

Effect of Training Program on Reduction of Nurse's Medication Errors

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Abstract

Background: One of the most important nursing functions is to administer medications safely. Effective and safe administration of medication is one of the most common nursing activities that require a set of knowledge and specialized skills. **Aim of the study:** Evaluate the effect of training program on reduction of nurse's medication errors. **Subjects & Methods: Research Design:** quasi-experimental design was used in the current study. **Setting:** study was conducted at Intensive Care Units at specialized medical hospital in Mansoura University which include three intensive care units namely (cardiac, hepatic and diabetic). **Subject:** study subjects include 50 nurses working in above mentioned setting, all patients assigned to observed nurses and drug doses that administer to the patient (n=230). **Tools of data collection:** two tools were used, 1) questionnaire interview sheet to assess nurses' knowledge about safe medication administration practice and medication errors. 2) Observation check list to assess medication administration practice for detecting medication errors there were used before and after implementation of the program. **Results** of the present study revealed that only 18% of nurses had satisfactory knowledge about medication administration and medication errors this percentage improve to 90% immediately after program implementation & 84% in the three months later and total high errors was 70.5% in pre program this percent decrease to 24.3% in three months later phase. **Conclusions:** Nurse's knowledge were improved immediately after program and three months later. As regard to medication errors, the percent of total high errors was decreased in comparing to preprogram implementation. **Recommendations:** Implementing of regular or scheduling training for all nurses in hospitals to improve and refreshing their knowledge and skills. Implement double check system to prevent medication administration errors and improve the effectiveness of communication among health care providers to ensure continuity of patient care and reduce medication errors.

Key words. Nurse, Medication errors, Training, Program

Introduction:

Patient safety has become area of interest in many countries. This is partly because international has demonstrated that adverse events, or poor outcomes caused by medical care are common. Patient safety problems of many kinds occur during the course of providing health care. They include transfusion errors, medication errors, wrong-site surgery and surgical injuries,

preventable suicides, restraint-related injuries or death, hospital-acquired or other treatment-related infections, falls, burns, pressure ulcers, and mistaken identity. ⁽¹⁾

One of the most important nursing functions is to administer medications safely. The process of administering medications is multidisciplinary, but the final check to ensure patient safety lies with the

nurse⁽²⁾. Furthermore, the process of medication administration takes many steps, and in any of them, the nurse may commit medication errors⁽³⁾. Effective and safe administration of medication is one of the most common nursing activities that require a set of knowledge and specialized skills to assess and teach patient (communication skills and teaching skills), calculate medication dosages and reconstitute and/or dilute

Medication errors are any preventable events that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient or consumer⁽⁶⁾. The types of medication errors are classified into three most frequently reported types of errors: Omission errors (failure to administer a prescribed medication), Improper dose (medication dose, strength, or quantity different from that prescribed) and Unauthorized drug errors (the medication dispensed and/or administered was not authorized by the

Significance of the study:

Medication errors (MEs) have been a significant problem resulting in excessive patient morbidity and cost. Effective and safe administration of medication is one of the most common nursing activities that require a set of knowledge and specialized skills⁽⁸⁾. Training is the act of increasing the knowledge and skills of staff nurses. Training is essential for job success. It can lead to higher production, fewer mistakes, greater job satisfaction and lower turnover these benefit accrue to both staff nurse and the organization and the present study applied training program about medication administration practice to improve staff nurse performance and reduce medication errors.

Aim of the study:

certain medications (mathematical skills), administer the medication by the appropriate route; safely dispose syringe and used equipment; and document information (motor skills) and observation of medication side effects (observational skills)⁽⁴⁾. In fact, problems of breakdown of communication and access to information lay at the heart of most medication administration errors (MAEs)⁽⁵⁾.

prescriber). An analysis of medication errors can help healthcare professionals and managers to identify error-prone medications or categories of drugs and make improvements to prevent or reduce them.⁽⁴⁾ Training often has been referred to as teaching specific skills and behavior. Training is the act of increasing the knowledge and skills of staff nurses for performing particular job and when staff nurses learn new habits, refined skills and useful knowledge during the training that helps him to improve their performance⁽⁷⁾.

The aim of the present study is to evaluate the effect of training program on reduction of nurse's medication errors, which was achieved through:-

- Assess nurse' knowledge and practice about medication administration practice.
- Designing and implementing training program for staff nurses at specialized medical hospital.
- Evaluate the effect of implemented training program on the nurses performance regarded medication practice and reducing medication errors

Research Hypothesis:

1 -The knowledge of nurses will be improved after implementation of training program.

2 -There is an positive effect of training program on reduction of nurse's medication errors.

Subject and methods

Research design: A quasi-experimental design was utilized in this study.

Study Setting: This study was conducted at Intensive Care Units (ICU) at specialized medical hospital Mansoura University which include three Intensive Care Units namely: cardiac, hepatic and diabetic intensive care units.

Study Subjects: consist of three groups:

-**The first group:** All staff nurses working in the previous mentioned units and have at least one year of experience at ICU (N=50).

- **The second group:** All patients admitted to the intensive care units during the study period (N=60).

- **The third group:** medication doses, a minimum sample size of 230 doses are chosen as large enough to obtain an adequate measure of an observation –based error rate for each of the three ICU. Number of doses was calculated using (EPI info. software version 6.02 taken into consideration the expected frequency of medication errors as 30% and total number of drug doses per shift in year 5175). Total No. of doses per shift in year = total No. of admitted Pt. x average No. of days of stay in ICU x average No. of doses per shift = 345 x 5 x 3= 5175. Ragheb ⁽⁶⁾.

Tools of data collection: Two tools were used for data collection

First tool: Interview questionnaire sheet:

It was adapted from Ragheb ⁽⁹⁾ to assess nurse' knowledge regarding safe medication administration and medication errors. It consist of three parts

Part I, Personal characteristic data sheet

Part II, Nurse' knowledge about safe medication administration process: it consists of (36 items).

Part III, Nurse' knowledge regarding medication errors: it consists of (16 items)

Scoring system:

For the knowledge items part II & part III, a correct response was scored 1 and the incorrect zero. For each area of knowledge, the scores of the items were summed-up and the total divided by the number of the items, giving a mean score for the part. These scores were converted into a percent score. Knowledge was considered satisfactory if the percent score was 60% or more and unsatisfactory if less than 60%.

Second tool: Disguised observation technique:

A modification of direct observation method developed by Barker and McConnell ⁽¹⁰⁾ it used to detect medication errors performed by nurses, It include:

- Data about observed nurse: name, unit, years of experience and educational qualification.

- Data about observed patient: name, age, gender, diagnosis,

- Data about observed medication: medication name, medication classification, dose, route of administration, duration of administration and medication instruction.

- The observation technique consists of (196 items) grouped under three parts namely; Medication preparation, Medication administration, and Post medication monitoring.

Were summed-up and the total divided by the number of the items, giving a mean score for the part. The "not applicable" items were discounted from the total. The total scores were converted into a percent. The practice of errors was considered low if 60% or more of the items were done, and high if less.

High medication error = item don less than 60%

Low medication error = item don 60% +

Content validity and Reliability:

Content validity was tested by a jury consisted of five professors from Nursing Administration department at Ain Shams, Cairo, Mansoura, and Zagazig Universities. Reliability was applied by the researcher for testing the internal consistency of the tool, using test-retest reliability. This method was done by administration of the same tools to the same subjects under similar conditions. Answers from repeated testing were compared, the correlation between scores on the first test and the scores in the re-test are used to estimate the reliability of the tool. The tool was strongly reliable in which $R=94.5$

Field work:

The researcher started to collect data through the following phases:

Preparatory phase: A nursing care training program of safe medication administration and medication errors has been developed for nurses based on actual assessment of their needs. These have been identified through the baseline testing of their knowledge, performance. The aim of the study is to

Scoring system:

For medication errors practices, the items observed to be done scored "1" and the items not done scored "0". For each area, the scores of the items

evaluate the effect of training program on reduction of nurse's medication errors. Total duration of a program was (six) hour, divided into (four) hours theory and (two) hours practice. For six days per each group.

Assessment phase: this was the first phase in the program, where the needs in knowledge and practice were identified in (pre-test) through the collection and analysis of the baseline data from the filled tools.

Planning phase: For planning the program, the following were taken into consideration, identifying the important needs of nurses, set priorities, goals, and objectives which should reflect nurses' knowledge about safe medication administration practice and medication errors.

Implementation phase: the training program designed for this study has been implemented through 4 sessions. These sessions lasted for 6 hours; 4 hours of theory, and 2 hours of practice. It was difficult to take the whole number of subjects at the same time; the nurses were divided into two main groups depending on the time of day they received classroom instruction, morning or afternoon.

Evaluation phase: The evaluation was done by post-test. The same knowledge questionnaire and observation checklist used as pre-tests were used in their entirety during the evaluation period. There were two post-test evaluations one immediately after implementation of the program and the second three months later program implementation.

Pilot study:

A pilot study was carried out to test the questionnaire feasibility, applicability and to estimate the time consumed for filling in the forms. The study was carried out on 10% of study sample (23 observation checklist & 5 questioner s' sheets). A brief explanation of the purpose of the study was provided to every participant in the pilot study, and then she was provided with a copy of questioner s' sheets. The time consumed in answering the questions was about (25 to 35) minutes. Data collected from the pilot study were reviewed and used in making minor modifications to items of observational checklist prior to the final application of the study tools. The all results collected for the pilot study were excluded, and it took about one month.

Administrative & Ethical considerations:

An official letter was sent from the Faculty of Nursing to the responsible authorities of the study setting to obtain their permission for data collection. The consent was obtained from subjects who agreed to participate in the study and assured about confidentiality and anonymity of the study.

Statistical design:

Data entry and statistical analysis were done using SPSS 14.0 statistical software package. Data were presented using descriptive statistics in the form of frequencies and percentages for qualitative variables, and means and standard deviations for quantitative variables. Qualitative categorical variables were compared using chi-square test. Whenever the expected values in one or more of the cells in a 2x2 tables were less than 5, a fisher exact test was used instead. In larger

than 2x2 cross-tables, no test could be applied whenever the expected value in 10% or more of the cells was less than 5. Statistical significance was considered at p-value <0.05.

Results:

Table (1) shows the personal characteristic of the study nurses. It is revealed that 74% of the studied sample age less than 30 years. Concerning the unit, the table shows that 40% of them work in hepatic intensive care unit. As regards educational qualification, 42% of the nurses had diploma degree. However 54% of study sample had less than five years of experience. And the only 10% of nurses attended training in medication administration. Also one fifth of them had pre-service orientation about medication administration.

Table (2) shows nurses knowledge scoring about medication administration and medication errors throughout the program phase. It is clear from the table the percent of nurses 18% had satisfactory knowledge about medication administration and medication errors this percentage improve to 90% immediately after program implementation & 84% in the three months later after program implementation

Table (3) shows that the relation between nurses' total knowledge about medication administration & medication errors and their personal characteristics immediate post program phase. It is clear from the table that there was statistically significant difference between the nurses' total knowledge and attended training in medication administration $p=0.02$.

Table (4) Show relation between nurses' total knowledge about

medication administration & medication errors and their personal characteristics three months later phase. This table illustrates that there was a statistically significant difference between the nurses' total knowledge and attended training in medication administration at $p=0.03$.

Table (5) Shows characteristics of medications prescribed to patients observed for medication administration and error throughout the program phase. It is clear from the table the highest percent of medication type was in cardiovascular medications 27.4% & 27.8% respectively in pre and post program implementation. Regarding route of administration the highest percent is intravenous route 54.% & 62% respectively in pre and post program implementation. However frequency of observed dose, it is 1-2 dose per/day 51.3% & 53% respectively in pre and post program implementation. And the most observed causes of medication errors are missing duration/route (86. %) in pre program. While the most observed causes of medication errors post program was in instruction are not present (79.1%)

Figure (1) Total medication errors observed among nurses in the study sample throughout the program phases

Table (6) Indicates the relation between total medication errors observed among nurses and their personal characteristics at pre program phase. The table illustrates that there is a statistically significant differences between total medication errors made by nurses and their years of experience and unit of work ($p=0.002$ & 0.001 respectively).

Table (7) Indicates the relation between total medication errors observed among nurses and their

personal characteristics three months later. The table illustrates that there is a statistically significant differences between total medication errors made by nurses and their years of experience and work unit ($p= 0.001$ & 0.002 respectively).

Table (8) Shows relation between total medication errors observed among nurses and patients' characteristics at pre program phase. The table illustrates that there is a statistically significant differences between total medication errors and patients age and sex ($p=0.02$).

Table (9) Shows relation between total medication errors observed among nurses and patients' characteristics three months later. The table reveals that there is a statistically significant differences between total medication errors and patients age and sex ($p=0.01$ & 0.03).

Discussion:

Finding of the present study reveals that nearly three quarter of the studied sample aged less than 30 years. Concerning the unit two fifth of them work in hepatic Intensive Care Unit. As regards nursing qualification two fifth of the nurses' staff had diploma degree in nursing, more than half of study sample had less than five years of experience. This result due to the policy of hospital that every new nurse work in ICUs for at least five years and after of this she work in general wards. This findings agreed with the study done in surgical intensive care unit at emergency hospital Mansoura University by Mohammed & Gaber, ⁽¹¹⁾. They founded that most of nurses in the study held a nursing diploma, but disagree in about three fifth of nurses were in the age group ranged from 30 to less than 40 years old. As regard to years of experience in nursing

profession, more than half of nurses had 10 to less than 20 years of experience in surgical intensive care units.

Regarding attended training program the finding of present study reveals that, few of staff nurses attended training program in medication administration and one fifth of them received orientation program at being of work about medication administration. These findings agreed with study done in intensive care units of El Shatby Pediatric University Hospital in Alexandria by Ally, ⁽¹⁾ who reported that none of nurses received in-service training program while majority of them received orientation training that is disagree with the present study.

Results of the present study revealed a statistically significant increase in total nurses' knowledge score immediately post program relative to before program, followed by a statistically significant slight decrease in three months later assessment. This marked improvement, in nurses' knowledge following the training program, seems logical, when compared to pre-program, due to absence of training program related to administration of medication and medication errors received by the participants, and absence of orientation at the beginning of their work at their units, besides the limited course contents they had during their studying, all these led to the poor knowledge that nurses had before implementation of the program. Therefore, they were highly receptive and interested in acquiring knowledge when engaged in the training program. These results agree with study conducted at Assiut University Hospitals, by El Shimy, et al ⁽¹²⁾, They found that there were marked improvement in nurses' knowledge,

attitude, and practice immediately after implementation of the training program. This improvement was mostly retained after 3 -months, with slight decline, although still higher compared to pre-implementation level.

Regarding relation between nurses' total knowledge about medication administration and errors and their personal characteristics throughout program phase. Regarding age of the participants, there were no significant statistical difference between age of the participant and their knowledge scores. Although, young nurses less than 30 years had satisfactory level of knowledge more than old age nurses. It may be due to the new graduation and fresh studying knowledge with intact memory. These results agree with Shahin, ⁽¹³⁾ who found also no significant statistical difference between age in pre-test knowledge and practice scores related to enteral nutrition.

Regarding nursing qualification; there were no significant statistical difference between nursing qualification of the participant and their knowledge scores. Regarding years of experience those nurses who have less than five years of experience got higher satisfactory knowledge score than other with no significant statistics this may be due to new graduation with fresh knowledge. These results agree with Abdullah et al, ⁽¹⁴⁾. They found those nurses who have less than one year of experience got higher mean knowledge score than other.

Regarding attended training in medication administration there is a statistically significant difference between the nurses' total knowledge and attended training in medication administration.

Regarding to total high medication errors pre, during and post administration of medication, at pre training program phase about three fifth of observed dose in medication preparation was in high errors, while the two third of observed dose during administration of medication was in high error. And the majority of nurses make high errors in medication documentation. However, the total high error in medication administration process was 70.5%. This finding agrees with. Abo El-Magd,⁽¹⁵⁾ & Abd Al-Wahab,⁽¹⁶⁾ Reported the rate of medication administration errors was (87.9% & 56.1% respectively). In the same line Ally,⁽¹⁾ reported rate of Medication Administration Errors (MAEs) in both ICU the MAEs rate in surgical PICU was (90.6%) and MAEs rate in medical ICU was (80%). Also Ragheb,⁽⁹⁾ Reported that the total high error in medication administration process was (90.4%). While the total high errors post program implementation is lower than pre program that mean the program have positive effect in improve nurses performance regard reduction of medication errors.

Regarding to relation between total medication errors and personal characteristic of observed nurses, as regarding years of experience presence of positive correlation between years of nurse's experience and medication errors. These results disagreed with Ally,⁽¹⁾ and other studies conducted in UK and USA that concluded that there no statistical significant differences between medication errors and years of experience. Concerning nurses' qualification, no difference was found between bachelor and diploma nurses regarding occurrence of MAEs although bachelor nurses were expected to have better knowledge and skills than

diploma nurses. These results agreed with Ragheb,⁽⁹⁾ Who found that no difference was found between bachelor and diploma nurses regarding occurrence of medication errors. While the relation between medication error and unit, the high error increases in cardiac ICU more than hepatic and diabetic ICU.

As regard to the relation between total medication errors and characteristics of observed patient pre and post program, the rate of high MAEs increases in patients their age more than 60 year old, increase in male more than female and increase in patients have cardiac diagnosis. These results may be due to the patient's age more than 60 years suffer from many chronic disease and use of many medication and with use of many drugs errors increase and the cardiac disease increase in male than female because of male are more prone to be smoker and expose to heavy situational stress than female. This result agrees with study done in elderly home care patients in European countries by Fialova et al.,⁽¹⁷⁾ who aimed to estimate the prevalence and associated factors of potentially inappropriate medication use among elderly home care patients in European countries and they found that the inappropriate medication use are more encounter between patients there age more than 70 years.

Conclusion

The findings of the current study revealed that after the program, nurse's knowledge were improved immediately after implementation and three months later. As regards medication errors, the percent of total high errors was decreased in comparing to pre program implementation that mean designed training program had a positive effect on nurses' Knowledge, performance

immediately and at follow up phase for nurses working at ICU.

Recommendations:

- Regularly review nurses' performance and assure continuous supervision to improve their performance and reduce medication errors.
- Improve the effectiveness of communication among health care providers to ensure continuity of patient care and reduce medication errors.
- Assure adequate supply of facilities and equipments necessary for proper preparation and administration of medications such as insulin syringe, crushing machines, medication storage containers, weight scales and syringe pump & infusion pump.
- Improve hospital policy concerning writing medication orders in correct, legible and readable form and controlling verbal orders to enhance medication administration process and reduce medication errors.
- Make medication safety committee to discover medication errors, analysis of causes and set strategy for reduction of medication errors.

Table (1): Personal characteristics of the study nurses (N=50)

Personal characteristics	No.	%
Age (years):		
<30	37	74
30+	13	26
Range	20.0-36.0	
Mean \pm SD	28.3 \pm 4.0	
Unit:		
Cardiac ICU	15	30
Hepatic ICU	20	40
Diabetic ICU	15	30
Educational qualification:		
Secondary school diploma	21	42
Technical Institute diploma	20	40
Bachelor of nursing	9	18
Experience (years):		
<5	27	54
5-	15	30
10+	8	16
Attended training in medication administration		
Since: <1 month	0	00
1-	3	60
3+	2	40
Had pre-service orientation about medication administration		
	10	20

Table (2): Nurses knowledge scoring about medication administration and medication errors throughout the program phase (N=50)

Satisfactory knowledge (60%+) about:	Pre program		Immediately post		Three months later	
	No.	%	No.	%	No.	%
Preparation of medication	12	24.0	43	86	40	80
Administration of medication	5	10.0	46	92	45	90
Monitoring patient after administration	9	18.0	30	60	30	60
Documentation after administration	9	18.0	34	68	32	64
Causes of medication errors	34	68.0	48	96	44	88
Definition of medication errors	7	14.0	35	70	30	60
Proper nurse action in case of medication errors	6	12.0	39	78	35	70
Total knowledge:						
Satisfactory (60%+)	9	18.0	45	90.0	42	84.0
Unsatisfactory (<60%)	41	82.0	5	10.0	8	16.0

Table (3) : Relation between nurses' total knowledge about medication administration and errors and their personal characteristics immediate post program (n=50)

personal characteristics	Total Knowledge (immediate post)				X ² Test	p-value
	Satisfactory (60%+)		Unsatisfactory (<60%)			
	No.	%	No.	%		
Age (years):	45	90	5	10		
<30	34	75.5	3	60.0	1.94	1.03
30+	11	25.5	2	40.0		
Unit:					Fisher	0.30
Cardiac ICU	13	28.8	2	40		
Hepatic ICU	18	40.0	2	40		
Diabetic ICU	14	31.1	1	20		
Educational qualification:					.701	0.10
Secondary school diploma	20	44.4	1	20		
Technical Institute diploma	18	40.0	2	40		
Bachelor of nursing	7	15.5	2	40		
Experience (years):					2.524	0.30
<5	25	55.5	2	40		
5-	13	28.8	2	40		
10+	7	15.5	1	20		
Attended training in medication administration						
Time since last course (month):					12.34	0.02*
<1	45	100.0	5	100		
1-	0	00.0	00.0	00		
3+	0	00.0	00.0	00		
Had pre-service orientation about medication administration					Fisher	1.00
No	37	82.2	3	60		
Yes	8	17.7	2	40		
Available equipment:					1.273	1.00
No	0	00.0	2	40		
Yes	45	100.0	3	60		
Available incident report:						

No	10	22.2	1	20	1.88	1.03
Yes	35	77.8	4	80		

Table (4): Relation between nurses' total knowledge about medication administration and errors and their personal characteristics in phase of three months later program implementation (n=50)

personal characteristics	Knowledge (three months later)				X ² Test	p-value
	Satisfactory (60%+)		Unsatisfactory (<60%)			
	No.	%	No.	%		
Age (years):	42	84	8	16		
<30	32	76.2	5	62.5	2.041	1.00
30+	10	23.8	3	37.5		
Unit:					Fisher	0.49
Cardiac ICU	12	28.8	3	37.5		
Hepatic ICU	18	42.8	2	25.0		
Diabetic ICU	12	28.8	3	37.5		
Educational qualification:					.518	2.00
Secondary school diploma	19	45.2	2	25.0		
Technical Institute diploma	17	40.5	3	37.5		
Bachelor of nursing	6	14.2	3	37.5		
Experience / (years):					1.705	1.00
<5	23	54.7	4	50		
5-	12	28.7	3	37.5		
10 +	7	16.6	1	12.5		
Attended training in medication administration						
Time since last course (month):					11.23	0.03*
<1	0	00.0	0	00.0		
1-	42	100.0	8	100.0		
3+	0	00.0	0	00.0		
Had pre-service orientation about medication administration					Fisher	1.00
No	34	80.9	6	75		
Yes	8	19.0	2	25		
Available equipment:					1.086	1.00
No	0	00.0	3	37.5		
Yes	42	100.0	5	62.5		
Available incident report:	8	19.0	2	25		
No						
Yes	34	81.0	6	75	1.299	0.36

Table (5) Characteristics of medications prescribed to patients observed for medication administration and errors throughout the program phase (N=230)

Characteristics of medications	Pre program		Three months later	
	No.	%	No.	%
Medications:				
Gastro-intestinal medications	35	15.2	35	15.2
Cardiovascular medications	63	27.4	64	27.8
Respiratory tract medications	31	13.5	6	2.6
Hepatic medication	29	12.6	27	11.7
Supplements/tonics	11	4.7	18	7.8
Antibiotic	52	22.6	67	29.1
Diabetic medication	9	3.9	13	5.7
Route:				
IV	124	54	142	62.0
IM or SC	22	9.1	18	7.9
Local	6	3.4	4	1.7
Oral	73	31.7	63	27.5
Inhalation	5	2.1	3	1.3
Number of doses/day:				
1-2	118	51.3	122	53.0
3-6	112	48.7	108	47.0
Observed causes of medication errors:				
Instructions are not present	188	83.2	182	79.1
Unclear handwriting	16	10	8	3.5
Missing duration/route	198	86	105	45.6
Phone prescription	4	1.7	2	0.9
Verbal prescription	5	2.1	3	1.3

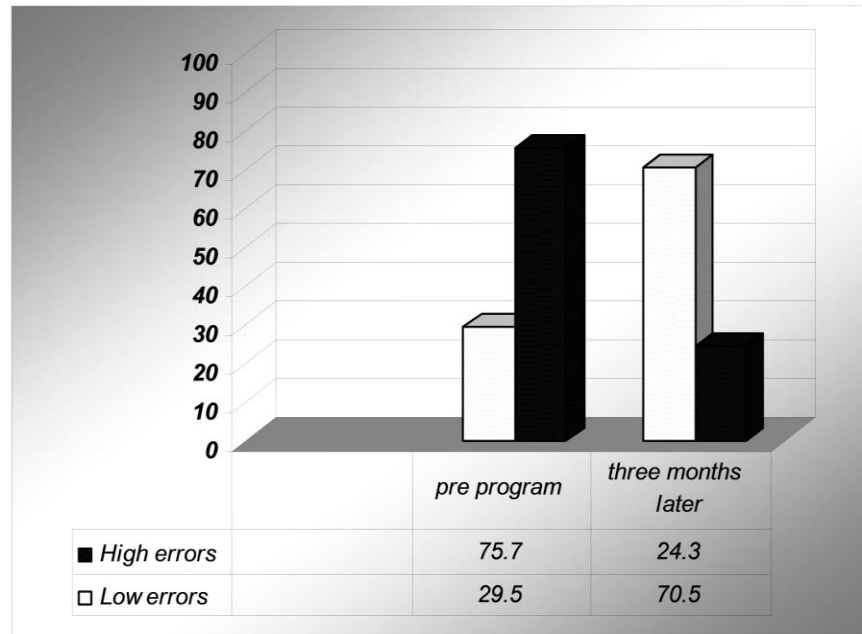


Figure (1): Total medication errors observed among nurses in the study sample throughout the program phases

Table (6) Relation between total medication errors observed among nurses and their personal characteristics in pre program phase (N=230)

Personal characteristic of observed nurses	Total errors				X ² Test	p-value
	High No.(162)	70.5%	Low No.(68)	29.5%		
Nursing qualification:						
Secondary school diploma	94	58.0	28	41.1	1.27	0.21
Technical Institute diploma	60	37.0	19	27.9		
Bachelor of nursing	8	4.9	21	30.8		
Experience years:						
<5	91	56.1	25	36.7	12.14	0.002*
5-	62	38.2	30	44.1		
10+	9	5.5	13	19.1		
Unit:						
Cardiac ICU	70	43.2	14	20.5	11.12	<0.001*
Hepatic ICU	55	33.9	20	29.4		
Diabetic ICU	37	22.8	34	50.0		

Table (7) Relation between total medication errors observed among nurses and their personal characteristics (three months later) (N=230)

Personal characteristic of observed nurses	Total errors				X ² Test	p-value
	High No.(56)	24.3%	Low No.(174)	75.7%		
Educational qualification:						
Secondary school diploma	27	48.2	73	42.0		
Technical Institute diploma	23	41.1	70	40.2		
Bachelor of nursing	6	14.7	31	17.8	1.37	0.21
Experience years:						
<5	30	53.5	87	50.0		
5-	17	30.3	55	31.6	13.12	0.001*
10+	9	16.0	32	18.4		
Unit:						
Cardiac ICU	25	44.6	55	31.6		
Hepatic ICU	13	23.2	63	36.2		
Diabetic ICU	18	32.1	56	32.2	11.12	<0.003*

Table (8) Relation between total medication errors observed among nurses and patients' characteristics in pre program phase (n=230)

patients' characteristics	Total errors				X ² Test	p-value
	High No.(126)	70.5%	Low No.(68)	29.5%		
Patient age (years)						
<40	10	6.2	7	10.3		
40-	40	24.6	36	52.9	4.12	0.02*
60 +	112	69.2	25	36.8		
Gender:						
Male	100	61.7	20	29.5		
Female	62	38.3	48	70.5	3.71	0.02*
Diagnosis:						
Cardiac diagnosis	48	29.6	30	44.1		
Hepatic diagnosis	35	21.6	10	14.7	1.22	0.70
Diabetic diagnosis	30	18.5	10	14.7		
More than one diagnosis	49	30.3	18	26.5		

Table (9) Relation between total medication errors observed among nurses and patients' characteristics three months later (N=230)

patients' characteristics	Total errors				X ² Test	p-value
	High		Low			
	No.(56)	24.3%	No.(174)	75.7%		
Patient age (years)						
<40	3	5.3	7	4.2		
40-60	10	17.8	60	34.4	4.12	0.01*
<60	43	76.8	107	61.4		
Sex:						
Male	35	62.5	88	50.6		
Female	21	37.5	86	49.4	3.71	0.03*
Diagnosis:						
Cardiac diagnosis	13	23.2	63	36.2		
Hepatic diagnosis	15	26.8	60	34.5	1.22	0.70
Diabetic diagnosis	14	25.0	24	13.8		
More than one diagnosis	14	25.0	27	15.5		

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