

# Perioperative transfusion of red cell products in patients operated at general surgical units of National Hospital of Sri Lanka

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## Abstract

Indications for red cell transfusion among general surgical patients have changed over time. Despite a scarcity in evidence, many international guidelines advocate a restrictive transfusion protocol.

**Objectives:** To describe the red cell transfusion practices including transfusion thresholds in general surgical wards of a tertiary hospital in Sri Lanka.

**Methods:** A descriptive cross-sectional study was done in all general surgical units of the National Hospital of Sri Lanka, Colombo. All patients transfused with red cell products for a 3-month period from 1/5/2017-1/8/2017 were included in the study. Indications for transfusion, haemoglobin at transfusion and the number of units transfused was the primary data recorded.

**Results:** A total of 196 patients were included in the study. Most transfusions 79.08% (n=155) were for elective reasons. Most elective transfusions were to facilitate chronic extremity wound healing (52.2%, n=81). Most emergency transfusions were for intraoperative bleeding (31.7%, n=13). The majority (73.5%, n=114) of elective transfusions occurred at a Hb of 7-10 g/dL. The mean number of RBC units transfused in elective circumstances for a Hb of 7-10 g/dL was 1.59. A pre-transfusion blood picture was not available in over 85% (n=132) of elective transfusions. Only a single febrile non-haemolytic transfusion reaction was reported.

**Conclusions:** The study revealed substantial divergence of red cell transfusion thresholds in perioperative practice when compared with international guidelines, non-adherence to rational practice such as obtaining a blood picture prior to elective transfusion and therefore the need to formulate local guidelines. It also highlighted the transfusion burden of diabetic foot disease.

## Introduction

Thresholds for perioperative red cell transfusions vary between surgical units and institutions. Historically, the target of red cell transfusion has been to conform to the “10/30 rule”, i.e., to maintain a haemoglobin (Hb) of 10 g/dl and a haematocrit of 30 [1]. The rationale for this was that it improved oxygen delivery to tissues.

However, oxygen delivery to tissues can be maintained in healthy individuals by physiological adaptations such as an increase in cardiac output, a right shift of the oxygen – haemoglobin dissociation curve and reduced peripheral vascular resistance caused by the reduced viscosity of blood. In healthy individuals, there is a 4-fold excess of oxygen delivery over consumption and tissue oxygenation can be maintained at haematocrits as low as 15 [1]. Cognitive function though is impaired at Hb levels less than 5g/dl, and these compensatory mechanisms are dysfunctional in the critically ill, who may require higher Hb levels to maintain tissue oxygenation [1].

Concerns regarding transfusion reactions, the transmission of blood borne infections and increased costs have also led to a review the “10/30” rule [2]. Red cell transfusions cause both immune and non-immune reactions and despite screening, the risk of HIV, Hepatitis B and C transmission also exists [3, 4]. Transfusion related mortality in the USA was reported to be 2.5 deaths per one million units transfused in 2006 [5]. Liberal intra-operative blood transfusions are also related to increased surgical site infections [6].

Outcomes related to red cell transfusions in those with solid organ malignancies have been mixed. Perioperative transfusions in gastric cancer have shown lower survival rates though this pattern was not reflected in colorectal cancer patients [7-11].

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Though data from randomized clinical trials to support evidence-based transfusion practice is limited [7], the American Association of Blood Banks (AABB), the United Kingdom National Clinical Guideline Centre and the American Society of Anaesthesiologists (ASA) largely recommend a restrictive protocol for the management of low Hb in perioperative settings.

In haemodynamically stable patients, including the critically ill, a restrictive Hb transfusion threshold of 7g/dL is recommended [8]. The TRISS (Transfusion Requirements in Septic Shock) trial demonstrated that in the absence of ischaemic heart disease, restrictive transfusions had mortality rates similar to liberal transfusions in patients with septic shock [9]. A transfusion Hb threshold of 7g/dL is also recommended in orthopaedic and cardiac surgical patients [10]. However, for general surgical procedures, such recommendations are not well defined, probably due to the heterogeneity in the scope of procedures and resulting data. This is mirrored in transfusion policies for patients with multiple comorbidities [11]. Nevertheless, it would not be injudicious to extrapolate the aforementioned recommendations of a restrictive transfusion Hb threshold of 7g/dL to general surgical patients without coronary artery disease.

The TRICC trial (Transfusion Requirements in Critical Care) demonstrated that a restrictive protocol (Hb <7g/dL) in coronary heart disease patients was associated with lower mortality. A meta-analysis conducted in 2016 contradicted this indicating that a restrictive protocol (Hb < 8 g/dL) may not be safe in coronary heart disease patients [12]. The meta-analysis itself was subject to criticism since all relevant studies had not been included in the study.

Thus, the question of a safe Hb threshold for transfusion of asymptomatic coronary heart disease patients is still subject to debate. A restrictive protocol of transfusion is recommended for patients with ischaemic heart disease who are critically ill, with a Hb >7g/dL considered acceptable for stable angina and a Hb of > 8-9 g/dL in acute coronary syndromes [13].

Interestingly, recommendations and guidelines on Hb thresholds for RBC transfusion to facilitate healing of chronic wounds, in particular extremity wounds, are scarce. This again may be explained by the heterogeneous prevalence and severity of cardiovascular, renal and peripheral occlusive arterial disease in this patient group impacting interpretation of outcomes. Conventional wisdom would suggest that the threshold for RBC transfusion should be lower in this group, considering that most have diabetes with compromised cardiac function and poor quality blood vessels [14, 15]. The actual threshold is not defined but is likely to be beyond the 7 g/dL recommended in restrictive transfusion protocols. Consensus empirical practice among most surgeons globally is to maintain a Hb of at least 10 g/dL when caring for chronic extremity wounds.

Red cell transfusions for anaemia are often dependent on the presence and severity of symptoms [16]. A more liberal approach is adopted in coronary artery disease [17] with RBC transfusions recommended in symptomatic patients when the Hb <10g/dL.

Alternatives or adjuncts to transfusion, especially in elective situations, include the use of haematinics. Early identification of the aetiology of anaemia utilising blood pictures and iron studies facilitates the timely administration of haematinics including iron, vitamin B<sub>12</sub> and folate by the oral or parenteral routes depending on circumstances [18, 19]. In selected patients including those with chronic kidney disease, pre-procedural erythropoietin is appropriate.

These strategies reduce perioperative transfusion requirements with attendant advantages [19]. Parenteral iron in combination with erythropoiesis stimulating agents has been shown to reduce the need for blood transfusions in chemotherapy patients [20].

In Sri Lanka, in-patient health care is delivered free by the state sector with no formal estimation of transfusion related costs has been made [21]. However, the cost of transfusing a single unit of red cells in the private sector ranges from 10-30,000 rupees (USD 50-150) at present. These figures give an indication of the substantial financial costs associated with red cell transfusions.

Anecdotal evidence points to high perioperative red cell transfusion rates in local surgical practice with no available published data. Reports from South Asia including India on this subject are also scarce [22]. Guidelines for perioperative transfusion appear to be limited to specific patient groups (e.g. orthopaedic and cardiac patients). Furthermore, guidelines are not available for red cell transfusions to optimise wound healing in patients with chronic wounds. In the absence of national guidelines, the objective of this study was to evaluate red cell transfusion practices of selected surgical units and assess their conformity to available international guidelines.

## Methods

This was a descriptive cross-sectional study done in all general surgical units of the National Hospital of Sri Lanka, Colombo. All patients transfused with red cell products for a 3-month period from 1/5/2017- 1/8/2017 were included in the study. Patients with peripheral occlusive arterial disease with chronic leg wounds were excluded. Data was extracted from bed head tickets using a data extraction form.

Indications and magnitude of transfusions, threshold for transfusion and transfusion reactions were assessed in the study. For the purpose of this study, emergency transfusions included blood given within 24 hours of active bleeding or prior to an emergency surgical procedure done within 24 hours. All other transfusions were categorised as elective.

Coded responses were entered, summarized and analysed using the “IBM SPSS Statistics” software package. Data were presented using frequency distributions and mean values. Associations were analysed using chi square test. A p value of <0.05 (95% CI) was considered as statistically significant.

## Results

### Demography

A total of 196 patients were recruited during the study period.

The male to female ratio was 3.04:1. Most transfusions occurred in the 50-59 (n=50, 25.5%) and 60-69 (n=49, 25%) year age group (Figure 1).

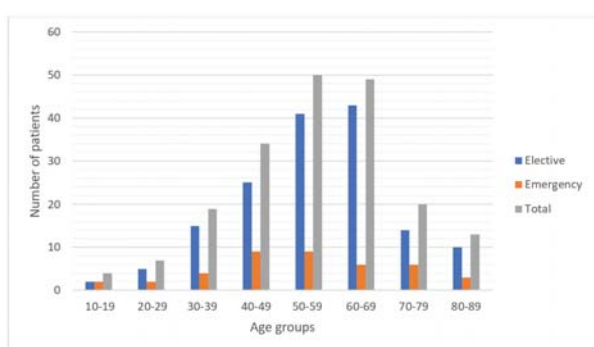


Figure 1. Indications for transfusion.

### Indications for transfusion

Most red cells transfusions 79.08% (n=155) were given on an elective basis, while 20.91% (n=41) were transfused for emergencies (Table 1a and 1b). The commonest indication for elective transfusions was the management of chronic extremity wounds or ulcers (52.2%, n=81). Pre-operative optimization (21.4%, n=34) and symptomatic anaemia (11.6%, n=18) were the other leading indications for elective transfusions (Table 1a). Common indications for emergency transfusions included intraoperative bleeding (31.7%, n=13), preparation for emergency surgery or other interventions (26.8%, n=11) and upper gastrointestinal bleeding (19.5%, n=8) (Table 1b).

### Transfusion threshold

Overall, RBC transfusion thresholds are summarised in Table 2. The majority (73.5%, n=114) of elective transfusions occurred at a Hb of 7-10 g/dL, while only about a quarter of those transfused had a Hb < 7 g/dL. Similarly, most emergency transfusions (51.3%, n=21) occurred at a Hb of 7-10 g/dL, while a minority (14.6%,

n=6) received transfusions at a Hb > 10g/dL. Fifty-one (51) patients received elective pre-procedural transfusions for surgical procedures, skin grafts and biopsies. Amongst them, the majority 68.6% (n=35) were transfused at a Hb between 7-10 g/dL and the rest 31.4% (n=16) at a Hb < 7g/dL (Table 3).

### Magnitude of transfusion

The mean number of RBC units transfused in elective circumstances for those with a Hb of 7-10 g/dL was 1.59. The majority (90.3%, n=102) received 2 units or less (range 1-6 units). The mean for those whose Hb < 7g/dL was higher at 2.07 units (Table 4). The mean RBC units transfused for emergencies at a Hb of 7-10 g/dL and Hb < 7g/dL were 2.05 (range 1-5) and 2.07 (range 1-4) respectively.

Table 1a. Indications for elective transfusion

Indication	No	%
Rectal bleeding	4	2.5
NSTEMI	1	0.6
Optimisation – procedural*	10	6.4
Optimisation – pre-operative	34	21.9
Optimisation – split skin graft	7	4.5
Symptomatic anaemia**	18	11.6
Optimization for wound healing	81	52.2
<b>Total</b>	<b>155</b>	<b>100.0</b>

\*Procedures: Endoscopy (n=4) and USS guided percutaneous aspiration (n=6)

\*\*Symptomatic anaemia: symptomatic anaemia alone (n=16), symptomatic anaemia with acute haemolysis (n=1) and symptomatic anaemia with ischaemic heart disease (n=1)

Table 1b. Indications for emergency transfusion

Indication for transfusion	N	%
Acute haematuria	1	2.4
Acute rectal bleeding	1	2.4
Acute upper GI bleeding	8	19.5
Acute haemolysis	1	2.4
Intraoperative bleeding	13	31.7
Preparation for emergency procedure	11	26.8
Postoperative bleeding	6	14.6
<b>Total</b>	<b>41</b>	<b>100.0</b>

**Table 2. Haemoglobin threshold for blood transfusion**

<i>Hb level (g/dL)</i>	<i>Situation</i>		
	<i>Elective No. (%)</i>	<i>Emergency No. (%)</i>	<i>Total No. (%)</i>
< 7	41 (26.5)	14 (34.1)	55 (28.1)
7-10	114 (73.5)	21 (51.3)	135 (68.9)
>10	0 (0.0)	6 (14.6)	6 (3.0)
<b>Total</b>	<b>155 (100.0)</b>	<b>41 (100.0)</b>	<b>196 (100.0)</b>

**Table 3. Indications for elective transfusions and Hb thresholds for elective transfusions**

<i>Indication</i>	<i>Hb</i>			<i>Total</i>
	<7	7 -10	>10	
Optimisation – procedural	6	04	0	10
Optimisation – pre-operative	10	24	0	34
Optimisation – SSG	1	06	0	07
Symptomatic anaemia	14	04	0	18
Wound healing	10	71	0	81
NSTEMI	0	01	0	01
Rectal bleeding	0	04	0	04
<b>Total</b>	<b>41</b>	<b>114</b>	<b>0</b>	<b>155</b>

**Table 4. Magnitude of RBC transfusion at different haemoglobin levels (units transfused)**

<i>Situation</i>	<i>Number of units transfused</i>	<i>Hb level (g/dL)</i>		
		< 7	7-10	>10
Elective	Mean	2.07	1.59	-
	SD	0.959	0.831	
Emergency	Mean	2.07	2.05	1.83
	SD	0.829	1.117	1.329

A pre-transfusion blood picture was not available in over 85% (n=132) of those who received elective transfusions. Table 6 shows the distribution of results in the remainder who had a pre-transfusion blood picture. In patients with microcytic hypochromic anaemia, only 2 patients had iron studies performed.

#### Post transfusion supplementation

Post transfusion iron supplementation was

prescribed to 17.4% (27/155) of those who received elective transfusions and 9.75% (4/41) after emergency transfusion (Table 5).

#### Transfusion reactions

Only a single febrile non-haemolytic transfusion reaction was reported in the entire study group during an elective transfusion.

**Table 5. Availability of blood picture in elective transfusions**

<i>Blood Picture</i>	<i>No</i>	<i>%</i>
Not Available	132	85.1
Available*	23	14.9
<b>Total</b>	<b>155</b>	<b>100.0</b>

\*NCNC (normocytic normochromic) n=13, MCHC (microcytic hypochromic) n=7, Others n=3

## Discussion

This study sought to compare red cell transfusion practices of general surgical units in a tertiary hospital with established international and national guidelines. Anecdotal evidence pointed to low thresholds for transfusion in perioperative patients and others largely guided by empirical practice. In the absence of national guidelines, the results were matched with international guidelines and recommendations.

In this study, a third of elective RBC transfusions were for peri-procedural or perioperative optimisation. In this group, more than 2/3rds were transfused at a Hb between 7-10 g/dL, in excess of the restrictive transfusion recommendations prescribed in international guidelines, though lack of data on the proportion of patients with CAD in this cohort was a limitation. Only a third, (31.4%, n=16) received transfusions at a Hb < 7 g/dL in line with recommendations.

These results also highlight the transfusion burden of extremity wound healing which accounted for more than half of all elective transfusions. In the absence of established guidelines, the vast majority in this group were transfused at a Hb of 7-10 g/dL and the rest below 7 g/dL, in conformity with current global practice. Further study is warranted on the thresholds for red cell utilisation in this group, especially with the high prevalence of diabetes and related foot morbidity requiring surgery in the Sri Lankan context, as also reflected in this study.

Most emergency transfusions were in the context of emergency surgery, intra-operative bleeding and acute gastrointestinal bleeding. Transfusion in these circumstances is largely dictated by haemodynamic status rather than Hb levels which can be misleading in the acute phase.

The Hb rise in a 70 kg adult following a unit of packed RBC transfusion is 1-1.5 g/dL. Though the threshold for red cell transfusion was below prescribed levels in the elective pre-procedural group, the number of units transfused in both the 7-10 and 7 g/dL groups was at an acceptable at 1.5-2 units per patient.

A major shortcoming exposed by this study was the poor adherence to standards of care in identifying the aetiology of anaemia and the use of supplements. The

majority of patients transfused electively did not get a blood picture, an inexpensive and reliable investigation, prior to transfusion. The performance of iron studies also was negligible. This negates the benefits of using appropriate haematinics such as iron and vitamin B<sub>12</sub> or erythropoietin in the peri-operative setting to reduce red cell transfusions. Post transfusion haematinic prescription was also poor, with less than a fifth of patients receiving iron or other supplements with likely chronic deficiency and related consequences in many patients.

The other observation from this study was the likely under-reporting of transfusion related reactions with only one (0.5%) febrile non-haemolytic reaction (FNHTR) documented. This is in comparison to the reported incidence of 1-5% for FNHTRs. It is unclear whether this is a reflection of non-identification, non-reporting or both of non-infectious serious hazards of transfusion (NSHOT).

The financial implications of clinical practice beyond recommendations are often not audited and are imperceptible to doctors and policy makers in free public health care systems such as ours. Based on data obtained from private hospitals, the estimated cost of excessive red cell transfusions in just 8 general surgical wards was approximately Rs 2.8 million (15,000 USD) per year. The estimation was based on out-patient transfusions; hence, in-ward transfusion costs are likely to be considerably higher. Though we are fortunate to have high levels of voluntary blood donations nationally, it is imperative that we make optimum use of this valuable resource.

## Conclusion

This is the first study to describe red cell transfusions in Sri Lankan surgical practice. It revealed substantial divergence of red cell transfusion thresholds in perioperative practice when compared with international guidelines. It also highlighted the high transfusion burden of diabetic foot disease in surgical wards and the failure to adhere to rational standards of care to investigate and treat anaemia. The clinical and financial implications of unwarranted transfusions cannot be underestimated and must be addressed by medical professionals and policy makers.

We recommend establishment of national red cell transfusion guidelines for use in all health care settings, and raising awareness of the same amongst medical professionals. Further study should be pursued into the appropriate thresholds for transfusion in diabetic foot disease. A rational approach to the investigation and treatment of anaemia should be adopted.

Significant monetary savings and efficient utilisation of a precious resource such as blood will result from the adoption strategies that streamline RBC transfusion. Alternatives to red cell transfusions should always be considered.



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## Author contributions

Ashan Fernando and Oshan Basnayake gathered data, analysed and formulated the manuscript. The main supervisor Professor Sivasuriya Sivaganesh edited the manuscript.

## Declarations

### Ethics approval

Ethics approval to conduct the study was obtained from the Ethics Review Committee of Faculty of Medicine University of Colombo Sri Lanka (EC-17-058). Written consent was obtained from all of the participants of the study.

### Conflict of interests

All authors declare that there are no competing interests.

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