Med Glas (Zenica) 2025;22(2)
https://doi.org/10.17392/1915-22-02

Med Glas (Zenica)

ORIGINAL ARTICLE

Assessment of recipient characteristics and blood product usage patterns at the Transfusion Medicine Institute of the Federation of Bosnia and Herzegovina in 2023

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ABSTRACT

Aim This study aimed to assess patterns of blood product use and recipient demographics at the Transfusion Medicine Institute of Federation of Bosnia and Herzegovina **(**FB&H) in 2023 focusing on clinic-specific blood requests.

Methods The study was conducted between 1 January and 29 December 2023. Data were collected from the Renovatio information system of the Transfusion Medicine Institute of FB&H. Information about patient age, gender, clinics requesting blood, and the number and types of issued blood products were gathered.

Results A total of 27,927 units of blood products were issued for 3,341 patients. The average age of transfused patients was 57.25 (range 0 to 98) years, with an almost equal number of males, 1,662 (49.75%) and females 1,679 (50.25%). Blood requests came from 28 clinic/hospital departments, with the following distribution of blood products: 12,267 units of red blood cells, 6,982 units of platelet products, 8,661 units of fresh frozen plasma, and 17 units of cryoprecipitate. The number of doses issued per patient ranged from 1 to 356.

Conclusion Our findings underscore the importance of evaluating transfusion practices to improve patient outcomes and safety. It is essential to incorporate clinical parameters, such as haemoglobin levels, to optimize transfusion strategies. Multidisciplinary patient blood management approaches are necessary for ensuring safe and effective transfusions, aimed at achieving appropriate clinical outcomes.

Keywords: blood components, blood transfusion, intraoperative care

INTRODUCTION

Blood transfusion remains an irreplaceable method in the treatment of patients requiring blood and blood products. This medical intervention has both advantages and disadvantages; despite its ease of use, blood transfusion can be considered as a form of liquid tissue transplantation (1).

Despite its widespread application, transfusion is frequently not used rationally, especially in developing nations where resource shortages can impact the safety and efficacy of the procedure (2). Blood is a scarce resource, and in some countries, transfusions are less safe due to inadequate testing for viral pathogens (3). The use of blood products as supportive therapy has significantly improved the ability to perform complex medical interventions, thereby increasing the chances of successful treatment and recovery for patients (4). Given the limitations of resources (5), it is crucial to establish clear guidelines for the rational use of transfusions. Haemoglobin concentration or haematocrit is often used as a clinical indicator for the need for red blood cell transfusions (6,7).

Blood transfusions are generally considered safe, but there is a certain risk of complications. Mild complications can arise during or within a few days after a transfusion (8), although severe complications are rare (8). Common reactions include allergic response, which may cause rashes, itching, and fever, and there is always a risk of blood-transmissive bacterial and viral infections (9). Serious reactions can include acute immune haemolytic reactions, delayed haemolytic reactions, and graft-versus-host disease (9).

Analysing the consumption of blood and blood products is vital to determine the effectivity of blood transfusion used in elective surgery (10,11). Clinical transfusion management (Patient Blood Management, PBM) improves patient outcome by enhancing medical and surgical care in ways that promote and preserve the patient's own blood (12). This approach is realised by optimising the patient's blood volume, minimising blood loss, and enhancing the physiological tolerance to anaemia (13). When the PBM approach is employed, patients generally require fewer transfusions of donated blood components, thereby avoiding the associated risks of transfusion (14,15).

Studies assessing blood transfusion patterns are essential for identifying areas of improvement and optimizing transfusion practices. In Bosnia and Herzegovina (B&H), there are no official guidelines in the field of Patient Blood Management (PBM), and blood is often used as a primary treatment rather than as supportive therapy. Limited blood resources, combined

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| Submitted: 16. Oct. 2025. Revised: 22 Apr. 2025. Accepted: 23 May. 2025.

with the increasing number of private, highly specialized hospitals, highlight the need to assess current transfusion practices in our country.

The aim of this study was to analyse the characteristics of blood recipients and patterns of blood product usage at the Transfusion Medicine Institute of the Federation B&H (FB&H) in 2023. The goal was to identify clinical areas with the highest demand, evaluate the appropriateness of blood product use, and contribute to the optimisation of transfusion practices through evidence-based insights.

PATIENTS AND METHODS

Patients and study design

This retrospective observational study was conducted on all patients for whom blood and blood products were issued between 1 January 2023 and 31 December 2023, at the Immunohematology Department of the Blood Transfusion Institute of FB&H in Sarajevo. A total of 3,341 patients were included in the analysis, consisting of 1,662 (49.7%) males and 1,679 females (50.3%), with an average age of 57.25 years (range 0-98 years).

The cohort was representative of a wide age range, from neonates to elderly patients, which allowed for a comprehensive assessment of blood transfusion practices across diverse clinical settings. Blood transfusion requests were received from 28 different clinics/hospitals in B&H, covering a broad spectrum of medical specialties, including surgery, oncology, trauma, and haematology, among others. This provides a broad context for understanding transfusion practices across various medical disciplines.

The study was approved by the Professional Council of the Blood Transfusion Institute of FB&H at the 62nd meeting held on 2 February 2024. As this was a retrospective study based on anonymized patient data, informed consent was not required. All data were handled according to ethical guidelines and institutional protocols for research involving human subjects.

Methods

Patient and transfusion-related data were retrospectively extracted from the Renovatio information system, a comprehensive electronic database used by the Blood Transfusion Institute of FB&H. The data collection process involved retrieving information about the following parameters for each patient: demographic data (age, gender, and blood group), clinic/hospital information that made the blood request, transfusion details (the total number of blood products issued per patient, and the types of blood products, e.g., red blood cells, platelets, fresh frozen plasma, cryoprecipitate).

Additionally, the total number of blood units issued (27.927 in total) and the distribution of blood product types were recorded. The number of blood products issued per patient ranged from 1 to 356, with an average of 8.4 products per patient.

Statistical analysis

Data were analysed using descriptive statistics. Continuous variables such as age and the number of blood products issued were expressed as means with standard deviation (SD), or medians with a range where appropriate, depending on the distribution of the data. Categorical variables, such as gender and blood product types, were presented as absolute numbers (N) and percentage values (%).

RESULTS

In the period from 1 January to 31 December 2023, a total of 27,927 blood products were issued for 3,341 patients from 28 different clinic/hospital departments. Concentrated red blood cells were the most commonly used product, with 12,270 doses issued. This was followed by plasma with 8,661 doses, individual platelet doses with 5,548, 605 platelet concentrates from a cellular separator, and pool-derived platelets with 829 doses. For three patients, requests for cryoprecipitate were recorded, resulting in the issuance of 17 preparations (Table 1).

Table 1. Number of patients and blood products in the period from 1 January to 31 December 2023

Variable	Number
Patients	3341
Clinics/Hospitals	28
Blood products	27927
RBC	12270
FFP	8661
PC	5548
PCA	605
Pool	829
Crio	17

RBC, red blood cell; FFP, fresh frozen plasma; PC, platelet concentrate; PCA, platelet concentrate from apheresis; PCA, pooled platelet concentrate; crio, cryoprecipitate

On average, each of 3,341 patients received 8.4 blood products. A total of 458 patients were recorded in the orthopaedic departments, where an average of 3 doses of concentrated red blood cells and 1.3 doses of fresh frozen plasma were issued per patient. The highest consumption of red blood cell concentrates per patient was noted in the haematology departments, where 2,482 doses were issued for 319 patients, equating to 7.8 doses of red blood products per patient. The anaesthesia and reanimation issued 6.9 red blood cell concentrates per patient, along with 11.6-doses of fresh frozen plasma (Table 2).

The haematology departments also recorded the highest consumption of platelet products per patient: 10% for individual doses, 1.8% for concentrates obtained by apheresis, and 1.9% for pool-derived platelets (Table 3).

The average age of patients was 57.25 years, with the youngest being only a few days old (0 years) and the oldest patient being 98 years old. Of the total number of patients, 1,662 were male and 1,679 were female. When analysing by gender and age, the average age was nearly equal for both males (57.75 years) and females (56.76 years). The largest proportion of patients had blood group A (40.58%), followed by group O (34.54%), group B (17.8%), and group AB (7.09%) (Table 3).

Excluding the gynaecology departments which treated exclusively female patients, a higher prevalence of female patients was also noted in the haematology (55%), orthopaedics (57.4%), glandular surgery (83%), and oncology (60%) departments. Conversely, a significantly higher number of male patients was recorded in the anaesthesia and reanimation (58.3%), cardiovascular surgery (70.8%), and urology (78.2%) departments (Table 4).

Table 2. Distribution of blood products according to clinic/hospital department in the period from 1 January to 31 December 2023

Clinic/hospital Department	No of patients	No blood products per patient							Average No of doses per patient
		RBC	FFP	PC	PCA	Pool	Crio	Total	
Angiology	39	76 (1.9)	100 (2.6?)	3 (0.1)	0	0	0	189	4.8
Otorhinolaryngology	35	59 (1.7)	67 (1.9)	0	0	0	0	126	3.6
Emergency centre	39	178 (4.6)	153 (3.9)	22 (0.6)	1 (0.02)	0	0	354	9.1
Haemodialysis	71	327 (4.6)	4 (0.1)	1 (0.01)	0	0	0	332	4.7
Haematology	319	2482 (7.8)	728 (2.3)	3446 (10.8)	567 (0.2)	603 (1.9)	0	7820	23
Anaesthesia and reanimation	156	1070 (6.9)	1811 (11.6)	599 (3.8)	18 (0.1)	62 (0.4)	6 (0.04)	3566	22.8
Heart disease	83	228 (2.7)	40 (0.5)	26 (0.3)	0	0	0	294	3.5
Children's surgery	16	15 (0.9)	32 (2.0)	5 (0.3)	0	0	0	52	3.2
Endocrinology	48	76 (1.6)	261 (5.4)	2 (0.0)	0	0	0	339	7.0
Physiatry	1	6 (6.0)	1 (1.0)	0	0	0	0	7	7
Gastroenterology	197	603 (3.1)	876 (4.4)	57 (0.3)	0	6 (0.03)	0	1542	7.8
Gynaecology	217	578 (2.7)	419 (1.9)	30 (0.1)	0	7 (0.03)	0	1034	4.7
Glandular surgery	12	23 (1.9)	17 (1.4)	0	0	0	0	40	3.3
Infectious disease clinic	61	239 (3.9)	28 (4.6)	140 (2.3)	5 (0.08)	26 (0.4)	0	693	11.3
Cardiovascular surgery	274	1180 (4.3)	826 (3.0)	277 (1.0)	0	29 (0.1)	11 (0.04)	2318	8.4
Nephrology	162	427 (2.6)	98 (0.6)	35 (0.2)	0	2 (0.01)	0	562	3.4
Neurosurgery	138	321 (2.3)	394 (2.9)	198 (1.4)	4 (0.03)	26 (0.2)	0	943	6.8
Neurology	24	27 (1.1)	56 (2.3)	2 (0.1)	1 (0.04)	0	0	86	3.6
Eye clinic	2	0	4 (2.0)	0	0	0	0	4	2
Oncology	163	667 (4.1)	25 (0.2)	255 (1.6)	1 (0.01)	34 (0.2)	0	982	6.0
Abdominal surgery	197	642 (3.3)	503 (2.6)	73 (0.4)	0	3 (0.02)	0	1221	6.3
Orthopaedics	458	1364 (3.0)	598 (1.3)	18 (0.04)	0	1 (0.002)	0	1979	4.3
Paediatrics	266	519 (2.0)	440 (1.7)	256 (0.9)	3 (0.01)	21 (0.1)	0	1239	4.7
Plastic surgery	21	61 (2.9)	104 (5.0)	2 (0.1)	0	2 (0.1)	0	169	8.0
Pulmonology	65	105 (1.6)	67 (1.0)	23 (0.4)	0	4 (0.1)	0	199	3.1
Psychiatry	2	3 (1.5)	0	0	0	0	0	3	1.5
Thoracic surgery	73	227 (3.1)	186 (2.5)	56 (0.8)	2 (0.03)	2 (0.03)	0	473	6.5
Urology	202	767 (3.8)	568 (2.8)	22(0.1)	3 (0.01)	1 (0.005)	0	1361	6.7
Total	3341	12267 (3.7)	8661 (2.6)	5548 (1.7)	605 (0.2)	829 (0.3)	17 (0.005)	27927	8.36

RBC, red blood cell; FFP, fresh frozen plasma; PC, platelet concentrate; PCA, platelet concentrate from apheresis; POOL, pooled platelet concentrate; crio, cryoprecipitate

Table 3. Patient demographic characteristics and blood group distribution in the period from 1 January to 31 December 2023

Variable	
Median age (range) (years)	57 (0-98)
	No (%) of patients
Gender	
Male	1662 (49.75)
Female	1679 (50.25)
Blood groups	
A+	1116 (33.41)
A-	240 (7.18)
0+	936 (28.02)
0-	218 (6.53)
B+	491 (14.70)
B-	103 (3.08)
AB+	204 (6.11)
AB-	33 (0.99)

Table 4. Distribution of blood products according to clinic/hospital department in the period from January 1 to December 31, 2023

Clinic/hospital department	No (%) of patients		
	No of patients	Male	Female
Gynaecology	217	-	217 (100)
Haematology	319	144 (45)	175 (55)
Orthopaedics	458	195 (43.6)	263 (57.4)
Glandular surgery	12	2 (17)	10 (83)
Oncology	163	65 (40)	98 (60)
Anaesthesia and reanimation	156	91 (58.3)	65 (41.7)
Cardiovascular surgery	274	194 (70.8)	80 (28.2)
Urology	202	158 (78.2)	44 (22.8)

DISCUSSION

The goal of transfusion is to achieve optimal intravascular concentration, stabilize volume, blood pressure, and capillary perfusion (14). This requires a multidisciplinary approach involving the assessment of clinical indications, monitoring patient responses, and preventing potential reactions, along with coordination of orders, compatibility testing, and distribution of blood products. The development of diagnostic procedures is accompanied by increasing demand for blood products, despite limited resources, highlighting the need to improve clinical transfusion management.

According to the U.S. Blood Donation Statistics and Public Messaging Guide (2024), the average red blood cell (RBC) transfusion recipient in the United States receives 2.6 units of blood per transfusion (15). In contrast, our results indicate an average use of 3.7 units of depleted plasma red blood cells per patient, which is significantly higher than the U.S. average. This discrepancy may reflect differences in transfusion practices, indication thresholds, availability of blood products, or the specific needs of the patient population in our institution. Our study found that 55% of transfused patients were from surgical and 45% from internal medicine departments, yet internal medicine departments received slightly more blood products (51.2%). Concentrated red blood cells were most commonly used, followed by plasma and various platelet products, while cryoprecipitate was rarely used. On average, each patient received 8.4 blood products.

In regards to perioperative blood transfusions, there are basically two different schools of thought: transfusing at a haemoglobin threshold of 100 g/L (referred to as "liberal") versus transfusing at a level of 70 g/L or less (referred to as "restrictive protocol") (16,17).

Our usage patterns varied by specialty—orthopaedics and anaesthesia used high red blood cells, while haematology used increased platelet demand.

In the study by Blankstein et al.(18), demographic indicators such as age and gender were similar; however, differences were observed in the average consumption of blood products (3.3 vs. 4.3 units, respectively, in our study). The lower transfusion rates seen in the Blankstein et al. study reflect the implementation of strategies to reduce perioperative transfusion, including preoperative correction of anaemia, advancements in surgical techniques, changes in transfusion thresholds, and the use of tranexamic acid.

Our transfusion practice reflects a liberal approach to transfusion. Some authors concluded that a liberal transfusion strategy, compared to a restrictive one, did not reduce mortality rates or inability to ambulate independently during a 60-day follow-up, nor did it lower hospital morbidity among older patients (19).

In transfusion therapy, red blood cell preparations are predominantly used. Many transfusion protocols recommend the "10/30 rule," meaning that a patient's haemoglobin (Hb) concentration should be greater than 10 g/dL and haematocrit above 30% before surgery (20). These recommendations apply not only to surgical patients but also to all transfusion protocols, regardless of whether the patient has acute or chronic anaemia (21). More modern guidelines from the American Society of Anesthesiologists suggest that transfusion is appropriate when the Hb concentration falls below 6 g/dL. In Europe, a target Hb value of 7–9 g/dL is accepted as an indication for transfusion (22).

Current trends in clinical practice are even more restrictive. Many authors advocate for a judicious use of red blood cells, questioning the efficacy of fresh frozen plasma and recommending antifibrinolytic agents and blood conservation during surgery (23). For most hospitalised adult patients who are haemodynamically stable, a restrictive transfusion strategy is recommended, considering transfusion when the Hb concentration is below 7 g/dL (24). Alternatively, clinicians may choose a threshold of 7.5 g/dL for patients undergoing cardiac surgery and 8 g/dL for those undergoing orthopaedic procedures or those with pre-existing cardiovascular conditions (25).

For hospitalised adults with haematological and oncological disorders, a restrictive transfusion strategy is also advised, with transfusion considered when Hb concentration is below 7 g/dL (20-25). Similar recommendations have been made within the European Union (26). For critically ill children and those at risk of critical illness who are haemodynamically stable and without symptoms of haemoglobinopathy, cyanotic heart conditions, or severe hypoxaemia, a restrictive transfusion strategy is also recommended, considering transfusion at Hb concentrations below 7 g/dL (27).

Research suggests that many transfusions with allogeneic red blood cells can be avoided for most patients with Hb thresholds between 7.0 g/dL and 8.0 g/dL, although some subsets of patients may benefit from maintaining higher haemoglobin concentrations (3). Unfortunately, we were unable to compare haemoglobin as a parameter for determining therapeutic approaches in transfusion, as requests from clinics were frequently inadequately filled without basic parameters of the blood count. This highlights the need for training clinical staff on the importance of properly completing forms to track indications for transfusion.

Most patients require only one or two types of blood components, with very few needing all types concurrently (28).

Due to the nature of haematological diseases and aggressive therapeutic protocols, haematology patients often require prolonged hospitalization and intensive transfusion therapy. Accordingly, our study also recorded the highest per-patient blood product consumption in the haematology clinic. Similar findings were reported by Arslan et al. (29), who demonstrated that a simple measure as checking haemoglobin level two hours after transfusion, leads to the reduction in red blood cell unit usage by as much as 30%. These data highlight the importance of rational transfusion practices and the continuous assessment of patients' actual needs.

Comparing the results of our study with other research (30–31), it is clear that the focus of modern transfusion practice is on the implementation of component therapy, with minimal use of whole blood. The highest consumption of blood products is generally recorded among haematology patients. One of the common challenges, both in our institution and in other centres, is incomplete medical documentation and insufficiently clear indication of transfusion criteria. These findings highlight the need for the development of local guidelines and ongoing education of clinical staff.

The specific characteristic of our centre, in comparison with other studies, lies in the fact that transfusions are more frequently administered in the elderly population, with almost equal distribution between male and female patients, as well as a notably high consumption of blood components per patient.

In conclusion, our findings support the need for comprehensive assessments of transfusion products on recipient outcomes, utilizing entry/exit clinical parameters like haemo-

globin level, to better understand the risks and benefits of red blood cell transfusion. Establishing protocols and guidelines for blood transfusions enhances the safety and efficacy of patient treatment. Educating patients and their families about the transfusion process, potential risks, and expected outcome plays a vital role in this context. Transfusion therapy requires interdisciplinary coordination to ensure optimal patient care. The role of the Clinical Transfusion Management is crucial for providing quality and safe healthcare, necessitating a high level of expertise and coordination to successfully address patients' blood product needs.

FUNDING

No specific funding was received for this study.

TRANSPARENCY DECLARATION

Conflict of interest: None to declare.

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