

## Staff Nurses' Performance Regarding Safety Measures of High Alert Medications

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### Abstract

**Background:** High alert medications (HAM) are medications that have an increased risk of causing significant patient harm when used erroneously. Staff nurses should have adequate knowledge and practices to be able to manage HAM administration process in critical care units. **Aim of the study:** is to assess staff nurses' performance regarding to safety measures of high alert medications. **Research design:** A descriptive design was utilized. **Setting:** The study was conducted in critical care units at Suez Canal University Specialized Hospital in Ismailia. **Subjects:** The study sample included (96) staff nurses. **Tools:** Data were obtained through two main tools; Nurses knowledge regarding to safety measure of HAM self- administered questionnaire sheet and Nurses practice observational checklist. **Results:** about two thirds and three quarters (65.6%, 71.9%, 70.8% and 75%) of staff nurses had unsatisfactory level of knowledge regarding to HAM in relation to (precautions, actions should be taken when errors happen, dealing with other HAM and side effects) respectively. Around three quarters and less than two thirds (74% and 63.5%) of staff nurses had unsatisfactory level of practice pre and during administration respectively while more than one half (52.1%) of staff nurses had satisfactory level of practice post administration of HAM. **Conclusion:** it can be concluded that about two thirds of staff nurses had unsatisfactory level of knowledge and practice. There was highly statistical significant relation found between staff nurses' total level of knowledge and total level of practice. **Recommendation:** Offer educational programs and upgrading courses armed with evidence based guidelines based on staff nurses' needs to improve their knowledge and practice related to administration of HAM.

**Keywords:** High alert medications, Performance, Safety measures.

### Introduction

High Alert Medication (HAM) have a large margin of safety, a small number of medication have a high risk of causing injury when they are misused. Mishaps may or may not be more common than other medication; the consequences following an error with these drugs can be especially serious to the patient. So the consequences of the errors are more devastating. For this reason, special considerations are required, these medications often need to be packaged, stored, prescribed and administered differently than others. Whenever possible, "forcing functions" methods that make it impossible for the drug to be given in a potentially lethal manner should be developed and instituted (Institute for Safe Medication Practices (ISMP), 2018 and Schepel et al., 2018).

Joint Commission on Accreditation of Health care Organization define HAM as

medications involved in a high percentage of medication errors or sentinel events and medications that carry a high risk for abuse, error, or other adverse outcomes. Examples include medications with a low therapeutic index, controlled substances, medications not approved or recently approved by Food and Drug Administration, psychotherapeutic medications and look-alike and sound-alike medications (Joint Commission International Accreditation (JCI), 2017 & Engel and Ciarkowski, 2015).

HAM includes medications that patients have administered frequently and for many years, such as insulin, heparin, warfarin, narcotics and sedatives. In fact, it has been reported that two thirds of emergency admissions for adverse medication reactions were related to warfarin, insulin, oral antiplatelet agents and oral hypoglycemic agents. HAM includes insulin amongst diabetics, anticoagulants, narcotics, sodium chloride for injection, opioids,

antiarrhythmic, intrathecal or epidural medications, anesthetic agents and neuromuscular blocking agents. Adverse events from these medications represent areas of greatest harm and greatest opportunity improving patient safety (Aly et al., 2016).

The plan to prevent HAM errors may include some strategies like improving access to information about these drugs, using auxiliary labels, preparation, administration of these products and employing redundancies such as automated or independent double checks when necessary (ISMP, 2018). Improving the safety of HAM is a part of the JCI Patient Safety Goal and Egyptian Hospital Accreditation standards which require that managers of organizations develop processes for managing HAM. Managers in the hospital have a legal and moral obligation to improve care and to ensure high quality of patient care. The managers are in a prime position to mandate policy, systems, procedures and organizational safety climates. Medication safety is one of the highest priorities of staff nurses (Aly et al., 2016).

Proper management of HAM has become more crucial than ever especially for staff nurses in all disciplines and health care settings. Staff nurses role in medication safety focuses on their effort in the delivery of care and their unique opportunity and responsibility to identify potential medication safety issues (Salhotra and Tyagi, 2019).

The head nurses' role in managing the safety of HAM is currently seen as one of the hardest and most complex roles in healthcare. Nowadays, little is known about what head nurses are doing in practice to ensure and improve the safety of HAM. If head nurses' roles are better understanding and well practicing, the health care organizations are able to anticipate and solve any errors that could arise in the future. Also they achieve many benefits regarding the patient, nurses and health care outcomes (DeWit et al., 2016).

### Significance of the Study

Globally, the cost associated with medications errors has been estimated at 42 billion dollar United States of America annually across the world. Medications errors approximately 6-7% of hospital admissions appear to be medications

related, with over two-thirds of these considered avoidable, thus and potentially due to medication errors (World Health Organization, 2016). Nearly one-third of adults in the United States take 5 or more medications. Each year adverse drug effects account for nearly 700,000 emergency department visits and 100,000 hospitalizations. Nearly 5% of hospitalized patients experience an adverse drug effects and making them one of the most common types of inpatient medication errors (Agency for Healthcare Research and Quality, 2018).

World health organization 2016, reported that just under one-fifth of primary care prescriptions contained medication errors and but only a small minority was considered serious. An Egyptian study was conducted at the in patients wards of dar el shefaa hospital, which is a health care organization and under the supervision of the specialized medical centers department of ministry of health. Found that about 45% of medications errors reached the patients: 43.5% were harmless and 1.4% harmful. 7.7% were potential errors and more than 47% could be prevented (Kamal Eldin and Ismail, 2016).

There is intense need to assess staff nurses' knowledge and practice regarding to high alert medications thus the present study will be conducted in attempt to assess staff nurses' performance regarding to safety measures of high alert medications.

### Aim of the study

This study aims to assess staff nurses' performance regarding to safety measures of high alert medications.

#### Research question

What are the staff nurses' knowledge and practice regarding to safety measures of high alert medications?

#### Subjects and methods

##### I. Technical design

##### Research design:

A descriptive design was used to carry out this study.

**Research setting:**

The study conducted in critical care units at Suez Canal University Specialized Hospital in Ismailia, which affiliated to the Ministry of Higher Education and provides service for all Egyptian and foreign patients. It consists of one main building and has 5 floors with total of 150 beds for inpatient and outpatient and critical care units. The total number of study units is 8 units as the following: Intensive Care Unit, Neonatal Intensive Care Unit, Cardiology Critical Care Unit, Stroke Critical Care Unit, Hepatic Critical Care Unit, Emergency Unit, Gynecology & Obstetric Emergency Unit and Major Operations Unit.

**Research subjects:**

The subjects for the study was include all available staff nurses' (96) of the staff nurses' who are working at Suez Canal University Specialized Hospital in Ismailia full time with experience of at least one year in the study units.

**Tool I: Nurses' knowledge regarding to safety measure of HAM self- administered questionnaire sheet:** It was used for collecting the data for this study. It consists of two main parts:

- Part 1: This part was intended to collect data related to socio-demographic characteristics of staff nurses'.

- Part 2: This part was intended for assessing staff nurses' knowledge regarding to safety measures of high alert medications. It was developed by (Sayad, 2016 & Mohamed, 2012 & Abdelhamid, 2010) and modified by the researcher. It had (60) question under following these dimensions:

- 1- Definition of HAM.
- 2- Types of HAM.
- 3- Safety precautions for HAM.
- 4- Measures should be taken when an error occurs when dealing with HAM.
- 5- Dealing with other HAM.
- 6- Side effects of HAM.

**Scoring system:** the items in the medication safety Self- administered questionnaire were scored

as correct answer (1) and incorrect answer (0). For each domain and subdomain and for the whole scale were summed-up & the total divided by the number of the items for giving mean scores. The level of knowledge considered to be satisfactory if the percent score was equal or more than 60% and considered unsatisfactory if the percent score was less than 60% (Sayad, 2016).

**Tool II: Nurses' practice observational checklist:** It was used for collecting the data for this study. It was intended for assessing the staff nurses' practice regarding to safety measures of HAM. It was developed from (Ibrahim, 2014). It had (138) statements under following these domains:

1. Pre Administration of HAM.
2. During Administration of HAM.
3. Post Administration of HAM.

**Scoring system:** the items in the staff nurses' practice observational checklist were scored on a 2 point likert scale; responses were scored as done (1) and not done (0). For each domain and subdomain and for the whole scale were summed-up & the total divided by the number of the items for giving mean scores. The level of practice considered to be satisfactory if the percent score was equal or more than 70% and unsatisfactory considered if the percent score was less than 70% (Abu El-Naser, 2012).

**II. Operational design**

This design includes an elaboration of the preparatory phase, pilot study and field work.

**A- Preparatory phase**

During this time, the researcher reviewed the national and international related literature concerning the topic of the study. This was through the use of text books, scientific journals and internet search. This helped in the preparation of the first data collection tool (Nurses' knowledge regarding to safety measure of HAM self- administered questionnaire sheet) and in the write-up of the literature review. While the second tool (Nurses' practice observational checklist) was adapted based on (Ibrahim, 2014).

### Tool validity

Once the data collection tools were prepared in a preliminary form, it was presented to seven panel of experts in nursing science for face and content validation, for relevance, comprehensiveness, clarity, applicability and some modifications in phrasing were done according to their opinions.

### Tool reliability

Reliability of the data collection tools was examined through assessing their internal consistency and measured by Cronbach's alpha coefficient.

Tool	Cronbach's alpha	N of items
Nurses' knowledge regarding to safety measure of HAM self-administered questionnaire sheet	0.812	60
Nurses' practice observational checklist	0.799	138

### B- Pilot study

A pilot study was conducted during the first week of October 2019; it was done on 10% of the study subjects and before starting field work and data collection. The pilot study was conducted on (10) staff nurses' in critical care units at Suez Canal University Specialized Hospital in Ismailia; and time needed for observing the staff nurses' practice using observational check list, subjects who participated in the pilot study were included in the main study sample because no modification was done after conducting the pilot study. The pilot study helped to estimate the time needed to complete the data collection forms, subjects took around 45 minutes to fill the questionnaires. Regarding to the observational check list it took about (30-35) minutes from the researcher to observe the practice of the pilot study nurses. It is also done for testing the clarity and feasibility of the data collection questionnaires.

### Fieldwork

Once the official permissions to collect data were obtained and the two study tools namely

(Nurses' knowledge regarding to safety measure of HAM questionnaire sheet and Nurses' practice observational checklist) were finalized.

### Regarding study tool I:

The researcher met (20-25) nurse per day. The meeting with the staff nurses was in the afternoon shifts because the working stress in this shift became less than morning so staff nurses had enough time to fill the questionnaire, the filling of the questionnaires took about 45 minutes. The researcher introduced himself and explained to study subjects the study aim and invited staff nurses to participate in the study, the researcher was present during the process of filling the questionnaire to clarify any ambiguities, after completion of the form the researcher checked it for completeness of all information, the field work extended from the first week of October (2019) to the end of October 2019, it took one month approximately.

### Regarding study tool II:

Each checklist was marked by code number, department and date of observation. The researcher observed staff nurses' actual practice during the morning and afternoon shifts. The observation time started from 8.00 a.m. - 6.00 p.m.; the time of medication administration. The researcher was available in the previously mentioned study settings three days/week by rotation. The researcher was observing actual practice of 2-3 staff nurses/day using the observational checklist. The observational check list was completed by the researcher in 30-35 minutes for every nurse. This process took three months, from beginning of October (2019) to the end of December (2019).

### Ethical considerations

The study proposal was approved by scientific research and ethics committee of the Faculty of Nursing Ain Shams University. In addition, approval was obtained from each participant, the researcher clarified the aim of the study and its implications to the staff nurses included in the study. The staff nurses' were assured that anonymity and confidentiality would be guaranteed. They also were informed about their right to refuse or withdraw from the study at

any time. The study procedures do not entail any harmful effects on participants.

### III. Statistical design

Collected data was revised, coded and entered using computer software PC. Data entry and statistical analysis were fulfilled using

the Statistical Package for Social Sciences (SPSS) Version 23. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables and total score of each dimension/domain of both questionnaires. Chi-square test ( $X^2$ ) and p value were used for the relation among socio-demographic data, knowledge and practice.

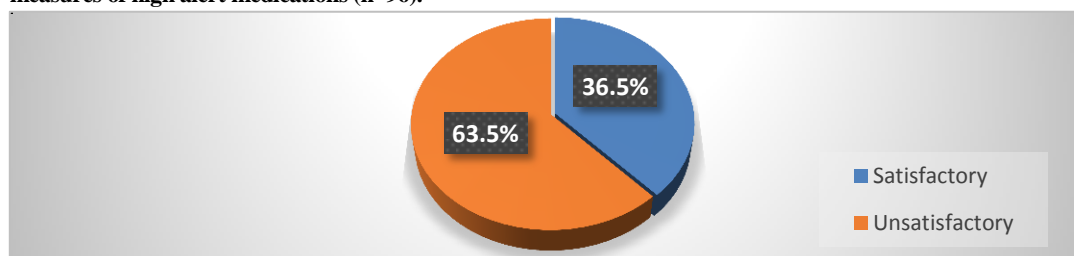
## Results

### Part I: Demographic characteristics of the studied staff nurses.

**Table (1): The studied staff nurses' demographic characteristics (n=96).**

Items	N	%
<b>Age (year)</b>		
20-< 25	17	17.7
25-<30	26	27.1
30-<35	38	39.6
≥35	15	15.6
Mean ± SD	32.12± 3.79	
<b>Gender</b>		
Male	36	37.5
Female	60	62.5
<b>Qualification</b>		
Bachelor of Nursing	14	14.6
Technical Institute of Nursing	79	82.3
Nursing Diplomat	3	3.1
<b>Department</b>		
Intensive care units (Intensive, cardiology, hepatic and stroke care units)	53	55.2
Operation	19	19.8
Emergency (Emergency and obstetric emergency)	17	17.7
Neonatal intensive care unit	7	7.3
<b>Years of Experience</b>		
1 < 3 years	12	12.5
3 < 5 years	20	20.8
5 < 10	40	41.7
≥ 10	24	25
Mean ± SD	7.69± 1.95	

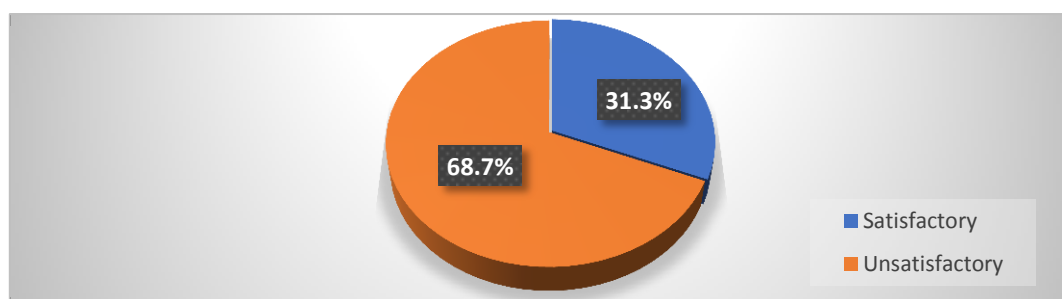
**Table (1):** demonstrates that the demographic characteristics of the studied staff nurses as regard to age more than one third (39.6%) of the studied staff nurses were between 30-<35 years with total mean ± SD 32.12 ± 3.79 and less than two thirds (62.5%) of them were females. More than three quarters (82.3%) of the studied staff nurses had technical institute of nursing as qualification, regarding to department more than half (55.2%) of the studied staff nurses were working in Intensive care unit. As regards to years of experience less than half (41.7%) of the studied staff nurses were between 5 < 10 years with total mean ± SD 7.69 ± 1.95.

**Part II:** Staff nurses' total knowledge regarding safety measures of HAM.**Figure (1):** Percentage distribution of the studied staff nurses' total knowledge regarding to safety measures of high alert medications (n=96).

-Satisfactory practice  $\geq 60\%$ .

-Unsatisfactory practice  $< 60\%$ .

**Figure (1):** Shows that less than two thirds (63.5%) of the studied staff nurses had unsatisfactory total level of knowledge about safety measures of HAM. While more than one third (36.5%) of the studied staff nurses had satisfactory total level of knowledge about safety measures of HAM.

**Part III:** Staff nurses' total practice regarding safety measures of HAM.**Figure (2):** Percentage distribution of the studied staff nurses' total practice regarding safety measures of high alert medications (n=96).

-Satisfactory practice  $\geq 70\%$ .

-Unsatisfactory practice  $< 70\%$ .

**Figure (2):** As clarified more than two thirds (68.7%) of the studied staff nurses had unsatisfactory total level of practice regarding safety measures of HAM. While less than one third (31.3%) of the studied staff nurses had satisfactory total level of practice regarding safety measures of HAM.

**Part IV:** Correlation between the studied staff nurses' total level of knowledge and practice regarding safety measures of high alert medications and their demographic characteristics.

**Table (2):** Correlation between the studied staff nurses' total knowledge and their total practice regarding to safety measures of high alert medications.

Items	Staff nurses' total practice
Staff nurses' total knowledge	r= 0.438 p= 0.000**

(\*)statistically significant at  $p < 0.05$ .

(\*\*) highly statistically significant at  $p < 0.01$ .

**Table (2):** Illustrates that there was a highly statistically significant positive correlation between the staff nurses' total knowledge and total practice regarding to safety measures of HAM as P- Value (0.000).

**Table (3):** Relationship between the studied staff nurses' age, gender, qualification and department and their total level of knowledge regarding to safety measures of HAM.

Items		Total practice				X <sup>2</sup>	P-Value
		Satisfactory		Unsatisfactory			
		(n=30)		(n=66)			
		N	%	N	%		
Age (year)	20-< 25	3	8.6	14	23	9.980	0.03*
	25-<30	5	14.3	21	34.4		
	30-<35	21	60	17	27.9		
	≥35	6	17.1	9	14.7		
Gender	Male	16	45.7	20	32.8	8.124	0.069
	Female	19	54.3	41	67.2		
Qualification	Bachelor	12	34.3	2	3.3	25.48	.000**
	Technical Institute	23	65.7	56	91.8		
	Nursing Diplomat	0	0.0	3	4.9		
Department	Intensive care units	18	51.4	35	57.4	6.102	0.085
	Operation units	10	28.6	9	14.7		
	Emergency units	5	14.3	12	19.7		
	Neonatal intensive						
	care unit	2	5.7	5	8.2		

(\*)statistically significant at  $p < 0.05$ .

(\*\*) highly statistically significant at  $p < 0.01$ .

**Table (3):** Shows that there was a statistically significant relationship between the studied staff nurses' total knowledge and their age as P-Value (0.03). And there was a high statistically significant relationship between the staff nurses' total knowledge and their qualification P-Value (0.000).

**Table (4):** Relationship between the studied staff nurses' years of experience, training courses in administration medication and training courses in administration of HAM and their total level of knowledge regarding to safety measures of HAM.

Items		Total practice				X2	P-Value
		Satisfactory		Unsatisfactory			
		(n=30)		(n=66)			
		N	%	N	%		
Years of Experience	1 < 3	2	5.7	10	16.4	23.15	0.001**
	3 < 5	3	8.6	17	27.9		
	5 < 10	10	28.6	30	49.2		
	≥ 10	20	57.1	4	6.6		
Training courses in administration medication	Yes	22	62.9	3	4.9	14.14	0.01*
	No	13	37.1	58	95.1		
Training courses in administration of HAM	Yes	18	51.4	0	0.0	20.24	0.002**
	No	17	48.6	61	100		

(\*)statistically significant at  $p < 0.05$ .

(\*\*) highly statistically significant at  $p < 0.01$ .

**Table (4):** Indicates that there was a high statistically significant relationship between the studied staff nurses' total knowledge and their years of experience and training courses in administration of HAM as P-Value (0.001 and 0.002) respectively. And there was a statistically significant relationship the studied staff nurses' total knowledge and with training courses in administration medication as P-Value (0.01).

**Table (5): Relationship between the studied staff nurses' age, gender, qualification and department and their total level of practice regarding to safety measures of HAM.**

Items		Total practice				X <sup>2</sup>	P-Value
		Satisfactory		Unsatisfactory			
		(n=30)		(n=66)			
		N	%	N	%		
Age (year)	20-< 25	0	0.0	17	25.7	10.89	0.025*
	25-<30	2	6.7	24	36.4		
	30-<35	20	66.7	18	27.3		
	≥35	8	26.6	7	10.6		
Gender	Male	12	40	24	36.4	7.804	0.071
	Female	18	60	42	63.6		
	Bachelor	14	46.7	0	0.0		
Qualification	Technical Institute	16	53.3	63	95.5	24.87	0.000**
	Nursing Diplomat	0	0.0	3	4.5		
	Intensive care units	15	50	38	57.6		
Department	Operation units	8	26.6	11	16.6	6.721	0.081
	Emergency units	5	16.7	12	18.2		
	Neonatal intensive						
	care unit	2	6.7	5	7.6		

(\*)statistically significant at  $p < 0.05$ .(\*\*) highly statistically significant at  $p < 0.01$ .

**Table (5):** Shows that there was a statistically significant relationship between the studied staff nurses' total practice and their age as P-Value (0.025). There was a high statistically significant relationship between the staff nurses' total practice and their qualification as P- Value (0.000).

**Table (6): Relationship between years of experience, training courses in administration medication and training courses in administration of HAM of the studied staff nurses and their total level of practice regarding to safety measures of HAM.**

Items		Total practice				X <sup>2</sup>	P-Value
		Satisfactory (n=30)		Unsatisfactory (n=66)			
		N	%	N	%		
Years of Experience	1 < 3	0	0.0	12	18.2	16.20	0.01*
	3 < 5	2	6.7	18	27.2		
	5 < 10	9	30	31	47		
	≥ 10	19	63.3	5	7.6		
Training courses in administration medication	Yes	23	76.7	2	3	20.97	0.002**
	No	7	23.3	64	97		
Training courses in administration of HAM	Yes	18	60	0	0.0	21.07	0.001**
	No	12	40	66	100		

(\*)statistically significant at  $p < 0.05$ .(\*\*) highly statistically significant at  $p < 0.01$ .

**Table (6):** Indicates that there was a statistically significant relationship between the studied nurses' years of experience and their total practice as P- Value (0.01). And there was a high statistically significant relationship between the staff nurses' total practice and their training courses in administration medication and training courses in administration of HAM as P- Value (0.002 and 0.001) respectively.

## Discussion

High alert medications known as high risk or potentially dangerous medications are those with higher potential to cause severe or even fatal damage when an error occurs during their utilization. HAM error detailed should be analyzed and documented. Prevention plan to avoid medication error should be implemented for each HAM category or class, creating a high alert list does little more than meet a regulatory requirement (Yadav et al., 2018).

Medication administration process is a complex and multistage practice in hospital settings. It plays a central role in nursing and is mostly managed by staff nurses' except prescribing that is conducted by the physicians. However, staff nurses' are in some way involved in each stage of it, including prescribing, documenting (transcribing), dispensing, administering and monitoring (Fahmy, 2018).

The present study aims to assess the staff nurses' performance regarding to safety measures of high alert medications. Discussion of the findings of this study will cover the main parts of result. The researcher used studies of different scope due to lack of researches that concerned with staff nurses' performance regarding to safety measures of high alert medications and the researcher compare the data that related to concept of nursing performance (knowledge and practice).

The result of this study revealed that the less than two thirds of staff nurses had unsatisfactory total level of knowledge regarding to safety measures of HAM. This result may be due to few training courses in administration medication and safety administration of HAM, the wide base for staff nurses' education is technical institute of nursing, staff nurses' were trying to divert their nursing career through the opening education to improve the word vision to word them, annual leaves for child care that effect on number of staff nurses', turnover of work and their belief that, the knowledge about medication safety no necessary and didn't need it.

The finding of this study is conceding with Milton (2015), who conducted a study titled: "Hypoglycemia from a Look-Alike, Sound-Alike Medication Error" stated that the majority of staff nurses had unsatisfactory level of knowledge regarding both LASA medications.

Concerning staff nurses' total level of practice in different areas of drug administration", the finding of this study documented that the majority of staff nurses had unsatisfactory level of practice regarding to safety measures of HAM in pre, during administration of HAM and had satisfactory level of practice regarding to safety measures of HAM in post administration of HAM. This result may be due to attributed lack of staff nurses' knowledge which reflects on their practice, inadequate training session to staff nurses, absence of continuous supervision and evaluation, absence of a great policy management system to organize and administer hospital policies especially the critical procedures, absence of slandered guidelines for administration of medication, HAM and lack of job description all of this make staff nurses' felt irresponsibility to give medication correctly and decrease their awareness about medication errors.

The finding of the current study is consistent with Mohamed (2014), who conducted a study titled: "Effectiveness of Training Program for Staff Nurses Regarding Dealing with High Alert Medication" who stated performance levels failures were judged as skills.

The present study demonstrates that there was a highly statistically significant correlation between the staff nurses' total knowledge and total practice regarding to safety measures of HAM. This result may be due to fact that the higher knowledge level among the staff nurses increases the expectation of having more satisfactory level of practice as the unknowledgeable staff nurses impossible to be practically professional in their career. It could not be possible to prevent medication confusion without paying attention to the factors: contributing to occurrence of HAM error such as unavailable drug information, miscommunication of drugs doses, misuse of

zeroes and decimal points, other dosing units, continuous production of new medications with similar names, doses, distraction and interruption during preparation of medications.

This finding was in agreement with **Shaheen et al., (2016)**, who conducted a study titled: "Health care Providers practice toward Patient Safety" who revealed statistically significant positive correlation between knowledge and practice of HAM.

The present study demonstrates that there was statistically significant relationship between the staff nurses' total knowledge regarding to safety measures of HAM and their age. This result may be due to that the evidence for the greater the age, the more knowledge as the older the staff nurses the more and higher chances of attending training courses and updating their knowledge. These results were accordance with **Lan et al., (2014)**, who conducted a study titled: "Medication Errors in Pediatric Nursing: Assessment of Nurses' Knowledge and Analysis of the Consequences of Errors", who mentioned that there were statistically significant relations between nurses' knowledge and their age.

The present study demonstrates that there was no statistically significant relationship between the staff nurses' total knowledge regarding to safety measures of HAM and their gender. This result might be explained as, there no difference between male and female nurses regarding to total knowledge regarding to safety measures of HAM. This may be due to that the female nurses have higher sense of responsibility, decision making capabilities in addition to recognition of others' lifesaving concept. So the female nurses weren't statistically significant different from male nurses.

The finding of the current study contradicting with **Mamdouh, et al., (2020)**, who conducted a study titled: "Assessment of Nurses' Performance Regarding the Implementation of Patient Safety Measures in Intensive Care Units", who revealed that there was statistically significant relations between nurses' knowledge and their gender.

The present study demonstrates that there was a highly statistically significant relation between staff nurses' total knowledge regarding to safety measures of HAM and their qualification. This result may be due to that the all governmental hospitals need to reduce numbers of diplomat and technical nurses at intensive care unit and increase numbers of bachelor nurses who have more knowledge about safe medication administration practices and their ability to calculate medications dose accurately, intravenous flow rate, understanding medication formulas, quickly identifying any mistakes at medication use process and their ability to manage this mistake quickly.

The finding of the current study inconsistent with **Shahin, (2018)**, who mentioned in the study titled: "Nurses' Knowledge and Practices Regarding Enteral Nutrition at the Critical Care Department at AL-Minia University Hospital in Egypt: Impact of a Designed Instructional Program" that more than half of nurses had diplomat degree.

The present study demonstrates that there was no statistically significant relationship between the staff nurses' total knowledge regarding to safety measures of HAM and their work place (departments), although the higher number of staff nurses in current study are working in intensive care units. This result may be due to fact that staff nurses are an important component of the health care delivery system and impacts on safety, all the staff nurses working in any department in the hospitals have similar chances of making errors related to HAM.

This finding was in agreement with **El-sayed et al., (2019)**, who conducted a study titled: "Nurses' Performance Regarding Infusion Pumps' Medication Administration among Critically Ill Patients" revealed that in their study, there was a statistically significant relation between the total nurses' knowledge and their working place.

The present study demonstrates that there were highly statistically significant relations between staff nurses' total knowledge regarding to safety measures of HAM and their

years of experience. These results might be due to the years of experience in nursing are an important factor that contributes to nursing quality. Multiple experiences of observing cues, recognizing patterns related to patient status that need to be acted on in specific ways and lead to higher levels of knowledge. An experienced staff nurses' may assess the same patient as an inexperienced nurse but respond differently based subtle changes (cues) that serve as a forewarning of significant. The more the years of experience the staff nurses have the higher satisfactory level of knowledge is expected as a result of their frequent dealings with different cases resulting from medication errors.

The finding was in agreement with **So (2017)**, who conducted study titled "Evaluation of the Effect of a Critical Care Follow-up Program on Patient Outcomes" who reported that there is strong correlation between total knowledge and years of experience about implementation patient safety measures.

The present study demonstrates that there was statistically significant relationship between the staff nurses' total knowledge regarding to safety measures of HAM and having training courses regarding (medication administration and administration of HAM). This fact may be due to that the more attendance the training courses more satisfactory knowledge expected, being more up to date, educational programs can raise nurses' awareness about medication errors and other medication related safety issues.

This result is inconsistent with **Fahmy (2018)**, who conducted a study titled: "Nursing Performance Regarding Intravenous Infusion of LASA at Intensive Care Unit", who reported that more than half of staff nurses' had previous training courses regarding look-alike/sound-alike medication.

The present study demonstrates that there was statistically significant relationship between the staff nurses' total practice regarding to safety measures of HAM and their age. This result may be due to that the evidence for the greater the age, the more practices among the staff nurses the more chances for learning from their trial and error. These results

were accordance with **Lan et al., (2014)**, who mentioned that there was statistically significant relationship between the studied staff nurses' practice and their age.

The present study demonstrates that there was no statistically significant relationship between the staff nurses' total practice regarding to safety measures of HAM and their gender. This result may be due to that the female nurses are similar to or nearly equal with male nurses in relation to seeking competitive chances in achieving the specific and various techniques of different skills. The finding of the current study contradicting with **Mamdouh et al., (2020)**, who revealed that there was statistically significant relations between nurses' practice, and their gender.

The present study demonstrates that there was a highly statistically significant relation between staff nurses' total practice regarding to safety measures of HAM and their qualification. This result may be due to that the nursing higher education that reinforces professional values, thus improving the quality of patient care and a significant impact on the competencies of nurses, all health care providers. Nurses with Bachelor of Science in Nursing degrees are enabled to meet various patients' needs; function as leaders; and advance science that benefits patients and the capacity of health professionals to deliver safe, quality patient care.

The finding of this study was in agreement with **Arifulla et al., (2015)**, who conducted a study titled: "Reporting of Adverse Drug Reactions" who reported that nurses with baccalaureate degree had slightly higher median practice score than diploma holders.

The present study demonstrates that there was no statistically significant relationship between the staff nurses' total practice regarding to safety measures of HAM and their work place (departments). This result may be due to fact that all the staff nurses working in any department in the hospitals have similar chances of making errors related to HAM. Staff nurses have important role in each department in hospital, effect on hospital quality, efficiency,

and nursing care often taken place independent of one another. Activities to assure the adequacy and performance of hospital nursing improve quality and achieve effective control of hospital costs need to be harmonized. Nurses are critical to the delivery of high-quality, efficient care. This finding was in agreement with **El-sayed et al., (2019)**, who revealed that in their study, there was a statistically significant relation between the total nurses' practice and their working place.

The present study demonstrates that there was statistically significant relationship between the staff nurses' total practice regarding to safety measures of HAM and their years of experience. This result may be due to that the one important factor that contributes to nursing quality is the staff nurses' years of experience in nursing. Multiple experiences of observing cues, recognizing patterns related to patient status that need to be acted on in specific ways and lead to higher levels of clinical performance. An experienced staff nurses' may assess the same patient as an inexperienced nurse but respond differently based subtle changes (cues) that serve as a forewarning of significant.

This finding of this study is consistent with **AL Yousseif (2017)**, who conducted a study titled: "Nurses' Experiences toward Perception of Medication Administration Errors", who mentioned in the study titled: "Nurses' experiences toward perception of medication administration errors reporting" that the majority of nurses had years of experience in ICU between 5-10 years.

The present study demonstrates that there was highly statistically significant relationship between the staff nurses' total practice regarding to safety measures of HAM and having training courses regarding (medication administration and administration of HAM). This fact may be due to that the hospital need to provide staff nurses' with a complete training program to give medications correctly and emphasized that accessible medication information should be readily available and close at hand for all staff for administration of medications to prevent negligence of this common source of medication error. These results in the

same line with **Labib et al., (2018)**, who conducted a study titled: "High Alert Medications Administration Errors in Neonatal Intensive Care Unit", who found that nurses with previous HAM training courses had significantly the highest mean percent score in practice.

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## Conclusion

In the light of the present study findings, it can be concluded that less than two thirds of the studied staff nurses had total unsatisfactory level of knowledge and more than two thirds of them had total unsatisfactory level of practice regarding to safety measures of high alert medications. Moreover there was a highly statistically significant correlation between the staff nurses' total knowledge and total practice regarding to safety measures of HAM. These findings answer the research question which stated that what are the staff nurses' knowledge and practice regarding to safety measures of high alert medications?

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## Recommendations

In the light of the present study findings, the following recommendations are suggested:

- Offer educational programs and upgrading courses armed with evidence based guidelines based on staff nurses' needs to improve their knowledge and practice related to administration of high alert medications.
- Offer updated in-service training program for staff nurses regarding high alert medication preparation, administration, storage, calculation and documentation.
- Conduct a session about HAM in orientation program for newly hired staff.
- Develop hospital protocol/ guidelines concerning all aspects related to dealing with HAM.
- Establish a standard of reward or promotion for nurses who follow the hospital policies related to dealing with HAM.
- Create blame free environment to help reporting of medication errors.

**Future research**

- Replication of the study on larger sample size selected from different geographical areas in Egypt is recommended to obtain data of more generalizability in relation to this problem.

- Study the effect of staff nurses' awareness of HAM on patients' satisfaction.

- Study the influence of staff nurses' practice of HAM on patients' satisfaction.

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