Medication Preparation Errors among Staff Nurses at Neonatal Intensive Care Units (NICUs)

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Abstract

Background: Medication errors are probably the most common type of child safety incidents worldwide and cause harm to neonates, distress to medical staff and costs to the health care system. The study **aimed** to assess medication preparation errors among staff nurses at Neonatal Intensive Care Units. **Research Design**: A descriptive analytical research design was utilized. **Research Settings**: This study was conducted at Neonatal Intensive Care Units belong to two University Hospitals the Children Hospital & Obstetric Hospital affiliated to Ain Shames University Hospitals, Abo-Elrish Children Hospital and New El-Kasr El Ainy affiliated to Cairo University Hospitals. **Subject**: A purposive sample consisted of 60 nurses at the previously mentioned settings regardless their age, gender, and qualification for a period of 6 months. **Tools**: Two tools were used a pre designed questionnaire sheet to assess knowledge of the studied nurses about medication preparation errors and observational checklists sheet to assess nurses' practice regarding medication preparation errors. **Results**: More than one third of studied nurses do not know the precautions during medication preparation and half of studied nurses asked the pharmacist to change medication sticker when had difficulty to read medication name. More than two thirds of studied nurses needed to know information before medication administration, while more than one third of studied nurses combined oral medication with artificial milk and more than two thirds of them didn't clarify medication label. **Conclusion**: The current study concluded that, the common medication preparation errors among the studied nurses were did not know precautions before leaving medication preparation, combined oral medication with artificial milk, didn't know clarify medication label, didn't know ten medication rights, didn't know precaution before oral medication administration, review the incubator card before medication administration and didn't monitor/assess child before medication administration. **Recommendations**: Periodical educational programs for enhancing level of nurses' knowledge and practice for prevention of medication errors and emphasize the importance of implementing the effective error prevention strategies, increasing the nurse to neonate ratio and participation of pharmacy department in drug preparation.

Keywords: Medication preparation errors, Staff Nurses, Neonatal Intensive Care Unit

Introduction

Medications are considered a great benefit to neonate lives for relieving pain or curing illness in Neonate Intensive Care Units (NICUs). Medications Preparation at NICU may be very dangerous if improperly used, more over medications' safety is one of the highest priorities of nursing practice, which a matter of considerable concern for all

health team members. Medication Errors (MEs) during preparation produce variety of problems for neonate ranging from minor discomfort to substantial morbidity that may prolong hospitalization or lead to death **(Alagha, 2011).**

Medication can mean either a process or an object that undergoes the process. A medication (the object) can be considered to be the same as a medicinal product, which has been defined in terms of medicinal product. Thus, a medication is a product that contains a compound with proven biological effects, plus excipients, or excipients only; it may also contain contaminants; the active compound is usually a drug or prodrug, but may be a cellular element **(Johnson and Thomas, 2013).**

Medication preparation is considered as one main function for nurse's and that nurse's competency and following guidelines of medication preparation is a warranty for neonate safety and a quality of nursing care. The World Health Organization reported that child safety requires that health care professionals focus on reducing the risk of unnecessary harm **(Aboshaiqah, 2014).**

Neonatal intensive care is defined as care for medically unstable or critically ill newborns requiring constant nursing, complicated intensive interventions. When an intensive care nursery is available, the intermediate nursery serves as a 'step down' unit from the intensive care area. When hospitals mix infants of varying acuity, requiring different levels of care in the same area, intensive care design standards shall be followed to provide maximum clinical flexibility **(White, 2017).**

The role of neonatal nurse at NICU includes identifying and reporting any medication errors and assessing their performance to provide safe and accurate preparation of medication to Neonates. In order to reduce the risk of medication preparation errors nurses can discuss risks in an incompatible drugs, safe preparation and administration, (**Gimenes et al., 2016).**

One of the responsibilities of nurses that require special attention is the process of preparing medication. In this process, nurses are required not to lose their concentration. However, interruptions may cause lose their concentration and make errors in preparing medication it is need for appropriate use of diluents. Since their excess may lead to an overload of volume, while their absence or insufficiencies may cause adverse events ranging from phlebitis to renal failure **(Duruk et al., 2015**).

Significance of the Study

Assessing medication preparation errors is beneficial in many ways, identifying different source of medication error help to suggest standard roll for medication preparation that lead to reduce the number of errors, saving neonate`s life, and improve quality of care; in addition it can reduce the costs associated with drug therapy problems; and decrease length of hospitalization, also it will reduce adverse neonate outcome.

The earlier Egyptian study, 1107 of the medication orders (78.1%) had at least one prescription error. In a descriptive analysis of medication errors reported to the Egyptian national online reporting system, out of the 12000 valid reports that were analyzed, prescription errors were the most common type of MEs (54%), followed by monitoring (25%) and administration errors (16%). The most common stage for medication

errors was during the ordering and prescription stage (38.1%), followed by the administration stage. (20.9%). Errors during monitoring, preparation and dispensing were: (18.3%), (12.3%) and (10.4%) respectively **(Alagha, 2011).**

Aim of the Study

The study aimed to assess medication preparation errors among staff nurses at NICUs.

Research Question

1-What are medication preparation errors among nurses at NICUs?

Material and Methods:

Study Design:

A descriptive analytical research design was utilized to achieve the aim of this study.

Study Settings:

This study was conducted at NICUs belongs to two University Hospitals; the Children Hospital & Obstetric Hospital affiliated to Ain Shames University Hospitals, Abo-Elrish Children Hospital and New El-Kasr El Ainy affiliated to Cairo University Hospitals.

Subjects:

A purposive sample consisted of 60 female nurses out of one hundred twenty at the previously mentioned settings regardless their age and qualification for a period of 6 months.

Tools of Data Collection:

Two tools were used to collect data as the following:

Tool (I):- A pre designed Questionnaire Sheet

It was designed by the researcher after reviewing the relevant literature. It was written in simple Arabic language to suit the level of understanding of the studied sample to collect data regarding to the following parts:

Part 1:

- It concerned with the characteristics of studied nurses such as age, qualification, marital status, position of the nurses', years of experience, and training courses.

Part 2:

- It related to nurses knowledge about medication preparation (concept of medication, medication preparation, medication preparation errors, medication storage and precautions, medication order content, medication preparation knowledge and precautions, factor affecting medication preparation and medication preparation complication).

Scoring system:

The correct answer was scored one, and that incorrect was scored zero. These scores were summed-up and converted into a percent score.

- Score from < 50 referred to poor knowledge.
- Score from 50 < 75 referred to average knowledge.
- Score from 75 ≤ 100 referred to good knowledge.

Tool (II):-Observational Checklist Sheet

Adopted from **Agency for Health care Research and Quality [AHRQ] (2015)** to assess nurses' practice regarding Medication preparation errors at NICUs.

Scoring system:

The right step (met step) was scored one, and that wrong (not met) was scored zero. These scores were summed-up and converted into a percent score.

- Score from < 80 referred to incompetent.
- Score from 80 ≤ 100 referred to competent.

Content Validity and Reliability:

It was ascertained by three of experts in Pediatric Nursing Specialty. Their opinion was elicited regarding the format, layout, consistency, accuracy, and relevancy of the tools. Reliability of the tools was done through using the appropriate statistical test according the knowledge tool

Pilot Study:

It was carried out on 6 nurses those represent 10% of the subject at the previously mentioned sittings to test applicability of the constructed tools, clarity, and efficiency of the included questions related to medication preparation errors, and then the necessary corrections and omissions of items were performed as needed according to the results of pilot study. The pilot study had also served to estimate the time needed for each subject to fill in the questions. Nurses under pilot study were excluded from the main study sample.

Field Work

To carry out the study, an approval was obtained from the Medical and Nursing Directors of NICUs at Children Hospital &Obstetric Hospital affiliated to Ain Shames University Hospitals, Abo-Elrish Children Hospital and New El-Kasr El Ainy affiliated to Cairo University Hospitals. A letter was issued to the mentioned settings from the Dean of Faculty of Nursing, Ain Shams University, explaining the aim of the study in order to obtain their permission and cooperation. Data were collected in six months, from the first of May to the end of October (2016)

The researcher first met with the neonatal nurses at the previously mentioned settings. The researcher introduced himself to the nurses. Then, the nurses were interviewed individually using the previously tools in the predetermined settings. The purpose of the study was simply explained to the nurses who agree to participate in the study. The researcher met each nurse individually to fill the knowledge tool within 20 minutes, while observational checklist sheet was filled by the researcher within 20 minutes. The researcher was visiting the study settings twice weekly by rotation in each setting at morning shift and afternoon shift to collect data and implement this study.

Ethical considerations

Verbal approval was obtained from the nurses before inclusion in the study a clear and simple explanation was given according to their level of understanding, physical, and mental readiness. The nurses secured that all the gathered data was confidential and used for research purpose only**.**

The ethical research considerations in this study were included the following:-

- Prior study conduction, ethical approval was obtained from the scientific research ethical committee of Faculty of Nursing, Ain Shams University.

- The researchers clarified the objectives and aim of the study to nurses included in the study before starting.

- The researcher assured that all gathered data was treated confidentiality and anonymity of subjects' data and was used for the research purpose only.

- Nurses were informed that they were allowed to choose to participate or not in the study and that they had the right to withdraw from the study at any time.

Statistical analysis:

Data collected from the studied sample was revised, coded and entered using PC. Computerized data entry and statistical analysis were fulfilled using the Statistical Package for Social Sciences (SPSS) version 19. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables and measured standard deviations for quantitative variables. Chi-square test (X^2) was used for comparisons between qualitative variables. Statistical significant was considered at p-value <0.05.Pearson correlation to assess the linear dependence (correlation) between two variables, it has a value between +1 and −1 inclusive. Statistical significant was considered at p-value <0.05

Results

Table (1) shows that, 71.7% of nurses' age ranging from 20 years to less than and equal to 30 years and the mean age of the nurses is 25.6±1.9 years. Regarding qualification, more than half (53.3%) of nurses are diploma nurse with specialty In relation to marital status 61.7% of nurses are married, 68.3% of them are staff nurses, 53.3% of the studied nurses have from 3 years to less than 6 years' experience, the mean years of the experience is 3.6±1.8 years and 60% of them did not attend training program regarding medication preparations errors. In addition to 86.7% of them not have policy and procedure regarding medication preparations.

Table (2) shows that, 63.3%, 70%, and 71.7% of nurses have incorrect answer regarding to meaning, preparations and wrong preparations respectively, while 73.3% of them have correct answer regarding to methods of medications administration.

Figure (1) clarify that, 76.7 % and 80.0% of nurses have incorrect answer regarding to medication storage temperature and medication storage precautions respectively.

Table (3) reveals that, 56.7 % of nurses don't know precautions before leaving medication preparation and 55.0 % of them don't know what should to do when have difficulty to read medication name. 70.0% of them need to know information before medication administration, while 75.0% of them don't combined oral medication with water and 71.7% of them don't know clarify medication label. In addition 53.3% of them don't know ten medication rights, 51.7% do not know precaution before oral medication administration, and 61.7% of nurses don't have responsibility to cancel medication order if she found risk, and 73.3% of them don't review the neonate identification band before medication administration and 51.7% don't monitor the neonate before medication administration.

Table (4) shows that, 71.7%, 51.7 % and 80,0% of nurses have incorrect answer regarding to content of ordering &emergency phone or verbally and missed part of actual ordering respectively.

Table (5) illustrates that 47.0%, 35.9%, 32.3%, 29.6% and27.6%of the studied nurses reported that drug allergy, limited nurse's number, no hospital policy and procedure, medication prescription route and age were from the factors affecting medication errors respectively

Table (6) shows that, 71.7%, 65.0% and 71.7 % of nurses reported incorrect answer regarding to types, causes handling medication preparation errors respectively.

Figure (2) clarify that 43.3% of nurses had poor knowledge, while 20.0% of them had good knowledge regarding medication preparation errors.

Table (7) shows that, 38.3% are competent parenteral medication preparation and administration, while 61.7% of the studied nurses are incompetent related parenteral medication preparation and administration.

Figure (3) shows that 60.0% of them had incompetent level regarding practices medication preparation errors, while 40.0% had competent level regarding medication preparation errors.

Table (8) illustrates that there was highly statistically significant relation between attending training courses of the studied nurses and their knowledge regarding to medication preparation errors at ($p<0.01$).

Table (9) illustrates positive correlation between nurses' knowledge in relation to their total practices level about medication preparation errors at ($P <0.05$).

Table (1): Distribution of studied nurses according to their socio-demographic characteristics (no =60)

Socio-Demographic Characteristics of the Studied Nurses		
Items	**No**	**%**
Age in years		
<20	3	5.0
20≤ 30	43	**71.7**
31 < 40	14	23.3
Mean ±SD	25.6±1.9	
Qualification		
Diploma nurse	7	11.7
Diploma nurse with specialty	32	**53.3**
Technical institute	7	11.7
Bachelor	14	23.3
Marital status		
Single	20	33.3
Married	37	**61.7**
Divorced	2	3.3
Widow	1	1.7
Positions		
Nursing supervisor	3	5.0
Head nurse	16	26.7
Staff nurse	41	**68.3**
Years of experience		
< one year	4	6.7
1 < 3	8	13.3
3 < 6	32	**53.3**
≥ 6	16	26.7
Mean ±SD	3.6±1.8	
Attending training courses		
Yes	24	40.0
No	36	**60.0**
Policy and procedure		
Yes	8	13.3
No	52	**86.7**

Table (2): Distribution of the studied nurses according to their knowledge regarding to medication preparation (No =60)

Knowledge of Medication Concept and Preparation		
Items	**No**	**%**
Meaning of medication		
Correct	22	36.7
Incorrect	38	**63.3**
Meaning of Medication Preparation		
Correct	18	30.0
Incorrect	42	**70.0**
Meaning of wrong medication preparation		
Correct	17	28.3
Incorrect	43	**71.7**
Methods of medication administration		
Correct	44	**73.3**
Incorrect	16	26.7

Figure (1): Percentage distribution of the studied nurses according to their knowledge regarding to medication storage.

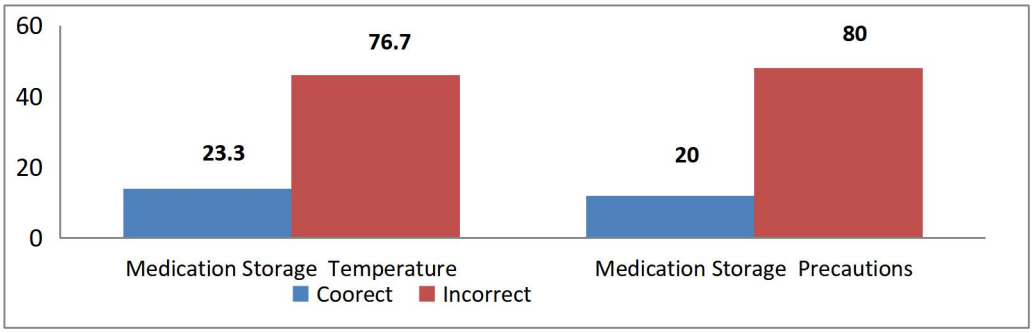

Table (3): Distribution of the studied nurses according to their knowledge during medication preparation& before administration (No=60)

Knowledge during Medication Preparation & before Administration		
Items	**No**	**%**
Precautions before leaving medication preparation		
Correct	26	43.3
Incorrect	34	**56.7**
Difficulty to read medication name		
Correct	27	45.0
Incorrect	33	**55.0**
Information need before medication preparation		
Correct	18	30.0
Incorrect	42	**70.0**
Oral medication combined with		
Correct	15	25.0
Incorrect	45	**75.0**
Clarify medication label		
Correct	17	28.3
Incorrect	43	**71.7**
Ten Medication rights before administration		
Correct	28	46.7
Incorrect	32	**53.3**
Precautions before oral medication administration		
Correct	29	48.3
Incorrect	31	**51.7**
Nurse has the responsibility to cancel medication order if he/ she found risk		
Correct	23	38.3
Incorrect	37	**61.7**
Before medication administration		
Correct	16	26.7
Incorrect	44	**73.3**
Monitoring child before medication administration		
Correct	29	48.3
Incorrect	31	**51.7**

Table (4): Distribution of the studied nurses according to their knowledge regarding to medication ordering (No =60)

Medication Ordering		
Items	**No**	**%**
Content of ordering		
Correct	17	28.3
Incorrect	43	**71.7**
Emergency phone or verbally ordering		
Correct	29	48.3
Incorrect	31	**51.7**
Missed part of Ordering		
Correct	12	20.0
Incorrect	48	**80.0**

Table (5): Distribution of the studied nurses according to their knowledge about factors affecting medication errors (No=60)

Factors Affecting Medication Errors		
Items	**No**	**%**
Factors affect medication errors related to:		
➢ **Child**		
Age	44	**27.6**
Health status	37	23.3
Weight	38	23.9
All of the above	16	10.1
Do not know	24	15.1
➢ **Physician**		
Physician experience	22	17.6
Medication prescribed route	37	**29.6**
Lack of training	32	25.6
Do not know	34	27.2
➢ **Nurse**		
Busy of the nurse with other tasks	3	3.4
Limit nurses number	32	**35.9**
Psychological stress which face nurses	11	12.4
Learn from nurse without reference	22	24.7
Lack of information	17	19.1
Do not know	4	4.5
➢ **Medication**		
Storage	8	9.6
Medication interaction	5	6.1
Medication expiration	10	12.0
Drug allergy	39	**47.0**
All of the above	13	15.7
Do not know	8	9.6
➢ **Hospital**		
Lack of medication	8	11.3
No reference for medication	8	11.3
Lack of role models	8	11.3
No hospital policy and procedure	23	32.3
Do not know	24	**33.8**

N.B: Numbers are not mutually exclusive

Table (6): Distribution of the studied nurses according to their knowledge regarding to types, causes and handling medication errors (No=60)

Handling Medications Preparation Errors Items	No	%
Types medication errors		
Correct	17	28.3
Incorrect	43	**71.7**
Causes of medication error		
Correct	21	35.0
Incorrect	39	**65.0**
Handling medication error		
Correct	17	28.3
Incorrect	43	**71.7**

Figure (2): Percentage distribution of the studied nurses according to their total knowledge about medication preparation errors

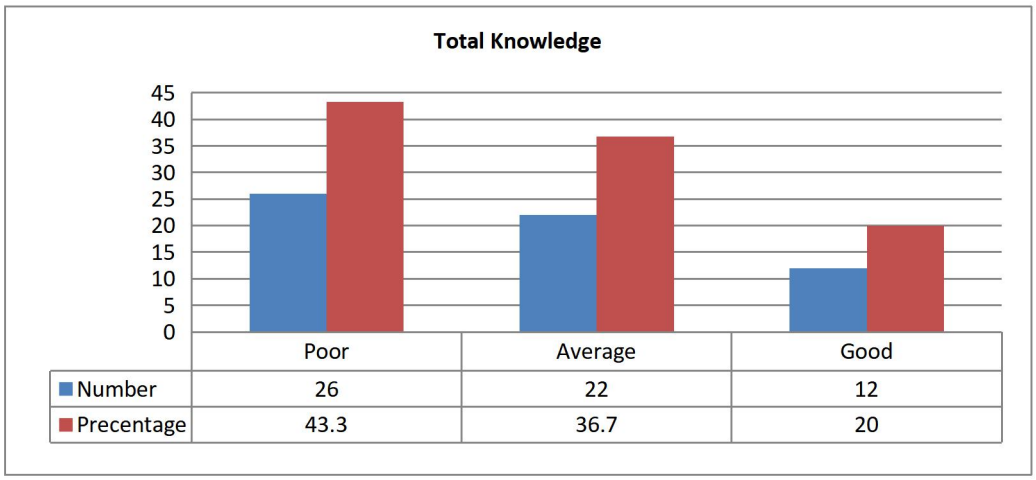

Table (7): Distribution of the studied nurses according to their practices regarding parenteral medication preparation and administration (No=60)

parenteral Medication Preparation	Observation			
	Competent		Incompetent	
Steps	**No**	**%**	**No**	**%**
Hand hygiene	20	34.0	40	66.0
Medications prepared in a clean area	19	31.7	41	68.3
Assemble supplies	22	36.7	38	63.3
Single-dose vials used for each neonate only and discarded	24	40.0	36	60.0
Multiple-dose vials only entered with a new	22	36.7	38	63.3
empty sterile syringe and needle	29	48.3	31	51.7
Open one vial of each medication	21	35.0	39	65.0
Label syringes	26	43.3	34	56.7
Hand hygiene	28	46.7	32	53.3
Don clean gloves	19	31.7	41	68.3
wipe injection port with antiseptic	17	28.3	43	71.7
inject medication	23	38.3	37	61.7
Discard syringe into sharps container	17	28.3	43	71.7
remove gloves	25	41.7	35	58.3
Hand hygiene	26	43.3	34	56.7
Total Mean Score	**23**	**38.3**	**37**	**61.7**

Figure (3): Percentage distribution of the studied nurses according to their total practices regarding medication preparation errors

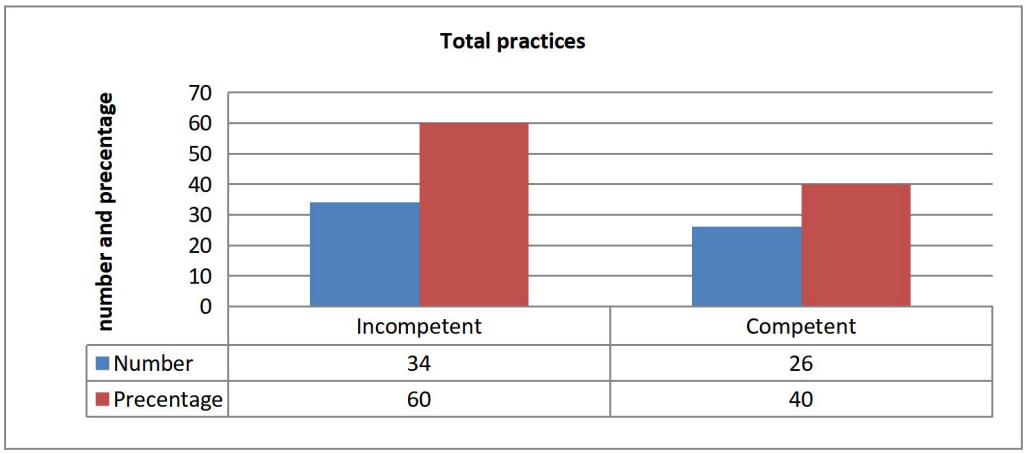

Table (8): Relation between attending training courses of the studied nurses and their total knowledge regarding to medication preparation errors

Relation between Attending Training Courses of the Studied Nurses and their Total Knowledge								
Items	**Poor**		**Average**		**Good**		**X²**	**P Value**
	No	**%**	**No**	**%**	**No**	**%**		
Attending Training Courses								
Yes	1	1.7	14	23.3	9	15.0	25.41	****0.0001**
No	25	41.7	8	13.3	3	5.0		

Table (9): Correlation between nurses' knowledge in relation to their total practices level about medication preparation errors.

Correlation between Nurses' Total Knowledge and Nurses' Total Practices Level		
Nurses' Knowledge	**Total Practices**	
	r	**P Value**
Knowledge	0.63	***0.04**

Discussion

Regarding to socio demographic characteristics of the studied nurses, the findings of the current study revealed that (table 1), more than two thirds of nurses' age ranging from 20 years to less than or equal 30 years with mean and SD was 25.6±1.9 years. Also more than half of nurses were diploma nurse with specialty, and these findings were in accordance with the study of **Said et al., (2016)** who in study an investigation of errors, the preparation and administration of parenteral medications in an intensive care unit of a tertiary teaching hospital in Malaysia, stated that more than three quarters of the studied nurses were had diploma qualification. Although this contradicts with the findings of **Burger and Degnan, (2016),** who studied comparative safety, efficiency, and nursing preference among 3 methods for intravenous push medication preparation: A randomized crossover simulation study in San Diego, found that nearly two quarters and nearly two thirds were registered nurses (RNs) and had a bachelor's degree in nursing respectively, and more than two thirds of them were staff nurses. From the researcher point of view, these differences may be due to differences of the study setting, from Malaysia, San Diego, and Egypt. In relation to marital status, three fifths of studied nurses were married.

Regarding to nurses' knowledge about medications storage, the findings of the current study showed that (figure 1), majority of the studied nurses had incorrect answer regarding to medication storage precautions and medication storage temperature. These findings contradict with **Abbasinazari**, **(2013)** who studied evaluating the frequency of errors in preparation and administration of intravenous medications in orthopedic, general surgery and gastroenterology wards of a teaching hospital in Tehran, found that inappropriate storage of diluted drug and incompatibilities were minor errors occurred in their setting.

Regarding to nurses' knowledge about types, causes, handling medication preparation errors, the findings of the

current study clarified that (table 6), nearly three quarters, nearly two thirds and nearly three quarters of the studied nurses reported incorrect answer regarding to types, causes, handling medication preparation errors respectively. These findings were in accordance with **Muzio and Simone, (2016),** who studied medication errors in Intensive Care Units, nurses' training needs, at 2 university hospitals in Rome stated that the studied nurses had inadequate knowledge about drug administration despite the importance of appropriate pharmacological knowledge, which is the basis of drug safety.

Regarding studied nurses' total knowledge, the findings of the current study clarified that (figure 2), more than two fifths of them had poor knowledge, while nearly one quarters of them had good knowledge regarding medication preparation errors. These findings were in agreement with **Miladinia et al., (2016)**, in studied pediatric nurses' medication error: The self-reporting of frequency, types and causes, who stated that most prevalent of MEs cause from nurses' perspective was poor medication knowledge. This lack of knowledge is one of the factors most frequently associated with nurses' error and represents more than one third of the total causes of drug administration errors in the US. From the researcher point of view, these may be due to differences in qualification of the studied nurses.

As regards the studied nurse's total practices about medication preparation errors, the findings of the current study clarified that (figure 3), three fifths of the studied nurses were incompetent regarding practices about medication preparation errors, while more than two fifths was competent regarding medication preparation errors. These findings were accordance with **Said et al, (2016),** who studied an investigation of errors, the preparation, and administration of parenteral medications in an intensive care unit of a tertiary teaching hospital in Malaysia, stated that medication errors were the highest during the reconstitution and dilution of parenteral medications. Also more than half were prepared erroneously either using the incorrect diluent, the incorrect volume or were mixed insufficiently of the drug during the preparation

The findings of the current study table (9), illustrated positive correlation between nurses' total knowledge in relation to their total practices level about medication preparation errors at ($P < 0.05$). From the researcher point of view, these may be due to knowledge help to increase practice level regarding medication preparation errors.

Conclusion:

Based on findings of the present study and answering research question the study concluded that, the common medication preparation errors among the studied nurses were did not know precautions before leaving medication preparation, combined oral medication with artificial milk, didn't know clarify medication label, didn't know ten medication rights, didn't know precaution before oral medication administration, review the incubator card before medication administration and didn't monitor/assess child before medication administration. Also nearly half of the studied nurses had poor level of knowledge regarding medication preparation errors, in addition the majority of them had incompetent level of practice about medication preparation errors, meanwhile the current study illustrated positive correlation between nurses' total knowledge in relation to their practices about medication preparation errors at ($P < 0.05$)

Recommendations:

- Periodical educational programs for enhancing level of nurses' knowledge for prevention/decrease medication errors
- Emphasize the need for procedural and policy development for the administration of drugs and for expanding the curriculum of nursing education on the preparation of medication.
- Emphasize the importance of implementing the effective error prevention strategies such as ward-based clinical nurses, increasing the nurse to neonate ratio and participation of pharmacy department in drug preparation instead of preparation of drug admixtures by the nurses. As in New El-Kasr El Ainy Hospital Cairo University Hospitals.
- Further researchers are required involving larger study sample of nurses at different study settings all over Egypt.

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