

Improvement of Blood Utilization at a Governmental General Hospital in the State of Kuwait

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ABSTRACT: Background: Red blood cells (RBCs) transfusions have saved lives and expedited the recovery of illnesses to millions of patients. However, RBCs transfusions carry high risk of life threatening complications and economic burden. **Objectives:** The present study aimed at assessing the appropriateness of RBCs transfusion at one Ministry of Health hospital in Kuwait and to assess the effect of multiple interventions for improving the appropriateness of RBCs utilization. **Methods:** The present study used one group pre-test post-test quasi experimental design. To assess the appropriateness of RBCs transfusions, 185 records were reviewed in each of pre and post intervention phases. Improvement interventions included involvement of hospital administrators and heads of departments, development of the hospital transfusion guidelines, improvement of participant physicians' knowledge, and improvement of blood transfusion documentation. **Results:** The present study revealed 22.4% reduction in the total number of RBCs transfusions in the post intervention phase as compared to pre intervention phase. However, low rate of appropriateness of RBCs transfusion in pre intervention phase (40.4%) was encountered which was minimally improved to 46.5% following implementation of multiple improvement interventions. Physicians showed very low compliance with completion of the newly introduced blood transfusion request and consent forms. **Conclusion:** The appropriateness of red blood cells transfusions at the study hospital is low before and after implementation of the improvement interventions. Documentation of blood transfusion is deficient at the study hospital. It is recommended to strengthen the blood transfusion interventions used in the present study and to implement these interventions in Ministry of Health Hospitals in Kuwait to improve the appropriateness of RBCs transfusions.

INTRODUCTION

Blood transfusion is the process of transferring blood and its components from the circulation of one individual to that of another for therapeutic purposes. Instead of transfusing whole blood, specific components of the blood can be used

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individually, according to patient's needs, which is known as component therapy. The most commonly used component is red blood cells (RBCs).⁽¹⁾ Literature indicated high utilization of RBCs transfusions with a considerable proportion of this use being unnecessary. A study conducted in ten intensive care units in Scotland in 2004 reported that 40% of the intensive care unit admissions received RBCs transfusions.⁽²⁾ Another study conducted in Kuwait in 2005 on 159 consecutive primary coronary artery bypass graft patients indicated a high rate of RBCs transfusions, at a rate of 70.5% which leads to increased the chance of adverse events exposure and to high economic impact.⁽³⁾

Improvement of blood utilization and appropriateness of its use have been the focus of quality improvement activities of many international organizations⁽⁴⁻⁷⁾ due to several reasons, including the association of blood transfusion with many life threatening complications, logistics of

supplying blood for transfusions, practice variation without any clear beneficial effect of transfusion on patient outcome and economic reasons.⁽⁸⁾ In the United Kingdom, the total cost of blood transfusions was £898 million in 2000/2001.⁽⁹⁾ In Kuwait, the cost of a single RBCs transfusion is 80 Kuwaiti Dinar, equivalent to US\$ 240 in 2005.⁽³⁾

Strategies have been implemented with varying degree of success to improve appropriateness of blood transfusions, including the use of alternative treatment methods, establishment of hospital transfusion committee, adoption of RBCs transfusion guidelines, improvement of transfusion documentation, education and training, and creation of reminder systems.⁽¹⁰⁻¹⁷⁾ The alternative treatment methods include volume expanders, hormones, blood salvage, blood substitutes, and pharmacological methods.⁽¹⁰⁾ Establishment of hospital transfusion committee has been associated

with a decrease in blood utilization as reported by a study conducted in 2003 on 131 hospitals in Japan.⁽¹¹⁾ Adherence to transfusion guidelines has been reported to improve the appropriateness of the blood transfusion through standardizing practice variation of physicians.⁽¹²⁾ Moreover, recent guidelines⁽¹³⁻¹⁶⁾ which recommended reduction of hemoglobin level at which blood is transfused to patients were not associated with higher rates of morbidity or mortality. A study conducted in USA in 2006 reported that educating clinicians to improve documentation along with appropriate indications for transfusions may enhance efficiency of blood utilization assessment and lead to reduced rates of unjustifiable transfusions.⁽¹⁷⁾ During the year 2005, the number of units of blood used by governmental hospitals in Kuwait was 47148 units.⁽¹⁸⁾ In order to improve the quality of transfusion services and reduce the economic burden of blood transfusions, the present study aims at

assessing the appropriateness of blood transfusion at one Ministry of Health hospital in Kuwait and to assess the effect of multiple interventions for improving the appropriateness of RBCs utilization.

MATERIAL AND METHODS

The study was conducted at Farwaniya hospital, which is one of the six general governmental hospitals in the state of Kuwait. It is an 855-bed general hospital that operates its own blood bank in collaboration with the Central Blood Bank of Kuwait. The target population consisted of medical records of transfused patients who received RBCs transfusion during the period of the study in departments of Medicine, Surgery, Intensive Care, Causality, and Obstetrics and Gynecology. Orthopedics department was excluded because it was established during the period of study. Patients under 18 years of age and thalassemic patients were excluded because both groups had their own specific guidelines and indications for

blood transfusion.⁽¹⁹⁾

The present study used one group pre-test post-test quasi experimental design to examine the appropriateness of RBCs transfusions before and after implementing improvement interventions. A sample size of 185 records of RBCs transfused patients for each of pre-intervention and post-intervention groups was estimated⁽²⁰⁾ based on the assumptions that the proportion of patients receiving indicated RBCs transfusion before the implementation of the intervention is 50% and investigators are interested to detect 15% improvement in that proportion with 90% power and 5% one-sided level of significance. In pre-intervention phase, a sampling frame was prepared of medical records of all admitted patients who had one or more RBCs transfusion during the period from July 2008 to December 2008. The sampling frame was developed based on review of blood bank register which documents all

transfusions that occurred in the hospital.

Computer generated random numbers were used to select 185 records from the sampling frame to be reviewed. Two months following the interventions, records of all consecutive patients who received RBCs transfusion were reviewed to complete the required sample size. The study consisted of three phases:

I. Assessment of the appropriateness of RBCs transfusion before improvement interventions

A. During this phase literature review was conducted to identify recent guidelines concerning the indications of RBCs transfusion in adult population. Guidelines supported by well designed experimental studies and/or professional societies were selected.^(1,2,13-16) Recommended hemoglobin levels for different patient categories were identified, summarized and approved by the head of the Donation Department of the Central

Blood Bank of Kuwait as follows:

1. Anemic patients with high risk of bleeding (elderly patients >65 years old, patients at risk of heart disease, patients at risk for cerebrovascular disease, patients with chronic obstructive pulmonary disease, patients on sympatholytic medications) should be transfused at hemoglobin level less than 8g/dL.
 2. Clinically significant blood loss of at least 15% of estimated blood volume with evidence of inadequate oxygen delivery following volume resuscitation should be transfused at hemoglobin level less than 8g/dL.
 3. Acute anemia with acute myocardial infarction or unstable angina (not including chronic coronary artery disease) should be transfused at hemoglobin level less than 10g/dL.
 4. Anemic patients on chronic transfusion regimen (transfused every 3-5 weeks) should be transfused at hemoglobin level less than 7g/dL; excluding thalassemic patients.
 5. Perioperative anemic patients (prior, during or within 72 hours after an invasive procedure) should be transfused at hemoglobin level less than 8g/dL.
 6. Anemic critically ill patients (requiring any form of organ support such as intubation, ventilation or inotropes) excluding other anemic patient categories should be transfused at hemoglobin level less than 7g/dL.
 7. Anemic stable patients excluding other anemic patient categories should be transfused at hemoglobin level less than 7g/dL.
- B. Medical records of transfused patients were reviewed to collect socio-demographic, administrative and clinical data for the pre-intervention sample. Pre-transfusion hemoglobin level, number of units transfused, and date and volume of each unit

transfused were collected for each RBCs transfusion. The appropriateness of RBCs transfusion was assessed based on the approved hemoglobin level for different patient categories.

II. Implementation of quality improvement interventions to improve appropriateness of RBCs transfusions

A. Involvement of hospital administrators and heads of departments

Several meetings were held with the hospital director and the heads of the involved clinical departments, the head of the Quality and Accreditation Department, and the director of the Central Blood Bank. The meetings were conducted to present results of the pre-intervention assessment, to discuss the identified documentation deficiencies especially in the RBCs ordering and request forms and to gain their support for implementation of the proposed interventions.

B. Implementation of interventions to

improve appropriateness of RBCs transfusions Interventions were conducted over a period of two months and included the following:

1. Development of the study hospital transfusion guidelines based on the approved hemoglobin level for different patient categories.
2. Improvement of participant physicians' knowledge

An educational session in the form of a lecture followed by group discussion was conducted by the hematology consultant at the study hospital and the head of Donation Department of the Central Blood Bank of Kuwait at each of the involved clinical departments. The session aimed at improving physician's knowledge regarding recent RBCs transfusion guidelines and their clinical benefits. An educational CD was distributed to participant physicians that included the recommended hemoglobin levels for different patient categories, recent literature supporting the

developed guidelines, presentation of the given lecture and the proposed RBCs request and consent forms.

3. Modification of the existing RBCs ordering form, and development of a RBCs transfusion consent form according to recent blood transfusion documentation guidelines.^(21,22)

4. Assessment of senior physicians' agreement

Following the educational sessions, agreement of the two most senior physicians of the involved clinical departments regarding the recommended transfusion hemoglobin level was sought through a self-administered questionnaire. The questionnaire consisted of questions about participants' agreement or disagreement with the proposed recorded hemoglobin level in requesting RBCs transfusion for patient categories. Additional comments were encouraged to cover any additional aspects that

were missed for each category.

III. Assessment of RBCs transfusion practices after conducting the improvement interventions

This was done two months after the interventions using the same data collection form that was used in the pre-intervention phase. Records of 185 consecutive patients who received one or more RBCs transfusion were reviewed.

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 13.0.⁽²³⁾ Chi-square test was used to assess the association for categorical variables. In case of sparse data, the Fisher's exact probability was used as indicated. For continuous variables, the difference among indicated and not indicated groups was tested using t-test. In case of non-normality, nonparametric test was used (Mann-Whitney test) for comparing pre and post-intervention groups. The cut-off value for statistical significance was set at 0.05.⁽²⁴⁾

RESULTS

A total of 185 patients records were reviewed in each of in each of pre-intervention and post-intervention phases. The total number of RBCs transfusions was 549 in pre-intervention phase and 426 transfusions in post-intervention phase. Table 1 shows that the age group between 18 and 39 years had the highest frequency among pre and post-intervention groups, being 37.3% and 49.2%, respectively. Females had a higher percentage than males among both study groups, being 56.8% among pre-intervention group and 71.9% among post-intervention group. There is statistically significant difference regarding gender between pre and post-intervention groups ($p= 0.002$). Non-Kuwaitis had a higher percentage among both study groups, which was higher in post-intervention (70.3%) than pre-intervention (56.8%); the difference is statistically significant ($p= 0.007$). Both groups showed higher frequency of

emergency admissions, being non-operated upon, and no Intensive Care Unit admission. These variables are not statistically significantly different between pre and post-intervention groups. Medical department had the highest frequency (33.5%) among the admitting departments in the pre-intervention group while Obstetrics and Gynecology department had the highest frequency (38.4%) among the admitting departments in the post-intervention group with no statistically significant difference between both groups regarding the admitting department.

Table 2 shows that pregnancy was the most common diagnosis among patients who received RBCs transfusions in pre and post-intervention phases, being 10.8% and 11.3%, respectively. Upper gastrointestinal bleeding ranked second in both study groups, being 8.7% in pre-intervention and 10.2% in post-intervention. Iron deficiency anemia ranked third in pre and post-intervention groups, being 4.9%

and 8.1%, respectively. The three diagnoses represented 24.4% of diagnoses in pre-intervention patients and 29.6% of diagnoses in post-intervention patients. Regarding performed procedures, upper gastrointestinal endoscopy had the highest percentage among pre and post-intervention groups, being 30.0% and 25.4%, respectively. Lower segment cesarean section ranked second in both study groups representing 28.6% in pre-intervention group and 17.0% in post-intervention group. Debridement ranked third in both study groups representing 5.7% in pre-intervention group and 6.8% in post-intervention group.

Table 3 shows that patients who received 2 to 4 RBCs transfusions had the highest frequency among pre and post-intervention groups, being 53.0% and 54.1%, respectively. The percentage of patients who received single blood transfusion was higher among post-intervention group (36.2%) than among

pre-intervention group (29.2%). The median number of RBCs transfusions was equal in pre and post-intervention study groups (2.0 units of blood). There is no statistically significant difference between both groups regarding the number of RBCs transfusions.

Regarding not-operated upon cases, pre-transfusion hemoglobin level between 7g/dL to less than 8g/dL had the highest percentage among pre and post-intervention groups; being 44.2%, and 37.3% respectively (Table 4). Pre-transfusion hemoglobin level less than 7g/dL ranked second among pre and post-intervention groups. For operated upon cases, pre-transfusion hemoglobin level between 7g/dL to less than 8g/dL had the highest percentage among pre and post-intervention groups; being 38.6% and 40.8%, respectively. Pre-transfusion hemoglobin level between 8g/dL to less than 9g/dL ranked second among operated upon pre-intervention group (23.6%) while

pre-transfusion hemoglobin level less than 7g/dL ranked second among operated upon post-intervention group (23.8%). There are no statistically significant differences between pre and post-intervention groups regarding pre-transfusion hemoglobin for both operated and not-operated upon cases.

Results of the present study showed that the majority of physicians (8-9) agreed to the recommended hemoglobin levels (Table 5). Minimal comments were made by senior physicians, where one or two senior physicians recommended increasing the level at which RBCs transfusions should occur for three patient categories which were patients with clinically significant blood loss, patients on chronic transfusion regimen, and perioperative anemic patients. One or two senior physicians recommended lowering the level at which RBCs transfusions should occur for three patient categories which were anemic patients with high risk of bleeding, anemic critically ill patients excluding other anemic patient categories, and anemic stable patients excluding other anemic patient

categories.

Table 6 shows that the range of appropriateness of blood transfusion in the pre-intervention phase was between 22.2% and 94.1%. The highest percentage (94.1%) of appropriate RBCs transfusions was among anemic patients who had acute myocardial infarction or unstable angina. The range of appropriateness of blood transfusion in the post-intervention phase was between 33.3% and 100.0%. The highest percentage (100.0%) of appropriate RBCs transfusions was among patients with clinically significant blood loss and anemic patients who had acute myocardial infarction or unstable angina. Statistically significant improvement in appropriateness of RBCs transfusions is demonstrated among one patient category only which was anemic stable patients not suffering from other specific conditions ($p= 0.02$).

Physicians showed very low compliance with completion of the newly introduced blood transfusion request form and consent forms. Out of 426 red blood transfusions, 15 request

forms were completed. While analysis of out of 185 patients who received RBCs the newly introduced consent form during transfusions, 10 consent forms were the post intervention phase revealed that documented.

Table (1): Distribution of study sample of patients who received RBCs transfusions according to demographic and administrative characteristics in pre and post-intervention phases

Characteristic	Pre-Intervention n = 185		Post-Intervention n = 185		p-value
	No.	%	No.	%	
Age (Years)					
18 – 39	69	37.3	91	49.2	
40 – 59	60	32.4	53	28.6	
≥ 60	56	30.3	41	22.2	
Mean ± SD	48.3 ±18.5		44.0 ±18.1		0.06
Gender					
Male	80	43.2	52	28.1	0.002*
Female	105	56.8	133	71.9	
Nationality					
Kuwaiti	80	43.2	55	29.7	0.007*
Non Kuwaiti	105	56.8	130	70.3	
Admission type					
Elective	6	3.2	3	1.6	0.34
Emergency	179	96.8	183	98.4	
Operated-upon					
Yes	70	37.8	59	31.9	0.23
No	115	62.2	126	68.1	
ICU admission during reviewed episode					
Yes	47	25.4	38	20.5	0.27
No	138	74.6	147	79.5	
Admitting department					
Medical	62	33.5	60	32.4	0.05
Surgical	25	13.5	24	13.0	
Obst & Gyn	48	25.9	71	38.4	
ICU	36	19.5	20	10.8	
Casualty	14	7.6	10	5.4	

ICU = Intensive Care Unit, Obst & Gyn = Obstetrics and Gynecology, * = Statistically Significant

Table (2): Distribution of the 5 leading diagnoses and performed operations for patients who received RBCs transfusions in pre and post-intervention phases

Diagnosis / Procedure	Pre-intervention			Post-intervention		
	Rank	No.	%	Rank	No.	%
Diagnosis						
Pregnancy	1	20	10.8	1	21	11.3
Upper gastrointestinal bleeding	2	16	8.7	2	19	10.2
Iron deficiency anemia	3	9	4.9	3	15	8.1
Unstable angina	4	8	4.3	-	0	0.0
Septicemia	5	7	3.8	-	0	0.0
Medical abortion	8	5	2.7	4	10	5.4
Menorrhagia	-	0	0.0	5	9	4.9
Procedure						
Upper gastrointestinal endoscopy	1	21	30.0	1	15	25.4
Lower segment cesarian section	2	20	28.6	2	10	17.0
Debridement	3	4	5.7	3	4	6.8
Spontaneous vaginal delivery	4	4	5.7	4	3	5.1
Incision and dilatation	5	3	4.3	-	0	0.0
Excision and curettage	-	0	0.0	5	3	5.1

Table (3): Distribution of patients who received RBCs transfusions in pre and post-intervention phases according to the number of transfusions

Number of RBCs transfusions	Pre-Intervention n = 185		Post-Intervention n = 185		p-value
	No.	%	No.	%	
Single	54	29.2	67	36.2	
2- 4	98	53.0	100	54.1	
5 - 7	19	10.3	14	7.6	
8 - 10	8	4.3	3	1.6	
>10	6	3.2	1	0.5	
Total transfusions	549		426		0.06
Median	2.0		2.0		
IQR	2.5		2.0		

IQR = Interquartile Range

Table (4): Distribution of RBCs transfusions in pre and post-intervention phases according to pre-transfusion hemoglobin level

Pre-transfusion hemoglobin	Pre-Intervention n = 549		Post-Intervention n = 426		p-value
	No.	%	No.	%	
Not operated-upon					0.08
< 7g/dL	82	26.6	92	33.0	
7- g/dL	136	44.2	104	37.3	
8- g/dL	73	23.7	60	21.5	
9- g/dL	12	3.9	21	7.5	
> 10 g/dL	5	1.6	2	0.7	
Subtotal	308	100.0	279	100.0	
Operated-upon					0.57
< 7g/dL	50	20.8	35	23.8	
7- g/dL	93	38.6	60	40.8	
8- g/dL	57	23.6	25	17.0	
9- g/dL	29	12.0	21	14.3	
> 10 g/dL	12	5.0	6	4.1	
Subtotal	241	100	147	100	

Table (5): Agreement of ten senior physicians at the study hospital regarding the recommended RBCs transfusion hemoglobin level

Patient Categories	Recommended transfusion hemoglobin level	Agreed physicians		Comments
		No.	%	
Anemic patients with high risk of bleeding	less than 8g/dL	8	80	Indicated hemoglobin level must be below 7 g/dL
Clinically significant blood loss	less than 8g/dL	8	80	Indicated hemoglobin level must be below 9 g/dL
Acute anemia with acute MI or unstable angina+	less than 10g/dL	9	90	-----
Anemic patients on chronic transfusion regimen++	less than 7g/dL	9	90	Indicated hemoglobin level must be below 10 g/dL
Perioperative anemic patients hemoglobin level	less than 8g/dL	8	80	If major surgery it must be below 10 g/dL
Anemic critically ill patients excluding other anemic patient categories	less than 7g/dL	8	80	Indicated hemoglobin level must be below 6 g/dL
Anemic stable patients excluding other anemic patient categories	less than 7g/dL	8	80	Indicated hemoglobin level must be below 6 g/dL

MI = Myocardial Infarction, + = not include chronic coronary artery disease, ++ = excluding thalassemic patients

Table (6): Appropriateness of red blood transfusions among different patient categories in the pre and post-intervention phases

Patient categories	Recommended transfusion hemoglobin level	Pre-Intervention		Post-Intervention		p-value
		No. of Transfusion	Transfusion fulfilling the recommended hemoglobin level No. %	No. of Transfusion	Transfusion fulfilling recommended hemoglobin level No. %	
Anemic patients with high risk of bleeding	less than 8g/dL	116	63 54.3	50	22 44.0	0.23
Clinically significant blood loss	less than 8g/dL	38	25 65.8	7	7 100.0	0.09
Acute anemia with acute MI or unstable angina+	less than 10g/dL	17	16 94.1	32	32 100.0	0.35
Patients on chronic transfusion regimen++	less than 7g/dL	33	16 48.5	23	11 47.8	0.96
Perioperative anemic patients	less than 8g/dL	110	48 43.6	81	43 53.1	0.20
Anemic critically ill patients excluding other anemic patients	less than 7g/dL	108	24 22.2	75	25 33.3	0.10
Anemic stable patients excluding other anemic patient categories	less than 7g/dL	127	30 23.6	158	58 36.7	0.02*
Total		549	222 40.4	426	198 46.5	0.06

MI = Myocardial Infarction, + = not include chronic coronary artery disease, ++ = excluding thalassemic patients, * = Statistically Significant

DISCUSSION

In Kuwait, the high burden of blood transfusion in the form of costs and complications was reported in previous study.⁽³⁾ The present study aimed at assessing and improving the appropriateness of blood transfusion at one of Ministry of Health hospitals in Kuwait. Before assessing the effect of the improvement interventions, comparisons between the characteristics of patients who received RBCs transfusions was conducted to identify important differences between both groups. Regarding demographic and administrative characteristics, gender and nationality were the only statistically significant different variables between transfused patients before and after implementation of blood transfusion interventions. However, in both pre and post intervention groups, non-Kuwaiti females had the highest frequency of RBCs transfusions (Table 1). Gender was found to have no effect on

appropriateness of blood transfusion in a study conducted in France in 2006.⁽²⁵⁾ Moreover, literature review did not identify any study that investigated the effect of nationality on appropriateness of blood transfusion. Analysis of the 5 leading diagnoses and performed operations for patients who received RBCs transfusions in pre and post-intervention phases revealed identical rank of the most frequent 3 diagnoses in both study groups and similarity of the first 3 frequent operations between both study groups (Tables 2). This indicates that both groups were not different with regard to the majority of investigated demographic factors, administrative characteristics, diagnoses and operations.

Assessment of the utilization of RBCs transfusions in the present study before and after implementation of the RBCs improvement interventions revealed reduction of the number of RBCs transfusions in the post intervention phase

(426 RBCs transfusions) as compared to pre-intervention phase (549 RBCs transfusions). This represents 22.4% reduction in the use of RBCs. In addition, the percentage of patients who received single RBCs transfusion was higher among post intervention group (36.2%) than among pre-intervention group (29.2%) (Table 3). Although it has been reported that transfusion of one unit in an adult usually indicates that transfusion was not needed at all⁽²⁶⁾, a study published in 2009 endorsed the use of single-unit transfusion as a strategy for reducing the consumption of donor blood when the transfusion hemoglobin trigger is strict.⁽²⁷⁾ This indicates reduction in the number of RBCs transfusions in post-intervention phase and increase in the percentage of single unit transfusion. However, the difference in the distribution of the number of units of RBCs transfused was not statistically significant between groups. The present study also showed that higher percentages of both

operated and not operated upon patients in post intervention phase had pre-transfusion hemoglobin level less than 7g/dL. Moreover, lower percentage of both operated and not operated upon patients in post intervention phase had pre-transfusion hemoglobin level more than 10g/dL (Table 4). This indicates reduction of the level at which blood was transfused to patients in the post intervention group.

Assessment of the appropriateness of RBCs transfusions in the pre-intervention phase revealed a low rate (40.4%) of appropriate RBCs blood transfusion. Following implementation of multiple improvement interventions, the level of appropriateness of RBCs transfusions was 46.5% which represent minor improvement in the appropriateness of RBCs transfusions. This indicates high level of inappropriate RBCs transfusion in pre and post intervention phases at the study hospital. Several studies that assessed the appropriateness of RBCs transfusion using

different methodologies reported lower percentage of inappropriateness ranging between 3% to 29%.⁽²⁸⁻³⁰⁾ This indicates the importance of the problem at the study hospital and urges authorities at the Ministry of Health of Kuwait to start improvement projects to reduce this high level of inappropriateness

In spite of the use of several interventions which were recommended in the literature,⁽³¹⁾ the present study did not reveal significant improvement (6.1% improvement in RBCs transfusions appropriateness) (Table 6). Similar findings supports the difficulty in achieving noticeable improvement in the appropriateness of RBCs transfusions across several settings in different countries.⁽³²⁻³⁴⁾ Developing and disseminating clinical guidelines or conducting training alone was reported to be ineffective.⁽³⁵⁾ Consequently, studies^(29,36,37) suggested the use of multiple types of innovative interventions

including physicians computerized decision support system⁽³⁷⁾ and Six Sigma/Change Acceleration Process (CAP) methodology⁽²⁹⁾ to strengthen the effect of improvement.

The appropriateness of RBCs transfusion in patients' subpopulations was evaluated based on categorizing patients into seven categories according to patients' conditions (Table 6). Out of these seven categories, five showed improvement in the appropriateness of RBCs transfusions in the post intervention phase and two categories showed reduction of appropriateness of RBCs transfusions following the implementation of improvement interventions. "Anemic stable patients excluding other anemic patient categories" represented 23.1% of pre-transfusion conditions in the pre-intervention phase and 37.1% in the post-intervention phase. This patient category was the only category which showed statistically significant improvement. This

might be attributed to the large sample size of this group and senior physicians' agreement to transfuse RBCs at the recommended level or even below the recommended level (6g/dL). Moreover, being stable anemic patients, this might have encouraged physicians to wait till the recommended lower level hemoglobin (below 7 g/dL) is reached. The improvement in appropriateness of RBCs transfusions in the remaining four categories ranged from 5.9% to 34.2% and is not statistically significant. This might be attributed to the smaller sample size of the four groups than the "Anemic stable patients excluding other anemic patient categories" group and the small percentage of improvement in appropriateness of RBCs transfusion between pre and post-intervention groups. In addition, the statistical testing of improvement in two categories namely, clinically significant blood loss and acute anemia with acute myocardial infarction or

unstable angina can not be reliably determined as the level of inappropriateness in the post-intervention phase was zero.

The study indicated that pregnancy and childbirth diagnoses and the female genital organ operations were responsible for large proportion of patients who received RBCs transfusions (Table 2). Several studies^(33,38) indicated that inappropriate blood transfusion is high among these groups of patients. A study conducted in Netherlands⁽³⁸⁾ reported that the rate of RBCs transfusions that were possibly inappropriate in post-partum period to be 46% while another study conducted in Canada⁽³³⁾ in 2004 found that the level of inappropriate RBCs transfusion among peripartum patients to be 32%. This indicates the importance of targeting new interventions towards this group of patients through development of specific protocols for management of these groups that incorporate specific indication for RBCs

transfusions.

The present study showed deficiencies in both blood transfusion request and consent forms during pre-intervention phase. As studies^(32,39) indicated that modifying blood transfusion documentation reduces the inappropriateness of blood transfusions, the present study developed a new blood transfusion request and consent forms. Although, adequate clarifications of the importance of request and consent forms were provided during physician's educational sessions, low compliance of completion of both forms was found. This might be attributed to a number of reasons including lack of senior physicians' leadership in completion of transfusion related medical record forms, physicians workload and the introduction of both forms as a part of the research process rather than being part of the hospital's medical record forms. In 2009, a study showed that strong leadership is an important factor in physician's

documentation.⁽⁴⁰⁾ Another study conducted in 2008 reported that workload is a prominent influential factor in the quality of documentation.⁽⁴¹⁾ Senior physicians' role modeling and inclusion of the newly developed forms in the hospitals' formal documentation system might improve physicians' documentation of request and consent forms with the aim of improving appropriateness of RBCs transfusions.

The present study had a few limitations including the non-randomized nature of study which has many disadvantages such as inability to control confounding factors and potential biases. On the other hand, the small sample size and the heterogeneity of groups being studied (all patient categories) might have hindered the appearance of the effect of the interventions. More homogenous groups are needed to be targeted in future studies. However, these limitations did not devalue our primary goal of demonstrating the presence of inappropriateness of RBCs

transfusions and the ability to create models in governmental hospitals in Kuwait to reduce this documented inappropriateness.

Conclusion and recommendations

The appropriateness of RBCs transfusions at the study hospital is low before and after implementation of the improvement interventions. Implemented interventions successfully improved appropriateness of RBCs transfusions for one category only of patients. Documentation of blood transfusion is deficient at the study hospital. Based on the study findings, the following recommendations can be suggested:

1. Strengthen blood transfusion interventions used in the present study through addition of innovative interventions such as transfusion computerized decision support system.
2. Disseminate the educational material and conduct lectures in other Ministry of

Health Hospitals in Kuwait in order to improve the appropriateness of blood transfusion in these hospitals.

3. Implement transfusion guidelines and other interventions proposed in this study at other Ministry of Health Hospitals in Kuwait and continuously monitor its effectiveness.
4. Incorporation of the newly developed blood transfusion documentation forms in the formal Ministry of Health patient record forms in order to improve physician's compliance with documentation.
5. Conduct an in-depth study for reasons for non-compliance with approved hospital blood transfusion guidelines and blood transfusion documentation.

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