacists' perspectives should be considered. Therefore, other studies should be conducted to assess the organizational readiness and identify the weaknesses in this regard. Additionally, training nurses regarding BCMA is also necessary.

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