

Effect of Implementing Nursing Intervention Program on Nurses' Knowledge and Practice Regarding Children Undergoing Blood Transfusion

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Abstract

Background: Blood transfusion had a positive effect on pediatric patients' life; so nurse play an integral role to maintain pediatric patients' safety related to blood transfusion. **Aim of the study:** was to evaluate the effect of implementing nursing intervention program on nurses' knowledge and practice regarding children undergoing blood transfusion. **Subjects and Methods: Research design:** A quasi-experimental study design was adopted to carry out this study. **Setting:** The study was conducted at Pediatric Medicine Departments at Benha University Hospital. **Subjects:** A convenient sample of fifty nurses who were providing direct nursing care to children. **Tools of data collection:** Two tools were used in the present study. A structured interviewing questionnaire to explore nurses' personal data and their knowledge regarding blood transfusion for children and observational checklist to evaluate the actual nurses' practice towards caring for children and educational training program to train nurses related to blood transfusion. **Results:** The present study revealed that, the mean age of nurses was 28.52± 5.06 years and more than half of them weren't attending training courses related to blood transfusion. There were highly statistical significant differences ($P < 0.001$) concerning nurses' knowledge and practice pre/ post implementation and follow up phases of the training program regarding blood transfusion and there was a positive correlation between total nurses' knowledge and practice regarding blood transfusion immediately after post implementation of the training program ($r = 0.539$ & $p < 0.001$). **Conclusion:** Nurses' total knowledge and practice scores regarding blood transfusion for children were improved post implementation of implementing nursing intervention program than pre-program implementation. **Recommendations:** Based on the results of the present study, recommended the importance of continuing in- service training for nurses regarding pediatric blood transfusion.

Key words: Blood transfusion, Nursing intervention program, Nurses' knowledge and Nurses' practice.

Introduction

Blood transfusion is it considered a highly effective and potentially life-saving treatment especially among pediatric patients. It also, considered an essential component of modern health care⁽¹⁾. It is a complex multistep process involving members of several different professional groups; nurses, doctors, laboratory scientists and pharmacists as well as, the donors and recipients. The transfusion of

a blood product into a child is associated with a greater risk of harm when compared to an adult. These risks may be resulted from omission of essential checks (short cuts) and perhaps an assumption of someone else is responsible for safety transfusion⁽²⁾.

A total of 3.230 cases were reported in the serious hazard of blood

transfusion, of which 85.5% of errors resulted from mistakes or "human factors" and only 10.3% were not preventable (mostly allergic/febrile reactions). The reported major morbidities were hemolytic transfusion reactions; transfusion associated circulatory overload and transfusion-transmitted infection, transfusion-related acute lung injury, ABO incompatible transfusion, and transfusion of incorrect blood product. Major contributing factors for these errors could be the problems in transportation of the blood constituent from blood bank to the hospital, lack of cross- checking practice at bed side, and lack of regular monitoring of the pediatric patients during and after transfusion process⁽³⁾.

Adequate knowledge is very important for safe and sound practice, and one of the new trends in nursing research

focuses on the advantage of investigating nurses' knowledge of clinical practice. Thus, the works are comprehensive with trainings examining the nurse's knowledge base of many areas the first stage in refining the excellence and patient care could be simplified through investigating and recording the current state of knowledge of blood transfusion⁽⁴⁾.

The transfusion process is composed of five interrelated phases; four of which are relevant to routine nursing practice which includes preparation before blood bag collection, blood pack collection, pre-transfusion initiation nursing responsibilities and post transfusion initiation nursing activities and monitoring to maintain pediatric patients' safety⁽⁵⁾.

Before starting blood transfusion; the nurse must recognize the right and correct child who intended blood through two approved persons and a three-test out which includes the blood component label, compatibility slip, and wristband of child, this is the most critical step of transfusion safety and the final opportunity to interrupt any incorrect blood component⁽⁶⁾.

During blood transfusion, nurses are responsible for maintaining registers related to the transfusion in patient's records, such as date, start and end date of the blood transfusion, vital signs at the beginning and end, origin and identification of the blood component bags, identification of responsible professionals and records of transfusion reactions. In addition, the vital signs (temperature, breathing frequency, blood pressure and pulse) of patients submitted to the procedure need to be registered immediately after the beginning and after the end; monitoring during the first ten minutes of the transfusion by a qualified health professional; and patient monitoring throughout the transfusion. These actions permit not only the early detection of any adverse reactions, but also their reporting⁽⁷⁾.

Post transfusion activities; at the beginning of transfusion; nurse must initiate infusion rate of blood slowly during the first 15 minutes to prevent

reactions that occur during this period. Also, nurse must observe the child for the first 10-15 minutes and record vital signs. Each transfusion should be completed within four hours from its beginning. In addition, the nurse should be aware of any signs and symptoms of reaction and how to deal with this condition to save patient life Post transfusion activities; at the beginning of transfusion; nurse must initiate infusion rate of blood slowly during the first 15 minutes to prevent reactions that occur during this period. Also, nurse must observe the child for the first 10-15 minutes and record vital signs. Each transfusion should be completed within four hours from its beginning. In addition, the nurse should be aware of any signs and symptoms of reaction and how to deal with this condition to save patient life⁽⁸⁾.

Due to the complexity of the transfusion process and the need for expertise during its development, this process requires skilled and trained professionals to achieve transfusion safety. Nursing professionals are directly involved in the care of pediatric patients submitted to blood transfusion⁽⁹⁾. Teaching and training are essential for nursing staff members to improve the quality of health care and to acquire new knowledge and skills. Educational programs are considered as means for providing nurses with theoretical and technical information needed to acquire new skills and to continually improve nursing practice⁽¹⁰⁾.

Significance of the study:

More than 108 million units of blood are collected globally every year. In low-income countries, up to 65% of blood transfusions are given to children under 5 years of age⁽¹¹⁾. From the researchers' clinical experience in internal medicine departments, many children receiving blood transfusions were exposed to many complications. These children are in need for special nursing care to minimize their complications. This study would be in this location handling this topic to help those children reducing blood transfusion complications and

provide nursing intervention program to develop nurses' knowledge and practice.

Aim of the study:

The aim of the study was:

To evaluate the effect of implementing nursing intervention program on nurses' knowledge and practice regarding children undergoing blood transfusion.

Research questions:

Nurses would be shown an improvement in their knowledge and practice about blood transfusion after implementation of nursing intervention program.

Subjects and Methods:

Research design:

A quasi-experimental study design was adopted to carry out this study.

Study Setting:

The study was conducted in Pediatric Medicine Department at Benha University Hospital, at Benha City.

Study Subjects:

A Convenient sample of all nurses who were providing care for children receiving blood transfusion at the previous mentioned setting (totally 50 nurses).

Tools for data collection:

Tool I: A structured interviewing questionnaire

Part (1): Personal data of the studied nurses which include; age, qualifications, years of experience and attendance of training courses regarding blood transfusion therapy.

Part (2): Nurses' knowledge about blood transfusion: It consisted of multiple choice questions has 3, 4 or more choice; Knowledge about blood transfusion (7 questions), knowledge of nurses about blood products (19 questions), and knowledge about acute adverse reactions (4 questions). It was divided into subparts. It included 28 questions as follow: Acute hemolytic reactions (10 marks), fever (11 marks), allergic reactions (14 marks), circulation overload reactions (13 marks), acute lung injury (10 marks), sepsis (12 marks) and air embolism (11 marks).

Scoring system:

One score was allocated for each correct answer and zero for incorrect answer. For each part, the scores of the items were summed up and the total divided by number of the items, giving a mean score for the part. These scores were converted into a percent score and mean and standard deviations were computed. The nurses' knowledge was considered satisfactory if the percent scores equal to or more than 60% and unsatisfactory if scored less than 60%.

Tool (II): Observational checklist

It was adapted from Kelsey & Mc Ewing⁽¹²⁾ and modified by the researcher to suit the Egyptian culture. It was used to assess actual nurses' practices provided care of children receiving blood transfusion in relation to; care provided before blood transfusion (26 steps), care provided during blood transfusion (28 steps), care provided after blood transfusion (6 steps). With total practice scores of (60 marks). Each nurse was observed during each procedure for three different times using nurses' observational checklists.

Scoring system:

A score of one was given for done and a score of zero was given for not done. For each part, the scores of the items were summed up and the total divided by number of the items, giving a mean score for the area. These scores were converted into percent scores. The nurses' practice was considered satisfactory if the percent scores is 60% or more and unsatisfactory if scored less than 60%.

Content Validity and reliability:

The structured interview questionnaire and observational checklist were developed after a thorough review of the related literature and then reviewed by 5 experts in nursing and medical staff including: Two professor of pediatric medicine, and three professor of pediatric nursing. Modifications of the tools were done according to the experts' judgment on clarity of sentences, appropriateness of content and sequence of items. The experts' agreed on the content but recommended minor language change that would make the information clearer

and more precise, the suggested changes were made. Internal consistency reliability of all items of the tools was assessed using Chronbach's Alpha test. It was 0.83 for structured interviewed questionnaires and 0.86 for nurses' practices observation checklist.

Field work:

Data collection took a period of six months from the beginning of March to the end of August 2017. After getting the official permission the pilot testing of the study tools was done and analyzed. Nurses were met by the researcher 6 days per weeks from Saturday to Thursday from 12:00 a.m. to 1:30 p.m. for morning shift and from 2:30 p.m. to 4 p.m. for afternoon shift. The researcher interviewed the nurses individually and in small groups according to their availability (after providing nursing activities of the unit). The purpose of the study was explained briefly to nurses and obtained their verbal consent.

Implementing nursing intervention program Development

Implementing nursing intervention program was developed to train nurses on the topic of blood transfusion for children.

General objectives of the program

The implementing nursing intervention program aimed to improve nurses' knowledge and practice regarding blood transfusion.

Specific objectives of the program:

At the end of this implementing nursing intervention program, nurses would be able to: -

- Acquire knowledge about blood transfusion definition and types of blood transfusion
- Acquire knowledge about acute adverse reactions and its types.
- Apply good practice regarding their care provided to children undergoing blood transfusion.

The implementing nursing intervention program was developed through four phases as follows:

(I) Assessment Phase:

The implementing nursing intervention program was constructed for

the assessment of nurses' knowledge and practice. The assessment was performed before the implementation of educational training by interviewing each nurse individually to assess their knowledge and practice (pretest) by using tool I and tool II after explaining the aim of the study and had their approval to participate in the study.

(II) Planning Phase:

Based on the results obtained from the interview questionnaire and observational checklist (from pilot and assessment phase) as well as reviewing the related literature the implementing nursing intervention program was developed by the researcher. Detected needs, requirements and deficiencies were translated into aim and objectives of the educational training program. The contents of the educational training program were selected on the basis of identified needs.

Teaching methods were selected to suit teaching in small groups in a form of lectures, group discussion, demonstration and re-demonstration. Teaching materials were prepared as colored poster, booklets and handout that covered theoretical and practical information.

(III) Implementation Phase:

The implementing nursing intervention program of this study was implemented through six sessions in which nurses given the program individually and in small group according to their availability and spare time after completing their activities in the pediatric medicine department. The length of each session differed according to the content and nurse's responses and ranged 30-45 minutes.

- The first session about definition of whole blood and blood transfusion, the second session about adverse reactions, the third session about types of adverse reactions and how to manage adverse reaction, the fourth session about care provided before blood transfusion, and the fifth session about care provided during blood transfusion, in addition to the six

session about care provided after blood transfusion.

- Each session started with a summary of the previous session and the objectives of the new one. Sessions were explained in Arabic language and simple English terms that suits the level of nurses' education. Motivation and reinforcement during a session were used in order to enhance nurses' learning.

(IV) Evaluation Phase:

In this phase every nurse of the studied sample were interviewed individually immediately after implementing nursing intervention program to assess their knowledge and practice (posttest) by using tool(I) part two and tool (II). Also after 3 months later the nurses of the studied sample reassessed for their knowledge and practice (follow up) by using tool I part two and tool II.

Pilot study:

The pilot study was conducted on 10% of the total sample (5 nurses) after the tools were developed and before starting the data collection to test the applicability, consistency, clarity and the feasibility of the study tools as well as to determine the required time to fulfill the tools. Subjects who shared in the pilot study were included in the main study sample as no radical modifications were needed on the study tools.

Administration and Ethical consideration:

An official permission was granted by submission of an official letter from the faculty of nursing to the responsible authorities of the study setting to obtain their permission for data collection. All ethical issues were taken into consideration during all phases of the study; the researcher maintained an anonymity and confidentiality of the subjects. The inclusion in the study was totally voluntary. The aim of the study was explained to every nurse before participation and an oral consent was obtained. The nurses were notified that they can withdraw at any stage of the research; also they assured that the information obtained during the study will

be confidential and used for the research purpose only.

Statistical analysis:

Data entry was done using compatible personal computer. The Statistical Package for Social Sciences (SPSS version 20.0) was used. The content of each tool was coded, categorized and then analyzed. The qualitative studied variables were compared using Chi-square test. Pearson correlation analysis used for assessment of the inter-relationships between the nurses' knowledge and practices about blood transfusion. A statistically significant difference was considered at P-value ≤ 0.05 , and a highly statistically significant difference was considered at P-value ≤ 0.001 .

Results:

Table 1 illustrated characteristics of the studied nurses; it was revealed that, the mean ages of them were 28.52 ± 5.06 years. Regarding nurses' education, more than half of studied nurses 60% had diploma in nursing. Also, it was noticed that 60% had 5-10 years of experience in pediatric medicine units and 72% of studied nurses not attended any previous training courses regarding blood transfusion for children.

The effect of implementing nursing intervention program on nurse's total knowledge score was illustrated in **table 2**. It was revealed that only 28% of the studied nurses had satisfactory knowledge score before implementation nursing intervention program compared to 86% and 82% after implementation nursing intervention program and at follow up phases of the program respectively. The difference was statistically significant with P value at 0.001.

The effect of implementing nursing intervention program on the studied nurses' practice regarding care provided to children before blood transfusion was illustrated in **table 3**. It was found that there was statistically significant improvement throughout the three phases of implementation of the program regarding to all steps. However; there

were some steps done by only small percentage of the studied nurses such as 24% checked rate of infusion and checked blood type before implementation of the program compared to 82% and 70% respectively immediately after implementation of the program and then to 72% and 60% at follow up phase respectively. The difference was statistically significant (P value <0.001). The same table also showed that 24% of the studied nurses didn't put blood in ward refrigerator before implementation of the program compared to 84% and 44% after implementation and at follow up phase of the program respectively. The differences were statistically significant with P value were 0.001 and 0.041 respectively.

Table 4 portrays the effect of implementing nursing intervention program on the studied nurses' practice regarding care provided during blood transfusion .It was found that 44% of the studied nurses assess vital signs and observed cannula site before implementation of the program compared to 78% and 64% after implementation and at follow up phase of the program respectively. The same table also indicated that 24% of the studied nurses remained with child during first 15-30 minutes before implementation of the program. This percentage improved to 70% and 60% after implementation and at follow up phase of the program. It was revealed from the same table that 44% of the studied nurses disposed equipment using clinical waste disposal guide lines before implementation of the program, improved to 80% after implementation of the program and then to 78 % in follow up phase.

Table 5 represented the effect of implementing nursing intervention program on the studied nurses' practice regarding care provided after blood transfusion .It was found that 18% of the studied nurses documented time of transfusion was completed before implementation of the program compared to 78% and 60% after implementation and at follow up phase of the program respectively. The difference was

statistically significant (P value <0.001). Also 28% of the studied nurses provided health education of acute adverse reactions before implementation of the program compared to 86% and 64% after implementation and at follow up phase of the program .The difference was statistically significant (P value <0.001).

Effect of the implementing nursing intervention program on total nurse's practice score was illustrated in **table 6** .It was revealed that 12% of the studied nurses had satisfactory practice score before implementation of educational program .This percentage improved to 84% after implementation of educational program and slightly decreased to 70% at follow up phase. The difference was statistically highly significant with P value <0.001.

Correlation between nurses' total practice score, total knowledge score were represented in **table 7**. It was revealed that there was positive correlation between total knowledge score and total practice score before implementation of program and at follow up phase while there positive correlation between total knowledge score and total practice score immediately after implementation.

Discussion:

Blood transfusion for children is a potentially hazardous procedure. Stringent procedures must be followed to ensure that the correct blood is given and adverse reactions should be dealt with promptly and efficiently. Blood transfusion should only be given when the clinical benefits to the child outweigh the potential risks World Health Organization⁽¹³⁾.

Blood transfusion should be appropriate to the child's health needs, delivered in time and correctly administered. Even when delivered in accordance with the recommended standards, correctly indicated and administered, the blood transfusion involves a health risk Cole and Walker⁽¹⁴⁾. This risk refers to the transfusion reactions during or after blood transfusion, besides the fact of being related to it. The complications include;

those that are due to bacterial contamination, acute hemolytic reactions caused by incompatibility of the ABO system, anaphylactic reactions and fluid overload. These complications may be non-immune, and may be associated with human error; or immune, linked to the organic response mechanisms due to the blood transfusion De Mattia and De Andrade^(7&15).

Characteristics of the studied nurses

As regard to nurses' characteristics, the present study showed that two thirds of studied nurses were in the age group 25- 35 years. These findings were in agreement with El- Sol and Badawy⁽¹⁶⁾ and Labrague et al⁽¹⁷⁾, they found that young age nurses had capability to gain knowledge and alter their behaviors. While Alwutaib et al⁽¹⁸⁾ who conducted a study to assess knowledge and attitude of the physicians and nurses regarding blood borne infections in primary health care in Kuwait, they stated that older age is an important indicator to lesser knowledge levels.

The results of the present study showed that two thirds of the studied nurses had diploma degree and one third had completed their education in technical institute of nursing, while the minority had bachelor degree in nursing. This was due to shortage in the number of the qualified nurses who were always busy with administrative duties that was considered one of the main factors which had an effect on the quality of care provided to children. It was inconsistent with Silva et al⁽¹⁹⁾ who conducted study to assess the knowledge of nursing professionals of a specialized hospital in oncology on transfusion practices and to identify factors associated with knowledge in Brazil, found that more than two thirds of studied sample had bachelor degree in nursing.

The current study found that majority of studied nurses in the present study reported that they had never received any training in the current field; although nurses had an important function in maintaining safety blood transfusion, by identifying its indications, applying

transfusion principles to prevent errors. So, this process requires skilled and trained professionals to achieve transfusion safety, this result in the same line with the present study finding, De Graaf et al⁽²⁰⁾ had reported that only 1% of registered nurses were estimated to have any specialist blood transfusion training.

Effect of an implementing nursing intervention program on the studied nurses' knowledge regarding blood transfusion

The results of the present study revealed that nurses' knowledge before the program was generally unsatisfactory due to lack of continuous educational training program, unavailability of blood transfusion handout to use as a nursing guide and absence of orientation programs related to blood transfusion. All of nurses had satisfactory knowledge level in the post-program implementation phase and during follow up phase. These results matched with Khalaf et al⁽²¹⁾, they conducted a study to determine the effect of training program on nurses' competent practices towards children receiving blood transfusion at Benha university hospital and found the same result as nurses' knowledge & practice had improved after implementation of the program.

The effect of an implementing nursing intervention program on the studied nurses' practice regarding care provided before blood transfusion

On the other hand, the current study assessed nurses' practice toward caring for children receiving blood transfusion. The study findings demonstrated very low levels of satisfactory practice among them before implementation of the program. This was particularly evident in crucial tasks such as preparation skills prior blood transfusion, observe blood ,checking history and nursing actions for all suspected reactions during blood transfusion for children and children monitoring after blood transfusion. Overall, none of the nurses had adequate total practice at pre-program

implementation. This linked to the previously mentioned low level of satisfactory knowledge among them. Both together deficient knowledge and practice would certainly have a negative impact on the quality of nursing care provided by the studied nurses. As emphasized by British Committee for Standards in Hematology⁽²²⁾, the primary responsibility of the nurse educator is to build quality program on the existing knowledge and practice and to translate their teaching needs into systematic learning experience. Learning in nursing must be related to the goal and objectives of the program.

The effect of an implementing nursing intervention program on the studied nurses' practice regarding care provided during blood transfusion

The results of the present study illustrated that there was a highly statistical significant differences between nurses' practice related to care provided during blood transfusion throughout program phases. This result was in line with Mohammed and Ibrahim⁽²³⁾ who mentioned that there was highly statistical significant differences between nurses' practice related to care provided during blood transfusion on pre, post and follow up implementation of program. This was attributed to the effect of training and instructions that were provided by the researcher.

Concerning remaining with the child during the first 15-30 minutes, Al Nasr⁽²⁴⁾ mentioned that staying with patients for the first few minutes of blood transfusion to monitor signs and symptoms of adverse reactions would help to detect early any abnormality. The study revealed that more than two third of nurses didn't remain with children during the first 15-30 minutes of blood transfusion on pre implementation of program. This could be attributed to the fact that the existing number of nurses was insufficient to perform all the required duties that were subjected nurses due to work overload.

In relation to monitoring vital signs; the present study revealed that two third

of studied nurses didn't monitor vital signs on pre implementation of program and improved after and follow up phases of the program. This was in line with Hendy⁽²⁵⁾ who conducted a study to assess nurses' performance caring for patient receiving blood transfusion in Ain Shams University, and mentioned that when nurses followed educational training program their competence increased and they performed more tasks safely. This might reflect the importance of continuous in-service training.

Concerning regulation of flow rate during transfusion; the present study revealed that two third of studied nurses didn't start infusion slowly, or regulate the flow rate to allow 2 ml/min for the first 15 minutes on implementation of program. Above all, the Vasiliki⁽²⁶⁾ reported that nurses should start blood transfusion slowly at rate 2 ml/min for the first 15 minutes. As well as Taylor et al⁽²⁷⁾ mentioned that severity of reaction was proportional to the amount of blood infused. This could be attributed to knowledge deficit that led to mal practice.

The effect of an implementing nursing intervention program on the studied nurses' practice regarding care provided to children after blood transfusion

The present study revealed that more than half of studied nurses didn't perform documentation on pre implementation of program. While on post and follow up phases of the program, the majority of studied nurses performed documentation. These findings were in agreement with Ibrahim et al⁽²⁸⁾ who mentioned that accurate documentation system depended on an in-service educational program that focused on the importance of nursing documentation.

These findings emphasized that both knowledge and practice are equally important for the work of the nurse and the focus should be on knowledge. Utilization of clinical nursing practice requires that; nurses should incorporate knowledge and skills into practice to reduce the occurrence of acute adverse

reactions in patients undergoing blood transfusion. This gain clarified the importance of in-service and continuing nursing education.

In order to design a training program for improving nurses' knowledge and practice regarding nursing care provided to children receiving blood transfusion, it was mandatory to assess their baseline knowledge and practice. The results of the present study revealed that nurses' knowledge before the program was generally unsatisfactory. This was quite clear regarding their knowledge about blood product which contains blood products and components of blood. The present study findings were supported by Reza et al⁽²⁹⁾ who found that the majority of nurses' knowledge was inadequate regarding blood and its components which in-turn prevent them from providing competent nursing care during transfusion procedure. Moreover, Kabinda et al⁽³⁰⁾ reported that training and education are essential for all staff involved in the transfusion procedure and as it minimize transfusion errors.

Overall, the present study revealed that the training program about blood transfusion was effective in achieving satisfactory knowledge and practice among studied nurses. This effect was further confirmed by multivariate analysis, which has revealed that program attendance was the strongest statistically significant positive independent predictor of nurses' knowledge and practice scores at the post training. These findings was supported by Khalil et al^(8,31) who revealed in their study that continued nursing education programs for nurses

increase their knowledge and practice where there was an improvement in nurses' practice after the attendance continuing nursing education sessions.

Conclusion

In the light of the current study findings, it was concluded that the implementing nursing intervention program among studied nurses had a positive effect on improving their knowledge and practice about blood transfusion as there was a statistical significant difference throughout the three phases of the study. Children who received blood transfusion program got fewer acute adverse reactions after implementation of blood transfusion program.

Recommendations:

Based upon the results of this study, the following are recommended:

- 1- Ongoing in services education programs must be designed and implemented at Pediatric units to improve nurses' knowledge and practices on the basis of nurses' actual needs.
2. Nurses should diagnose child's adverse reactions for blood transfusion and provide immediate care.
3. New staff members in pediatric units should be oriented to standardize international nursing care protocols to prevent adverse reactions.
4. Further studies in this field should be done, and large sample should be included to assess the effectiveness of blood transfusion program on the reduction of acute adverse reactions and to allow the generalization of the findings.

Table 1: Characteristics of studied nurses (n= 50)

Characteristics	No	%
Age		
▪ <25	12	24.0
▪ 25 - 35	32	64.0
▪ >35	6	12.0
Mean ±SD	28.52 ±5.06	
Years of experience		
▪ <5	12	24.0
▪ 5 –10	30	60.0
▪ > 10	8	16.0
Mean ±SD	9.52 ±4.85	
Educational level		
▪ Diploma of nursing	30	60.0
▪ Nursing institute	15	30.0
▪ Bachelor of nursing	5	10.0
Previous training related to blood transfusion		
▪ Yes	14	28.0
▪ No	36	72.0

Table 2: Total nurse's knowledge score throughout the study phases

Knowledge	Unsatisfactory		Satisfactory		Post VS Pre		Fu VS Pre	
	No	%	No	%	Z	P	Z	P
▪ Pre	36	72.0	14	28.0	5.048	<0.001**	4.564	<0.001**
▪ Post	7	14.0	43	86.0				
▪ Follow-up	9	18.0	41	82.0				

**highly significant at 0.001

Table (3): Nurses satisfactory practice levels regarding care provided to children before blood transfusion throughout the study phases

Steps	Pre		Post		FU		Post Vs. Pre	Fu Vs. pre
	No	%	No	%	No	%		
Rate of infusion	12	24.0	41	82.0	36	72.0	<0.001**	<0.001**
Observe blood label	30	60.0	50	100.0	50	100.0	<0.001**	<0.001**
Expired date	22	44.0	50	100.0	43	86.0	<0.001**	<0.001**
Checking history	24	48.0	42	84.0	33	66.0	<0.001**	0.072
Patient blood type	12	24.0	35	70.0	30	60.0	<0.001**	<0.001**
Never put blood in ward refrigerators	12	24.0	42	84.0	22	44.0	<0.001**	0.041*
Equipment check as oxygen and suction	34	68.0	43	86.0	37	74.0	0.039*	0.513
Give pre-medication 30 min	22	44.0	40	80.0	35	70.0	<0.001**	0.016*
Assess vital signs								
Pulse	25	50.0	35	70.0	27	54.0	0.050*	0.637
Respiration	25	50.0	35	70.0	28	56.0	0.050*	0.532
Blood pressure	27	54.0	40	80.0	29	58.0	0.009*	0.637
Body temperature	24	48.0	44	88.0	38	76.0	<0.001**	0.004*

*P<0.05 (significant)

**P<0.001 (highly significant)

Table (4): Nurses satisfactory practice levels regarding care provided to children during blood transfusion throughout the study phases

Steps	Pre		Post		FU		Post Vs. Pre	Fu Vs. pre
	No	%	No	%	No	%		
Assess vital signs.	22	44.0	39	78.0	32	64.0	<0.001**	<0.001**
Observe the cannula site	22	44.0	40	80.0	39	78.0	<0.001**	<0.001**
Remain the first 15-30 min	12	24.0	35	70.0	30	60.0	<0.001**	<0.001**
Documentation	12	24.0	39	78.0	35	70.0	<0.001**	<0.001**
Time the infusion was started	11	22.0	25	50.0	16	32.0	0.008*	0.251
Dispose of equipment using	22	44.0	39	78.0	32	64.0	<0.001**	0.033*
Wash hands	22	44.0	40	80.0	39	78.0	<0.001**	<0.001**

*P<0.05 (significant)

**P<0.001 (highly significant)

Table (5): Nurses satisfactory practice levels regarding care provided to children after blood transfusion throughout the study phases

Steps	Pre		Post		FU		Post Vs. Pre	Fu Vs. pre
	No	%	No	%	No	%		
Document the following Amount of blood	24	48.0	32	64.0	30	60.0	0.102	0.221
Time the transfusion was completed	9	18.0	39	78.0	30	60.0	<0.001**	<0.001**
Patient response	9	18.0	28	56.0	19	38.0	<0.001**	0.041*
Type of reaction	11	22.0	38	76.0	26	52.0	<0.001**	*0.003
Assess vital signs	22	44.0	37	74.0	35	70.0	0.004*	0.012*
Provides health education	14	28.0	43	86.0	32	64.0	<0.001**	<0.001**

*P<0.05 (significant)

**P<0.001 (highly significant)

Table (6): Total nurses practice score throughout the study phases

Practice	Unsatisfactory		Satisfactory		Pre Vs. Post		Pre Vs. FU	
	No	%	No	%	Z	P	Z	P
Pre program	44	88.0	6	12.0				
Post program	8	16.0	42	84.0	5.840	<0.001**	4.902	<0.001**
Follow-up	15	30.0	35	70.0				

**P<0.001 (highly significant)

Table (7) Correlation between nurses 'knowledge and Practice Score throughout three phases of program

	Pre Knowledge Total		Post Knowledge Total		FU Knowledge Total	
	r	p	r	P	r	p
Pre Practice Total	0.169	0.241				
Post-Practice Total			0.539	<0.001**		
FU Practice Total					0.239	0.95

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