IOSR Journal of Nursing and Health Science (IOSR-JNHS)
e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 7, Issue 1 Ver. X. (Jan.- Feb .2018), PP 47-54
www.iosrjournals.org

Effect of Nursing Education Guidelines about High Alert Medications on Critical Care Nurses Knowledge and Practices.

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Abstract:*medication errors are a major cause of morbidity and mortality in medical profession and critical care. Literature review cited that about 80% of all deaths from medication errors are caused by high alert medications errors. Nurses' knowledge and practice could contribute either positive or negative about this issue. Therefore, the Aim of the current study: was to evaluate the effect of nursing education guidelines, regarding high alert medications on critical care nurses' knowledge and practices. . Design: One group Quazi - Experimental interrupted time series research design. Research hypotheses: H1: Nurses who will receive the nursing education guidelines about safe handling of high alert medications will have higher post total mean knowledge score than their pre mean total knowledge score. H2: Nurses who will receive the nursing education guidelines about safe handling of high alert medications will have higher post total mean practices scores than their pre mean total practice scores. Sample: Convenient sample of 44 adult male and female critical care nurses. Setting: three different Critical Care Units at one of the hospitals in Cairo were recruited to participate in the current study. Tools: Three tools were used to collect data pertinent to the study namely; Nurses' demographic data sheet, Interview knowledge questionnaire schedule and High alert medications administration observational checklist. Results: The main study results revealed that the mean age of the study subjects was 28.6±6.1years, (65.9%) were females, the mean post-test knowledge and practices scores of nurses attending to the nursing education guidelines regarding high alert medications was significantly higher than their mean pre-test knowledge and practices scores.Conclusion: significant improvement in the mean nurses' knowledge and practices were found after implementation of the nursing education guidelines which supports the study hypotheses with few declinment after three-months but still better than the pre-intervention mean knowledge and practices scores. Recommendations: the importance of continuous education for maintaining and improving quality nurses knowledge and practices regarding safe handling of high alert medications*.

Keywords:*High alert medications, Medication errors, Nursing education guidelines, Nurses' knowledge, Nurses' practice.*

Date of Submission: 24-02-2018 Date of acceptance: 12-03-2018

I. Introduction

Medication errors are ongoing problems among hospitalized patients and may occur during prescribing, transcribing, prescription auditing, preparing, dispensing, administration, and monitoring. Medication administration errors (MAEs) are those errors that actually reach patients and pose a threat to patient safety [1].About 80% of all deaths from medication errors are caused by high alert medication error. Even when errors with these dangerous drugs aren't fatal, outcomes are poor. According to the Institute for Safe Medication Practices (ISMP), who identified these drugs as high-alert, they require special safeguards to reduce the risk of patient's harm [1]. As well, studies in the Intensive Care Unit found high-alert IV medication administration error rates of 34 % and 49 %. In addition, 41% of drug administration mortalities associated with dosing errors. Dosing errors were by far the most common type of medication error at 28 %. While 70 % of ordering errors were intercepted. Only 6 % of the wrong dose errors occurring in the nurse administration stage were intercepted. The second most common cause of nurse Administration errors, at 13 %, was infusion pump and delivery problems [2]. The most commonly used high alert medications are inotropes and vasopressors. The naturally occurring catecholamine's (dopamine, noradrenaline, and adrenaline) act as neurotransmitters and hormones. Inotropes and vasopressors must be administered via central access because there is a risk of skin

necrosis if they extravasate. Invasive monitoring is required because rapid changes in blood pressure and arrhythmias can occur during the administration of these drugs [3].Nurses' lack of knowledge is considered to be one of the most significant factors contributing to medication administration errors. Most medication errors cause no harm to patients, but serious injuries and deaths are usually due to incorrect administration of high-alert medications. .Medication administration is an important part of nursing practice and an important responsibility for nurses. It is a daily basic activity in nursing practice and nurses need to have sufficient knowledge, attitude and competency to perform these tasks. 10 to 18% of all reported hospital injuries have been said to be caused due to medication errors and nurses can be involved in the occurrence of these errors [4].

Nurses have very important responsibilities in the prevention of medication errors as they play a key role in the medication process. Nurses would need a very high level of knowledge of drugs. With the increasing number of drugs available for administration in hospitals and in the community, the nurses' responsibility for updating their knowledge of drugs has increased greatly [5]. An important intervention to reduce medication errors is continuing education to improve knowledge of medications management and administration. Nurses must have knowledge and skills in order to recognize potential medication errors before they occur [6].

1.1. Significance of the study

It is estimated that a hospitalized patient is exposed to one medication error daily. In addition, a low estimation of 450,000 medication errors result in harm annually to patients in the United States, with approximately 25% of these errors considered preventable. According to the Institute of Medicine, 7.000 deaths each year are attributed to preventable medication errors [7]. According to [8], medications are the most common intervention in healthcare but are also most commonly associated with adverse events in hospitalized patients. At least 20% of all harm is associated with medication errors. High-alert medications are more likely to be associated with harm than other medications; they cause harm more commonly, the harm they produce is likely to be more serious, and they "have the highest risk of causing injury even when used correctly. As well, [9], Conducted a study about "Critical Care Nurses' Knowledge and Practice Regarding Administration of Selected Positive Inotropes at Cairo University Hospitals revealed that the majority of critical care nurses had unsatisfactory knowledge levels (87.1%) and unsatisfactory practice level (98.6%) regarding selected positive inotropic medications. As well they recommended, offering educational programs, upgrading courses and follow up nurses' performance armed with evidence based guidelines to improve their knowledge and practice related to administration of high alert medications.

So that, the result of this study help in identifying the level of knowledge and practice for safe handling of high alert medications in three different critical care units in Cairo-Egypt, as well as provided a base line data that will help in establishing guidelines and apply intervention that will influence the implementation of change in clinical practice in other critical care units. In addition this research might safeguard this category of patients against serious consequences of high-alert medications.

II. Material And Methods

The current study aims at evaluating the effect of nursing education guidelines, regarding high alert medications on critical care nurses knowledge and practices. To achieve the aim of this study, two hypotheses were formulated:

H1: Nurses who will receive the nursing education guidelines about safe handling of high alert medications will have higher post total mean knowledge score than their pre mean total knowledge score.

H2: Nurses who will receive the nursing education guidelines about safe handling of high alert medications will have higher post total mean practices score than their pre mean total practice scores.

2.1. Design

One group Quazi - Experimental interrupted time series research design was used to achieve the aim of the current study.

2.2. Setting

The study was conducted at three different critical care units affiliated to one of Cairo university hospitals.

2.3. Sample

Convenient sample of 44 adult male and female nurses who were working at three different critical care units at Cairo university hospitals, were recruited to participate in the current study. Who directly handle with high alert medications.

2.4. Data collection tools:

Three data collection tools were used to collect data pertinent to these study variables. The study tools consisted of :

1-Nurses demographic data sheet (TOOL 1): It included data related to gender, age, educational level, years of experience in nursing field and years of experience in ICU.
2-Interview knowledge questionnaire schedule (TOOL2): The tool was developed by Youssef, Ali &Samy, (2014), slight modifications were done by the investigator. This tool includes a set of multiple choice questions and true &false questions related to: General Knowledge about high alert medications, Knowledge about positive inotropes and Knowledge about Potassium chloride.
3- High alert medications administration observational checklist (TOOL3): the tool was developed by Youssef, Ali&Samy. (2014), slight modifications were done by the investigator .It was Conducted to assess nurses' practices related to administration of selected high alert medications (positive inotropes and potassium chloride).

2.5. Pilot study

A pilot study was conducted during March 2016 for two weeks on 10% of total number of the study sample (five nurses) working at the same critical care units. The purpose of the pilot study was to assess the feasibility, and applicability of the study, test the adequacy and internal consistency of the study tool. Nurses involved in the pilot study were included in the actual study sample. This phase culminates in a clear implementation plan with tasks and timeline to facilitate putting the nursing education guideline into practice.

2.6. Ethical considerations

An official permission to conduct the proposed study was obtained from the ethical committee and hospital directors. Participation in this study was voluntary; each potential subject was informed about the purpose, procedure, benefits, and nature of the study and that he/she had the right to withdraw from the study at any time without any rationale, then written consent obtained from them. Subjects were informed that obtained data will not be included in any further researches without second consent. Confidentiality and anonymity of each subject were assured through coding of all data and all information has taken was protected and didn't affect their annual appraisal.

2.7. Procedure for data collection:

The study was conducted through the following phases:

Assessment phase: This was an important initial phase during data collection. It was divided into two steps. The first step was to select the study design, sample size; preparing tools for data collection. Standardized guidelines regarding high alert medications were selected. The second step was to assess the situation before going to implement the nursing education guidelines. In which, an assessment of critical care unit facilities and resources was done; cooperation and accessibility of study subjects were assessed. Assessment of the socio demographic variables of the study subjects and work related variables were done using the self- administered questionnaire. Pre-assessment nurses' knowledge and practices about high alert medications were done; it started on April 2016 and lasted for one month. **. Planning phase**: Based on the outcomes of the assessment phase, study subjects were grouped; content of nursing education guidelines (knowledge and practices) was distributed among sessions and duration for each session was estimated.

Implementation phase: This phase consisted of specific dynamic iterative activities designed to put the nursing education guidelines into actions effectively. The study subjects (44 critical care nurses) were divided in to seven subgroups; two of them included seven critical care nurses and the other five subgroups included six critical care nurses for each. Content of nursing education guidelines (knowledge and practices) was distributed among six sessions for each subgroup separately, duration for each session was estimated about 30 minutes approximately, each session was repeated seven times to cover all subgroups. 21 hours were the total time required, distributed over 42 days (three days/week) lasted for three months and two weeks. It took over a period from May to the middle of august 2016. The nursing education guideline was implemented through seminars, group discussion, and demonstration/re-demonstration using the audiovisual aids such as booklet, video film and power point presentation. **Evaluation phase:** This was the last phase, which aimed to evaluate the effectiveness of nursing education guidelines about safe handling of high alert medications through reassessment of nurses' knowledge and practices. It ran over two times, the first time started within one week after the end of nursing education guidelines (September 2016) and lasted for one month, the second time started within three months later during (December 2016) using the same study tools each time (except the nurses demographic data).

2.8. Statistical analysis:

The statistical package for social sciences (SPSS ver.20) was used for data analysis. Descriptive statistics for some data such as gender, age category, education qualification, years of experience …etc were computed using frequencies, percentages, mean and standard deviation. For numerical data such as nurses' knowledge and practices scores mean and standard deviation was generated. Comparison of the critical nurses

knowledge and practices scores were done using paired t-test to compare the means before and after implementation of nursing education guidelines about High alert medications and to determine any significant differences between variables. Person correlation "r" used to determine the relationship between nurses knowledge and practices mean score regarding High alert medications.

III. Results

Table (1): the majority (65.9%) of the studied sample were females. The most frequent education qualification was nursing diploma (52.3%). More than half of studied subjects (52.3%) their age were ranged between 26-35 years with a mean age of (28.6± 6.1). Regarding years of experience in nursing field, 34.1% of the study subjects were having 1-5 years of experience and 31.8 % have 6-10 years of experience, with mean years of experience of 9.0± 6.2 while 45.5% of the study subjects were having1-5 years of experience in ICU, with the mean years of 7.7 ± 6.0.

Table (1): Percentage distribution of the study subjects ' demographic data (n=44).

Variables	N	%
Age		
• <20 years	3	6.8
• 20-25 years	12	34.1
• 26-35 years	23	52.3
• >35 years	6	13.6
Mean ± SD 28.6±6		
Gender		
• Female	29	65.9
• Male	15	34.1
Educational level		
• Bachelor of nursing	7	15.9
• Technician institute of nursing	14	31.8
• Nursing diploma	23	52.3
Years of experience in nursing		
• from 1-5	15	34.1
• from 6-10	14	31.8
• from 11-15	7	15.9
• from 16-20	4	9.1
• more than 20	4	9.1
Mean ±SD 9.± 6.2		
Years of experience of ICU		
• from 1-5	20	45.5
• from 6-10	15	34.1
• from 11-15	3	6.8
• from 16-20	2	4.5
• more than 20	4	9.1
Mean ±SD 7.7 ± 6.0		

As it is shown from table (2), regarding critical care nurses knowledge about safe handling of High alert medications. The majority of the critical care nurses (90.9%) had unsatisfactory knowledge score pre-test with a mean of 48.6±13.6. More than (88%) had satisfactory knowledge with mean post-test scores of 86.0±5.7. While (84.1%) of critical care nurses had satisfactory knowledge with mean scores of 82.6±6.1three months post-test. Regarding practice scores, the studied subjects were having unsatisfactory practice level (4.5%) before receiving the educational guidelines, while this percentage was improved to have an increased satisfactory level after receiving the educational guidelines as more than 81% satisfactory level in post one and more than 72% satisfactory level in post two.

Table (2): frequency distribution of study subjects as regards to total and subtotal knowledge and practice scores pre and post application of the nursing education guidelines:

Items	Pre				Post (1)				Post (2)			
	Satisfactory		Unsatisfactory		Satisfactory		Unsatisfactory		Satisfactory		Unsatisfactory	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Total knowledge scores	4	9.1	40	90.9	39	88.6	5	11.4	37	84.1	7	15.9
General knowledge about HAM	10	22.7	34	77.3	41	93.2	3	6.8	39	88.6	5	11.4
Knowledge about positive inotropes	4	9.1	40	90.9	37	84.1	7	15.9	35	79.5	9	20.5
Knowledge about KCL	3	6.8	41	93.2	40	90.9	4	9.1	38	86.4	6	13.6
Total practice scores	2	4.5	42	95.5	36	81.8	8	18.2	32	72.7	12	27.3
Pre-administration	13	29.5	31	70.5	41	93.2	3	6.8	34	77.3	10	22.7
During administration	1	2.3	43	97.7	33	75	11	25	25	56.8	19	43.2
After administration	3	6.8	41	93.2	30	68.2	14	31.8	27	61.4	17	38.6
Documentation	8	18.2	36	81.8	35	79.5	9	20.5	26	59.1	18	40.9

As illustrated in table(3), there was a statistical significant difference related to total knowledge scores of the study subjects about high alert medications both in pre-test ,post-test and three months post-test as well as between post-test and three-months post-test (t=19.7.17.9,6.0, p=0.000) respectively.

Table (3). Paired t-test comparing total knowledge scores regarding high alert medications among the study subjects. (Pre-test, post-test and three months post- test) (n-44).

Comparison	Mean ±SD	t-value	p-value
(Pre-test)	48±13.6	19.7	0.000*
(Post-test)	86.0±5.7	17.9	0.000*
(three months post-test)	82.8±6.1	6.0	0.000*

*Significance at the P≤0.05 probability level.

In respect to the total nurses practices score regarding high alert medications, table (4) denotes that there was high a statistical significant difference in pre-test ,post-test and three months post-test as well as between post-test and three-months post-test with t value of (20.6,16.9,6.2) respectively , at p=0.000

Table 4. Paired t-test comparing total practice scores regarding high alert medications among the study subjects. (Pre-test, post-test and three months post- test) (n-44).

Comparison	Mean ±SD	t-value	p-value
(Pre –test)	39.7±14	20.6	0.000*
(Post-test)	80.0±5.5	16.9	0.000*
(Three months post-test)	75.1±10.1	6.2	0.000*

*Significance at the P≤0.05 probability level

IV. Discussion

In Egypt, nursing is a female occupation, this gives a reason why the entire study sample was female .It is worth mentioning that the total number of nurses in Egypt is 161.949 nurses (96%) are female , while only (4%) are male [10].In the current study the majority of the studied sample were females (65.9%), this finding could be interpreted in the light of the fact that majority of nurses in Egypt are females and their number are still greater than male in nursing fields till ten years ago [11]. Regarding the education qualification of the study sample ,it was found that the majority (52.3%) of them were diploma nurses .This finding is consistent with many Egyptian studies such [12] and [13], who reported that more than two third off their study sample under

the study were diploma nurses .In addition) [14], mentioned that the majority of the study sample in their study had a diploma degree .In Egypt diploma nurses are 139.249(86%) nurses of the total nursing manpower that is why the majority of the study sample were diploma nurses. [10]. In relation to age and years of experience, more than half of the nurses their age ranged between 26- 35 years and having 1-5 years of working experiences in the ICU and approximately two third of them having 1-5 years of working experience in nursing. This finding agreed with [11], a study performed to assess nurses' experiences Perception of medication administration errors reporting and revealed that 77.1% of nursing staff were females, and more than half of them aged between 26-30 years old as well as 50.2% of them carrying diploma degree, and most of them had less than 5 years of experiences. It was also agreed with[15], a study that performed to assess nurses' knowledge of high-alert medications and revealed that the majority of nurses were females with an average age of 29 years and working experience of 7.0 ± 6.0 years. Moreover, it agreed with [16], entitled "nurses' knowledge of high-alert medications: instrument development and validation" revealed that all nurses were females with an average age 28.8 ± 5.4 years and average working experience 6.4 ± 5.1 years.

In respect to critical care nurses knowledge in the current study regarding high alert medications, it is was noted during the first meeting (pre-test) with the study subject when base line data were obtained Nurses' knowledge questionnaire about administration of high alert medication revealed that 90.9% of the studied subjects have got unsatisfactory total knowledge while only 9.1% of the studied subjects demonstrated satisfactory level. The pervious finding also supported by [7]. Their Studies support that lack of education and knowledge deficiency on high-alert medications contributes to medication errors and patient harm. The unsatisfactory level of nurses knowledge in the initial assessment (pre-test) might be due to the inadequate educational preparation level and lack of in-service training, this finding agreed with [16], 3.6%of nurses had sufficient knowledge. Before reporting insufficient knowledge, we must ask first whether enough and pertinent education has been provided. Previous reports have indicated that not having sufficient pharmacology teaching in school and during training in hospitals, especially for high-alert medications, contributed to more errors being committed by less experienced nurses and a greater number of serious consequences. To reduce or eliminate administration errors, our results strongly suggest the importance of providing drug administration training programs, particularly for high-alert medications.

In respect to the mean post –test total knowledge scores of critical care nurses , the results of the current study revealed a significant increase in nurses mean knowledge scores which became the required satisfactory level .Satisfactory knowledge levels were found in general knowledge of high alert medication ,positive inotropes and potassium chloride ,other knowledge area such as definition of high alert medications preparation ,storage transferring were satisfactory and showed a steady increased compared with the pre-test scores. Furthermore , the data analysis of the current study revealed highly statistically significant differences of nurses total mean knowledge scores regarding safe handling of high alert medications between the different assessment times: 'pre-test, post-test and three months post-test. The investigator of the current study argues that this difference in nurses' knowledge score might be due to the implemented the nursing education guidelines regarding high alert medications that fit their needs information regarding high alert medications.

According to the forgetting curve theory, there is correlation between memory retention and length of time .So, it is suggested that there is a rapid decline in knowledge and skills during the months following a training courses [17], [18] and [19], reported a drop in mean score of nurses knowledge in three months post-test compared to the immediate post-test mean scores. In addition [20], found some deterioration of the nurses knowledge scores two months after implementation the study protocol. This is in the same line with the finding of the current study that find some decline in nurses mean knowledge scores at three months post-test. This revealed the importance of continuous provision of in-service training for nursing to maintain the required level of their knowledge regarding the usage of high alert medications and organizations need to employ multidisciplinary education programs to promote universal understanding and adherence to medication policies.

Analysis of high alert medication administration observational checklist revealed that 95.5% of the studied samples have got unsatisfactory level before administration, during administration, after administration and documentation of high alert medications. several factors may have relevance to this finding are inadequate knowledge regarding administration of high alert medication in addition inadequate communication between nurses and physicians, and absence of updating courses regarding high alert medications. The current finding is agreed with [21], a study conducted to assess potential risks associated with medication administration and showed that incorrect practices related to checking the accuracy and completion of documentation in the medication administration in relation to the prescription, validating the name , dose of the drug and the route of administration, preparing the medication and labeling it with the appropriate patient identifiers (e.g., name, room number, and patient's file number), hand hygiene according to prescribed technique, both before and after medication administration and verification of patient's presence and availability to take the medication.

Also, this study revealed that there were high statistical significant differences between pre-test, post-test and three months post-test in total mean practices score. This finding is agreed with [19], study revealed

there was statistical significant improvement of nurses level of total nurses practices after implementation of an education program. The same study also that the nurses practice level was high immediately post intervention and diminished at three-months post nursing education guidelines, but still better than the pre-intervention data. In contrast to the present study findings [12], found that the baseline mean scores for total nurses practice were high post implementation of designed nursing guidelines and great improvement in the practice score levels obtained by nurses after the application of the nursing education guidelines regarding high alert medications. This has been concluded by the presence of significant difference between result of pre-test and post-tests.

This could direct the attention toward the importance of implemented nursing education guidelines regarding high alert medications and it is usefulness as mean for improving and maintaining quality nurses practices, knowledge and attitude toward the safe use of high alert medications.

V. Conclusion

Based on the result of the current study, it is can be concluded that although the critical care nurses knowledge and practices level regarding safe handling of high alert medications were unsatisfactory before the implementing of nursing education guidelines. Nurses who attended the nursing education guidelines showed significant improvement on their knowledge and practice level this improvement was manifested by increase in the post total mean knowledge and practices level and reached to the satisfactory level (80%) within week after the implementation.

After three months post-test the total mean post-test knowledge and practices diminishes this could direct the attention toward the importance of continuous education for maintaining and improving quality nurses knowledge and practices.

The present study demonstrates that there is an apparent gap between what is recommended by guidelines regarding High alert medications and what is actually practiced in the critical care areas

There is a gap between nurses' knowledge and practices. Nurses with higher educational level had better knowledge and practice score than nurses with low educational level. the studied subjects.

VI. Nursing Implications And Recommendations

1. Continuous education program regarding safe handling of high alert medications.
2. Integration of topics about administration of high alert medications in the nursing curriculums for different categories (diploma – technical- bachelor).
3. Continuous and mandatory in-service training for health care worker who are dealing with high alert medications (preparation, storage, transferring, administration etc……).
4. Regular performance appraisal and feedback on compliance with safe handling of high alert medications policies and procedures.
5. Appropriate workplace polices and procedure about safe handling of high alert medications should be developed and reviewed and reviewed based on international safety standards/guidelines.
6. Replication of the study on larger sample selected from different geographical areas in Egypt is recommended to obtain data of more generalizability in relation to this problem.
7. A comparative study on the knowledge and practices for safe handling of high alert medications among critical care nurses in different health care sectors in Egypt are required. This will help to determine the extent of nurses' knowledge and practices regarding High alert medications in different settings.

Acknowledgment

My deep appreciation and thanks goes to critical care nurses in critical care units in the Hospital affiliated to Cairo University for their co-operation and positive response.

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AmrZaherRadyYousef"Effect of Nursing Education Guidelines about High Alert Medications on Critical Care Nurses Knowledge and Practices" IOSR Journal of Nursing and Health Science (IOSR-JNHS) , vol. 7, no.1 , 2018, pp. 47-54.