

Evidence Based Care Journal

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The online version of this article can be found at
http://ebcj.mums.ac.ir/article_16741.html

Evidence Based Care Journal 2020 10:07 originally published
online 01 October 2020

DOI: 10.22038/ebcj.2020.47919.2293

Online ISSN: 2008-370X

Address: Mashhad Nursing and Midwifery School, Ebn-e-Sina St., Mashhad, Iran

P.O.Box: 9137913199

Tel.: (098 51) 38591511-294

Fax: (098 51) 38539775

Email: EBCJ@mums.ac.ir





Performance of Nurses in Neonatal Intensive Care Unit Regarding Transfusion of Blood and Blood Products

Samane Sefatbaqa¹, Seyedeh Roqayeh Jafarian Amiri², Ali Zabihi², Parisa Pourdada³, Afsaneh Arzani^{4*}

Received: 13/05/2020

Accepted: 27/09/2020

Evidence Based Care Journal, 10 (3): 7-14

Abstract

Background: Critically ill neonates receiving blood products are at risk of transfusion-related complications. The quality of nursing care in this regard can be enhanced through continuous evaluations.

Aim: This study aimed to assess the performance of nurses in a neonatal intensive care unit (NICU) regarding the transfusion of blood and blood products.

Method: This descriptive cross-sectional study was carried out on the nurses working in an NICU in Tehran, Iran, during 2017. The performance of nurses was investigated for 550 blood transfusion procedures by structured observation through a researcher-made checklist with 40 items in three steps. The data were analyzed using SPSS software (version 22) using descriptive statistics and a generalized estimating equation.

Results: The highest frequency (66.2%; n=365) of transfusions was observed for fresh frozen plasma. In the pre-transfusion phase, no case out of 550 transfusion procedures, ensuring the openness of the vein with normal saline injections run (100%), the carriage of blood products from the blood bank to the ward by the box Specific (76.2%), assess blood and blood products sensitivity (34.1%) and control of blood tests for blood count and coagulation factors (20.5%). In the transfusion phase, slow shaking the blood bag during injection (68.6%) and venous line washing with saline solution (45%) were not according to guidelines. After the transfusion phase, the volume of infused products, blood types, post-transfusion reactions and vital signs, and status of product labeling were recorded in 100% of the nursing reports.

Implications for Practice: The performance of nurses was poor in many cases during the transfusion stage which can affect the health of the neonates. Therefore, it is recommended to provide continuous and persistent training for the staff.

Keywords: Blood component transfusion, Blood safety, Critical illness, Nursing care, Premature neonate

1. MSc in Neonatal Nursing, Faculty of Nursing and Midwifery, Babol University of Medical Sciences, Babol, Iran
2. Assistant Professor of Nursing, Nursing Care Research Center, Faculty of Nursing and Midwifery, Babol University of Medical Sciences, Babol, Iran
3. Instructor of Neonatal Nursing, Faculty of Nursing and Midwifery, Babol University of Medical Sciences, Babol, Iran
4. Assistant Professor of Nursing, Nursing Care Research Center, Health Research Institute, Faculty of Nursing and Midwifery, Babol University of Medical Sciences, Babol, Iran

* Corresponding author, Email: a.arzani@mubabol.ac.ir

Introduction

About 90% of neonates admitted to neonatal intensive care units (NICUs) receive blood products at least once during hospitalization; therefore, newborns are at high risk for transfusion-related complications and side effects (1-3). The rapid growth of premature neonates, iron deficiency, low levels of erythropoietin, low erythropoiesis, short lifespan of fetal hemoglobin, and oxidative hemolysis, especially iatrogenic loss due to frequent blood sampling, are the main factors contributing to the need for transfusion (2, 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, emergence of incomplete oxygenation, and adverse changes in vital signs (5).

Due to the continuous presence of nurses at neonates' bedside, they play a unique role in neonatal care, thereby requiring special knowledge and skills to provide quality care (6). The quality of nursing care provided in the transfusion of blood products is critical (7) and can be enhanced through continuous audits and evaluations (8). A nursing audit is a process of evaluating the quality of nursing care in order to identify the strengths and weaknesses of nursing care (9). In fact, without an effective control system, no task will be well performed in any desired organization (10).

The documentation of human errors, as the biggest risk threatening the recipient of blood products, is a major part of global hemovigilance programs (11). Errors in hemovigilance are very similar to those occurring during infusions. Errors are often rooted in mistakes and faults associated with detailed patient recognition. This will expose vulnerable newborns to significant risks (12). Clinical hospital staff are responsible for possible negligence during transfusion and should perform this task very carefully (13). A recent study carried out by Orkuma JA et al. in Africa (2014) evaluated the performance of nurses working in NICUs. Based on the results, the rates of compliance with hemovigilance guidelines and implementation and documentation of transfusion were 47%, 63.2%, and 68%, respectively. Accordingly, authorities were recommended to provide healthcare providers, especially nurses, with continuous training in the area of hemovigilance in order to raise the care standards (14).

In a study conducted by Hijji et al. in the United Arab Emirates (2013), it was observed that nurses do not have adequate knowledge in this regard (15). Dehghan Nayeri et al. (2015) in hospitals affiliated with Tehran University of Medical Sciences (TUMS), Tehran, Iran, showed undesirable conditions in terms of patient safety (16). Neonatologists have also recommended that the quality of nursing care in the transfusion of blood and blood products in neonates should be minimally harmful to newborns (17-19). Considering the importance of the issue and lack of studies on the performance of nurses working in NICUs, the present study was investigated in order to assess the performance of nurses in the transfusion of blood and blood products.

Methods

This descriptive cross-sectional study was conducted in the NICU of a referral hospital affiliated to TUMS in 2017 (this center was randomly selected from other NICUs of TUMS). Due to the default of 65% performance of nurses with standards (20) and 10% error at 95% confidence interval with 80% power, the sample size was estimated at approximately 550 procedures (21) using convenience sampling. In addition, the current study assessed the performance of 35 eligible nurses on average in 13 to 16 blood transfusion procedures. The inclusion criteria of the current study were a certificate of attending the hemovigilance program by the Iranian Blood Transfusion Organization (IBTO) and minimum of 6 months of work experience in the NICU with a fixed or rotating shift.

The exclusion criterion was the change in nurses' workplace during the study. The data were collected through a researcher-made checklist (based on reliable articles on neonates' hemovigilance (22, 23), nursing reference books (24), and guidelines applied in Iran) containing 40 items on the provision of standard care in hemovigilance process during three steps, namely before transfusion (19 items; range: 0-19), during transfusion (17 items; range: 0-17), and after transfusion (4 items; range: 0-4). These tasks are assessed and scored based on a bi-criteria approach of "is performed" (score 1) and "is not performed" (score 0).

The final score at each stage is the sum of scores related to all the items. Considering the different score ranges in the dimensions of the checklist of data collection, a percentile-based or normalized

score was used by the following formula to express every score on a 0-100 point scale (25). Accordingly, the scores of the three phases of the checklist can be easily compared to each other, and it was determined which scores were better or worse than others.

Normalized score = Raw score – Possible minimum response score/range of possible response scores × 100

To confirm the validity (i.e., face and content validity) of the checklist, it was examined by 10 experts (i.e., neonatologists, nursing professors, and NICU nurses). Furthermore, the content validity ratio and content validity index were reported as 0.88 and 0.91, respectively. For the reliability of the checklist, two authors of this article independently appraised NICU nurses while performing blood transfusion tasks (i.e., from physician request for blood transfusion and implementation of transfusion to the documentation of the process in three stages of before, during, and after transfusion) and completed the checklist for 30 procedures using the structured observation and patient medical documentation. Then, the intraclass correlation coefficient (ICC) was calculated for these two raters (ICC=85%). Procedures were entered into the study that all the above-mentioned stages (i.e., physician request, infusion, and documentation) and incomplete procedures were excluded. It should be noted that according to the laws of the IBTO, every procedure must be approved by the two nurses at each stage before, during, and after transfusion; in cases of control of physician's prescription before injection, recording vital signs before, during, and after the implementation of the procedure, as well as control of forms and specifications of the product bag in terms of color, turbid, bag number, infant name and ward, date of collection and expiration of blood and blood products and expiration date of the infusion set (26).

The present study was approved by the Ethics Committee of Babol University of Medical Sciences, Babol, Iran (MUBabol_HRI.IRC.1395.79). The ethical considerations observed in this study included providing information about the study objectives for nurses. Moreover, the nurses were informed that some of their nursing practices were monitored by a team; however, no certain practice/procedure was declared. The collected data were analyzed by SPSS software (version 22), and a p-value of less than 0.05 was considered statistically significant.

We used descriptive and inferential statistics (e.g., relative and valid frequencies) and a generalized estimating equation (GEE) model with an autoregressive (AR-1) structure, correlation structure (due to the nature of the data which is in the form of a cluster; with a different number of transfusion performance of nurses and to control and investigate the correlation within each cluster, this model has been used), in order to determine the effect of some demographic variables of nurses on their total performance score regarding the transfusion of blood and blood products.

Results

All 35 nurses participating in this study were female, with a mean age of 35.42±6.66 years. In addition, most of the participants had a bachelor's degree. Moreover, 71.4% of the staff had more than 5 years of experience in the neonatal ward. Furthermore, 60% and 40% of the nurses worked in rotating shifts and fixed morning/evening shifts, respectively. In addition, 91.4% of the staff had attended only one hemovigilance training course. A total of 550 transfusions of blood and blood products were assessed in this study. The highest frequency (66.2%; n=365) of transfusions was observed for fresh frozen plasma (FFP), followed by packed cells (29.9%; n=164), platelets (3.8%; n=19), and cryoprecipitate (0.1%; n=2).

Performance of nurses before transfusion

The nurses performed their tasks, including checking physicians' orders (i.e., requests), providing pre-transfusion care, using infusion or syringe pumps, and observing the injection speed (in accordance with physicians' prescriptions and based on the type of injected product), in all (100%) the procedures; however, the transfusion process of blood and its products were not explained in any of the 550 procedures for the parents. The nurses performed their tasks regarding the control of the expiry dates of products and their comparison to blood bag sheets, control of the donation number and full name of the neonate, compatibility of a neonate's blood group and Rh (Rhesus factor) with the product's form, and control of the hospital's name by two nurses in 93.2% of the procedures.

The nurses also performed their tasks regarding the control of families for a history of allergy in 65.5% of the procedures. Regarding the control of the contents of product bags in terms of color, turbidity, and presence of air bubbles, control of the bag numbers and availability of stamps put by two personnel on blood bag sheets, and attachment of the transfusion form for further documentation, the nurses performed their tasks in 99.8%, 93.5%, and 98.8% of the procedures, respectively. However, in all the procedures, they did not administer 0.9% sodium chloride (NaCl) to ensure that peripheral intravenous (PIVs) was open. In 98.6% of the procedures, they washed and dried their hands and wore gloves. As presented in Table 3, the score of nurses for corrected performance in this stage was 70.97% (8.72).

Performance of nurses during transfusion

The nurses performed their tasks associated with inserting the volume of blood and blood products in the monitoring form and safe controlling of carrying blood and blood products from the blood bank to the department using special blood transfer bags in 96.9% and 23.6% of the procedures, respectively. Among 166 procedures related to the transfusion of packed cells, only in 31.4% of the procedures, the nurses gently shook blood bags during injection to prevent the sedimentation of red blood cells (RBCs). In 99.1% of the cases, two nurses controlled the onset of transfusion reaction symptoms, such as fever and chills, hives, and hemodynamic disorders. Two nurses monitored the process of recording neonates' vital signs in the first 15, 30, and 60 min in 92.5%, 89.5%, and 89% of the procedures, respectively. In addition, two nurses monitored the process of recording vital signs at 2, 3, and 4 h after the completion of transfusion in 87.9%, 84.5%, and 71.7% of the procedures, respectively. Based on Table 1, the nurses had a poor performance related to the duration of storage and consumption of blood and blood products (i.e., cryoprecipitate, platelet, FFP, and whole blood). Table 3 tabulates that the nurses' score for corrected performance in this stage is reported as 31.59% (5.23).

Performance of nurses after transfusion

Regarding the task of recording all relevant items in neonates' medical records, the process of blood collection before transfusion was not recorded in 91.5% of the nursing reports; however, other items, including the volume of infused products, blood types, post-transfusion reactions and vital signs, and status of product labeling, were recorded in all nursing reports. On the other hand, the safe disposal of syringes and infusion sets to prevent the transmission of infectious agents was performed in none of the cases. The score of the nurses for corrected performance in this stage was 71.63% (8.53) as shown in Table 3.

Table 1. Frequency of proper nursing care performance during transfusion (i.e., duration of storage and consumption of blood and blood products)

Type of performance	Total procedure	Correctly performed procedure n (%) [*]
Beginning the injection of whole blood and PRBC product within 30 min of removing from blood bank	164	1 (0.2)
PRBC product should be kept in a refrigerator at 1-6°C until injection	164	1 (0.2)
FFP should be used within 4 h of thawing	365	365 (100)
If FFP is not used after thawing, it can be stored for up to 24 h in a refrigerator at 1-6°C	365	1 (0.2)
Cryoprecipitate can only be stored for 6 h at room temperature and each unit should be injected within less than half an hour	2	1 (50)
Platelet concentrates should be injected within 20 min of removing from blood bank	19	10 (52.6)

*Proportion of correctly performed procedures

PRBC: Packed red blood cells

FFP: Fresh frozen plasma

Table 2. Relationship of some demographic variables of nurses and their total performance score regarding blood transfusion

Variable		Total performance score (mean±standard deviation)	*P-value
Education level	Bachelor's degree	21.75±2.26	0.773
	Master's degree	21.41±2.24	
Employment status	Contractual employment	21.55±2.30	0.188
	Job contract	21.42±1.96	0.183
	Formal employment	21.83± 2.29	**
Work experience in neonatal ward	Less than 5 years	21.43±2.25	0.082
	More than 5 years	21.85±2.26	
Shift work	Fixed	21.66±2.34	0.927
	Rotating	21.85±2.10	
Transfusion training times	Once	21.96±2.18	0.732
	More than once	21.0±1.00	
Marital status	Married	21.75 ±2.30	0.505
	Single	21.60±2.10	

* Use of generalized estimating equation; P<0.05 considered significant

** Reference category

Table 3. Mean and standard deviation of raw and standardized scores of nurses' performance in three stages

Blood transfusion	Possible score range	Minimum	Maximum	Mean (standard deviation)	Normalized mean score (%)
Before transfusion	0-19	6.00	16.00	13.48 (1.65)	70.97 (8.72)
During transfusion	0-17	2.00	6.00	5.37 (0.88)	31.59 (5.23)
After transfusion	0-4	2.00	3.00	2.86 (0.34)	71.63 (8.53)
Total score	0-40	12.00	25.00	21.72 (2.26)	54.30 (5.66)

Table 2 shows relative and valid frequencies of some demographic variables and the GEE model show that their variables such as educational level, employment status, work experience in the neonatal ward, type of shift, transfusion training times, and marital status of nurses, did not have a significant correlation with their total performance score regarding the transfusion of blood and blood products ($P>0.05$). Table 3 also tabulates the mean and standard deviation of raw and standardized scores on the scale of 100% of nurses' performance in the three stages (i.e., before, during, and after the blood transfusion).

Discussion

Based on the results of the present study, the nurses had poor performance in many cases during the transfusion stage. Some of the desired criteria derived from the national hemovigilance guidelines were not met in this study. The results of the current study are consistent with the findings of a study conducted by Piri et al. (2009) regarding the poor performance of nurses (27). On the other hand, studies carried out by Emami (2014) and Aslani et al. (2010) reported the performance of nurses at a mediocre level (17, 28). In contrast, Pourfarzad et al. (2012) indicated that nurses had high performance in this regard. This difference can be attributed to different evaluation methods used in the two studies, and Purfarzad et al. used a self-reporting method which can yield inaccurate results due to the shortcomings of self-assessment tools (19).

Moreover, most of the above-mentioned studies have been conducted on adults and pediatric wards, and the performance of nurses is very sensitive in NICUs. According to the results, the PIVs were not flushed with normal saline in about half of the cases. However, most protocols emphasize the use of 1 mL of 0.9% NaCl to flush the PIVs before any injection (24). Moreover, the findings of a study conducted by Tajalli et al. (2016) indicated that in most cases the nurses controlled the compliance of

patients' identity with products and request sheets. This may be due to the strong emphasis of the safety and clinical governance committee of the respective hospital in their study (20).

Regarding the control of vital signs, the nurses had an acceptable performance in the first hour; however, the level of their performance decreased over the next hours. Therefore, the nurses should be reminded about the importance of post-transfusion monitoring. In a study carried out by Sapkota et al. (2018), vital signs were controlled in the first 15 min in a limited percentage of all cases (29). Among all the procedures related to the transfusion of packed cells, the gentle shaking of blood bags during infusion was performed only in one-third of the procedures to prevent the precipitation of RBCs. In another study, vigorous blood bag shaking was reported that is probably due to poor knowledge of nursing staff (20), and vigorous movement of blood bags will lyse RBCs (30). In most of the procedures, the NICU nurses washed and dried their hands and wore gloves. This is a good performance, compared to those reported in other studies (31, 32).

Despite the recent emphasis of the Iranian Ministry of Health and Medical Education on the implementation of clinical governance, establishment of clinical governance headquarters at medical universities, extensive monitoring for the implementation of quality improvement activities, and enhancement of patient safety and blood-care programs (i.e., hemovigilance), these issues have not been properly dealt with. In addition, no major increase or improvement has been observed in the performance of nurses in this regard (17). The nurses had poor performance concerning the control of standard time for using each product, indicating the reception of inaccurate information or poor training. The risk of bacterial growth is directly related to the storage duration of blood outside the refrigerator (33).

In the present study, the nurses did not explain the transfusion process to the parents in none of the cases. Sapkota et al. (2018) also observed that a limited number of patients and/or their relatives were informed about the causes of transfusion (29). Similarly, in a study carried out by Tajalli et al. (2016), the staff did not inform mothers about the causes and stages of transfusion (20). However, providing information to families and engaging them in healthcare activities are among the principles of family-based care. Regarding the demographic characteristics of the neonates, the results of the current study indicated that there was a direct correlation between the age of newborns and quality of nursing care. This finding is consistent with the results of a study by Tajalli et al. (2016). Nurses prioritize treatment and care behaviors based on the age of neonates and their maturity status (20).

The results of the present study did not show the significant effect of some demographic variables (i.e., educational level, employment status, work experience in the neonatal department, type of shift, times of transfusion training, and marital status) on the total performance scores of nurses regarding the transfusion of blood and blood products. Nevertheless, a study conducted by Dehghan Nayeri et al. (2016) showed that there was no significant relationship between marital status and work experience with the nurses' performance regarding the observance of the patient's level of safety during the transfusion process; however, the level of education was significant with respect to safety during transfusion (16).

The syringe and infusion set should be re-sealed and disposed of in a hospital waste bag to prevent the transmission of the infection, which was performed in no case out of 550 transfusion procedures in the present study. Making efforts to recognize complications associated with blood transfusion and removing their causes can reduce mortality rates, infections, and disability and enhance the quality of services provided to patients. It can also increase the level of patient satisfaction and overall performance of hospitals. Finally, it can improve public health; therefore, hemovigilance is a very important procedure (34). The use of non-random convenience sampling, evaluation of the performance of nurses in only one center, and presence of researchers to observe the procedures (probably affecting nursing practices) were among the limitations of the current study; as a result, the findings cannot be generalized to other centers. Therefore, it is suggested to carry out further studies using randomized sampling in several centers. On the other hand, in this study, the performance of the nurses was monitored for 550 transfusion procedures in three stages (i.e., before, during, and after transfusion); this large sample size is considered one of the advantages of this study.

Implications for Practice

The nurses had poor performance during the transfusion phase and were not careful enough; therefore, nursing managers should exercise more supervision, and nurses should be more attentive at this stage.

In addition, it is recommended to hold continuous training courses for nurses in this regard.

Acknowledgments

This paper was derived from the research project no. 4154 approved by the authorities of Babol University of Medical Sciences. The researchers would like to express their gratitude to all the nursing staff and neonatal subspecialists for their sincere cooperation with this project.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

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