



Research article

Nurses' hemovigilance knowledge and performance after teach-back, concept map, and lecture: A quasi-experimental study

Daryadokht Masror Roudsari^a, Shahoo Feizi^{b,*}, Mahtab Maghsudlu^c^a Department of Medical-Surgical Nursing, School of Nursing and Midwifery, Iran University of Medical Sciences, Tehran, Iran^b Student Research Committee, Department of Medical-Surgical Nursing, School of Nursing and Midwifery, Iran University of Medical Sciences, Tehran, Iran^c Blood Transfusion Research Center, High Institute for Research and Education in Transfusion Medicine, Tehran, Iran

ARTICLE INFO

Keywords:

Blood safety
Hemovigilance
Knowledge
Teaching
Nurses
Work performance

ABSTRACT

Objectives: This study aimed to compare the effects of teaching by three methods of teach-back, concept map, and lecture on knowledge and performance of nurses in hemovigilance process.**Methods:** This quasi-experimental study was performed on 108 Iranian nurses. In the lecture group, the educational intervention was conducted during a 4-hour session; and in the concept map and teach-back groups, it was performed in two 2-hour sessions. The nurses' knowledge and performance were measured by "routine blood transfusion knowledge questionnaire (RBTQ)" and "self-reporting performance-evaluator questionnaire".**Results:** After the interventions, knowledge was significantly higher in the teach-back and the concept map groups compared to the lecture group ($p = 0.001$), but the performance in the lecture group was higher than the other two groups ($p = 0.01$). No statistically significant differences were found between teach-back and concept map groups.**Conclusion:** Teach-back and concept map methods were effective in improving the nurses' hemovigilance knowledge, while the lecture was associated with a significant increase in their performance. Therefore, integrating the hemovigilance teaching methods is suggested.

1. Introduction

Blood transfusion is a measure for preserving the patients' life and promoting their health with multiple clinical benefits [1]. However, many specialists describe this procedure as a double-edged sword due to its occasional fatal complications [2]. According to the Iranian Blood Transfusion Organization (IBTO), the number of registered complications of the blood transfusion process has increased from 3052 cases in 2015–5275 cases in 2018, suggesting carefully and continuous monitoring of blood transfusion process [3].

Hemovigilance is a nationwide monitoring system for blood health and its products, aimed to prevent the occurrence of unwanted side effects of blood transfusion [4]. This system covers all stages of blood transfusion chain, from the time of blood collection from donors to the follow-up of the recipients, and also analyzing of the adverse effects of blood transfusion [5]. Proper implementation of the hemovigilance process depends on performing clinical, educational, quality, and risk management activities [6].

Human error is one of the most important causes of adverse side effects during the blood transfusion process [7, 8]. Therefore, health care personnel should be aware of their roles and responsibilities in the blood transfusion process as well as related national policies and procedures such as hemovigilance [9]. Nurses, as part of the medical team, have special responsibility for the hemovigilance process, and the safety and effectiveness of this process depend on their knowledge and performance [10].

Although the proper knowledge and performance of nurses in the hemovigilance process can minimize the probability of blood transfusion risks [11, 12, 13], recent studies were reported an inappropriate level of nurses' knowledge and performance in hemovigilance process or blood transfusion in different countries [10, 14, 15, 16, 17]. Therefore, considering the important role of nurses in safe blood transfusion and also hemovigilance process, it seems necessary to use the effective educational strategies for improving their knowledge and performance [17, 18, 19]. Nowadays, it is recommended to use active educational and learning strategies that can help nurses to ensure learning, gain problem-solving ability, and acquire appropriate planning for patient

* Corresponding author.

E-mail address: Shaho.faizy1992@gmail.com (S. Feizi).

care [20]. In this regard, teach-back and concept map as learner-centered methods have been identified as useful interventions in nursing education [21, 22].

Teach-back, also known as “show me” or “closing the loop”, is a method that aims to increase learners' understanding by asking them to repeat back key points of the instruction in their own words [23]. This method consists of four stages of explaining, assessing, clarifying, and understanding. In the first stage, the instructor begins education by explaining the information that the learners need to know. In stage two, the instructor assesses learners' understanding of the teaching session using teach-back. The third stage provides the instructor with the opportunity to clarify any concepts the learners did not understand. The instructor may need to repeat stages two and three until the learner is ready to move to stage four, the stage of understanding all the information that has been presented [24]. By using the teach-back method, instructors can examine the errors in learners' memory and understanding through open dialogue, and reteach or modify teaching if comprehension is not demonstrated [25].

Concept map method is another active and illustrative teaching method used in nursing to promote thinking, improve problem-solving, evaluate nursing practices, and promote clinical competence [26, 27, 28]. It was developed by Novak and Gowin in 1984, based on the Ausubel's significant learning theory [22]. The concept map is a graphical and schematic representation which expresses the relationship between two concepts and also their relationship with other concepts related to a specific subject [29]. In this model, a set of concepts are arranged hierarchically in pyramids and their relationship is determined in up-down and side-by-side forms by means of words in order to build meaningful statements [30]. It was believed that when learners link new concepts to previously known ones, the concepts effectively store, and as a result, meaningful learning might be enhanced and creativity could be reinforced [31].

Given that an appropriate level of knowledge and performance can play important roles in nurses for preventing and controlling blood transfusion complications, and since active educational and learning strategies have emphasized on nursing education; it is necessary to compare different educational strategies in relation to blood transfusion. Previously, it was indicated that teaching of blood transfusion by lecture method similarly to active teaching methods (such as multimedia and simulation) increased the nursing students' knowledge or performance as [32, 33]. To the best of our knowledge, no study has yet compared the effects of teach-back and concept map in blood transfusion education. However, it was shown that the concept map led to a significant increase in the level of nursing students' knowledge in haemovigilance in comparison with lecture [12]. Hence, we aimed to compare the effect of teaching by three methods of teach-back, concept map, and lecture in enhancing nurses' knowledge and performance in the hemovigilance process.

2. Methods

2.1. Study design

This is a three-arm, non-randomized, controlled, parallel-group study (Registration No: IRCT20160719028997N1). The nurses were assigned to the three groups non-randomly and pre-test and post-test were performed for each group.

2.2. Ethical considerations

This study was approved by the Regional Ethics Committee of Iran University of Medical Sciences under the Code of Ethics IR.IUMS-REC.1397.720. All study and research activities were performed in accordance with the ethical considerations of the Institutional Research Committee. The objectives and methods of the study were explained to

the potential nurses. Written informed consent was obtained from all nurses, who met the inclusion criteria.

2.3. Participants and setting

Nurses, who were worked in the oncology, medical, surgical, and emergency wards as well as intensive care unit (ICU) (of Kowsar, Besat, and Towhid hospitals, located in Sanandaj, Iran, were invited to participate in the study, using advertisement posters and brochures displayed in the hospitals. The inclusion criteria were as follows: 1) the Bachelor of Science degree in nursing or higher degrees; 2) willingness to participate in the educational session; and 3) working experience of at least 6 months in the relevant ward. On the other hand, participants were excluded if they had any experience of participating in the hemovigilance training course.

2.4. Sample size and sampling

Based on Eq. (1), the sample size was estimated to be 32 nurses per group at a confidence interval of 95% and power of 90% and an effect size of 0.5. However, 36 nurses were selected per group considering the possible dropout.

$$n = \frac{\left(Z_{1-\frac{\alpha}{2}} + Z_{1-\beta}\right)^2}{ES^2} = \frac{(1.96 + 0.84)^2}{0.5^2} = 32 \quad (1)$$

The nurses who met the inclusion criteria were entered the study by convenience sampling method. To avoid contamination between the groups, group allocation was done according to the hospital. For this purpose, the nurses who worked in the Besat, Towhid, and Kowsar hospitals were allocated to three groups of lecture ($n = 36$), teach-back ($n = 36$), and concept map ($n = 36$), respectively.

2.5. Data collection

Knowledge and performance were measured by the two following questionnaires, which were completed before and two weeks after the educational sessions by a self-report method. To examine the homogeneity of the groups in terms of demographic and working-related data, a researcher-made questionnaire was completed before the intervention, which consisted of information about age, gender, educational status, employment status, recruiting ward, work experience, and frequency of blood transfusion.

2.5.1. Routine blood transfusion knowledge questionnaire (RBTKQ)

This self-report questionnaire was developed by Hijji et al. to measure the Jordanian nurses' knowledge of blood transfusion with 32 knowledge items (2 true-false; 20 multiple-choice; 10 multiple-response) [10]. The Persian version of RBTKQ also consists of 32 questions in issues relating to patient preparation (5 items), blood pack collection from blood bank (3 items), pre-transfusion initiation nursing responsibilities (6 items), post-transfusion initiation nursing responsibilities (10 items), and complications related to blood transfusion (8 items). According to RBTKQ, a score of one is given to correct answers and a score of zero to wrong answers. Therefore, the minimum score is zero and the maximum is 32. Rafii et al. evaluated the psychometric properties of the Persian version of RBTKQ and indicated an adequate qualitative contented validity by 10 members of Science Committee of Iran University of Medical Sciences. Also, they obtained an internal consistency of 0.789 in a sample of Iranian nurses with a BSc degree [33].

2.5.2. Self-reporting performance-evaluator questionnaire

This self-report questionnaire was designed by Purfarzad et al. to measure the Iranian nurses' performance of blood transfusion nurses. It consists of 20 questions about necessary actions before, during, and after blood transfusion and incidence of possible adverse reactions. The

questionnaire should be answered based on a five-point Likert-type scale ranging from never (score zero) to always (score four). Hence, the minimum and maximum scores are zero and 80 [34]. In the preliminary psychometric evaluation of this questionnaire in a sample 30 Iranian nurses, Purfarzad et al. indicated a satisfactory internal consistency obtained by Cronbach's alpha coefficient ($r = 0.70$) [34]. Also, the qualitative content validity of this questionnaire was confirmed in a recent study by 10 members of Science Committee of Iran University of Medical Sciences and its reliability was confirmed with Cronbach's alpha of 0.759 in a sample of Iranian nurses with BSc degree [33].

2.6. Intervention

The interventions for the three groups were performed from June to August 2019. The education contents for three groups were identical, which include hemovigilance goals, types of blood products, pre-transfusion measures, blood transfusion complications, and related measures. The contents were adapted from valid books and articles by the research team members; then, it was validated and approved by IBTO. All educational interventions were presented in the corresponding hospital by a qualified master's degree student of Medical-Surgical Nursing, who had successfully completed a workshop on "hemovigilance" held by IBTO and had 5 years' working experience of blood transfusion. At the end of the session in all groups, the content of the tutorial was summarized by the instructor and participating nurses. The education in three groups was free of charge, and nurses were given incentives for their participation.

In the teach-back group, nurses were taught in two 2-hour sessions as shown in Figure 1. In the concept map group, the educational intervention was performed in two 2-hour sessions by using a two-dimensional, visual drawing of the educational contents in a spider-like manner, with the main concept centered on the map and sub-concepts placed on the edges of the map. The concept maps were prepared by the instructor, and were then presented to the nurses and they were asked to study them for two weeks.

In the lecture group, the education was presented by lecture and the question-and-answer methods in a 4-hour session in the hospital conference room, using Microsoft PowerPoint. During the session, the nurses' questions were answered according to the standard materials of the IBTO; and at the end of the session, the content of the tutorial was summarized. In addition, a prepared training booklet, which was approved by the faculty members of Iran University of Medical Sciences and the specialists of IBTO, was presented for the nurses of the lecture group.

2.7. Statistical analysis

At the end of the study, data were analyzed using SPSS version 21. In all analyses, P-value of less than 0.05 was considered statistically

significant. To assess the homogeneity of groups for age, one-way analysis of variance (ANOVA) was used. The Chi-squared test was also used to assess the homogeneity of groups for nominal qualitative variables including gender, educational status, employment status, and recruiting ward. Moreover, to assess the homogeneity of groups for ordinal qualitative variables including work experience and frequency of blood transfusion, the Kruskal-Wallis test was applied. The normal distribution of the quantitative data was confirmed using the Kolmogorov-Smirnov test. The results of ANOVA indicated a non-significant minimal difference between groups in terms of knowledge before the intervention. Hence, analysis of covariance (ANCOVA) was used to compare knowledge and performance after the intervention, considering pre-test scores of these variables as covariates. Since the results of ANCOVA were statistically significant, multiple comparisons of scores between each two groups were done via Post-hoc analysis, using the Tukey's test. In addition, the paired sample t-test was performed to compare the scores within the groups.

3. Results

The demographic and working-related characteristics of nurses in the three groups are presented in Table 1. No significant differences were found between the groups in terms of these characteristics ($P > 0.05$).

Paired sample t-test results showed that the mean of knowledge and performance scores significantly increased in all three groups after the intervention ($P = 0.001$ in two cases). The results of ANOVA showed that the mean score of two variables was not significantly different in the three groups before the intervention; however, the ANCOVA results showed a significant difference in the knowledge and performance between three groups after the intervention ($P = 0.001$, $P = 0.01$). The Tukey's test showed that the mean scores of knowledge in the teach-back and concept map groups were significantly more than the other group ($P = 0.001$ for two groups). In addition, the performance score in the lecture group ($P = 0.01$) were more than the other two groups. However, no statistically significant differences were found between the two groups of teach-back and concept map in knowledge and performance (Table 2).

4. Discussion

The purpose of this study was to compare the effects of teaching by three methods of teach-back, concept map, and lecture on the knowledge and performance of nurses about the hemovigilance process. The results showed that in three groups, the knowledge and performance significantly increased two weeks after the intervention in comparison with prior to the intervention. It means the positive effects of teach-back, concept map, and lecture educational methods on nurses' knowledge and performance.

The findings of present study substantiate the available data regarding the positive effects of education on the knowledge and

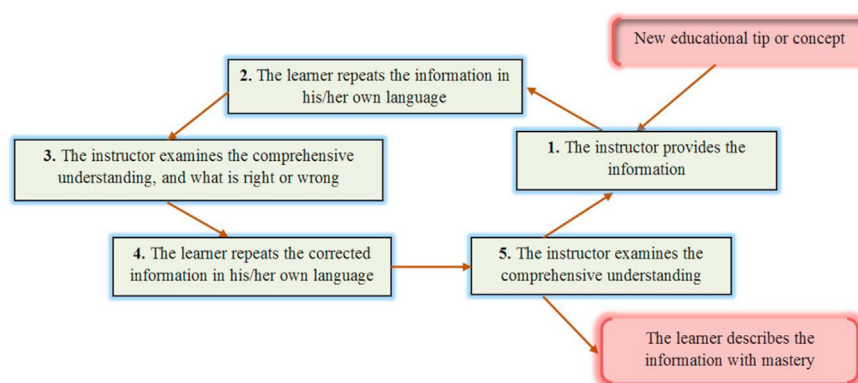


Figure 1. Teach-back training cycle in the current study.

Table 1. Demographic and working-related data of nurses in three studied groups.

Variables		Teach-back (n = 36)	Concept map (n = 36)	Lecture (n = 36)	P-value
Age (year)		28.75 ± 3.88	29.61 ± 5.17	30.58 ± 3.80	0.20 [†]
Sex	Men	19 (52.8)	15 (41.7)	23 (63.2)	0.17 ^{††}
	Women	17 (47.2)	21 (58.3)	13 (36.8)	
Educational status	Bachelor	31 (86.6)	34 (94.4)	30 (83.3)	0.32 ^{††}
	Master	5 (13.9)	2 (5.6)	6 (16.87)	
Employment status	Formal	3 (8.3)	6 (16.7)	5 (13.9)	0.29 ^{††}
	Semi-formal	3 (8.3)	1 (2.8)	2 (5.6)	
	Contractual	12 (33.3)	6 (16.7)	12 (33.3)	
	Conventional	3 (8.3)	10 (27.8)	8 (22.2)	
	Informal	15 (41.7)	13 (36.1)	9 (25.0)	
Ward	Oncology	9 (25.0)	1 (2.8)	8 (22.2)	0.16 ^{††}
	Medical	7 (19.4)	13 (36.1)	5 (13.9)	
	Surgical	4 (11.1)	5 (13.9)	7 (19.4)	
	Emergency	6 (16.7)	8 (22.2)	6 (16.7)	
	Intensive care unit	10 (27.8)	9 (25.0)	10 (27.8)	
Work experience (year)	<5	27 (75.0)	29 (80.6)	20 (55.6)	0.07 [‡]
	6–10	9 (25.0)	6 (16.7)	12 (33.3)	
	11–15	0 (0.0)	1 (2.8)	4 (11.1)	
Frequency of blood transfusion	0	4 (11.1)	12 (33.3)	5 (13.9)	0.14 [‡]
	1–4	12 (33.3)	18 (50.0)	15 (41.7)	
	5–8	7 (19.4)	1 (2.8)	6 (16.7)	
	9–12	6 (16.7)	5 (13.9)	6 (16.7)	
	>12	7 (19.4)	0 (0.0)	4 (11.1)	

Data are presented as mean ± standard deviation or number (percentage).

[†] One-way analysis of variance.

^{††} Chi-square test.

[‡] Kruskal-Wallis test.

Table 2. Comparison of nurses' knowledge and performance between three studied groups.

Variables		Teach-back (n = 36)	Concept map (n = 36)	Lecture (n = 36)	P-value
Knowledge	Before intervention	15.52 ± 3.24	16.83 ± 3.26	15.05 ± 2.73	0.06 [†]
	After intervention	26.0 ± 2.20 ^a	26.77 ± 1.89 ^a	23.41 ± 2.11	0.001 ^{††}
	Mean change	10.48 ± 2.57	9.94 ± 2.98	8.36 ± 2.17	
	P-value [‡]	0.001	0.001	0.001	
	Performance	Before intervention	69.42 ± 6.18	69.94 ± 6.45	69.83 ± 7.69
	After intervention	84.44 ± 5.07	83.83 ± 6.40	87.02 ± 6.13 ^b	0.01 ^{††}
	Mean change	15.02 ± 4.61	13.89 ± 5.88	17.19 ± 6.94	
	P-value [‡]	0.001	0.001	0.001	

Data are presented as mean ± standard deviation.

^a Significant in comparison to lecture method: Obtained from Tukey's test.

^b Significant in comparison to two other groups: Obtained from Tukey's test.

[†] One-way analysis of variance.

^{††} Analysis of covariance.

[‡] Paired sample t-test.

performance in the hemovigilance process or blood transfusion services [35, 36, 37]. In line with our findings, Islami Vaghar et al. reported that a lecture-based educational program significantly increased Iranian nurses' knowledge and performance about blood transfusion [36]. Moreover, Rudrapan indicated that a 3-day training program using Microsoft PowerPoint presentations, practical sessions, and group activities related to daily activities in blood bank lead to significant improvements in the knowledge, skills, and performance of Indian nurses regarding blood transfusion services [35]. Also, Patel et al. indicated that educational lecture utilizing the American Association of Blood Banks red blood cell transfusion guidelines significantly reduced inappropriate

red blood cell transfusion rates prescribed by physicians. However, they reported that computerized feedback via email following the education non-significantly decreased inappropriate transfusion [38].

The findings showed that the lecture method exerted less effect on the knowledge of nurses in comparison to the teach-back and concept map methods; however, it had more effects on nurses' performance than the other two methods. To the best of our knowledge, there is a scarcity of research to compare the effects of different educational interventions on the hemovigilance process. In line with our study, four sessions of training by concept map led to a significant increase in the level of knowledge in hemovigilance compared to the lecture method amongst nursing students

[12]. Also, the findings of present study support previous studies indicating the better effects of concept map in comparison with lecture in nursing students' knowledge and critical thinking in other courses such as "cardiovascular nursing" and "fundamentals of nursing" [39, 40]. However, Rafii et al. [33] and Flood and Higbie [32] indicated that instructions of blood transfusion process through lecture method had the same or better effect in increasing the nursing students' knowledge and/or performance as active methods such as multimedia educational workshop and simulation. The differences in the findings can result from the differences in target population, educational intervention type, and tool used.

The present study improved our understanding of the value of educational programs in promoting nurses' knowledge and performance in the hemovigilance process. In the current study, nurses' performance was better in the lecture method; thereby, it can be concluded that lecture can still be used as a standard method to increase the nurses' performance in the hemovigilance process if it is used properly. On the other hand, since both concept map and teach-back methods had a better effect on nurses' knowledge, it can be concluded that two methods can be used to increase nurses' knowledge in the hemovigilance process. Therefore, it seems that conducting comprehensive hemovigilance training workshops or programs using a blended method of lecture, concept map, and teach-back can enhance the knowledge and performance of nurses in the hemovigilance process. Although the results of this study cannot be generalized to all educational settings, such interventions can be introduced as an effective educational method for nurses and all members of the medical staff and also undergraduate nursing students to make an effective step in promoting the knowledge and performance in the hemovigilance process. Moreover, findings from this study could be beneficial in developing concept map and teach-back training guidelines in the hemovigilance process and also training nurse instructors about how to use and teach these methods. Considering no statistically significant differences between teach-back and concept map methods regarding knowledge and performance, further studies are suggested to compare the effect of these methods in nursing education.

4.1. Limitations

The study findings should be interpreted with caution due to some limitations. First, the study was performed on a sample of Iranian nurses in a non-blinded manner, since the scale used for performance was self-reported, and also the nurses could not be blinded due to the educational nature of the intervention. In addition, the generalization of the findings may be limited as nurses were allocated to groups non-randomly. Finally, there was only one follow-up period after the intervention.

5. Conclusion

Concept map and teach-back methods had the same effect on nurses' knowledge and performance in the hemovigilance process, but the lecture method was more effective on nurses' performance compared to the concept map and teach-back methods. Hence, integrating the hemovigilance training programs using three methods is suggested to improve both the knowledge and performance of nurses. However, further research is suggested to accomplish the study goals, especially comparison of the concept map and teach-back, while considering different intervals for assessment of knowledge and performance. Moreover, for a reliable analysis of performance, the use of observational measures and multiple informants' reports (i.e., managers' reports of nurses' performance), in addition to questionnaires, can be beneficial.

Declarations

Author contribution statement

D. Masror Roudsari and M. Maghsudlu: Conceived and designed the experiments; Analyzed and interpreted the data; Wrote the paper.

S. Feizi: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Funding statement

This work was supported by Iran University of Medical Sciences, Tehran, Iran (Registration No. 97.4.3.13297).

Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

The clinical trial described in this paper was registered at the Iranian Registry of Clinical Trials under the registration number IRCT20160719028997N1.

Acknowledgements

This study is the result of a thesis for the degree of Master of Science in Medical-Surgical Nursing, approved by Iran University of Medical Sciences. We appreciate the "Student Research Committee" and the "Vice Chancellor for Research and Technology" of the Iran University of Medical Sciences for their financial support of this study. The authors also would like to appreciate the nursing staff of Sanandaj Kowsar, Besat, and Towhid hospitals.

References

- [1] L.T. Goodnough, A.K. Panigrahi, Blood transfusion therapy, *Med Clin North Am* 101 (2017) 431–447.
- [2] A.R. Harvey, S.V. Basavaraju, K.W. Chung, M.J. Kuehnert, Transfusion-related adverse reactions reported to the national healthcare safety network hemovigilance module, United States, 2010 to 2012, *Transfusion* 55 (2015) 709–718.
- [3] K. Shams Asanjan, M. Balali, A. Mardani, F. Rajabpour Niknam, A. Hadad Dailami, S. Zadeh Dadashi, et al., Report of Hemovigilance Performance in 2018, Iranian Blood Transfusion Organization, Iran, 2018.
- [4] E.M. Wood, A.L. Ang, A. Bisht, P.H. Bolton-Maggs, A.G. Bokhorst, O. Flesland, et al., International haemovigilance: what have we learned and what do we need to do next? *Transfus. Med.* 29 (2019) 221–230.
- [5] B. Lassale, G. Daurat, M. Besse-Moreau, J.P. Aullen, French haemovigilance from 1994 to nowadays: evolution and prospects, *Transfus. Clin. Biol.* 24 (2017) 268–272.
- [6] L. Bielby, L. Stevenson, E. Wood, The role of the transfusion nurse in the hospital and blood centre, *ISBT Sci. Ser.* 6 (2011) 270–276.
- [7] N.B. Hensley, C.G. Koch, P.J. Pronovost, B.H. Mershon, J. Boyd, S. Franklin, et al., Wrong-patient blood transfusion error: leveraging technology to overcome human error in intraoperative blood component administration, *Joint Comm. J. Qual. Patient Saf.* 45 (2019) 190–198.
- [8] D. Stainsby, J. Russell, H. Cohen, J. Lilleyman, Reducing adverse events in blood transfusion, *Br. J. Haematol.* 131 (2005) 8–12.
- [9] D. Stainsby, J.C. Faber, J. Jorgensen, Hazards of transfusion "hemovigilance", in: T. Simon, E. Snyder, B.G. Solheim, C. Stowell, R. Strauss, M. Petrides (Eds.), *Principles of Transfusion Medicine* Markono Print Media Pte Ltd, Wiley Blackwell, 2009, pp. 681–689.
- [10] B. Hijji, A. Oweis, R. Dabbour, Measuring knowledge of blood transfusion: a survey of Jordanian nurses, *Am. Int. J. Contemp. Res.* 2 (2012) 77–94.
- [11] M. Keramti, M. Tafazoli, Assessment of various medical groups' knowledge of transfusion medicine, *Hakim Health Sys. Res.* 10 (2008) 53–59.
- [12] M.S. Mirzaee, M. Karimi, The assessment of the effect of the haemovigilance education by the conceptual map on the knowledge of nursing students, *Pajouhan Sci. J.* 17 (2018) 51–56.
- [13] C. Le Niger, L. Lepioul, Professional-practice evaluation of the medical and nursing dysfunctions observed during the transfusion chain at the university hospital of brest, *Transfus. Clin. Biol.* 14 (2007) 457–463.
- [14] F. Saillour-Glenisson, S. Tricaud, S. Mathoulin-Pelissier, B. Bouchon, I. Galperine, P. Fialon, et al., Factors associated with nurses' poor knowledge and practice of transfusion safety procedures in aquitaine, France, *Int. J. Qual. Health Care* 14 (2002) 25–32.

- [15] A. Shamshirian, Z. Alirahimi, A. Ghorbanpour, S. Motamen, N. Maadi, P. Zamani, et al., Knowledge and awareness of nursing students on blood transfusion, *Int. J. Med. Investig.* 6 (2017) 129–134.
- [16] D. Tramalloni, A. Auperin, N. Oubouzar, V. Lapiere, Implication of nurses in transfusion safety: knowledge assessment and practice evaluation at the gustave-rousseau institute, *Transfus. Clin. Biol.* 12 (2005) 427–432.
- [17] S. Emami, A. Rezamand, J.S. Tabrizi, S. Valizadeh, Factors influencing nurses' performance in the process of blood transfusion in children with thalassemia, *J. Pediatr. Nurs.* 1 (2014) 63–71.
- [18] D. Watson, K. Hearnshaw, Understanding blood groups and transfusion in nursing practice, *Nurs. Stand.* 24 (2010) 41–48, quiz 49.
- [19] N. Agnihotri, A. Agnihotri, Active hemovigilance significantly improves reporting of acute non-infectious adverse reactions to blood transfusion, *Indian J. Hematol. Blood Transfus.* 32 (2016) 335–342.
- [20] B.A. Khan, F. Ali, N. Vazir, R. Barolia, S. Rehan, Students' perceptions of clinical teaching and learning strategies: a pakistani perspective, *Nurse Educ. Today* 32 (2012) 85–90.
- [21] C.K. Holman, L.D. Weed, S.P. Kelley, Improving provider use of the teach-back method, *J. Nurses Prof. Dev.* 35 (2019) 52–53.
- [22] B.J. Daley, S. Morgan, S.B. Black, Concept maps in nursing education: a historical literature review and research directions, *J. Nurs. Educ.* 55 (2016) 631–639.
- [23] T.T. Ha Dinh, A. Bonner, R. Clark, J. Ramsbotham, S. Hines, The effectiveness of the teach-back method on adherence and self-management in health education for people with chronic disease: a systematic review, *JBIC Database Syst. Rev. Impl. Rep.* 14 (2016) 210–247.
- [24] M. Caplin, T. Saunders, Utilizing teach-back to reinforce patient education: a step-by-step approach, *Orthop. Nurs.* 34 (2015) 365–368, quiz 369–370.
- [25] P.H. Yen, A.R. Leasure, Use and effectiveness of the teach-back method in patient education and health outcomes, *Fed. Pract.* 36 (2019) 284–289.
- [26] W. Lee, C.H. Chiang, I.C. Liao, M.L. Lee, S.L. Chen, T. Liang, The longitudinal effect of concept map teaching on critical thinking of nursing students, *Nurse Educ. Today* 33 (2013) 1219–1223.
- [27] S. El-Hay, S. El Mezayen, R. Ahmed, Effect of concept mapping on problem solving skills, competence in clinical setting and knowledge among undergraduate nursing students, *J. Nurs. Educ. Pract.* 8 (2018) 34–46.
- [28] J.K. Garwood, A.H. Ahmed, S.A. McComb, The effect of concept maps on undergraduate nursing students' critical thinking, *Nurs. Educ. Perspect.* 39 (2018) 208–214.
- [29] S. Aliyari, A.H. Pishgooie, A. Abdi, M.S. Mazhari, M.R. Nazari, Comparing two teaching methods based on concept map and lecture on the level of learning in basic life support, *Nurse Educ. Pract.* 38 (2019) 40–44.
- [30] B.J. Daley, D.M. Torre, Concept maps in medical education: an analytical literature review, *Med. Educ.* 44 (2010) 440–448.
- [31] P. Hagell, E. Edfors, G. Hedin, A. Westergren, C.S. Hammarlund, Group concept mapping for evaluation and development in nursing education, *Nurse Educ. Pract.* 20 (2016) 147–153.
- [32] L.S. Flood, J. Higbie, A comparative assessment of nursing students' cognitive knowledge of blood transfusion using lecture and simulation, *Nurse Educ. Pract.* 16 (2016) 8–13.
- [33] F. Rafii, M. Jan Amiri, A. Dehnad, H. Haghani, The effect of workshop and multimedia training methods on nurses' knowledge and performance on blood transfusion, *J. Client-Cent Nurs. Care* 2 (2016) 223–230.
- [34] Z. Purfarzad, M. Farmahini Farahani, Z. Ghamarizade, M. Ghorbani, M. Zamani, Nurses' knowledge and practice of blood transfusion in hospitals of arak in 2010, *Sci. J. Iran Blood Transfus. Organ.* 9 (2012) 337–345.
- [35] R.B. Rudrappan, Evaluating the knowledge and practices of nurses and paramedics in blood transfusion services—a survey in the states of Tamil nadu and pondicherry, India, *J. Educ. Health Promot.* 8 (2019) 48.
- [36] M. Islami Vaghar, The impact of an educational program on blood and blood products transfusion on nurses' level of knowledge and performance, *J. Med. Life* 11 (2018) 238–242.
- [37] A. Freixo, I. Matos, A. Leite, A. Silva, F. Bischoff, M. Carvalho, et al., Nurses knowledge in transfusion medicine in a Portuguese university hospital: the impact of an education, *Blood Transfus.* 15 (2017) 49–52.
- [38] V.M. Patel, A.W. Rains, C.T. Clark, Effectiveness of provider education followed by computerized provider order entry alerts in reducing inappropriate red blood cell transfusion, *J. Blood Transfus.* 2016 (2016) 2859720.
- [39] M. Masoumy, A. Ebadi, A. Raisifar, R. hosseini, R. Javanbakhtian, Comparison of two teaching methods on nursing students' learning and retention: concept mapping or lecture? *Iran J. Med. Educ.* 12 (2012) 498–507.
- [40] H. Sadeghi Gandomani, S. Shahbazi, N. Naseri Borujeni, V. Pooiesh, Comparison of the effects of concept mapping and conventional teaching methods on critical thinking of nursing students, *Nurse Educat.* 5 (2016) 27–33.