

Effect of Training Program Based on ADDIE Model on Pediatric Nurses' Performance Regarding Blood Transfusion: A Randomized Clinical Trial

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Abstract

Background: Clinical failures are considered as a serious problem in the health system and a threat for patients' safety. The nurses' performance was poor during the blood products transfusion for children. One of the main obstacles to implement a national blood policy in developing countries is the lack of trained staff.

Aim: To determine the effect of a designed training program based on the ADDIE model (analysis, design, development, implementation, evaluation) on nurses' performance regarding blood transfusion for children.

Method: This randomized clinical trial (RCT) study was performed in Bint Al-Huda teaching hospital at Al- Nasiriya City in Iraq. The study started from July 2021 to March 2021 and involved 60 nurses. Data was collected using a demographic data questionnaire and the observational checklist of nurses' performance regarding transfusion of blood and blood products. At first, nurses' performance regarding transfusion of blood and blood products to a child was checked. Then, the intervention group received a designed training program based on the ADDIE model. Again, nurses' performance was assessed. Finally, data were analyzed with SPSS 25 software. $P < 0.05$ was considered statistically significant.

Results: The scores of nurses' performance in pretest stage in the intervention and control groups was relatively similar ($M = 10.23 \pm 1.07$ versus $M = 10.83 \pm 4.49$; $P > 0.05$), but in post-test stage, the scores of the intervention group were higher ($M = 36.40 \pm 3.08$ versus $M = 10.85 \pm 4.53$; $P < 0.001$).

Implications for Practice: According to the results, the designed training program based on ADDIE model can be used in pediatric setting to improve the nurses' knowledge and practices about blood transfusion.

Keywords: Blood transfusion, Educational model, Nurses, Performance evaluation, Program

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Introduction

Patients' safety is one of the main issues in the health care system and has high importance in hospitals due to the economic, humanitarian and ethical aspects, which are the first and the most important issues in professional identity. Clinical failures are considered as a serious problem in the health system and a threat for patients' safety. Although eliminating clinical failure is not entirely achievable, avoiding it is a key component of health care quality (1,2). In this regard, in most healthcare centers, nurses are responsible for performing blood transfusion. An integrative review reported that nurses as the healthcare professionals rarely manage to complete an activity without interruption, especially in the pediatric unit, with more interruptions, which often occur when providing direct care to the patients (3). One of these activities, is transfusion of blood and blood products (4).

Transfusion of blood products requires special care, such as proper compliance with medical treatment guidelines for controlling the infusion speed, monitoring vital signs, and documenting all procedures. Neglecting such items may result in an increased risk of embolism, sudden increase in blood concentration, emergent incomplete oxygenation, and adverse changes in vital signs (5).

The quality of nursing care in the transfusion of blood products is critical (6) and can be enhanced through continuous audits and evaluations (7). According to the results of previous studies, the performance of nurses was poor in many cases during blood products transfusion which can affect the children health (8); so authorities were recommended to provide healthcare providers, especially nurses, with continuous training in the area of hemovigilance in order to raise the standards of care (9).

Effective instructional design is essential for efficient teaching and learning outcomes in all disciplines, particularly in the nursing content-laden curriculum. Instructional design model steps and processes enable the instructor to determine the scope of the course contents, sequence of instructions, innovative presentation, and evaluation strategies. Sound educational and instructional design principles, theory, and research underlie the creation of meaningful learning experiences that meet the educational goals and objectives of adult learners in nursing education (10).

There are many instructional design models that define the phases for producing instructional product for effective learning experiences. These models, which include Gagne; Dick and Carey; and Morrison, Ross and Kemp models, have processes that employ a combination of content area material, technology, and critical and creative thinking skills in the design of instructions (11). The generic instructional model of analysis, design, development, implementation, and evaluation (ADDIE) underlies every instructional design process (12).

One of the main obstacles to implement a national blood policy in developing countries is the lack of trained staff (13). The blood transfusion skill therapy is an adult learning activity in nursing. Application of the designed training program based on ADDIE model for blood transfusion adult learning activity, demonstrates the constant planning, design, development, and assessment processes to ensure effective instruction and acquisition of necessary competencies. So, this study was performed with aim to determine the effect of designed training program based on ADDIE model on nurses' performance regarding transfusion of blood and blood products for children.

Methods

This randomized clinical trial (RCT) study was performed to identify the effect of designed training program based on ADDIE model on nurses' performance regarding transfusion of blood and blood products for children. The study was performed in Bint Al-Huda hospital at Al- Nasiriya City in Iraq from July 2021 to March 2021.

The present study was conducted on nurses in pediatric wards (Pediatric Intensive Care Unit (PICU), Sterilization preterm infants, Unsterilization preterm infants, Emergency Room (ER), Children's operations room, and Surgical Wards). Pediatric wards were assigned to the intervention and control groups using simple randomization with flipping coin. Then, a quota sample of 60 nurses enrolled in the study.

According to the findings of the study by Salem et al. (2019) (14), the effect size of training on improving nurses' performance was very high (>0.8), so in calculating the sample size, the medium effect size = 0.6 was considered. Then, according to the formula (comparison of two independent samples means), the sample size was calculated as 22 person in each group ($\alpha = 0.05$; $\beta = 0.20$;

$Z_{1-\frac{\alpha}{2}} = 1.96$; $Z_{1-\beta} = 0.84$; $\Delta = 0.6$). Considering the loss and increasing accuracy, finally 30 samples were considered for each group (Figure 1). In addition, to examine and eliminate the effect of the studied children and other factors, at least two observations were made for each nurse in each stage.

The inclusion criteria were: minimum of 6 months of work experience in the pediatric wards, not previously participation in training program regarding transfusion of blood and blood products and tendency to participate in the study. Exclusion criterion were: nurses' workplace change during the study and nurses' absence from attending more than one session of training sessions.

The tools of the study were a demographic characteristics of nurses' questionnaire and an Observational checklist of nurses' performance regarding transfusion of blood and blood products. An Observational Competence Checklist of Blood Transfusion (BT) was developed by Sefatbaqa et al. (15). It is used to assess the nurses' practices before, during and after BT. The total score of observation checklists was 41 grades. Score "one" was assigned for each correct step and "zero" if nurses practices incorrectly or not done. The final score at each stage is the sum of scores related to all the items and ranged 0-41. The content validity ratio and content validity index were reported as 0.88 and 0.91, respectively. For the reliability of the checklist, two researchers of the study independently appraised NICU nurses while performing blood transfusion tasks and completed the checklist for 30 procedures. Then, the intraclass correlation coefficient (ICC) was calculated for these two raters (ICC=85%) (15).

The face and content validity of the checklist in the present study has been confirmed through a panel of eighteen experts from University of Mashhad, University of Basra, University of Baghdad, University of Kerbala, University of Babylon, University of Al-Muthana, University of Thi-Qar and Thi-Qar Health Office. Also, the performance of nurses in blood transfusion on 10 children was observed simultaneously by the researcher and the supervisor using a checklist, then the correlation test was used to calculate inter rater reliability and obtained 0.86.

After obtaining the official approval, the purpose and method of the study was explained to the

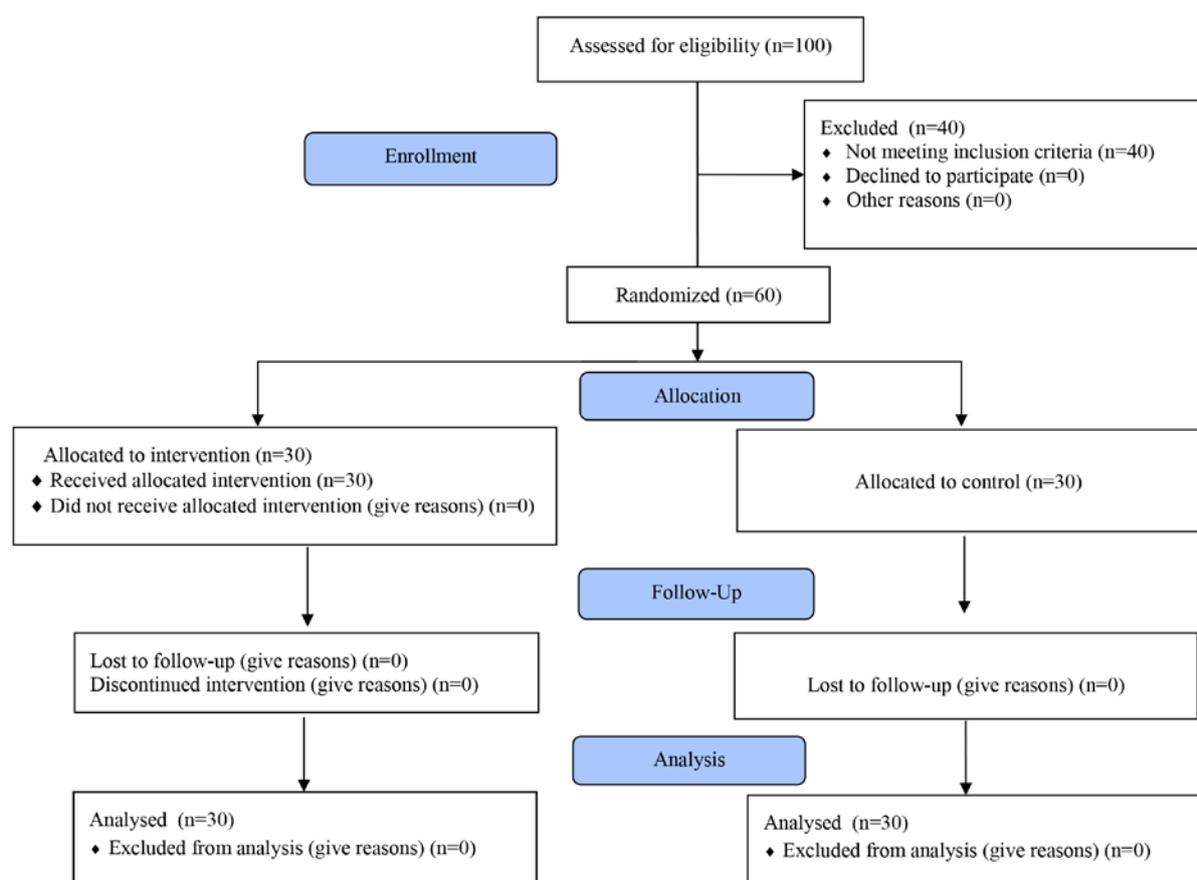


Figure 1. CONSORT 2010 Flowchart

studied nurses. The researcher evaluated the nurses' practices regarding transfusion of blood and blood products by using the study tools. The observation checklist of nurses' performance regarding transfusion of blood and blood products was filled out by the researcher who attended 7 days per week in the evening and night shifts in different study's settings to assess the actual nurses' practices regarding transfusion of blood and blood products. Two observations were made for each nurse. The assessment was done during one month.

The generic instructional model of analysis, design, development, implementation, and evaluation (ADDIE) underlies every instructional design process. In this study, training program was designed under the components of ADDIE model:

Analysis

The filled observation checklist of nurses' performance was analyzed to evaluate the actual nurses' practices regarding blood transfusion on children for identifying the pediatric nurses' common practical errors related to blood transfusion and a list of these errors was made. Also in this stage, the characteristics of nurses and hospital educational facilities were analyzed and used in the following steps.

Design

In this stage, the researcher prepared a set of goals for before, during and after blood transfusion for nurses' performance with emphasis on nurses' error in this regard.

The training program was performed in three successive sessions. The researcher illustrated the content related to blood and blood products, blood functions, indications and contraindications of blood transfusion, complications of blood transfusion, manifestation of blood transfusion reactions, and nurses' role during blood transfusion. Also, the content included precautions before, during and after transfusion, and general guideline for the management of adverse effects of blood transfusion reactions in 3 sessions. The duration of each session was approximately 2 hours: one hour for theoretical and one hour for practical training. In theoretical sessions, different teaching strategies (Mini lecture, Case-based discussion, small group discussion) and media (Power Point Presentation, Figures, Diagram) were used for training nurses. These theoretical sessions were followed by three practical demonstrated and re- demonstrated sessions related to blood transfusion of nurses (before, during and after blood transfusion) by the researcher at the clinical setting.

Development

Suitability criteria is critical for instructional materials (16). Content of training program adopted from British Committee for Standards in Hematology (BSCH) (2015). It provides a standardized approach for transfusion. The total numbers of nurses were divided into three groups (each group involved 10 nurses). Media were prepared and location was selected for theoretical class in hospital.

Implementation

Training program was implemented for each group. Three 2-hour sessions were executed within 2 weeks for each group.

Evaluation (Post intervention phase)

The researcher used summative evaluation and assessed the nurses' practice outcomes by using the same study tool. The observation checklist of nurses' performance regarding transfusion of blood and blood products was completed by the researcher who was available 7 days per week in the evening and night shifts in different study's settings. The assessment was done during one month. Two observations were made for each nurse.

Data were collected, coded and entered into the computer, and after confirming their accuracy, SPSS statistical software version 25 was used to analyze data. Descriptive statistics including mean, standard deviation and frequency distribution (number and percentage) were used to express the characteristics of the research sample. The normal distribution of quantitative variables was determined by Kolmogorov-Smirnov and Shapiro-Wilk tests. Due to the fact that the research variables did not have a normal distribution, the Mann-Whitney test was used to compare the study's groups. Chi-square and Fisher's exact tests were used to evaluate the nominal variables. Intergroup

comparisons, Wilcoxon signed-rank test was used to compare the study's stages. $P < 0.05$ was considered statistically significant.

Results

According to the results, the majority (33.3%) of nurses in the study group aged 36-40 years, while (30.0%) of nurses in the control group aged ≥ 41 years. Also, 73.3% of nurses in the study group and 76.7% in the control group were female (Table 1).

According to the Chi-square test results, there was no significant difference between the intervention and control groups in terms of demographic characteristics.

According to $P < 0.05$ for all levels of the nurses' performance in the intervention and control groups, the results of Shapiro-Wilk test showed that the nurses' performance didn't have normal distribution.

According to the results of the Mann-Whitney test, the difference between the mean performance before and after the intervention in the intervention group was 25.77 ± 2.01 ; while this difference was 0.02 ± 0.04 in the control group. Before the intervention, there was no significant difference between the performance of nurses in the intervention and control groups ($P > 0.05$). However, the results of the Mann-Whitney test showed a significant difference in the performance of nurses after the intervention in the two groups ($P < 0.001$) (Table 2).

Also, Wilcoxon test was used for intergroup comparison of nurses' performance. The results in both intervention and control groups were shown in Table 2.

The mean score of the nurses' performance in the control group before the intervention was 10.83, which after the intervention reached 10.85. Also, considering the $P > 0.05$ in the Wilcoxon test for all dimensions of the observational checklist, the results showed no significant difference between the nurse's performance before and after the intervention in the control group. The mean score of the nurses' performance in the intervention group before the intervention was 10.23, which after the intervention reached 36.4. Also, considering the $P < 0.05$ in the Wilcoxon test for all observational

Table 1. Distribution of The Study Sample for intervention and Control Group (No=60 Nurses)

Variable		Group		Test Result
		Study	Control	
		Number (Percent)		
Gender	Male	8(26)	7(23)	df=1 X ² = 0.089 P=0.766*
	Female	22(73)	23(76)	
Age	20-25	6(20)	3(10)	df=4 X ² = 4.33 P = 0.363*
	26-30	6(20)	6(20)	
	31-35	5(16.7)	4(13.3)	
	36-40	10(33.3)	8(26.7)	
	40years or older	3(10)	9(30)	
Education	Diploma	13(43.3)	14(46.7)	df=3 FET= 2.68 P = 0.194**
	Bachelors	11(36.7)	14(46.7)	
	Master	5(16.7)	2(6.7)	
	Phd	1(3.3)	0	
Economic status	poor	8(26.7)	13(43.3)	df=2 X ² = 5.52 P= 0.063*
	good	18(60)	9(30)	
	Very good	4(13.3)	8(26.7)	
Marital status	Single	13(43.3)	11(36.7)	df=1 X ² = 0.278 P= 0.598*
	Married	17(56.7)	19(63.3)	
Insurance status	No	29(96.7)	30(100)	P= 0.50**
	Yes	1(3.3)	0	

*Chi- square test

**Fisher Exact test

Table 2. Comparison of nurses' performance within and between intervention and control group before and after intervention

	Group	Stage		Result of Wilcoxon
		Before	After	
Performance before transfusion	Control	6.30±2.56	6.36±2.68	Z=0.743 0.073=P
	Intervention	6.56±0.72	18.50±2.20	Z=4.79 0.005=P
Performance during transfusion	Control	3.50±1.87	3.46±1.79	Z=0.378 0.167=P
	Intervention	3.67±0.80	14.16±1.20	Z=4.81 0.007=P
Performance after transfusion	Control	0.90±0.711	1.30±0.80	Z=1.30 0.083=P
	Intervention	0.00	3.73±0.58	Z=5.10 0.002=P
Total score of performance	Control	10.83±4.49	10.85±4.53	Z=1.84 0.06=P
	Intervention	10.23±1.07	36.40±3.08	Z=4.79 P=0.005
	Between groups	Z= -4.05 P>0.05*	Z= -6.67 P<0.001*	

*Result of Mann-Whitney Test

checklist dimensions, the results showed a significant difference between the nurse's performance before and after the intervention in the intervention group.

Discussion

This study was performed aimed to determine the effect of a designed training program based on the ADDIE model on nurses' performance regarding the transfusion of blood and blood products for children in Bint Al-Huda teaching hospital at Al- Nasiriya City in Iraq.

The scores of nurses' performance in pretest stage was relatively similar in the intervention and control groups, but in post-test stage, the scores of nurses' performance were higher in the intervention group.

Table 2 showed a comparison between the two groups before the intervention and the results showed that nurses in both groups had no admirable practice in blood or blood products transfusion. This result is consistent with the results of the studies by Choudhary and colleagues (2020) and Soliman and Elhapashy (2021) that noticed the nurses' practice before starting the training program (17,18). Moreover, Salem et al. (2019) found no change in nurses' practice before enrolling in the training program (14). Furthermore, Khalaf et al. (2017) stated that there was no difference between the control and study groups in terms of nurses' performance before the training program. This is an expected result because both groups have not yet been exposed to the training program (19).

The result shown in Table 2 indicated the success of the program in improving the nurses' practices for transfusions of blood and blood products in the pediatric wards. This result is in line with the result of the study by Kafli and El-Shahat (2020) that they found a great improvement in nurses' practices regarding transfusion of blood and its products in the pediatric wards after the educational program intervention (20). Also, Vaghar in his study (2018) recognized an elevation in nurses' practice level after engaging in the training program (21). Furthermore, Basal and Elshemy (2015) reported positive progress in nurses' knowledge and practice regarding blood transfusion in medical and hemolytic departments after the structured teaching program (22). Moreover, Kaur and colleagues (2014) mentioned that the difference between the two groups was statistically significant after completing the training program (23). The reason for this could be the researcher's dedication to deliver the correct information and practices based on guideline, in addition to the good properties of ADDIE model for designing and conducting the training program for nurses to learn the best

professional practice.

According to the results of the present study, there was a significant difference between nurses' performance in the two groups after the intervention. The intervention group had a significant change in their performance after the intervention, while the performance of the control group did not have a significant change. This result is consistent with the result of the study by Chilapur et al. (2021) that reported the practice of nurses in the pediatric ward regarding blood transfusion and its products were greatly improved after exposure to the training program (24). Also, Bayoumi and El-Nagger (2020) found a significant difference between the two groups' performance after completing the program (25). Moreover, Rudrappan (2019) reported a significant difference in nurses' practice related to blood transfusion between pre-intervention and post-intervention periods (26). Furthermore, Elewa and Elkattan (2017) stated that the practice of nurses changed after enrolling in the training program (27). The difference between the two groups can be explained as the fact that the study group underwent the practical program and systematically trained in terms of knowledge and practice on how to transfer blood and its products, while the control group did not receive this program.

One of the limitations of this study is that the observation checklist of nurses' performance regarding transfusion of blood and blood products was filled out by the first researcher. She was available 7 days per week in the evening and night shifts in different study settings. To decrease the effect of bias in observation, two observations were made for each nurse.

Implications for practice

According to the findings of the present study, it can be concluded that a training program based on the ADDIE model had a positive effect on nurses' performance in the intervention group regarding transfusion of blood and blood product for children. So, training program based on ADDIE model can be used in pediatric units to develop nurses' information and practices based on attendants' fundamental requirements in blood transfusion. It can be suggested that future research be done to assess the children's adverse reactions after implementing the blood transfusion program and patients' satisfaction.

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Conflicts of interest

The authors declared no conflict of interest.

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