

Guideline Model for Nurses to Prevent the Medication Errors and Adverse Drug Events in Pediatric InpatientsHanan T., Elbahnasawy¹, Samia Elnagar² and Maha Atout¹¹Pediatric Nursing Department, Faculty of Nursing, Isra University¹Pediatric Nursing Department, Faculty of Nursing El-Menoufya University
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Abstract: Medication errors were defined as errors in medication ordering, transcribing, dispensing, administering, or monitoring. Quasi experimental design was conducted for this study, The study aimed to identifying nurses needs of knowledge, practice, and attitude, developing guideline model for prevention of medication errors according to nurses needs and evaluating the effect of guideline model for prevention of medication error on nurses knowledge, practice, and attitude. The study was conducted in the pediatric medical, surgical and neonatal intensive care units in Al – Basher hospital in Amman city Jordan. This is a convenient sample of 85 registered nurses who's worked in the mentioned above setting. For data collection an interview questionnaire (pre/ posttest format) was used to assess nurses knowledge and practices as regard to definition, causes, contributing factors and complication of medication errors also medication calculations, correct reading order, review patient six rights and double check of medication. The result of the study showed the effectiveness of guideline model on nurses who caring with children for medication administration. The implementation of guideline model showed significant improvement in nurses knowledge regarding all tested items , also concluded that the highest statistical significant improvement in nursing practices were noticed in most of the tested area which lead to prevent of medication errors . According to this study it is recommended that using the guideline model by all pediatric nurses which are dealing with children to prevent the medication errors, encourage continuous education program for pediatric nurses by using the different educational strategies to achieve high level of care for children and develop other standardized guideline model relevant to different aspect in pediatric nursing in order to cover most of the nurses educational needs.

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1. Introduction

Medication errors were defined as errors in medication ordering, transcribing, dispensing, administering, or monitoring. Medication errors in pediatric inpatients occur at similar rates as in adults but have three times the potential to cause harm. Error prevention strategies in this setting remain largely untested⁽¹⁾.

The medication administration process is an everyday part of nursing practice and is so much more than a simple psychomotor task. Although nurses have the central role in this process, it involves a multidisciplinary team that also consists of the physician, pharmacist, and patient. In the acute care setting of a hospital the medication process is complex and time-consuming, occupying up to one-third of the nurses time⁽²⁾.

Medication administration is often carried out under chaotic and stressful circumstances and is probably the highest risk activity a nurse performs. An error in the medication process can be minor or lead to devastating effects for the patient and also for the nurses' career⁽³⁾.

A health care professional's knowledge about medication errors has increased substantially, partially in response to widely publicized national reports and

medication error reporting programs. Not enough is known, however, about the products involved in pediatric medication errors⁽⁴⁾.

Nurses working with pediatric patients require special knowledge and skills, concerning the proper care throughout the medication administration. For this reason, nurses need special guidelines when planning the care of pediatric patients⁽⁵⁾.

The pediatric nurse plays an important role in medication administration to children because children vary so greatly in size and individual need, medication administration to children begins by assessing, the child's height and weight so a correct dose of medicine or amount of IV fluids can be calculated based on the child's surface area. Also crucial to assessment is the child's developmental age⁽⁶⁾.

Guideline model (self-learning module) is a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes⁽⁷⁾.

The purpose of guideline model is to assist pediatric nurse practitioners and other health care providers in providing high quality of primary health

care for children. The guideline model has information on definition, causes, complications, prevention and management regarding medication error⁽⁸⁾.

Magnitude of the problem:

Pediatric populations are at significant risk for drug-related errors, particularly in the setting of multiple drug therapy, complex illness, and immature organ systems. This is especially true in practice areas such as pediatric and neonatal intensive care units (PICUs and NICUs) where the intensity of care is high, the patients are frequently unable to communicate symptoms, and clinical signs may be difficult to elicit. It is important to recognize aspects of care and disease that are unique to pediatric medicine, because these help to define some of the difficulties in the prevention of error. Medication errors influence negatively patients, nurses, and organizations. Thus, this issue requires immediate attention of all members of the healthcare team. The rate of medication errors reported is increasing over the years, which requires immediate interventions. Strategies to reduce or eliminate medication errors are mandated.

Aim of the study

The aim of this study was to evaluate the effect of guideline model for prevention of medication error for nurses working in pediatric unit through:

- Identifying nurses' needs of knowledge, practice and attitude.
- Developing guideline model for prevention of medication error according to nurses' needs.
- Evaluating the effect of guideline model for prevention of medication error on nurses' knowledge, practice and attitude.

2. Subjects and methods

Research design:

Quasi experimental design was conducted for this study.

Setting:

The study was conducted in the pediatric medical, surgical and neonatal intensive care units in Al Bashir hospital in Amman city Jordan.

Sample:

A convenient sample of 85 registered nurses who's worked in the mentioned above setting.

Tools of data collection:

A. Questionnaire by Interviewing study subject (Pre/Posttest format)

1. An interviewing questionnaire.

The questionnaire was developed by the researcher in an Arabic language to assess the nurse's knowledge, practice, and attitudes pre and posttest related medication errors. It comprised of the following parts:

- **Socio- demographic** data of studied nurses as gender, age, qualifications, years of experience, Rate of reported medication errors and Type of shift.
- **Nurses knowledge** about definition, causes, contributing factors and complications of medication errors.
- **Nurses practice** through asking questions as regard medication calculations, correct reading the order, review patient sex rights and double check of medications.

2. Lickert Attitude scale

It was constructed in a way to show attitudes of the nurses' towards using of technology to prevent the medication errors. It consists of 10 items to assess their attitude, each item was rated on 3 points, 3, 2, 1 means always, sometimes, and never respectively.

Scoring system:

The questionnaire consisted of 22 items of multiple choice questions to assess the knowledge and practice equal values were provided. Score +1 for a correct answer, zero for an incorrect answer was considered. The total scores of questionnaire were less than 50% was graded as poor, 50% to less than 75% score was graded as average, and more than 75% score was graded as good.

Also, 10 items were on 3 point lickert attitude scale (always, sometimes, and never), each of them has three alternatives from 3-1. Nurse's attitude was considered, the total scores of attitude less than 50% was graded as poor, 50% to less than 75% score was graded as average, and more than 75% score was graded as good.

Validity test was done by 7 expertise's of faculties' staff nursing from the pediatric nursing.

Reliability test was done by applying the questionnaire to 20 nurses using test-retest and Pearson Coefficient factor was 90.8%. The scale was applied on them and retested after 2 weeks. The degree of Spearman's rank correlation coefficient test was (0.82).

Guideline model for nurses

A guideline model was designed by the researchers according to the actual educational need assessment of the studied nurses.

1. Assessment phase

Review of relevant literatures and Preparation of the guideline model design for objectives and contents. The general objective of the guideline model is to improve the nurses' knowledge, practice and attitude regarding to safety medication administration and prevent the medication errors. The researcher began with implementation of pretest to identify and

determine the weak points of the nurses' knowledge, practice and attitude toward medication errors, and give the nurses the basic knowledge about safety medication administration and give the guideline model.

2. Planning phase

The guideline model was in a form in Arabic language to be easy understood for the nurses. Pretest was given to identify weakness in nurses' knowledge to include it in the guideline model. The content of the guideline model has information about medication error definition, causes, contributing factors and complications, also regarding practice such as medication calculations, correct reading the order, review patient sex rights and double check of medications.

3. Implementation Phase

A clear and simple explanation was offered to nurses about aim of the study and its expected outcomes. Each nurse was assessed individually (20-30 minutes) using the previously mentioned tools. The total number of the sample 85 nurses was divided by 10 nurses per week. The guideline model was introduced to each nurse separately over a period of 2 months and 1 day, 2 sessions /week the total numbers of sessions was 17 session each session is ranged from 60 - 90 minutes. In the first session pre-test was done and objective of the program were explained to the nurses. Also, a copy from guideline model was given to each nurse, then the subject of the session was introduced followed by a period of discussion.

4. Evaluation phase

The evaluation of the effectiveness the guideline model was measured after one month by reassessing the nurses' knowledge, practice and attitude by using the same tools.

Limitation of the study

Many of the nurses were too overloaded with work, and there were many interruptions during the time of answering of questionnaires.

Ethical consideration:

- Permission to conduct the study will be obtained from the dean of the Faculty, Ministry of Health and administrator of hospital manager. Verbal consent were obtained from each participant. The researcher will offer adequate information about the study purposes and its significance. Participation is voluntary. Participants were assured that their responses would be confidential and information that might reveal their identity would not be recorded, and only aggregated data would be communicated.

Pilot study

A pilot study was carried out on 5 nurses who working in the medical unit of Pediatric in Al-basher Hospital in Amman in order to test the applicability of tools and clarity of the included questions as well as to estimate the average time needed to fill in the sheets. Those who shared in the pilot study were excluded from the main study sample.

Field work

- Preparation of data collection tools was carried out about period of two months and 1 day from beginning of October 2011 to the first of December 2011 after revised from experts' opinions, and validity test.
- Once the official permission was granted to proceed with the proposed study, plan for appointment with nurses to explain the nature & purpose of the study, as well as to discuss the plan of work to ensure their cooperation will be accomplished.
- Data collection was carried out two days / week (Monday and Wednesday) from 10 a.m. to 1 p.m. For assessment 10 nurses / week. All nurses were interviewed by the researchers for about 30 minutes to fill in the tools.

Table (1) Distribution of the studied nurses according to their characteristics (No. = 85)

Nurses Character	No	%
Gender		
Male	4	4.7
Female	81	95.3
Age		
20 >25	22	25.9
25 >30	35	41.2
30 >35	21	24.7
≥35	7	8.2
Qualifications		
Diploma Nursing	8	9.4
Associate Nursing	11	12.9
B.Sc. Nursing	61	71.8
MSc. Nursing	5	5.9
Experience year		
3 >5	40	47.1
5 >7	24	28.2
7 >10	10	11.8
≥10	11	12.9
Rate of reported medication errors		
1-5 in last 12 months serious	4	4.8
1-5 in last 12 months non serious	7	8.4
Type of shift		
8 hours morning	37	43.6
8 hours night	6	7.1
12 hours day	23	27
12 hours night	19	22.3

3. Results

Table (1) showed that, the majority of nurses were females 95.3%, their ages it was found that less than half of the studied nurses 25>30 and one quarter 20 >25 it was found that 52.5%, 27.9% and 19.7% of them were in the age group of 20<25, 25<30 and ≥30 respectively. IN relation to qualification and years of experience of the studied nurses, it was found that two third of them 71.8% were bachelor nurse while only 12.9% of them were associate nurses It was noticed also that less than half of them 47.1%, had years of experience that ranged from 3>5 years, while 4.8 and 8.4 the rate of reported medication errors in the last twelve months serious and non-serious respectively, also this table found that less than half 43.6 % of nurses worked eight hours morning shift while more than one quarter 27% worked twelve hours day shift.

Table (2) illustrates that there is a statistically significant differences between pre and post implementation of the guideline model on nurses knowledge regarding medication errors. Also, showed a better improvement of nurse's knowledge on post test

scores after the intervention by guideline model specifically causes, contributing factors, prevention and complications (1.76, 1.83, 2.10 and 2.41) respectively. ($P<0.01$).

Table (3) demonstrates that statistical significant difference regarding nurses practice pre and post implementation of the guideline model specifically correct reading the order, review patient six rights and double check of medications (1.89, 1.93 and 2.03) respectively. ($P<0.01$)

Table (4) illustrated that the nurse's attitude toward using of technology to prevent the medication error the table shows that the two third of nurses 70% were good attitude especially toward computerized physician order entry and two third 60% toward Smart infusion pumps.

Table (5) shows a positive relations between nurse's knowledge, practice and their qualification. Meanwhile, the table reflects statistical significant relation between nurse's knowledge and their qualification.

Table (2): Distribution of nurses' knowledge regarding medication errors, pre/post intervention with guideline model (No. = 85).

Nurses' Knowledge	(Mean Score ± SD) of Nurses' Knowledge			
	Pretest	Posttest	T test	P value
Definition	1.919±.212	1.95±.992	17.57	.231
Causes	.761±.011	1.76±.750	21.00	.000*
Contributing factors	1.02±.318	1.83±.848	19.36	.000*
Prevention	1.29±.051	2.10±1.175	16.24	.000*
Complications	1.30±.270	2.41±1.053	17.44	.000*
Total Knowledge	7.43±1.962	10.21±2.431	29.51	.000*

Table (3): Distribution of nurses' practice by asking questions regarding medication errors, pre/post intervention with guideline model (No. = 85).

Nurses' Practice	(Mean Score ± SD) of Nurses' Practice			
	Pretest	Posttest	T test	P value
Calculation of medication	1.781±.412	1.85±.901	14.54	.196
Correct reading the order	.530±.091	1.89±.956	18.00	.000*
Review patient six rights	.590±.217	1.93±.803	20.36	.000*
Double check of medications	1.41±.051	2.03±1.122	19.44	.000*
Total practice	6.90±1.052	9.21±2.531	27.58	.000*

Table (4) Attitude of nurses toward using of technology to prevent the medication errors (No. = 85).

Nurses Attitude	Total No. of nurses = 85		
	Good (75% +)	Average (50<75 %)	Poor (< 50%)
Bar code of medications administration	40	30	15
computerized physician order entry	70	10	5
Automated dispensing	50	25	10
Smart infusion pumps	60	22	3

Table (5): Statistical relationsbetween nurse’s knowledge, practices and their qualifications.

Nurses qualifications	Knowledge		Practice	
	Pre	Post	Pre	Post
Diploma Nursing	.565 ± .590	1.780 ± .636	.689 ± .892	3.790 ± 1.058
Associate Nursing	.859 ± .453	1.544 ± .656	1.762 ± 1.387	3.931 ± .817
B.Sc. Nursing	1.066 ± .003	1.821 ± .523	1.124 ± .795	4.760 ± .844
MSc. Nursing	1.788 ± .043	1.992 ± .662	1.143 ± .761	4.644 ± .806
ANOVA	16.761	.046	.043	.798
P value	.850	.000**	.019*	.011*

4. Discussion

Medication errors and adverse drug event are serious problems in pediatrics as well as in adult medicine. The relatively higher rates of potentially harmful errors in hospitalized children compared with adults probably occurs primarily because dosing is more complex in pediatrics and underscores the need for safer systems in this setting⁽⁴⁾. Nurses working with pediatric patients require special knowledge and skills, concerning the proper care throughout the medication administration. For this reason, nurses need special guidelines when planning the care of pediatric patients⁽⁹⁾.

As regard to the general characteristics of the studied nurses, the majority of them were females due to they communicate with mothers, more than half of them were in the age group of 20<25 and the majority of them held bachelor degree in nursing and less than half their experience between 3>5 years, These findings due to newly graduate females.

All health care personnel involved in medication administration are aware of the potential for error, both serious and non-serious. While the majority of nurses in this study had not made a medication error causing harm in the past 12 months, the minority of the nurses responding to the survey had made a severe error causing harm. Eighty percent of nurses reported making one or more errors that “did not cause harm” in the past twelve months. Additionally, this study found less than half of nurses worked eight hours morning shift while more than one quarter worked twelve hours day shift This result is in agreement with **Jones and Brown** who reported that specifically looked at the number of medication errors in relation to 12 hour shifts as compared to eight hour shifts found no significant relationship, the type of medication error (serious versus non-serious) was not taken into account⁽¹⁰⁾.

The present study shows that, nurses’ knowledge was improved significantly post intervention with guideline model regarding causes of medication error. These errors results from many causes, these include but are not limited to poor hand writing, inadequate documentation, and the nursing shortage. This result is supported by **American**

Hospital Association who stated that the causes of drug errors are multifactorial. Therefore, medication error improvement programs must focus on system improvements and team communication. The top 10 causes of pediatric errors identified by miscommunication, inaccurate or omitted transcription, improper documentation, drug distribution system error, knowledge deficit, calculation error, computer entry error, and lack of system safeguards⁽¹¹⁾. Also causes could be happen due to poor hand writing, inadequate documentation, and the nursing shortage

The study revealed that, nurses’ knowledge regarding contributing factors of medication error was improved post intervention with guideline model. This result is in agreement with the research study conducted by **Fry and Dacey** found that the main contributing factors to medication errors were interruptions by patients, relatives, visitors, and telephone calls which influenced concentration during the process of medication administration. Relevant hindering factors included illegible medication charts, incomplete prescriptions and medications that were not available⁽¹²⁾. Also supported by **Tang et al.**, found that the majority of nurses identified more than one factor contributed to medication errors. The most important factors identified included: personal neglect (e.g. solving other problems while administering medications, heavy workload, and new staff, such as a new graduate or change in ward). They also identified a lack of clarity on the second nurse’s check for certain medications and a common practice of administering medications without a complete order. Lack of feedback to staff about previous medication errors was also cited as a contributing factor⁽¹³⁾.

The current study shows that, nurses’ practice was improved significantly post intervention with guideline model regarding calculation of medication. This area of practice is the cornerstone for understanding the medication administration. This result is supported by **McBride and Foureur** who reported that Children are particularly vulnerable to medication dosing errors. Accurate pediatric prescribing requires accurate weight, proper conversion of pounds to kilograms, and the choice of an appropriate preparation and concentration⁽¹⁴⁾. The

prescriber must calculate a daily dose on the basis of weight and then divide it into multiple doses for the appropriate frequency of medication. Their small size makes children more vulnerable than adults to substantial dosing errors because of a misplaced decimal point or a trailing zero. Unfortunately, when medication errors occur, children cannot always demonstrate signs or communicate symptoms that may alert parents and providers to seek proper care⁽¹⁵⁾.

The current study showed that nurses' practice in review patient six rights pre intervention with guideline model did not follow the patient six rights may follow two or three patient rights. This could be due to the lack of training and insufficient practice. While the this practice for nurses was improved post intervention this finding agreement with **Root**, which explained that Administering drugs safely to children requires that you first determine that you are giving the right drug to the right child, in the right dosage and by the right route, at the right time. You also need to ensure that the parents or child have the right information about the medicine⁽¹⁶⁾. Also it was noticed in the same table that they were lacking in the essential practice double checking of medications, specifically before the application of the nursing health program compared to post program results, with statistical significant improvement on posttest scores. This result explains by **Kunac and Reith** as a way of minimizing medications error to improve the efficacy of the double-checking process, it has been suggested that a process of independent double-checking (IDC) be adopted. **Grissinger** in supporting IDC suggests that, to preserve the effectiveness of the IDC process, it should be limited to situations involving high-risk medications, complex processes such as calculating doses, or high-risk patient populations such as infants and children⁽¹⁷⁾.

Concerning nurses practice regarding prevention and complication of medication errors were improved post intervention with guideline model. This finding was in correspondence with **Kozeret al.**, who reported that the total potential error prevention strategies were including checks of drug ordering with regard to drug factors including dose, route, and frequency, and patient factors, including weight, allergies, renal function, and age, a clinical pharmacist on physician rounds or monitoring medication ordering, transcribing, and delivery. Changes in communication between health care providers, such as increasing nursing involvement during physician work rounds⁽¹⁸⁾.

The majority of nurses perceive that medication technology such as bar code medication administration, computerized physician order entry (CPOE), automated dispensing, and "smart infusion pumps" decrease medication errors and increase safety for hospitalized patients. The **Wright and Katz** currently recommends technological interventions for the

prevention of medication errors in hospital care, specifically CPOE with decision support systems⁽¹⁹⁾.

In relation to nurses' qualifications, it was found that there is a highly statistical significance difference pre and post intervention with guideline model. This result is in agreement with **Yousef**, who stated that, education can assist nurses in becoming aware and overcoming oppression. It seems that baccalaureate education in nursing serves to increase nurses' confidence in themselves and their own profession⁽²⁰⁾.

Lastly, the guideline model provides nurses with an opportunity for professional growth and success in correcting weakness in the nurses' knowledge, practice and attitude. This result is in agreement with **Seif**, who included self-learning module as an essential and successful tool for orientation and continuing education program for nurses⁽²¹⁾.

5. Conclusion

In conclusion, the results of this study proved the effectiveness of guideline model on nurses who caring with children for medication administration. The implementation of guideline model showed significant improvements in nurses' knowledge regarding all tested items. Also, concluded that the highest statistical significant improvement in nursing practice was noticed in most of the tested areas which lead to prevent of medication errors

Recommendations

In the light of the results of this study the following recommendation are suggested:

Using the guideline model by all the pediatric nurses, which are dealing with children to prevent the medication errors, to refresh their knowledge and skills.

Encourage continuous education program for pediatric nurses by using the different educational strategies to achieve high level of care for children.

-Develop other standardized guideline model relevant to different aspects in pediatric nursing in order to cover most of the nurses' educational needs.

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