Clinical Trial

Knowledge Improvement of Blood Transfusion Safety Among Pediatricians: Post Educational Intervention

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ABSTRACT

Human factors account for most reported errors in the serious hazards of blood transfusion report, thus staff training on safe blood transfusion is strongly recommended. This study aimed to assess knowledge of blood transfusion safety among pediatricians and determine the impact of an educational initiative. A quasi-experimental study was conducted on 190 pediatricians. A questionnaire was designed and validated through a pilot study after which all participants were invited to fill it pre- and posteducational intervention. The educational material has been prepared based on the WHO blood transfusion safety guidelines; prepared by the researcher and reviewed by experts in the field. Near miss was identified by 47% of the participants and around 78.3%, 63.2%, and 60% of them correctly identified the indication of red blood cells, fresh frozen plasma, and platelet transfusion. These percentages were significantly improved post education. Only 55% knew that it's not allowed to co-administer drugs or IV fluids with the transfused blood and that rose to almost 80% after intervention. Consent information and correct patient identification were well known among most of them. Only 18.4% knew the pre transfusion screening protocol, which was increased to 85.8 % posteducation. Almost 65.3% correctly responded to the transfusion reaction quiz with no significant change after intervention. Age and work experience were significant independent risk factors for poor knowledge of transfusion safety. Transfusion safety knowledge needs further enhancement with more tailored training programs focusing on the topics that did not show a significant change after our educational training.

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Introduction

Blood transfusion is the most common life-saving critical intervention performed in hospitals that needs to be appropriately prescribed, stored and transfused as per guidelines to ensure recipient safety [1]. The serious hazards of blood transfusion (SHOT) report showed that more than 84% of the reports in 2018 resulted from human errors and only 10% were not preventable. The annual report recommended that clinical and laboratory staff should be trained in fundamentals of transfusion, human factors, cognitive biases, and patient safety principles [2].

In Egypt, the efforts of the Blood Safety Taskforce created under Egypt's national viral hepatitis programme, collaborating all service providers including the Ministry of Health and Population, Ministry of Higher Education, Ministry of Defense, Ministry of Interior, the private sector, and the Egyptian Red Crescent resulted in the launching of the Revised National Standards for Blood Transfusion Services in 2015. The Standards have being disseminated throughout blood centers nationwide [3]. As, the risks from inadequate administration exceeds the risk of product associated harm by far, there is an urging necessity for continuing training programs implementation for medical staff [4].

Proper education and training are required in management regarding blood transfusion. Identifying the current knowledge status of blood transfusion practice is crucial to identify target areas of teaching and patient management [5].

A survey study was held in Burkina Faso to assess the knowledge and attitudes in the field of blood transfusion of the clinical healthcare professionals in a university hospital. The participants had an average of 7 years of professional practice. The

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Table 1
General characteristics of the studied participants (n = 190).

General characteristics		Frequency	Percent %
Age *(years)*	*20-30*	71	37.4
	31-40	64	33.7
	> 40	55	28.9
Gender	*Male*	49	25.8
	Female	141	74.2
Place of Work	*Secondary hospital which doesn't offer blood transfusion*	26	13.7
	Tertiary teaching hospital offering transfusion	60	31.6
	Tertiary non-teaching hospital offering transfusion	94	49.5
	Others	10	5.2
Work Experience	*3y-5y*	35	18.5
	6y-8y	13	6.8
	>8y	142	74.7
Educational level certificate	*Bachelor*	45	23.7
	Diploma	36	19
	Master	89	46.8
	Doctorate	20	10.5

results showed that knowledge is insufficient and compliance with transfusion best practices is limited [6]. Another study on different professional staff from Niger showed inadequate level of knowledge about basic information on blood transfusion and clinical use of blood [7].

There is no available data on physician's knowledge and attitude regarding transfusion safety in Egypt. The purpose of this research was to evaluate the knowledge of pediatricians regarding patient safety during blood transfusion and to how much it was improved after an educational initiative.

Material and Methods

A designed questionnaire was used through personal interview with 190 pediatricians working in Suez Canal Area. All working pediatricians for at least previous 6 months were included from Pediatrics departments from Suez Canal University hospital and four general hospitals from three governorates. The study protocol was reviewed by the Research Ethics Committee of the Faculty of Medicine, Suez Canal University.

The study was accomplished through 3 stages:

Stage 1: A pilot study on 20 pediatricians was carried out to test the reliability and validity of the questionnaire before its application.

The questionnaire (Appendix A) has been prepared by 3 of the authors (SS, EA, and NK) to cover the personal data of the participants, the definition of safety (Q1), the most important topics of the WHO guidelines; including hospital requirement (Q4, 7), transfusion guidelines and protocol (Q2, 5), transfusion in the clinical area (Q 3, 8), transfusion laboratory procedures (Q6) and the reporting and monitoring process (Q 9, 10).

After rephrasing of some questions, the questionnaires were distributed and filled by the participants.

Stage 2: The educational material has been prepared based on the WHO blood transfusion safety guidelines (WHO/EHT/10.05) [8] in the form of leaflet and short power point presentation by one of the authors (EA) and reviewed by external experts in the field. The educational session was delivered by a consensus of Pediatrics experts including Prof. Amal El-beshlawy, professor of Pediatrics Hematology, Cairo University, Prof. Laila Sherief, professor of Pediatrics Hematology, Zagazig University and Dr. Shaimaa Sahmoud, Lecturer of Pediatrics Suez Canal University.

Stage 3: Participants who were exposed to the educational tools were offered to answer the same questionnaire after the education session.

Table 2
Responses to the different definition of medical error (pre- and postintervention) by the studied participants (n = 190).

Medical error is:		Pre-Freq. (%)	Post-Freq. (%)	P-value
Failure of a planned action.	**True**	**136 (71.6)**	**185 (97.4)**	0.624[a]
	False	54 (28.4)	5 (2.6)	
Using a wrong plane.	**True**	**132 (69.5)**	**185 (97.4)**	0.642[a]
	False	58 (30.5)	5 (2.6)	
Errors only result in adverse outcomes.	*True*	69 (36.3)	32 (16.8)	0.687[b]
	False	**121 (63.7)**	**158 (83.2)**	
Errors expose patients to risk but not harm.	**True**	**104 (55.6)**	**121 (63.7)**	0.002*
	False	83 (44.4)	69 (36.3)	
Near Miss if caused harm.	*True*	100 (52.6)	28 (14.7)	0.013[c]
	False	**90 (47.4)**	**162 (85.3)**	

The right answers are bolded.
[a] Fisher's test is not statistically significant at level of confidence 95%.
[b] Chi-square test is not statistically significant at level of confidence 95%.
[c] Chi-square test is statistically significant at level of confidence 95%.

Statistical Analysis

The data was coded, organized and the final results was analyzed using the SPSS (statistical package for social science) version 20.0. The Pearson's chi-square test was used to compare proportions for qualitative variables while independent *t*-test was used for quantitative variables. Logistic regression analysis of general characteristics as predictors of pre- and postintervention knowledge was used. Statistical significance was considered at *P*-value $<.05$.

Results

The study was conducted on 190 medical staff, less than 30% of them were over 40-year-old. Most of them were females (74.2%), and are working in tertiary nonteaching hospital (49.5%). The majority of our participants had an experience of more than 8 years in the Pediatrics field (74.7%; Table 1). Almost two thirds (63.7%) of our study group had previous training on general patient safety, while none of them had any training on transfusion safety. Different definitions of medical errors were tested and near miss was the least correctly identifiable among the group with the percentage of correct answers of only 47.4% which was significantly increased to 85.3% after our training (*P* = .013; Table 2).

As for the indications of different blood components transfusion, percentage of correct answers for packed red cell transfusion significantly increased from 44.3% to 59.5% (*P* =0.02; Table 3). Re-

Table 3

Responses assessing the knowledge about correct usage of blood and blood component by the studied participants (n = 190; pre- and postintervention).

Conditions are:		Pre-*Freq. (%)*	Post-*Freq. (%)*	*P-value*
Packed red cell transfusion in acute hemolytic anemia	**True**	**148 (78.9)**	**156 (82.1)**	*0.02*[b]
	False	42 (22.1)	34 (17.9)	
Fresh frozen plasma in factor V deficiency.	**True**	**120 (63.2)**	**173 (91.1)**	*0.794*[a]
	False	70 (36.8)	17 (8.9)	
Cryoprecipitate in factor IX deficiency.	*True*	83 (43.7)	53 (27.9)	*0.746*[a]
	False	**107 (56.3)**	**137 (72.1)**	
Platelet concentrate in immune thrombocytopenia.	*True*	76 (40)	36 (18.9)	*0.706*[a]
	False	**114 (60)**	**154 (81.1)**	
Packed red cell in well compensated iron deficiency anemia	*True*	106 (55.7)	77 (40.5)	*0.02*[b]
	False	**84 (44.3)**	**113 (59.5)**	

The right answers are bolded.
[a] Chi-square test is not statistically significant at level of confidence 95%.
[b] Chi-square test is statistically significant at level of confidence 95%.

Table 4

Knowledge about transfusion monitoring (hemovigilance) system among the studied participants (n = 190; pre- and postintervention).

Transfusion monitoring (hemovigilance) system:	Pre-*Freq. (%)*	Post-*Freq. (%)*	*P-value*
There is a national monitoring system and I know its procedures.	23 (12.1)	168 (88.4)	*0.001*[a]
There is a national monitoring system but I don't know its procedures.	91 (47.9)	18 (9.5)	
There is no national transfusion monitoring system.	76 (40)	4 (2.1)	

[a] Fisher's test is statistically significant at level of confidence 95%.

sponses to the general precautions during blood transfusion, items of patient consent, and details of blood request form showed no significant change after the educational session. Protocol of blood screening before donation in Egypt includes HBsAg, HCV Ab, HIV Ag-Ab, and syphilis antibodies. While only 18.4% of participants were well aware of this screening protocol, this percentage increased to 85.8% after our educational training ($P = .026$). A fair percentage of our study group knew the steps of proper patient identification (65.3%), and though it increased to 85.8% post education, that increase was of nonstatistical significance ($P = .254$).

We offered different scenarios to test, in a case-based format, how accurate medical staff participants would identify the different blood transfusion reaction. The difference between the Transfusion Associated Circulatory Overload (TACO) was confused with Transfusion Related Acute Lung Injury (TRALI) by 22.1% of participants. This percentage was nonsignificantly reduced to 12.1% ($P > .05$). Almost half of the tested group (47.9%) didn't know about the procedures of the national transfusion monitoring (hemovigilance) system what significantly rose to 88.4% post-test (Table 4). Only 8.9% of our group ever reported any medical events during blood transfusion. After raising the importance of medical events reporting, the percentage of staff planning to report in the next 6 months surged from 27.4% to 68.4% ($P < .001$).

Intraclass correlation coefficient was low positive but statistically significant (P value $<.05$). Using logistic regression, age and work experience were significant independent risk factors for poor preintervention knowledge of blood transfusion safety (P value $<.05$).

Discussion

In low-income countries, up to 54% of blood transfusions are given to children under 5 years of age; whereas in high-income countries, the most frequently transfused patient group is over 60

years of age, accounting for up to 75% of all transfusions. Providing safe and adequate blood should be an essential part of every country's national health care policy. To promote uniform implementation of standards and consistency in the quality and safety of blood, a national blood policy and legislative framework should govern the national blood system. In 2018, 39% of low-income countries have specific legislation covering the safety and quality of blood transfusion. WHO recommends the development of hospital transfusion committees and hemovigilance systems to monitor and improve the safety of transfusion processes [9].

Human errors stand as important risk factors for blood transfusion therapy [10]. Both SHOT report and guidelines on administration of blood issued by the British Committee for Standards in Hematology (BCSH) recommended training staff on safe blood transfusion in order to minimize these errors [11]. An adequate education in transfusion medicine helps to promote patient's safety and reduce blood transfusion errors [12].

Although, several studies have been conducted to assess knowledge and practice of blood transfusion among medical and nursing staff, we could not find data about physician's knowledge and attitude with regard to transfusion safety in Egypt. Thus we intended to assess the improvement of knowledge about blood transfusion safety among pediatricians in Suez Canal area after educational intervention.

We have conducted this study on 190 pediatricians, most of them were working on a tertiary nonteaching hospital with a working experience of more than 8 years. None of them had previous training on transfusion safety which is in contrast to various other studies [5,6,12].

Medical error terminology is sometimes confusing, but the current study participants identified most of them except for the "near miss" and the "exposure to risk without harm" definitions; they were correctly identified by only half of them. However, this proportion was significantly improved after our educational session.

For the correct clinical usage of blood and blood products, we found that around 78.9%, 63.2%, and 60% correctly identified the indication of red blood cells, fresh frozen plasma, and platelet transfusion, respectively.

Among 57 post internship doctors from a specialized Hospital in Sri Lanka participated in a survey, the overall percentage of correct answers for blood products demand and doses was 34%, while the percentage was 56% regarding administration of blood and blood components [13]. In another study which assessed 1242 Iranian physicians' knowledge in transfusion medicine, only 37% of them could be identified as having an adequate knowledge of clinical aspects of blood use [14].

Our results showed a significant improvement in physician's knowledge of the blood transfusion usage and hemovigilance sys-

tem post intervention which was similarly found in others studies [1,5]. About 55% of our study participants knew that it's not allowed to co-administrate drugs or IV fluids with the transfused blood pre-intervention which reached 80% postintervention. Kavaklioglu and colleagues (2017) found that 85% of 100 healthcare personnel working in a training and research hospital in Istanbul correctly refused the co-administration of drugs to transfused blood which is in accordance with our post intervention result [15].

More than three fourth of the current study participants correctly identified the information that should be provided in the informed consent before application of our educational session which is consistent with another study who found that 87% of their study group were well aware of the blood transfusion consent [5]. However, when it came to practical application, a previous observational study found that the percentages of patients who were informed about the reason of transfusion, its probable risks, and its benefits were only 8.2%, 2.4%, and 4.7%, respectively [16].

As for the blood request form, most of our study group correctly identified the items that should be filled for except "the indication of transfusing blood," and "the need for screening and testing of the patient's serum," only 70% and 58%, respectively knew it was to be mentioned in the blood request. However, these percentages were nonsignificantly improved after our educational session (89% and 75%, respectively), probably because this point was not adequately covered.

In Egypt, the pre transfusion routine screening includes HBV, HCV, HIV, and syphilis. Only a minority of our study group (18.4%) knew this fact; but this markedly improved post intervention to reach 85.8%.

Correct steps of patient identification before blood administration were enlisted as a priority to ensure safe blood transfusion practice. About 65% of our study participants correctly answered the questions covering this item, which was improved to 85% postintervention. Kavaklioglu and co-authors [15] found a similar percentage of almost 91%. While, it was observed by another study comprised 85 resident doctors; 13 of them were pediatricians in a tertiary care hospital in western India; that the correct responses about administration of blood components were 54.5% and 42.8% in the whole sample and pediatricians, respectively [17].

Transfusion reactions' knowledge was assessed in our study through a case scenario and the most identifiable cause was the transfusion related circulatory overload (TACO) which was correctly answered by almost 65% of our participants and reached 85% after intervention. In other studies, the percentages of the correct answers related to transfusion reactions were 54.3% in Philip and colleagues study [17], and 47% in Kumarage et al. [13]. While in Gharehbaghian et al. [14] study, 40% of the questions regarding transfusion reactions were replied correctly.

Only 12% of our study group knew about the procedure of national transfusion monitoring system and this markedly increased to about 88% after education. As for reporting the medical events during blood transfusion, less than 10% of our study group have ever reported them, and after our educational session; 32% of the participants were going to report events within the next month while about 68% of them were going to do it in a 6 months' time. This attitude definitely requires our attention as it might need a more tailored educational intervention to improve.

There were multiple factors helped the success of our educational intervention. First, the training was conducted by a pretrained team and the questionnaire was revised from experts making sure that it would not be so long. Second, the venue of the training was their work setting on their free time to ensure a good compliance. Third, we involved the team work of the places we visited including the hospital administrators whom offered a great support.

We still have some limitations. Depending on our results we might need more tailored program to tackle some specific issues like the recording of medical events and the transfusion reactions. Moreover, an observational study might be needed so to evaluate how this intervention actually improved the practice.

Conclusion

We achieved a significant improvement of the transfusion safety level of knowledge among participating pediatricians after the educational intervention. Both age and work experience were significant independent risk factor for pre-intervention poor knowledge of transfusion safety.

Author contribution

Shaimaa Sahmoud: Conceptualization, software, Writing- Reviewing and Editing. Esraa M Ashry: Data curation, Methodology. Mohamed El Kalioby: Supervision, Validation, Writing- Reviewing and Editing. Noha Kamel: Methodology, Writing- Original draft preparation.

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Conflicts of interest

The authors declare no competing interest.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.tmrv.2021.03.002.

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