

UNDERSTANDING BLOOD TRANSFUSION IN NURSES/MEDICAL TECHNICIANS

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ABSTRACT

Introduction: In blood transfusion, nurses play a key role in ensuring patient safety by performing identification, compatibility and vital parameter monitoring procedures as well as providing support and education to patients. Their contribution is crucial for achieving high standards of medical care and improving medical treatment outcomes.

Objective: To assess the level of knowledge amongst nurses with regards to safe and proper application of transfusion therapy.

Participants and Methods: This research was conducted as a cross-section descriptive-analytical study with the aim of assessing knowledge of routine blood transfusion among three groups of nurses and analyzing differences in their results. The sample consisted of three target groups of nurses studying at the Faculty of Health Studies (of the University Clinical Hospital Mostar, the Cantonal Hospital Dr. "Safet Mujić" Mostar and the County Hospital "Dr. fra Mihovil Sučić" Livno). A modified version of the RBTKQ questionnaire was used for the research. The questionnaire consists of 6 sections and 49 items. Descriptive and inferential statistical measures were used, including frequencies and percentages, normality distribution tests, as well as the Mann Whitney U test and Kruskal-Wallis test, with results evaluated at both levels of significance.

Results: The analysis of nurses' knowledge on blood transfusion indicates an average level of 77.4%, with notable variation among participants. These findings underscored the need for more intensive education particularly in recognizing symptoms and responding to serious complications. Additionally, statistically significant differences between male and female participants, as well as participants from different institutions and qualifications, highlight specific areas where overall improvement of nurses' knowledge in these domains require focus.
Conclusion: Lack of knowledge in recognizing the causes of fatal transfusion reactions, especially patient identification errors, compromises patient safety during transfusions, emphasizing the urgent need to improve education of nurses in this area.

Keywords: blood transfusion, nurses, knowledge, patient safety, education

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INTRODUCTION

The role of nurses and technicians in blood transfusion is key to ensuring patient safety. Their responsibilities include patient identification, blood compatibility verification, establishing intravenous access and monitoring vital parameters during transfusion. Expertise in proper procedures, including handling and managing blood components, minimizes the risk of adverse reactions (1,2). Nurses are primarily responsible for administering blood transfusions, and the safety and efficiency of the transfusion process depend significantly on their skills and knowledge (3,1).

In addition, nurses play a vital role in educating patients about the procedure, potential complications and alternative therapies hence offering information that empowers patients to make informed decisions and provides a sense of security during the transfusion (4,5). By providing support to patients, informing them about possible side effects and addressing their concerns, nurses establish essential communication during this process (6).

The Council of Europe recommends that "all nurses should undergo training in blood transfusion," while the development of quality assurance programs in healthcare services is a focal point for both the Council of Europe and the World Health Organization (WHO) (7,8).

As integral members of the multidisciplinary team, nurses collaborate with physicians, pharmacists and other healthcare professionals to ensure safe

transfusion therapy. Their continuous education, adherence to guidelines, and engagement with transfusion medicine research contribute to improving the quality of patient care (9). Nurses also play a crucial role in education about the use of blood and blood components, providing information on patient identification and other critical factors that ensure the safe administration of blood products (10). Research conducted in Abu Dhabi highlights the need for further training and education in transfusion medicine (11).

The aim of this study is to assess the knowledge of nurses and technicians regarding the administration of blood and blood components and emphasize the importance of adhering to Standard Operating Protocols (SOPs) to protect patients from potentially fatal errors.

PARTICIPANTS AND METHODS

Participants

The study sample comprised several targeted groups of participants: employed nurses at the University Clinical Hospital Mostar (80.3%), the Cantonal Hospital "Dr. Safet Mujić" Mostar (14.9%), and the County Hospital "Dr. fra Mihovil Sučić" Livno (4.8%). The participants were nurses and technicians studying at the Faculty of Health Studies, University of Mostar and working in these institutions. The research was conducted in the period from February 2023 to December 2023.

Methods

A modified version of the RBTKQ questionnaire on routine blood transfusion knowledge, consisting of six sections (49 items), was used (3). Eight items (Section A) pertained to sociodemographic information and educational background of nurses/technicians. Sections B through E contained 39 items assessing knowledge on blood collection from the blood bank, patient preparation, nurses' responsibilities before and after transfusion, and complications associated with blood transfusion. The final section, F, included two items evaluating knowledge of blood transfusion policies and procedures within institutions. The maximum possible score on the RBTKQ in this study was 62 points. The total score was converted into a percentage and categorized as follows: <50% (low knowledge), 50–74% (moderate knowledge), or $\geq 75\%$ (high knowledge).

Researchers distributed paper-based questionnaires accompanied by an informational letter and a consent form. Nurses and technicians willing to participate were required to sign the informed consent form.

Statistical Data Analysis

Descriptive and inferential statistical measures were used, and data analysis was performed using IBM SPSS Statistics (version 24). Frequencies and percentages were employed to describe sociodemographic characteristics and knowledge items, while measures of central tendency and dispersion were used for knowledge scores. For most items, a score of 1 was assigned for a correct answer and 0 for each incorrect answer.

Based on the assessment of normality in score distribution, non-parametric statistical methods were applied. Differences in blood transfusion knowledge between male and female participants were evaluated using the Mann-Whitney U test, while differences based on workplace, qualifications, and age were assessed using the Kruskal-Wallis test. The results of these tests were evaluated at significance levels of $p = 0.01$ and $p = 0.05$.

RESULTS

Sociodemographic Characteristics of Participants

The study included a sample of 208 participants. Most of the participants (68.3%) had completed undergraduate studies, with 5–12 years of work experience (51.4%), an average age between 26–35 years (31.7%), and were predominantly female (87.5%). Majority of participants were employed at the University Clinical Hospital Mostar (80.3%).

Most participants (85.1%) had never attended a professional development program related to blood and blood component therapy, while 28.8% had not administered blood or blood products in the past six months. Additionally, 18.8% expressed a desire for further education on adverse reactions and serious risks associated with transfusion therapy. Adequate guidelines for blood administration were confirmed to exist in their departments by 63.9% of participants, and 63.5% reported having read these guidelines.

Overall Knowledge of Blood Transfusion

The knowledge results, presented in Table 1, show an average knowledge level of 77.4% across the sample. Based on mean

values, participants from the County Hospital "Dr. fra Mihovil Sučić" demonstrated a knowledge level of $M = 42.90$. None of the nurses answered all the questionnaire items correctly.

Table 1. Descriptive Values of Overall Knowledge Scores on Blood Transfusion Among Participants from Different Healthcare Institutions

	N	Min	Max	M	SD
	208	29	43	38,19	3,610
University Clinical Hospital Mostar	167	29	47	37,97	3,399
Regional Medical Center "Dr. Safet Mujić" Mostar	31	31	45	37,53	3,543
County Hospital "Dr. fra Mihovil Sučić" Livno	10	36	48	42,90	3,446

Knowledge on Blood Dose Collection from the Blood Bank and Pre-Transfusion Patient Preparation

Education regarding the collection of blood doses from the Blood Transfusion Center, the mandatory pre-transfusion preparation of patients, and proper identification is crucial to ensure safe blood administration, reduce the risk of complications, and maintain the balance between the supply and demand of blood and blood components.

A total of 93.3% of respondents correctly identified that blood should be transported in thermally stable containers, while 63.0% recognized the importance of verifying identification details on the blood bag and request form to ensure patient safety. However, only 12.5% knew that after the blood is delivered to the department, the availability and patency of the intravenous line must be checked and just 1.4% answered the question regarding

the procedure in case of Rh factor mismatch.

Knowledge of Nurse Responsibilities Before Initiating Transfusion

The study on nurses' knowledge of responsibilities prior to administering blood and blood components highlighted the importance of adhering strictly to protocols as this is the only way to prevent errors that could prove fatal. A total of 96.2% of respondents knew that patient information must always be verified before starting a blood transfusion. About 62.5% selected the correct filter size for blood transfusion (170–200 μm). Over half (57.7%) recognized three critical actions before starting a transfusion: patient identification, documenting vital signs and reviewing the doctor's order with the supervising nurse. Approximately 49.5% of respondents knew the maximum time blood can remain outside the refrigerator before transfusion (30 minutes). However,

only 29.3% correctly identified three key pieces of information to convey to the patient before transfusion (reasons, risks, and symptoms of a reaction). A total of 73.1% were aware of the need to wear non-sterile gloves to protect against bloodborne diseases during transfusion administration.

Knowledge of Nurse Responsibilities After Initiating Transfusion

Nurses' knowledge of blood and blood component administration is critical for the prompt recognition and proper management of complications or adverse reactions in patients. A total of 88.0% of respondents recognized that normal saline (0.9%) can safely be used with red blood cell concentrates, while 78.8% knew the correct procedure for administering medication via the transfusion line in cases of pulmonary edema without another access line (stop the transfusion, flush the line with saline, administer the medication, and resume the transfusion). More than half (60.1%) correctly answered that patients need to be closely monitored for the first 15 minutes for possible transfusion reactions. Additionally, 44.7% knew the correct time intervals for recording vital parameters during transfusion.

A total of 42.8% correctly calculated the infusion rate (50 drops per minute). However, only 9.6% knew how to initiate a transfusion at the correct rate of 2.5 ml/min for a 300 ml transfusion over two hours, and just 2.4% identified all categories of patients requiring slow transfusion (cardiac conditions, elderly patients, and severe anemia). The analysis of nurses' knowledge regarding

responsibilities during transfusion revealed that 39.9% recognized the need for specific nursing activities throughout the transfusion process.

Knowledge of Complications Related to Blood Transfusion

The knowledge of nurses/medical technicians regarding complications associated with blood transfusion highlights varying levels of awareness. The highest percentage of participants (73.6%) correctly identified patient misidentification as the most common cause of fatal transfusion reactions with an equal percentage aware that wearing non-sterile gloves is essential for protection against bloodborne diseases. More than half of the respondents (67.3%) recognized urticarial rash as the most common symptom of a mild allergic reaction, while 49.5% correctly concluded that transfusion should be stopped if a blood product remains at room temperature for more than 4 hours. However, only 39.9% knew that any remaining blood must be discarded and the physician notified if the transfusion is not completed within the prescribed timeframe. A total of 24.5% identified all bloodborne diseases, while only 5.3% accurately recognized the symptoms of an acute hemolytic transfusion reaction. When asked about emergency interventions for acute reactions, only 2.4% of respondents provided a complete and correct answer.

Relationships Between Sociodemographic Characteristics and Knowledge of Blood Transfusion

To determine statistically significant differences in knowledge about the administration of blood and blood components, the Mann-Whitney U test and Kruskal-Wallis test were used.

Table 2. *Statistical Analysis of Blood Transfusion Knowledge Based on Participants' Sociodemographic Characteristics*

Characteristic	Statistical Test	Statistic	Degrees of Freedom	p-value
Gender	Mann Whitney U test	U = 1886.000	208	0.009
Institution	Kruskal-Wallis	$\chi^2 = 14.935$	2	0.001
Qualifications	Kruskal-Wallis	$\chi^2 = 13.986$	3	0.002
Age	Kruskal-Wallis	$\chi^2 = 0.495$	4	0.974

The results of the Mann-Whitney U test showed a statistically significant difference in knowledge of blood transfusion between male and female participants (U = 1886.000, p = 0.009). Male participants had lower ranks, indicating lower knowledge scores compared to female participants.

The results of the Kruskal-Wallis test showed a statistically significant difference in knowledge of blood transfusion among participants from different healthcare institutions ($\chi^2 = 14.935$, df = 2, p = 0.001). Participants working at the County Hospital "Dr. fra Mihovil Sučić" Livno achieved the best results in blood transfusion knowledge compared to participants from other institutions. There was also a statistically significant difference in knowledge of blood transfusion among nurses with different qualifications ($\chi^2 = 13.986$, df = 3, p = 0.002). Nurses with an undergraduate degree achieved the best results in blood transfusion knowledge. However, the analysis of variance

(Kruskal-Wallis test) showed no statistically significant difference in blood transfusion knowledge among nurses of different ages ($\chi^2 = 0.495$, df = 4, p = 0.974).

Knowledge Deficits

To highlight the knowledge deficits in certain areas related to blood transfusion, the following questions received the least accurate responses from the nurses. For example, only 1.4% of participants correctly answered the question regarding what to do if there is a discrepancy in the RhD blood factor between the patient and the donor, with the correct procedure being to check details with the doctor and transfusion center and proceed with the administration of erythrocyte concentrate.

9.6% were unable to correctly calculate the transfusion rate of red blood cells for an adult patient according to the guidelines. 2.4% answered correctly the question about when slow blood transfusion is necessary for patients with

certain diseases, while only 3.8% of participants knew which interventions could minimize the risk of acute transfusion reactions. Although the symptoms of acute hemolytic transfusion reactions were recognized by 5.3% of participants, only 2.4% correctly answered what immediate actions should be taken when these symptoms appear. Additionally, only 2.9% of participants knew what action to take first in the case of a mild transfusion reaction.

DISCUSSION

This research highlights the knowledge deficit regarding the use of blood and blood products. Based on the analysis of the results, it is clear that education, continuous learning and staying updated with new findings play a crucial role. The results suggest that nurses are adequately informed about standard operational procedures; however, significant gaps remain in recognizing transfusion reactions and properly identifying patients. These findings align with the research of other authors, such as those conducted by Auerswald and colleagues (12), which also demonstrate similar deficiencies in knowledge regarding blood and blood product management, especially in recognizing transfusion side effects and complications.

Nurses and medical technicians from different institutions showed variations in their knowledge, indicating the need for specific educational approaches tailored to the context of each healthcare facility (12). These findings align with the research of Johnson and colleagues (13), who also pointed out variations in knowledge among nurses with different qualifications and work

experience, emphasizing the need for customized educational approaches.

The research revealed that nurses, in general, have a good understanding of the Standard Operational Protocols for handling blood and blood products. Sixty-three percent of participants correctly answered questions about patient identification. Although responses to questions related to patient preparation and blood transport from the bank were highly rated (93.3%), nurses struggled with questions about specific clinical interventions, such as calculating transfusion rates or handling RhD incompatibility (1.4%). Only a small percentage of nurses (5.3%) knew how to recognize symptoms of acute hemolytic reactions, and only 2.4% knew the correct emergency actions to take in such situations. These findings are consistent with those from the studies by Auerswald and colleagues (12) and Smith and colleagues (14), who also found significant knowledge deficits in recognizing transfusion reactions and the proper administration of blood and blood products.

Significant areas where improvement is needed include knowledge of nurses' responsibilities before, during, and after transfusion. For example, the results indicate that nurses are not fully acquainted with all the procedures they must perform before the start of a transfusion, such as documenting vital signs and verifying the doctor's orders. Although most nurses have basic knowledge of these responsibilities, the results suggest that there is a need to further strengthen awareness of the details of these procedures in order to increase patient safety. Additionally, despite a good

understanding of procedures after the transfusion has started, the results show room for improvement regarding the volume of blood transfused, particularly in pediatric cases (8.2%), and transfusion speed (9.6%). These findings align with research by Johnson and colleagues (15), who also identified similar knowledge gaps regarding nurses' responsibilities during transfusion.

A deficit in knowledge about complications related to blood and blood product treatment also represents a concerning indicator. These deficiencies are confirmed by previous research, which also pointed to a significant lack of education among nurses in recognizing and responding to transfusion reactions (16). Only 3.8% of participants in this study could correctly list all preventive measures to reduce the risk of transfusion complications and only 24.5% identified blood-borne diseases (BBVs). Recognizing symptoms of acute hemolytic transfusion reactions was accurate for only 5.3% of respondents, while 2.4% knew the correct emergency measures to take in case of an acute reaction. These data point to a serious knowledge gap that could compromise patient safety, requiring the implementation of targeted educational programs and simulation training, as highlighted in Smith and colleagues' study (17). Similar findings were confirmed in a study by Miller and colleagues (18), who also warned of a severe lack of education in recognizing blood transfusion complications.

In addition to specific technical areas, the research also highlights the need for a broader approach to education, including training on infection prevention and allergic reactions, which are crucial

for the successful course of blood transfusion. A lack of awareness in these areas can increase the risk of adverse reactions and serious complications. As emphasized in studies by other authors (19), the lack of specific knowledge regarding transfusion reactions can significantly impact patient safety, underscoring the importance of further investment in educational programs focusing on these critical aspects. The need for sustainable improvements in patient safety and quality of care has never been greater (20), while the workload of healthcare professionals is increasing (21, 22). The quality of healthcare depends on both the education and training of nurses and the implementation of evidence-based practice (23, 24).

One of the main limitations of this study is the restricted sample size, as it was conducted in only a few healthcare institutions, which may reduce the generalizations of the results to a broader population of nurses. Additionally, the use of a self-assessment questionnaire on knowledge could lead to biased responses, as participants may consciously or unconsciously exaggerate their abilities. The study also relied on the current assessment of knowledge without evaluating the long-term application of these skills in real transfusion situations. This approach does not provide insight into nurses' ability to respond in emergency situations or their practice in real-world conditions.

Future research should include a larger number of healthcare institutions, incorporating various types (hospitals, clinics, primary healthcare) to make the results more representative of the broader population. The use of combined methods,

including real-world testing and simulations, is also recommended to provide a more objective insight into nurses' knowledge and abilities. Continuous evaluation of knowledge, along with the development of specific educational programs tailored to sociodemographic characteristics, could improve educational approaches and reduce the risk of transfusion complications, thereby significantly enhancing patient safety.

This study contributes to a greater understanding of the knowledge gaps among nurses regarding blood and blood product administration, highlighting specific guidelines for future educational programs. Improving education, with a particular focus on the technical aspects of the procedure, is crucial for enhancing patient safety during transfusion procedures. Given the identified differences in knowledge, tailored educational approaches, both socio-demographically and according to qualification level, could significantly improve the quality of healthcare in transfusion medicine.

Practical significance of the research

This research highlights the lack of a basic understanding of key aspects of blood and blood product administration among nurses/medical technicians. While the questionnaire used was helpful, it could be improved for continuous assessment of knowledge. Regular evaluations can identify gaps that require education and further training, emphasizing the need for improvement in nurses' knowledge in this area.

CONCLUSION

Based on the findings of the research, we can conclude that there is a need for further education for nurses with regards to key procedures in blood and blood product administration. Special attention should be given to recognizing and responding to complications, accurate patient identification, proper management of blood products and comprehensive patient preparation before transfusion.

The use of simulation methods and targeted educational programs, which take into account specific sociodemographic characteristics, will be crucial for improving nurses' knowledge and practice.

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POZNAVANJE TRANSFUZIJE KRVI KOD MEDICINSKIH SESTARA/TEHNIČARA

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SAŽETAK

Uvod: Medicinske sestre imaju ključnu ulogu u transfuziji krvi osiguravajući sigurnost pacijenta, provodeći postupke identifikacije, kompatibilnosti i praćenja vitalnih parametara te pružajući podršku i edukaciju pacijentima. Njihov doprinos ključan je za ostvarenje visokih standarda skrbi i unapređenje rezultata liječenja.

Cilj: Procijeniti nivo znanja medicinskih sestara o sigurnoj i pravilnoj primjeni transfuzijske terapije.

Ispitanici i metode: Ovo istraživanje provedeno je kao presječno deskriptivno-analitičko istraživanje s ciljem procjene znanja o rutinskoj transfuziji krvi među trima skupinama medicinskih sestara te analize razlika u njihovim rezultatima. Uzorak su činile 3 ciljne skupine medicinskih sestara koje studiraju na Fakultetu zdravstvenih studija (iz Sveučilišne kliničke bolnice Mostar, iz Kantonalne bolnice „Dr. Safet Mujić“ Mostar te iz Županijske bolnice „Dr. fra Mihovil Sučić“ Livno). Za istraživanje je primijenjena modificirana verzija RBTKQ upitnika, koji se sastoji od 6 dijelova i 49 stavki. Korištene su mjere deskriptivne i inferencijalne statistike, frekvencije i postoci, test normalnosti raspodjele, te Mann Whitney U test i Kruskal-Voliz test, čiji rezultati su procjenjivani na obje razine značajnosti.

Rezultati: Analiza znanja medicinskih sestara o transfuziji krvi ukazuje na prosječnu razinu od 77,4%, s istaknutom varijacijom u različitim segmentima među sudionicima. Ovi nalazi naglašavaju potrebu za intenzivnijom edukacijom, posebno u prepoznavanju simptoma i postupanju kod ozbiljnih komplikacija. Također, statistički značajne razlike između muških i ženskih sudionika, kao i između sudionika iz različitih ustanova i kvalifikacija, ukazuju na specifična područja koja zahtijevaju fokus na generalno unapređenje znanja medicinskih sestara o navedenim područjima.

Zaključak: Nedostatak znanja u prepoznavanju uzroka fatalnih transfuzijskih reakcija, posebno grešaka u identifikaciji pacijenta, ugrožava sigurnost pacijenata tokom transfuzije, što naglašava hitnu potrebu za unaprjeđenjem edukacije medicinskih sestara u ovom području.

Ključne riječi: transfuzija krvi, medicinske sestre, znanje, sigurnost pacijenta, edukacija
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