Evaluation of Teaching Safety Procedure to Acquire Nurses' Best Practice for Patient Receiving Blood Transfusion

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Abstract: A nurse by profession has opportunities to establish policies and procedures, design nursing practices, and educate staff to help avoid blood transfusion errors. Aim: To evaluate the effect of teaching safety procedure to acquire nurses' best practice for patient receiving blood transfusion. Hypotheses: The mean score of knowledge, practice and attitude post educational program of nurses providing care for patients during blood transfusion procedure will be higher than pre program. Design: A quasi experimental design was used to conduct this study. Setting: This study was carried out at three critical units (ICU, Hematological unit & Neurosurgery). Affiliated to Ain Shams University Hospitals. Sample: A purposive sample included all nurses working at the previously mentioned settings. Tools: A- Self administered interviewing questionnaire involved five tools: 1- nurse's demographic data, 2- Blood transfusion questionnaire: To assess the level of nurse's knowledge pre/post program and follow-up period. 3 - **L**ikert questionnaire : To assess level of nurse's attitude towards safety of patient care pre/post program. 4- Nurse's barrier questionnaire: To assess nurse's barriers toward her work pre/post program. 5- Nurses' opinionair: To assess nurse's opinions toward the educational program at the end of follow-up period .B - Blood transfusion observation checklist: To assess the level of nurse's practices pre/post program and during follow up-period. Results: That there were statistically significant differences among, studied nurses in different settings of their work as regards satisfactory level of their knowledge and competent level of their practice pre/post program and during follow up-period. There were positive correlations found between total nurses' knowledge and practices. There were changes recorded in the work barriers among the studied nurses pre/post program. There were statistically significant differences as regards nurses' attitude towards patient safety pre/post program. There were differences recorded among the studied nurses' opinions as regards patient safety. Conclusion: After conduction of the present study, results revealed nurses' knowledge and practices about safety procedure of patient receiving blood transfusion were increasing significantly after the educational program more than before its implementation. Meanwhile, nurses' barriers as regards their work were decreasing significantly after education program versus before its application. As well, nurses' attitude was having statistically significant improvement post educational program .A positive feedback was recorded as regards nurses' opinions towards educational program at the end of follow up-period. Recommendation: This study revealed inadequate practices that nurses and hospitals should strive to change to provide a safe and more effective care that would, hopefully, minimize the risks and maximize the benefits of blood transfusion.

Introduction:

Blood transfusion is a usual procedure in a hospital. Yet, it is important and life-saving. It is an invasive procedure and can be fatal if there is negligence. Every pint of blood received, there is always at least one percent of risks from the transfusion and that the main cause of death due to transfusion is acute hemolysis (51% of death). Most transfusion errors (56%) happen in critical area **(Yong et al., 2008**)

Blood transfusion life-sustaining and life-saving treatment but it is not without risk. Conditions that warrant blood transfusions range from acute trauma to intra-operative blood loss, to compromised blood-cell production secondary to disease or treatment. The nurse on the front line of patient care must be adept at administering blood products safely and managing adverse reactions quickly and with confidence. A lack of awareness of good transfusion practice has been identified as a reason for poor compliance **(Lynne et al.,2013)**.

The practice of blood transfusion is the transference of blood from the circulation of one individual to another for practical therapeutic purposes. Blood transfusion was performed with excessive complications in the beginning of the 20th century. Today, these complications are limited by increasing in the knowledge of healthcare workers in hospitals especially the nursing staff and the knowledge of blood function. Error in transfusion is one of the original causes of mortality, thus the awareness of this error is important. Nowadays, blood and components are used more frequently in surgical and non-surgical procedures (**Lesley et al.,2007;and Richard, 2012).**

In medical procedures, blood transfusion is important and needs adequate skills. Security, safety and trust in transfusion are variables by guidance about blood and components and depend on the expertise of nursing staff. Blood transfusion is an elaborated procedure and performing this procedure for a patient requires adequate skills and knowledge. Healthcare workers in hospitals and other personnel who work with them

are both of the original safe performers in transfusion procedures **(Aslani et al.,2010).**

There is an urgent need of training programmers in critical units to educate nurses on blood transfusion risks reduction, latest safety guidelines, nurse interventions and decision making. Blood transfusion saves lives and improves health, but millions of patients' need transfusions do not have time access to have safe blood **(WHO, 2008).**

Blood transfusion is a safe process that saves lives and improves the quality of life in a large range of clinical conditions. However, there are a number of risks associated with transfusion as with any other clinical intervention, right blood, right patient, and right time. Royal College of Nursing guidance for improving transfusion practice sets out pragmatic advice for nurses in the administration of red blood cells and plasma components (fresh frozen plasma & cryoprecipitate and platelets), in acute hospital care. The guidance is not wholly evidence-based but built on recommendations to improve the safety of blood ordering and administration from current national guidelines and serious hazards of transfusion **(Royal College of Nursing, 2005 and Adams et al., 2011).**

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The nurse handling the transfusion has a number of responsibilities to ensure that the procedure is performed correctly and to ensure the patient's safety and health. Before, during and after the transfusion, the nurse will check the patient's temperature, pulse and blood pressure, and will check for any signs of adverse reactions to the transfusion. While reactions are rare, they are monitored. Symptoms for adverse reactions include breathing problems, chills, fever, itching/hives, rash, nausea, lower back pain, apprehensive feelings, tingling or numbness, heat, pain, or swelling at the site where the IV is inserted. Patients are urged to keep the nurse abreast of any symptoms they experience **(Saillour et al., 2007 and Imperial College London, 2011).**

There is an urgent need of training program in hospital critical units to have that educated nurses on blood transfusion risk reduction, latest safety guidelines, nurse interventions and decision making. Nurses should be aware of the recent advances and technological innovations in planning and management of transfusion medicine **(Sabrina &Justine, 2009 and Fellowship Training Program, 2012).**

Careful assessment of the risks and benefits of blood transfusion is essential for a good patient outcome. In addition, it is essential that the utilization of blood and blood products to be rationalized and they are saved for critical situations (**Asmaa et al.,2011).**

Blood transfusion remarkably is a safe procedure, but like many other clinical procedures, it is associated with clinical risks. These clinical risks include adverse effects that occur due to error and suboptimal care during the transfusion process. In the last 20 years, many studies have documented errors at all stages in the transfusion process and there have been many initiatives to minimize the occurrence of errors. Finding better ways to train and support the staff directly involved in many steps of the transfusion process remains essential **(Frances,2011 and Rachel et al., 2011).**

Significance of the study:

The safety and effectiveness of the transfusion process are dependent on the knowledge and skills of nurses who perform the procedure. Poor practice may result in avoidable complications that may threaten patients' safety. Published work indicated that nurses' practice varied across contexts and highlighted that patients received suboptimal care and incorrect transfusion culminated in death or morbidity **(Hijji et al., 2010 and Michael etal.,2011).**

Studies assessing best practice of safety procedure of blood transfusion couldn't be traced in developing countries especially Egypt **(Asmaa et al.2011).** Educationalal program in the current study for nurses in the critical units about blood transfusion practice was the first trial in the University Hospitals (Ain shams & El-Demardash). this result was reported by the researchers through Heads of Departments 2012.

Aim of the study

The aim of the current study is to evaluate the effect of teaching safety procedure to acquire nurses' best practice for patient receiving blood transfusion

Research hypotheses

1- The mean score of knowledge and practice post educational program of nurses providing care for patients during blood transfusion procedure will be higher than pre program.

2- The mean score of nurses' attitude towards patient safety post educational program will be higher than pre program.

Subjects and Methods

I-Technical Design:

It includes the study design, setting, subjects as well as tool for data collection

Design: A quasi experimental design was used to conduct this study

Setting:

This study was carried out at three critical units (ICU, Hematology &Neurosurgery) affiliated to El-Demerdash and Ain Shams University Hospitals.

Sampling:

1- Size: All nurses working at the previously mentioned settings were recruited for the study. They were 40 nurses (18 nurses in ICU,12 nurses in hematological unit &10 in neurosurgery).
2- Inclusion criteria: All nurses, who did not attend of any educational program about blood transfusion.
3- Sampling strategies: A purposive sample was used.

Tools of data collection:

A- Self administered interviewing questionnaire (studied nurses): involved five tools:

1- Bio-socio demographic data sheet :

It was used to collect data as regards studied nurses at different settings of their work (ICU, Hematology& Neurosurgery) about; age, gender, qualifications, and years of experience.

2- Blood transfusion questionnaire:

It was used to assess the level of nurses' knowledge pre/post program and follow-up period. It was adopted from **lynne et al**.,(2013)and the **Nursing Blood Transfusion Reaction (2012)**.It was developed by the researchers to suit the study. A questionnaire with 40 questions was divided into four parts. The first part consisted of 11 questions related to blood components, the second part consisted of 10 questions related to principles of blood transfusion, and the third part involved 10 questions related to complications of blood transfusion, while the fourth part consisted of 9 questions related to nursing intervention of blood transfusion reaction. Each part was given 30 minutes to provide answers to these questions. Satisfactory level of nurses knowledge scored ≥ 70% ,while unsatisfactory level of nurse's knowledge scored <70% , the correct answer =2 and the incorrect =zero.

3 - Likert questionnaire patient safety:

It was used to assess level of nurse's attitude towards safety of patient care pre/post program. It was adopted from **Likert-scale-survey-best practices, (2007**) and **Lynne et al**., **(2013)** and modified by the researchers according to the study aim. For the purpose of the following 10 questions, the nurse defined her attitude as regards safety care for the patient, about willingness to report procedure errors, agree that patients also play a role in preventing procedure errors, fear there will be negative consequences associated with reporting procedure errors, cooperate with other nursing staff to resolve patient safety issues, regularly report procedure errors, feel comfortable reporting unsafe patient conditions to the supervisor, believe most procedure errors are preventable, believe their immediate supervisors are committed to improving patient safety, hesitate to change practice habits to improve patient safety and are willing to share information about procedure errors and what caused them. Scoring was follows: an answer by strongly agree (3), agree (2), disagree (1) or strongly disagree (0) and total score=30 marks.

4- Nurse's barrier questionnaire:

It was used to assess nurse's barriers toward their work during blood transfusion procedure pre/post program. It was developed by the researchers after reviewing of related literature (**Blood Transfusion Policy ,2010)** and also by participation of studied nurses. It involved eight items as follows**,** absence of training program about procedure, lack of experience, dangerousness procedure, fear of responsibility, insufficient time of practice and change in workplace. It was answered by scored "Yes /No"

5- Nurses' opinionair:

It was used to assess nurse's opinions toward the educational program at the end of follow-up period after reviewing of other programs (**Fellowship Training Program, 2012)** and guided by 3 experts from medical surgical nursing. It included facilities available for training, key learning objectives clearly defined, clear information available regarding training needs of target group, resources available for teaching, and quality of teaching material. It included nurses' opinions according three responses "'good" ,"uncertain " and "poor".

B - Blood transfusion observation checklist**:**

It was used to assess the level of nurse's practices about blood transfusion pre/post program and during follow up-period .It was adopted from **David and Leuven**, **(2007)** and **(Tabiee &Nakhaei, 2010**) and consisted of 3 phases; preparatory phase (8 items), procedure phase(22 items), and blood transfusion reaction phase(10 items).

Scoring system: Total items = 40 and scored by done correctly = 1 or not done= zero**.** Evaluation of best nurse's practice considered to be competent level was ≥80% , while incompetent level was <80%.

Content validity and reliability:

Validity test was done by three experts from Medical Surgical Nursing specialty and others from hematologists. Alpha chronbach test was used to measure the internal consistency of the tools. Reliability of used tools or instruments, showed high reliability scores for the following tools: Likert questionnaire patient safety, blood transfusion observation checklist and nurse's opinionair having above the significant level (R=0.8) and "test-re-test results' that all items of the barrier questionnaire and knowledge questionnaire having acceptable reliability (alpha coefficients ranged from (0.70 to 076).

II- ***Operational Design:***

-Field work:

After the official permission was taken from the Dean of the Faculty of Nursing, the implementation phase for data collection started as follows:

Data collection was carried out from May 2012 to January 2013. The questionnaires were filled in by the nurses, while they were on work place. The purpose of the study was explained before the distribution of the questionnaire sheet and the sheets were answered within 30 minutes then collected.

The tools were administered to the study subjects three time (1) Before the implementation of the program to have a baseline assessment about nurses' level of knowledge to the conducted the program (2) Immediately after the program implementation to assess the effect of program (3) Three months later to assess the retention of knowledge through comparing the result of pre, immediate post and follow up test of the program to assess the effects of the educational program.

Concerning the observational checklist this sheet was filled in by the researchers, while observing the studied nurses during applying procedure related to care of patient receiving blood transplantation. The time taken to complete this sheet was 15-20 minutes and according to the availability of their time.

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The construction of education program goes through four phases as follows:

1. **Assessment phase:**

Assessment is the first phase in the program. Development of the program was based on the context of the detected needs; this assessment has shed light and given more insight about the professional needs of nurses relevant to care of patient receiving blood transfusion. Preliminary survey of nurses in different work places was achieved to help detecting practical defects, deficiencies related to care of patient receiving blood transfusion. Afterwards needs were classified to three main categories: knowledge, practice, and attitude categories. Detected needs, requirements and deficiencies were translated to aim and objectives of the program.

2. Planning phase*:*

For planning the program as pointed out by (Teaching Program (2013), the following was taken into consideration:

1. Participants: Sample characteristics defined the population actually attending.
2. Method of assessing learner was identified.

3. The scheduling of educational activities gave consideration to time and location of sessions that best serve the learners.
4. Scheduling of courses provided evidence of different distributions and locations convenient to the learners.

5-Detected needs were translated to aim.

6- Objectives were categorized and to specific objectives.

7-Contents of the program were selected on the base of identified needs, objectives and educational background of nurses' trainees.

8-Educational activities were selected to suit teaching small groups of learners and available facilities. Selection of educational activities was also made to facilitate a comprehension and integration of theory and practice.

9- An illustrated guidance booklet about blood transfusion developed by the researchers to be handled to each participant.

3- Implementation phase*:*

In the implementation phase, the program was applied three times on six successive months as trainees had a part time for the program, and night nurses were unable to participate in educational activities when the first time the program was implemented and also it was very difficult to take the whole number of the nurses at the same during their working hours.

Teaching and learning activities were achieved in both the classroom and the clinical area. It was aiming at providing trainees with as much experiences as possible within the limitation of the research and available resources of the study setting. Classroom activities consumed 2 hours/day in 3 days. Prerequisite level was defined according to workplace, to evaluate nurses' level of knowledge practice and their attitude in different critical units. Teaching methods in the classroom were lectures, small group discussions, clinical conferences; real situations in clinical area, problem solving, and brain storming. The studied nurses were taught either individually or in groups. Teaching aids utilized were work sheet, pen and paper, flip chart and board. The settings were equipped and prepared to be used. The illustrated guidance booklet was handled to each participant as a reference.

4. Evaluation phase:

It was divided into two parts:

The first evaluation by the researchers

The evaluation phase was emphasized on estimating the effect of the program on nurses' knowledge, practices and attitude through a written test, observation checklist and rating scale. On one hand, evaluation of the three domains was applied before and after the educational program in order to identify differences, similarities and areas of improvement as well as defects. On the other hand, the program was evaluated three times, one before the program (pre-test), the second immediately after the program (post-test) and the third one after three months of the program implementation (follow-up). Education and training are fundamental to every aspect of blood transfusion safety.

The second evaluation by trainees:

A. In this part the studied nurses evaluated the educational program at the end of the following-up period through answering by "Yes/No as regards the following items:

- Facilities available for training
- Key learning objectives clearly defined
- Clear information available regarding teaching needs of target group
- Resources available for teaching
- Quality of teaching material (learner feedback, handouts etc)

B. In this part the studied nurses' barriers pre/post program percentage change were noticed .Decrease percentage as regards absence of training program, lack of experience, dangerousness of the procedure, fear of responsibility, insufficient time of practice except change of workplace.

III- Administrative Design:

Ethical consideration

After taking permission from Dean of Faculty of nursing to get experience in the field blood transfusion, the researchers visited the critical units of the mentioned hospital and got agreement from the directors of these units to carry out the present study. This was after clarifying and explaining the objectives of program of the study to ensure maximum cooperation as well as to make arrangement for attendance of the participants.

- Pilot study:

A pilot study was carried out on 4 nurses. It was done to test the clarity and practicability of the tools. The results of the data obtained from the pilot study helped in modifications on the tools, items were then corrected or added as needed. Accordingly, modifications were done and the final form was developed. Subjects who shared in the pilot study were not included in the main study sample. The aim of this study was explained to each nurse. Nurses were assured that information would be confidential and used for their benefit and researching purpose only.

IV- Statistical Design:

Upon completion of data collection, variables included in each data collection sheet were organized and tabulated and were coded before the entry of computerized data, by using a program of statistical analysis, the statistical package for social science (SPSS), including percentage, chi-square and r-test. The observed differences and associations were considered at $p<0.05$.

Limitation of the study:

1- It was very difficult to gather all nurses at the same time, so, the program was applied three times on 6 successive months.

Table (1): Socio- demographic data of studied nurses in different setting of their work (n=40)

Items	ICU (n=18)		Hematology (n=12)		Neurosurgery (n=10)		X^2	p-value
	No	%	No	%	No	%		
Age(in years) <25 25-<35 35+	2 12 4	11.1 66.7 22.2	2 9 1	16.7 75.0 8.3	3 6 1	30.0 60.0 10.0	3.9	>0.05
Mean ±SD	31.4±5.3		29.6±4.4		28.8±5.3			
Gender Male Female	11 7	61.1 38.9	3 9	25 75	3 7	30.0 70.0	4.7	>0.05
Qualification Bachelor Technical institute Diploma nurse	3 8 7	16.7 44.4 38.9	4 2 6	33.3 16.7 50.0	0 3 7	0.0 30.0 70.0	4.3	>0.05
Years of experience <3 3-<8 8-<13 13+	3 8 1 6	16.7 44.4 5.6 33.3	8 1 1 2	66.7 8.3 8.3 16.7	8 1 0 1	80.0 10.0 0.0 10.0	5.2	>0.05

p>.05 (Insignificant)

Table (2): Comparison among studied nurses in different setting as regards level of knowledge of blood transfusion therapy pre/post program and during follow-up period. (n=40)

Satisfactory Level of Nurses Knowledge									
Items	ICU (n=18)			Hematology (n=12)			Neurosurgery (n=10)		
	Pre-	**Post-**	**Follow-up**	**Pre-**	**Post-**	**Follow-up**	**Pre-**	**Post-**	**Follow-up**
	No	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Blood components(11 items)	3	15	12	2	12	12	0	9	7
	$\mathbf{X^2}$=33.1 p<0.001			$\mathbf{X^2}$=28.0 p<0.001			$\mathbf{X^2}$=18.0 p<0.001		
Principles of blood transfusion therapy(10 items)	3	15	12	2	12	12	0	9	7
	$\mathbf{X^2}$= 33.1 p<0.001			$\mathbf{X^2}$= 28.0 p<0.001			18.0 $\mathbf{X^2}$= p<0.001		
Complications of blood transfusion therapy (10 items)	4	17	16	3	12	12	1	8	7
	$\mathbf{X^2}$=32.8 p<0.001			$\mathbf{X^2}$= 27.1 p<0.001			$\mathbf{X^2}$=11.5 p<0.05		
Nursing intervention of blood transfusion reaction(9 item)	2	15	12	3	12	12	0	10	8
	$\mathbf{X^2}$=35.2 p<0.001			$\mathbf{X^2}$=27.1 p<0.001			$\mathbf{X^2}$=31.7 p<0.001		

p<0.001 (highly significant)

Table (3): Comparison among studied nurses practices in different setting as regards blood transfusion pre/post program and during follow-up period. (n=40)

Competent Level of Nurses Practices									
Items	ICU (n=18)			Hematology (n=12)			Neurosurgery (n=10)		
	Pre-	**Post-**	**Follow-up**	**Pre-**	**Post-**	**Follow-up**	**Pre-**	**Post-**	**Follow-up**
	No	**No**	**No**	**No**	**No**	**No**	**No**	**No**	**No**
Preparatory phase (8 items)	2	18	12	1	12	12	0	10	9
	$\mathbf{X^2}$=37.4 p<0.001			$\mathbf{X^2}$=29.7 p<0.001			$\mathbf{X^2}$=33.4 p<0.001		
Procedure phase(22 items)	0	15	13	0	12	10	0	9	9
	$\mathbf{X^2}$= 31.8 p<0.001			$\mathbf{X^2}$= 32.9 p<0.001			$\mathbf{X^2}$=43.1 p<0.001		
Nursing intervention of blood transfusion phase(10 items)	2	16	14	3	12	12	0	10	9
	$\mathbf{X^2}$=36.3 p<0.001			$\mathbf{X^2}$= 27.1 p<0.001			$\mathbf{X^2}$=33.4 p<0.001		

p<0.001 (highly significant)

Table (4) Correlations between total nurses' knowledge and total nurses' practice pre/post program and at the end of follow up-period in different settings of their work (r- test)

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Total Nurses' Practices	**Total Nurses' Knowledge**		
	Pre -program	**Post -program**	**Follow up- period**
Pre-program			
ICU	0.26	0.95**	0.87**
Hematology	0.25	0.97**	0.99**
Neurology	0.24	0.98**	0.98**
Post-program			
ICU	0.87**	0.25	0.37
Hematology	0.97**	-	-
Neurology	0.96**	-	0.84
Follow up- period			-
ICU	0.85**	0.33	0.24
Hematology	0.91**	0.26	0.26
Neurology	0.99**	-	

****P <0.001 (highly significant)**

Table (5): Distribution among studied nurses towards their work barriers about blood transfusion procedure pre/post program.

Items	*Number of Nurses Towards Work Barriers Pre/Post Program*											
	ICU (n=18)				Hematology (n=12)				Neurosurgery(n=10)			
	Pre-program		Post - program		Pre-program		Post - program		Pre-program		Post - program	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
Absence of training program about procedure	**18**	**100**	**0**	**0.00**	**12**	**100**	**0**	**0.00**	**10**	**100**	**0**	**0.00**
Lack of experience	**3**	**16.7**	**0**	**0.00**	**4**	**33.3**	**1**	**8.3**	**7**	**70.0**	**3**	**30.0**
Dangerousness of procedure	**3**	**16.7**	**0**	**0.00**	**4**	**33.3**	**1**	**8.3**	**7**	**70.0**	**3**	**30.0**
Fear of responsibility	**3**	**16.7**	**1**	**5.6**	**4**	**33.3**	**1**	**8.3**	**7**	**70.0**	**1**	**10.0**
Insufficient time of practice	**3**	**16.7**	**1**	**5.6**	**4**	**33.3**	**1**	**8.3**	**7**	**70.0**	**1**	**10.0**
Change of workplace	**3**	**16.7**	**3**	**16.7**	**4**	**33.3**	**4**	**33.3**	**4**	**40**	**4**	**40.0**

Table (6): Distribution among studied nurses in different setting towards patient safety procedure pre/post program. n=(40)

Nurses' Attitude as Regards Patient Safety Procedure Pre/Post Application of Program						
Response Level	ICU (n=18)		Hematology (n=12)		Neurosurgery (n=10)	
	Pre-	**Post-**	**Pre-**	**Post-**	**Pre**	**Post-**
	No	**No**	**No**	**No**	**No**	**No**
Strongly agree(3) **Agree(2)** **Disagree(1)** **Strongly disagree(0)**	1 3 12 16	10 6 2 0	0 2 10 10	9 3 0 0	0 1 7 8	6 3 1 0
	X^2=16.9 p<0.001		**X^2=26.8 p<0.001**		**X^2=18.2 p<0.001**	

Table (7) Studied nurses opinions as regards educational program at the end of follow-up period (n=40).

Nurses Opinions' as Regards Educational Program at the End of Follow-up Period		
Variables	N=40	
	No	%
Facilities available for Training -Good -Uncertain -Poor	 10 20 10	 25.5 50.0 25.5
Key learning objectives clearly defined -Good - Uncertain -Poor	 38 2 0	 95.0 5.00 0.00
Clear information available regarding training needs of target group -Good - Uncertain -Poor	 35 5 0	 87.5 12.5 0.00
Resources available for teaching -Good - Uncertain -Poor	 30 10 0	 75.5 25.5 0.00
Quality of teaching materials -Good - Uncertain -Poor	 25 15 0	 62.5 37.5 0.00

Results:

Table (1) reveals no statistically significant differences detected among the studied nurses in different settings of their work (ICU, Hematology,& Neurosurgery), as regards socio-demographic characteristics (age, gender, qualification and years of experience) ($p>0.05$). In different settings, the mean of their age was 31.4±5.3, 29.6±4.4 and 28.8±5.3 respectively.

Table(2) shows that there were highly statistically significant differences among, studied nurses in different settings of their work as regards satisfactory level of nurses' knowledge pre/post program and during follow up-period towards blood components, principles, complication of blood transfusion therapy and nursing intervention of blood transfusion reaction ($p<0.001$) .However, there was statistically significant difference in Neurosurgery Unit as regards complications of blood transfusion therapy ($p<0.05$).

Table(3) indicates that there were highly statistically significant differences among studied nurses in different settings of their work as regards competent level of nurses practice pre/post program and during follow up-period towards preparatory phase, procedure phase of blood transfusion therapy and nursing intervention of blood transfusion phase ($p<0.001$).

Table (4) reveals no statistically significant correlations found between total nurses' knowledge and practices in pre-program stage in different settings, of their work, while there were highly positive correlations among the three groups between pre/post program and during follow up-period ($p<0.001$).

Table (5) indicates that there were changes recorded in the work barriers among the studied nurses in ICU, Hematology and Neurosurgery units pre/post program about blood transfusion procedure. Decreased percentages were detected as regards absence of training program from 100% pre-program to 0.00% in different settings of their work ,as well, lack of experience and dangerousness of procedure were decreased from 16.7% to 0.00%,from 33.3% to 8.3% and from 70% to 30% respectively.

As regards fear of responsibilities and insufficient time of practice they decreased from 16.7% to 5.6% from 33.3% to8.3% and from 70% to 10%respectively. However there were no recorded changes in their work barriers as regards change of workplace in the same groups.

Table (6) shows that there were highly statistically significant differences among the studied nurses in different settings of work as regards their attitude towards patient safety during blood transfusion procedure pre/post application of program ($X^{2=}$16.9,26.8&18.2 respectively at $p<0.001$).

Table (7) reveals that there were differences recorded among the studied nurses opinions at the end of follow up- period of the educational program as regards patient safety during blood transfusion therapy. The evaluation of their opinions for all items of the educational program included the key learning objectives clearly defined, clear information availability, resources available for teaching and quality of teaching materials to be good (95%,87.5%,75.5%,&62.5% respectively) .However half of them (50%) their opinions were uncertain about the facilities available for training program.

Discussion:

In the blood transfusion process, by becoming educated practitioners, nurses can demonstrate their skill and competency in this field. This will lead to increased compliance, in high risk areas, of the transfusion process, such as patient identification procedures and record keeping. Further, it will improve patient outcomes, and reduce procedure risk and error rates (**Royal College of Nursing, 2005).**

In the present study, the socio-demographic characteristics of the studied nurses revealed no statistically significant difference detected among them as regards gender, qualification and years of experience. This finding may increase chance of researchers of this study to assess the role of educational program on level of knowledge, practices and attitude of studied sample without interference of different variations or variables. As well, may help the researchers to compare between these variables and others in different study results.

As regards the satisfactory level of knowledge among the studied nurses in different settings, of work pre-educational program they couldn't get a passing level about blood components, principles, complications of blood transfusion therapy and nursing intervention of blood transfusion reaction, while post program, all of them were having a satisfactory level of knowledge. Congruent with this study finding **Hurt et al. (2012)** showed that the average knowledge of nurses can increase probable incidence of risks related to blood transfusion and reduce safety procedure. Therefore, the previous study recommends activation of a blood transfusion training program in hospitals to control reports of blood transfusion and its components as well as possible complications in wards, for nurses emphasizing the weak points to increase their knowledge and continuously supervise this task. The positive feedback of the educational program in the current study on nurses' knowledge may help them in nursing intervention phase during blood transfusion therapy.

In the same line, other studies supported the result of the current study, as that of **Michael et al.(2011**) which reported that in their experimental study on a stratified sample of 48 nurses showed that erroneous decisions occurred in 18.2% of the 576 blood compatibility tests were performed at the bedside which underscored the importance of continuing efforts to update theoretical knowledge of nurses about this transfusion safety procedure.

In the same issue, the studied nurses in different settings of their work were having a competent level of practice post-educational program versus pre-education program, where they couldn't get a passing level as regards preparatory, procedure and nursing intervention of blood transfusion phase. **Best Nursing School (2012**) reported that the nurse on the front line of patient care must be adept at administering blood products safely and managing adverse reactions with speed and confidence. A lack of awareness of good transfusion practice has been identified as a reason for poor compliance. In this point **Hijji et al, (2010**) added that the safety and effectiveness of the transfusion process is dependent on the knowledge and skills of nurses who perform the procedure. These findings may reflect the positive effect of educational program to achieve main goal of this study, and may help increase self confidence of studied nurses to make right decisions during urgent situations such as blood transfusion reaction.

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In the same line, there were no statistically significant differences between nurses working in hematology unit and intensive care unit or neurosurgery unit as regards their level of knowledge and practices pre- educational program .This result is incongruent by **Best Nursing School (2012**), which emphasized that most hospitals are looking for experienced hematology nurses who can train the other nurses in an effective manner. Therefore, the scope for hematology nurses with leadership skills is excellent, adding that they can attain high positions in very little time by demonstrating skills in quick decision making In additional by hematology nurses are also required to educate the patients and their family members. The result of the current study, indicating no differences among the studied nurses about their level of knowledge and practices in dealing with blood transfusion, may be due to the absence of specialty and change of nurses' workplace according to critical units needs.

On the other hand, the results of this study revealed strong statistically significant relations between level of nurses' knowledge and their practices as regards blood transfusion therapy in all stages of procedure. In the similar study **Nursing Transfusion Reaction (2012)** was in agreement with these study findings and stated that insufficient knowledge about blood transfusion was reflected in undesirable practice. Although he emphasized that a positive correlation existed between the nurses' knowledge and practice scores in his study. The result of this study may indicate that the studied nurses were in need for an educational program to overcome their deficiency of performance as regards blood transfusion therapy.

Concerning assessment of the studied nurses' work barriers about blood transfusion procedure pre/post program, percentage changes were noticed .Decreased percentages related to absence of training program, lack of experience, dangerousness of procedure, fear of responsibility, insufficient time of practice were found except for change of workplace. In this respect **Lynne et al.(2013)** identified that the lack of competence may be an issue if over a prolonged period of time, a nurse makes continuing errors or demonstrates poor practice which involves lack of skill or knowledge, poor judgment and inability to work as part of a health team. It might also identify a training need and set up a supervised support program for the nurse to overcome on this problem. The educational program might break down of most nurses' barriers except

change of their workplace as barrier due to hospital system. In their study **Bielefelt and Dewitt (2009)** added that the shortage of nurses in many medical settings can lead to lack of time. Without enough nurses on staff, the amount of time available for each patient declines.

In the current study, the results indicated that there were statistically significant differences among nurses in the different settings of work as regards their attitude towards patient safety procedure pre and post application of educational program. This study result is congruent with that of **Frances (2011),** which reported that optimizing nursing staff's time at the bedside is the key to better patient safety because the nurses spend between 20 percent to 30 percent of their time in direct patient care also the nurse and patient relationship is a pivotal component of any patient safety program. The role of the nurse in patient safety presents best practices to support the nurse as a patient safety advocate, so the traditional educational programs do not prepare nurses for their evolving role within the hospital setting. The result of this point in the current study indicated that the studied nurses may achieve the main hypothesis of this study.

In the same issue, the **Fellowship Training Program (2012**) added that lack of competence may be an issue if over a prolonged period of time a nurse makes continuing errors or demonstrates poor practice, which involves, for example lack of skill or knowledge, poor judgment inability to work as part of a team difficulty in communicating with colleagues or lack of competence of their patient care, might also identify a training need and set up a supervised support programmed for the nurse, but their work may only show a temporary improvement which slips back when the program is completed.

As regards the studied nurses' opinions in all items of educational program, during follow up-period, they included; the key learning objectives clearly defined, clear information available regarding training needs of target group, resources available for teaching, and quality of teaching materials were good, except half of them were uncertain about the facilities available for training program. Effective training programs answer the studied nurses' questions. The educational program on nursing transfusion reaction carried out by **Richard (2012**) added that the design of every training program must begin with learning objectives and instructional designers need to create their programs with specific

objectives that their trainees must accomplish. These objectives must also relate to actual skills that trainees need to be more successful at their jobs. Trainers must also mention these objectives at the beginning of every training module. The trainees will discover that they are more actively engaged, and learn more when they clearly understand how training relates to their jobs. The results of this issue, which may reflect the success of the educational program, may overcome the weak points of most educational program.

Conclusion:

After conduction of the present study, results revealed nurses' knowledge and practices about safety procedure of patient receiving blood transfusion were increasing significantly after the educational program more than before its implementation. Meanwhile, nurses' barriers as regards their work were decreasing significantly after education program versus before its application and .As well, nurses' attitude was having statistically significant improvement post educational program .A positive feedback was recorded as regards nurses' opinions towards educational program at the end of follow up-period.

Recommendation:

This study revealed inadequate practices that nurses and hospitals should strive to change to provide a safer and more effective care that would, hopefully, minimize the risks and maximize the benefits of blood transfusion through the following:

1. All nurses must receive training program in blood transfusion.
2. Only nurses who have been trained and have specific qualifications in blood transfusion method are allowed to practice it.
3. Nurse training curricula reflect the requirements of modern transfusion method and other specialized fields of critical care units such as hematological, intensive care and neurosurgical units.
4. Implementation and evaluation of continuous training programs is carried out in order to improve the quality and safety of blood transfusion.

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