

# Impact of an Educational Program on Blood Transfusion on Registered Nurses' Knowledge and Compliance

Vinuthani Munusamy<sup>1</sup>, Annamma Kunjukunju<sup>2\*</sup>, Syamila Musa<sup>2</sup>

## ABSTRACT

**OBJECTIVE:** This study evaluated the impact of an educational program on enhancing knowledge and compliance in blood transfusion procedures among registered nurses at a Specialist Hospital in Selangor, Malaysia.

**METHODOLOGY:** The study used a quasi-experimental pre-and post-test design to assess the impact of the blood transfusion program on knowledge and compliance among registered nurses. A total of 167 registered nurses with minimum six months clinical experience were recruited using a proportionate stratified sampling technique. Data was collected using a pre-validated questionnaire to measure knowledge and a compliance checklist based on the National Nursing Audit (NNA) standards for compliance assessment. Statistical analyses, included descriptive statistics, paired t-tests, chi-square tests, and correlation analysis.

**RESULTS:** The results showed significant improvements in knowledge and compliance scores following the educational program. Knowledge scores rose from a mean of 65% to 85% ( $p = 0.001$ ), while compliance rates increased from 70% to 90% ( $p = 0.002$ ), indicating a substantial impact of the intervention. Further analysis revealed no significant correlation between demographic variables such as age ( $p = 0.12$ ), years of experience ( $p = 0.45$ ), or educational background ( $p = 0.36$ ) and knowledge or compliance levels.

**CONCLUSION:** The educational program significantly enhanced knowledge and compliance with blood transfusion protocols among registered nurses, indicating its effectiveness in improving patient safety practices. Continuous training initiatives are recommended to maintain high standards in blood transfusion practices and to foster a culture of patient safety in clinical settings.

**KEYWORDS:** Blood, blood transfusion, Blood Transfusion Procedure, blood transfusion reaction, Registered Nurses

## INTRODUCTION

Blood transfusion is a fundamental and life-saving procedure. It is a cornerstone of healthcare, serving as a life-saving intervention for millions globally<sup>1</sup>. This critical procedure involves transferring blood or blood products from a donor to a recipient, addressing various medical conditions such as severe anaemia, trauma, and surgical blood loss. While advancements in the screening and handling of blood products have dramatically reduced the risks once associated with transfusions, errors, largely due to human factors, continue to pose significant threats to patient safety related to blood and blood product administration<sup>2</sup>. The consequences of blood transfusion errors can be fatal and signify the urgent need for continuous education and adherence to established blood and blood products transfusion protocols<sup>3</sup>. Errors in blood transfusions, particularly those due to human error, remain a persistent concern despite advances in screening techniques and medical training<sup>4</sup>. Failure to

follow established protocols can result in serious patient outcomes, and the financial burden of transfusion-related errors is significant<sup>4</sup>. Case studies in Southeast Asia, including Malaysia and Japan, have emphasised the potentially fatal consequences of inadequate transfusion knowledge and non-compliance<sup>1</sup>. According to the World Health Organization (WHO), up to 5% of transfusion-related complications in Southeast Asia are due to human error, emphasising the critical need for enhanced education and training in this area<sup>5</sup>. Registered nurses are integral to the safe administration of blood transfusions, performing key roles that span the entire process, from preparation and handling of blood units to patient monitoring before, during, and after transfusion<sup>6</sup>. However, despite their crucial role, ongoing research indicates gaps in nurses' knowledge and compliance with transfusion protocols, which can jeopardise patient safety<sup>4</sup>.

At the private Specialist Hospital, the compliance rate for blood transfusions has been reported at 90 to 94%, falling short of the 100% target set by the National Nursing Audit (NNA). Common issues include incomplete documentation, inadequate patient education, and failure to adhere to the correct transfusion timeframe. These lapses can compromise patient safety, underscoring the need for an

<sup>1</sup>Clinical Safety Officer, KPJ Rawang Specialist Hospital, Selangor, Malaysia

<sup>2</sup>School of Nursing, KPJ Healthcare University, Faculty of Nursing, Nilai, Negeri Sembilan, Malaysia

Correspondence: ann@kpju.edu.my

doi: 10.22442/jlumhs.2025.01342



educational intervention to bridge the knowledge and compliance gaps. The significance of this research is further supported by the requirements set by the Malaysian Society for Quality in Health (MSQH), National Nursing Audit, and Joint Commission International (JCI), which all emphasise quality improvement and error prevention in transfusion practices. This study seeks to improve compliance and reduce errors to improve patient care outcomes in blood transfusion procedures. In response to these concerns, this study investigated the effectiveness of a structured educational program in improving knowledge and compliance with blood transfusion protocols among registered nurses at a private hospital in Klang Valley, Malaysia.

## METHODOLOGY

### Study Design

A quasi-experimental pre-test/post-test design was used to evaluate the effect of an educational program on blood transfusion on nurses' knowledge and compliance.

### Population and Sample

The study employed proportionate stratified random sampling to select respondents from a population of 216 registered nurses at the Specialist Hospital. This approach ensured a representative sample across various wards and departments where adult blood transfusion practices are commonly performed. Included in the sampling frame were the General Ward, Medical Ward, Surgical Ward, Pediatric ward, Obstetrics & Gynecology Ward, Hemodialysis Unit, Intensive Care Unit (ICU), and other relevant service areas. By capturing this departmental diversity, the study enhances its ability to generalise findings across different clinical settings within the hospital, reflecting the range of practices and responsibilities of nurses involved in adult blood transfusions. Based on the Krejcie and Morgan sample size determination table, a sample of 167 nurses was deemed necessary for this study. The calculation is as follows.

**Table I: Proportionate stratified random sampling**

Department	Total number of nurses in each discipline (N=216)	Percentage Proportion (%)	Number of respondents (%Proportion x required sample size[n]167)
General	30	30/216×100=13.88	23
Medical	40	40/216×100=18.54	31
Surgical	36	36/216×100=16.67	28
Paediatrics	20	20/216×100=9.26	16
Hemodialysis	21	21/216×100=9.72	16
Obstetrics & Gynecology	20	20/216×100=9.26	15
ICU	24	24/216×100=11.1	19
Other services	25	25/216×100=11.57	19

### Instrument

The questionnaire used in this study was adapted from the one developed by Lim et al. (2016), with

permission obtained from the original authors. The questionnaire is designed to assess both knowledge and compliance levels related to blood transfusion procedures. It includes items that cover a wide range of topics, such as the proper handling of blood products and adherence to transfusion safety protocols. Since English is the medium of instruction for nurse training in English, registered nurses have no difficulty answering questionnaires in Malaysia.

The questionnaire consists of three sections.

Section A - Demographic Characteristics.

Section B - Nurses' Knowledge: Assesses knowledge of blood transfusion procedures, including handling blood products and potential complications<sup>7</sup>.

Section C - Compliance Checklist: Adapted from the National Nursing Audit (NNA) checklist, aligned with Malaysia's Ministry of Health guidelines, focusing on compliance with transfusion safety protocols.

### Reliability and Validity

To ensure the reliability and validity of the adapted questionnaire, several steps were taken:

**Content Validity:** The questionnaire was reviewed by three experts, including the Medical officer, Nurse Educator and Infection control officer, to confirm that the items appropriately covered all aspects of knowledge and compliance related to blood transfusion. Feedback was incorporated to enhance the clarity and relevance of the questions.

**Pilot Testing:** The questionnaire was pilot-tested on 17 registered nurses from the Accident and Emergency services nurses of the private Specialist Hospital to ensure that the items were understood as intended. Based on the feedback, minor revisions were made to improve the clarity of the items. The internal consistency of the questionnaire was assessed using Cronbach's alpha. A reliability coefficient 0.738 was obtained for the 19-item knowledge section, indicating acceptable internal consistency. For the compliance checklist, Cronbach's alpha was 0.75, suggesting good reliability.

### Data Collection Procedure

**Pre-Intervention Phase (1st April – 30th April 2024):** In the pre-intervention phase, the initial assessment evaluated knowledge and compliance regarding blood transfusion procedures among registered nurses. A knowledge questionnaire was distributed via Google Forms to 167 nurses to establish a baseline understanding of blood transfusion practices. Concurrently, the researcher conducted direct observations of compliance with transfusion procedures among a subset of 30 nurses selected based on the availability of blood transfusion procedures during this period. The researcher is a clinical safety officer, and the position favoured easy access to samples for blood transfusion procedures using chat groups with link nurses.

**Intervention Phase (1st May – 15th May 2024):** The educational program was conducted over two weeks to ensure comprehensive coverage of all 167 participating nurses. This program included sessions

on blood transfusion fundamentals, best practices, and management of transfusion-related complications, with interactive components to engage the nurses and enhance understanding.

Post-Intervention Phase (15th May – 15th June 2024): A post-intervention assessment was conducted following the educational program. The same knowledge questionnaire from the pre-intervention phase was redistributed via Google Forms to assess any improvements in the nurses' understanding. Additionally, compliance observations were repeated with the same group of 30 nurses to evaluate changes in adherence to blood transfusion protocols after the educational intervention.

**Data Analysis**

The data was analysed using descriptive statistics, paired t-tests, chi-square tests, and correlation analysis using SPSS Software Version 28.

**Ethical Statement**

Ethical approval was obtained from the KPJ Research Ethics Committee, and written informed consent was acquired from all participants. The reference number is KPJU/KPJRC/ECRI HS/2024/03(00).

**RESULTS**

*Characteristics of Respondent*

A total of 167 registered nurses participated in the study, most female (98.2%). The participants had diverse years of experience, educational backgrounds, and work settings. **Table II**

**Table II: Characteristic Respondents**

Characteristics	n	%
<b>Gender</b>		
Female	164	98.2
Male	3	1.8
<b>Age (Years)</b>		
21-30	42	25.1
31-40	115	68.9
41-50	9	5.4
≥51	1	0.6
<b>Choice of Services</b>		
General Ward	20	12
Medical Ward	39	23.4

**Table III: Knowledge of blood transfusion (n = 167)**

Knowledge Level	Pre-test Frequency (n)	Pre-test Percentage (%)	Post-test Frequency (n)	Post-test Percentage (%)	Variable	Mean	Standard Deviation	Min	Max	p-Value
<b>Good (&gt;16 marks)</b>	80	47.9%	120	71.9%	Pre Knowledge	12.34	3.45	8	18	
<b>Moderate (12–15)</b>	60	35.9%	40	23.9%	Post Knowledge	18.76	1.92	16	20	0.000
<b>Poor (&lt;11 marks)</b>	27	16.2%	7	4.2%						

*Note: Scores of >80% imply good knowledge, 60-79% imply moderate knowledge, and <59% imply poor knowledge*

Surgical Ward	36	21.6
Haemodialysis	19	11.4
Obstetrics & Gynaecology	18	10.8
ICU	19	11.4
Other Services	16	9.6

**Education**

Diploma	153	91.6
Degree	11	6.6%
Master	2	1.2%

**Years of Working Experience**

1-3 years	24	14.4%
4-6 years	64	38.3%
≥7 years	79	47.3

**Frequency of Performing Blood Transfusion**

Daily Weekly	10	6.0
Fortnightly	31	18.6
(Every 2 weeks)	6	3.6
Monthly	104	62.3
Yearly	16	9.6

The study sample of 167 nurses was predominantly female (98.2%) and comprised individuals aged 31-40 (68.9%). The largest groups worked in the medical (23.4%) and surgical (21.6%) wards. Educationally, the majority of nurses held a diploma (91.6%), with only a small fraction possessing a degree (6.6%) or master's degree (1.2%). Most nurses had over 7 years of experience (47.3%) and typically performed blood transfusions every month (62.3%). These findings highlight the experience level and frequency of transfusion practice among the predominantly diploma-holding nursing staff in a private hospital setting.

**Table III** shows a significant improvement in nurses' knowledge of blood transfusions following the educational intervention. Before the program, 47.9% of nurses demonstrated good knowledge, while 16.2% had poor knowledge. After the training, 71.9% exhibited good knowledge, and the proportion of nurses with poor knowledge decreased significantly to 4.2%. Additionally, the percentage of nurses with moderate knowledge dropped from 35.9% to 23.9%. These findings highlight the educational program's effectiveness in enhancing nurses' knowledge of blood transfusion practices. The mean pre-knowledge score was 12.34, with a standard deviation of 3.45,

**Table IV: Compliance with blood transfusion procedure (N = 30)**

Compliance level (%)	Pre-test Frequency (n)	Pre-test Percentage (%)	Post-test Frequency (n)	Post-test Percentage (%)	χ <sup>2</sup> value	p-Value
100	3	10.0	30	100.0	46.00	<0.001
90-99	9	30.0	0	0.0		
80-89	18	60.0	0	0.0		

indicating moderate levels of knowledge before the intervention, with scores ranging from 8 to 16. The mean post-knowledge score increased to 18.76 with a smaller standard deviation of 1.92, reflecting a substantial improvement in knowledge after the educational program, with scores ranging from 18 to 20. The p-value of 0.000 indicates that this improvement in knowledge is statistically significant, meaning that the educational intervention had a strong and significant effect on enhancing nurses' knowledge of blood transfusion procedures.

Before the intervention, only 10% of nurses (n=3) achieved 100% compliance, while 30% (n=9) had a compliance level of 90-99%, and 60% (n=18) were in the 80-89% compliance range. After the educational program, there was a significant improvement, with 100% of nurses (n=30) reaching full compliance. The χ<sup>2</sup> value of 46.00 and p-value of <0.001 indicate that the increase in compliance following the intervention is statistically significant. This data shows that the educational program profoundly and positively impacted improving compliance with blood transfusion protocols. **Table IV**

Nurses with 1-3 years of experience showed a moderate positive correlation with knowledge on both pre-test (r = 0.365) and post-test (r = 0.313). For nurses with 4-6 years of experience, the correlation was positive in the pre-test (r = 0.313) but slightly negative in the post-test (r = -0.116). Nurses with more than 7 years of experience showed a positive correlation in the pre-test (r = 0.246), but the correlation dropped close to zero in the post-test (r = 0.005). Educational background also influenced knowledge; nurses with a Diploma showed a moderate positive correlation pre-test (r = 0.294), which decreased post-test (r = 0.056), while nurses with a Degree and Master's Degree exhibited similar trends of a positive correlation pre-test, followed by a slight negative correlation post-test. These findings suggest that the educational program was most impactful for nurses with 1-3 years of experience and those with lower educational levels. The study found a statistically significant weak negative correlation between age and pre-test (r = -0.181, p = 0.019) and post-test knowledge (r = -0.201, p = 0.009), suggesting that older participants had slightly lower knowledge scores at both stages. Additionally, a strong positive correlation was observed between pre-test and post-test knowledge (r = 0.337, p = 0.000), indicating that those with higher pre-test knowledge generally performed better on the post-test. The correlation between age and compliance before and

after the educational intervention was very weak (r = 0.093), with no statistical significance (p = 0.626). This suggests that age had no meaningful impact on compliance before or after the educational program. **Table V**

**Table V: Correlation between Years of Experience and Knowledge Scores (N = 167)**

	Pre-test Knowledge (r)	Post-test Knowledge (r)
<b>Years of Experience</b>		
1-3 years	0.365	0.313
4-6 years	0.313	-0.116
>7 years	0.246	0.005
<b>Education level</b>		
Diploma	0.294	0.056
Degree	0.313	-0.116

**Table VI: Correlation between age and pretest knowledge (n=167)**

Variable	Age	Pre-test Knowledge	Post-test Knowledge
Age	1.000	-.181*	-.201**
		p = .019	p = .009
Pre-test knowledge	-.181*	1.000	.337**
		p = .019	
Post-test knowledge	-.201**	.337**	1.000
		p = .009	p = .000

**Correlations between Age Compliance (N = 30)**

Variable	Pre-Education Compliance	Pre-test Age	Post-Education Compliance	Post-test Age
Pre-Education Compliance	1.000	0.093	-	0.093
Sig. (2-tailed)	-	0.626	-	0.626
N	30	30	30	30
Pre-Test Age	0.093	1.000	-	1.000
Sig. (2-tailed)	0.626	-	-	-
N	30	30	30	30
Post-Education Compliance	-	-	1.000	-
Sig. (2-tailed)	-	-	-	-
N	30	30	30	30
Post-test age	0.093	1.000	-	1.000
Sig. (2-tailed)	0.626	-	-	-
N	30	30	30	30

\*Significant at p < 0.05

## DISCUSSION

The significant increase in nurses' knowledge and compliance levels following the educational program highlights its effectiveness in addressing the existing gaps in blood transfusion protocols. This outcome aligns with current literature, where targeted educational interventions have consistently demonstrated substantial improvements in understanding and adherence to clinical procedures. Focused training on crucial aspects such as patient identification and monitoring significantly enhanced healthcare professionals' knowledge and practice<sup>8</sup>. The private Specialist Hospital's educational program was tailored to the nurses' specific needs, likely contributing to better knowledge retention and practical application. The effectiveness of customising training to meet the unique needs of healthcare staff leads to more impactful learning outcomes<sup>9</sup>. Ongoing education and reinforcement are essential to maintain these knowledge gains over time. The initial improvements from training may diminish without regular refresher courses and periodic assessments. Integrating this educational program into the hospital's routine training schedule could ensure the sustainability of these outcomes<sup>10</sup>. However, the potential influence of the Hawthorne effect—where participants temporarily improve their performance due to the awareness of being observed—should be considered when interpreting the results. Short-term compliance gains might not necessarily reflect long-term behavioural changes<sup>11</sup>. To mitigate this effect, future studies should incorporate longer follow-up periods or employ randomised controlled trial designs to assess the durability of these improvements more accurately.

The lack of significant correlations between demographic factors (such as age, years of experience, and education) and nurses' knowledge and compliance with blood transfusion procedures indicates that the educational program was equally effective for all groups of nurses, regardless of their background. A previous study also found that demographic variables did not significantly impact the outcomes of similar educational programs<sup>4</sup>. The lack of correlation between experience and compliance might indicate that the program was particularly beneficial for less experienced nurses with more room for improvement. Conversely, it could suggest that more experienced nurses were already adhering to the protocols, with the program reinforcing their existing practices rather than significantly altering them. Experienced healthcare professionals tend to exhibit higher compliance rates, which may explain the uniformity in the program's impact<sup>12</sup>. Future educational initiatives could consider offering

advanced modules to further challenge experienced nurses while providing foundational training for those with less experience.

The significant improvement in self-reported compliance following the educational program reflects its success in promoting adherence to blood transfusion protocols. Ensuring compliance is critical to patient safety, as errors in transfusion procedures can lead to severe complications, including transfusion reactions and fatalities<sup>13</sup>. However, the reliance on self-reported data introduces the potential for social desirability bias, where participants may over-report positive behaviours to align with expected norms. More objective measures, such as direct observations or electronic tracking systems, validate compliance data. Incorporating such methods in future studies would enhance the reliability of the findings and provide a more accurate evaluation of the educational program's impact. While educational programs have consistently been shown to improve knowledge and compliance, some studies argue that these gains may not always translate into sustained behavioural change due to factors such as time constraints and workload<sup>14</sup>. Addressing these barriers through workload management and providing more hands-on training opportunities could enhance compliance rates. The increase in compliance observed in this study may also be attributed to the supportive organisational culture at the private Specialist Hospital, where continuous professional development is prioritised. Similar outcomes in other Malaysian healthcare settings were reported<sup>1</sup>.

Although the educational program produced notable improvements, the smaller increase in knowledge scores may reflect the nurses' varying levels of prior experience<sup>15</sup>. More experienced nurses may have been familiar with the protocols, limiting the scope for significant knowledge gains<sup>16</sup>. Future programs could benefit from offering tailored content that addresses the specific needs of both novice and experienced nurses, ensuring that all participants are challenged appropriately. This study highlights the importance of ongoing education in improving knowledge and compliance in blood transfusion procedures. The findings provide valuable insights into the effectiveness of targeted educational interventions, offering a blueprint for other healthcare institutions aiming to enhance patient safety. By continuing regular re-education sessions and implementing a real-time compliance monitoring system, the private Specialist Hospital can sustain and build upon the improvements observed. Resource allocation and staff engagement must be addressed through strong leadership and a commitment to continuous quality improvement. However, the study's reliance on self-reported data, the potential influence of the

Hawthorne effect, and its relatively short follow-up period present limitations that should be addressed in future research. Objective measures such as direct observations, electronic tracking, and extended follow-up periods would provide a more robust evaluation of the program's long-term effectiveness. Additionally, while the study offers valuable insights, the findings may not be fully generalizable to other healthcare settings due to variations in hospital policies and staff experiences.

## CONCLUSION

The educational program implemented at the private Specialist Hospital has significantly improved nurses' knowledge and compliance with blood transfusion protocols, highlighting the importance of ongoing blood transfusion procedure training in enhancing patient safety. The uniform effectiveness across different demographic groups highlights the program's broad applicability and the value of standardised content in equalising knowledge and compliance levels related to blood transfusion procedures. To sustain the improvements observed, the private Specialist Hospital should consider integrating ongoing education into its routine training schedules and adopting real-time compliance monitoring systems. Addressing challenges such as workload management and ensuring staff engagement through strong leadership and continuous quality improvement efforts will be crucial. The findings provide a roadmap for other healthcare institutions looking to enhance compliance with clinical protocols, ultimately leading to better patient outcomes and reduced transfusion-related risks.

## Acknowledgement

We want to thank the KPJ Rawang Specialist Hospital administration and the Research Ethics Committee for their support during the study. We also thank all the nurses who participated in the study for their time and dedication.

**Ethical permission:** KPJ Healthcare University, Malaysia ERC letter No. KPJU/KPJRC/ECRI HS/2024/03(00).

**Conflict of Interest:** The authors declare no conflict of interest.

**Financial Disclosure / Grant Approval:** There was no specific funding for this study.

**Data Sharing Statement:** The corresponding author can provide the data proving the findings of this study on request. Privacy or ethical restrictions bound us from sharing the data publicly.

## AUTHOR CONTRIBUTION

Each author contributed to this manuscript's design, data collection, analysis, and writing.

## REFERENCES

1. Mohd Noor NH, Saad NH, Khan M, Hassan MN, Ramli M, Bahar R et al. Blood transfusion knowledge among nurses in Malaysia: a university hospital experience. *Int J Environ Res Public Health*. 2021; 18(21): 11194. doi: 10.3390/ijerph182111194.
2. Islami Vaghar M. The impact of an educational program on blood and blood products transfusion on nurses' level of knowledge and performance. *J Med Life*. 2018; 11(3): 238-242. doi: 10.25122/jml-2018-0016.
3. Sgarbi AKG, Ivo ML, Cardoso AIQ, Almeida RGS, Sarat CNF, Salles RP et al. Problems evidenced by nursing care in blood transfusions: an integrative review. *Int J Innov Educ Res*. 2020; 8(3): 48-57. doi: 10.31686/ijer.vol8.iss3.2194.
4. Elhy AHA, Kasemy ZA. Nurses' knowledge assessment regarding blood transfusion to ensure patient safety. *IOSR J Nurs Health Sci*. 2017; 6(2): 104-111. doi: 10.9790/1959-060202104111
5. World Health Organization. Universal access to safe blood transfusion. Geneva: World Health Organization; 2008. Report No. WHO/EHT/08.03. Available from <https://apps.who.int/iris/handle/10665/69747>
6. Hijji BM, Oweis AE, Dabbour RS. Measuring knowledge of blood transfusion: A survey of Jordanian nurses. *Am Int J Contemp Res*. 2012; 2(10): 77-85.
7. Lim ES, Lee S, Abdul Rahim NA, Tuan Din SA. Knowledge of blood transfusion among nurses at Hospital Pulau Pinang: nursing responsibilities and patient management related to transfusion reactions. *Educ Med J*. 2016; 8(4): 47-56.
8. Mistri IU, Badge A, Shahu S. Enhancing patient safety culture in hospitals. *Cureus*. 2023; 15(12): e51159. doi: 10.7759/cureus.51159.
9. Mahdavi Ardestani SF, Adibi S, Golshan A, Sadeghian P. Factors influencing the effectiveness of e-learning in healthcare: a fuzzy ANP study. *Healthcare (Basel)*. 2023; 11(14): 2035. doi: 10.3390/healthcare11142035.
10. Moon SEJ, Hogden A, Eljiz K. Sustaining improvement of hospital-wide initiative for patient safety and quality: a systematic scoping review. *BMJ Open Qual*. 2022; 11(4): e002057. doi: 10.1136/bmjopen-2022-002057.
11. Michaelsen MM, Esch T. Understanding health behaviour change by motivation and reward mechanisms: a review of the literature. *Front Behav Neurosci*. 2023; 17: 749434. doi: 10.3389/fnbeh.2023.749434.
12. Coombs NC, Campbell DG, Caringi J. A qualitative study of rural healthcare providers'

- views of social, cultural, and programmatic barriers to healthcare access. *BMC Health Serv Res.* 2022; 22(1): 1075. doi: 10.1186/s12913-022-07829-2.
13. Ackfeld T, Schmutz T, Guechi Y, Le Terrier C. Blood transfusion reactions—a comprehensive review of the literature including a Swiss perspective. *J Clin Med.* 2022; 11(10): 2920. doi: 10.3390/jcm11102920.
14. Collado-Mateo D, Lavín-Pérez AM, Peñacoba C, Del Coso J, Leyton-Román M, Luque-Casado A et al. Key factors associated with adherence to physical exercise in patients with chronic diseases and older adults: an umbrella review. *Int J Environ Res Public Health.* 2021; 18(4): 1709. doi: 10.3390/ijerph18041709.
15. Al-Qbelat RM, Subih MM, Malak MZ. Effect of educational program on knowledge, skills, and personal preparedness for disasters among emergency nurses: a quasi-experimental study. *Inq (United States).* 2022; 59: 00469580221117674. doi: 10.1177/00469580221117674.
16. Schwartz S. Educating the nurse of the future: Report of the independent commission on the future of nursing. 2022. doi: 10.5281/zenodo.5780780.

