ACTA MEDICA SALINIANA

ORIGINAL PAPERS

BLOOD RESERVES AND AVAILABILITY OF BLOOD PREPARATIONS IN UNIVERSITY CLINICAL CENTER TUZLA, BOSNIA AND HERZEGOVINA

Sunita Delić Ćustendil[1,2], Igor Hudić[3,2], Aida Žabić[1], Sabina Čamdžić-Smajić[1], Almira Ćosićkić[1,5], Lejla Mešalić[2,5], Zlatan Mehmedović[6]

ISSN 0350-364X

DOI: 10.5457/794

Sunita Delić Ćustendil
Igor Hudić
Aida Žabić
Sabina Čamdžić-Smajić
Almira Ćosićkić
Lejla Mešalić
Zlatan Mehmedović

ABSTRACT

Introduction: Transfusion treatment is very important therapeutic modality. Polyclinic for Transfusion of University Clinical Center (UKC) Tuzla provides reserves for all patients in Tuzla Canton. The only way to get this biological medicine is through voluntary blood donation. An adequate blood transfusion supply is essential for all patients.

Material and methods: Retrospective data were collected from the Renovatio information system in the period from July 1, 2022 to 31.12.2022. The analyzed data were age, gender, number of blood doses and components. Analyzed data for patients who received blood transfusions were: age, sex, diagnosis, type of blood preparation indicated and issued.

Results: Out of 835 healthy people female voluntary blood donors median age 36.8 (IQR: 24-46) years and 4962 male voluntary blood donors median age 40.3 (IQR: 31-50) collected 5797 units of blood. Analyzing total product volumes for 2626 patients who required substitution blood derivatives in the analyzed period, we find that the production of blood products is in full responded to requests. Analysis of needs at individual clinics revealed a slight deviation in the ratio of requested and issued doses.

Conclusion: Stable blood reserves are one of the prerequisites for the functioning of the health system of a country. The results of the study showed that the production of blood products completely responded requirements, which confirms a well-managed transfusion practice. By using a cell-separator the production of blood components are now days far much easier and facilitated such as platelet concentrate.

Key words: blood reserves, transfusion treatment, hospitalized patients

Affiliations:
[1]University Clinical Center Tuzla, Polyclinic of transfusion medicine,
[2]Medical Faculty University of Tuzla,
[3]University Clinical Center Tuzla, Clinic for gynecology,
[4]University Clinical Center Tuzla, Clinic for pediatric diseases,
[5]Primary healthcare institution, department for gynecology,
[6]University Clinical Center Tuzla, Clinic for surgery

Received:
11.4.2024.

Accepted:
19.05.2024.

Corresponding author:
Sunita Delić Ćustendil
University Clinical Center Tuzla, Ibre Pašića Tuzla
Email: sunitacustendil1970@gmail.com

Funding: none

Competing interests: none

INTRODUCTION

Transfusion treatment in modern clinical practice includes substitution therapy certain components of the blood, which adequately and effectively contribute to quick recovery and healing diseases [1]. Almost every branch of medicine is transfusion-dependent, starting with surgery and internal medicine branch to diagnostic ones, where the safety of the patient is ensured by substitution with certain blood preparations [2]. Blood and blood products differ from other drugs and pharmaceutical preparations while the only source is human blood from voluntary donors [3]. In practice they use two ways of getting blood, by voluntary donation, when whole blood is taken, which is the most common used as a starting point for the production of other drugs from blood, and by the apheresis procedure on cell separator, when only one blood component is taken, such as platelets, plasma, erythrocytes [1,4] An adequate blood transfusion supply is crucial for the functioning of the health system [5]. Although they are blood and its components recently added to the WHO essential drug list, insufficient blood supplies in most of low- and middle-income countries still lead to mortality and morbidity, which can prevent by ensuring sufficient blood reserves [6,7]. Ensuring sufficient amounts of blood implies strategic consideration of local, epidemiological factors, demographic structure, equipment and ability to produce medicines from whole blood [8,9]. Currently, voluntary blood donation in many low- and middle-income countries is not adequately [10]. The main reasons for the unavailability of blood is the high prevalence of viral hepatitis and inadequate production of blood components [11]. Overall relations in society, socio-economic and demographics are an important factor for as-

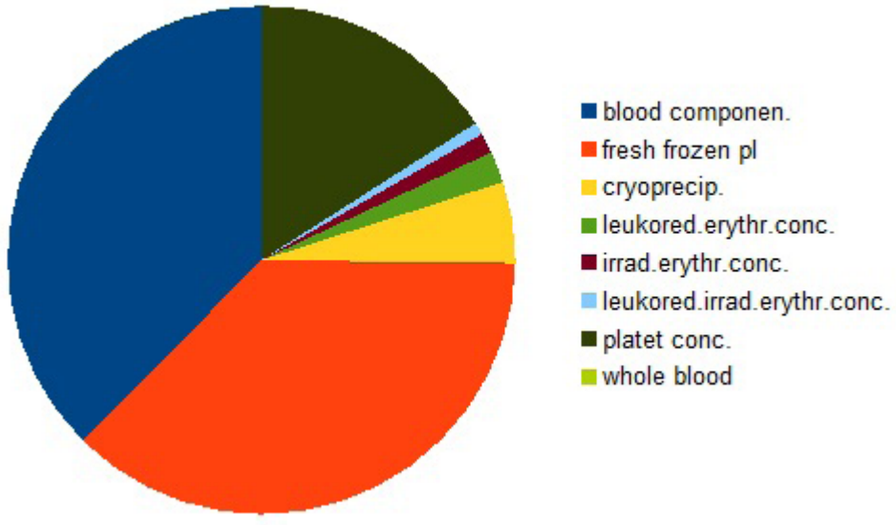
sessing the possibilities of ensuring stable reserves of safe blood, which they represent the national resource of a country [12]. The estimation of the daily consumption of blood products is unpredictable nature, due to possible incident situations, natural disasters, and limited lifetime of different preparations. The limited lifespan of blood increases the number of unused doses, resulting in a decrease in stable reserves and high costs [6]. According to WHO guidelines, recommendations for ensuring stable blood reserves include 10 to 20 donations per 1000 inhabitants [13]. These assessments are important because they can serve to guide further ones investments in strategies to ensure sufficient amounts of blood, then analysis of current transfusion practice, introduction of rationalization measures during transfusion treatment and implementation of the system for blood management [14,15]. In the area of Tuzla Canton, the annual blood donation is approx. 13000 doses. For more than three decades, the Polyclinic for Transfusion has been producing various medicines from blood, whose lifespan and storage method are different, namely: whole blood, erythrocyte concentrate, concentrate erythrocytes with a reduced number of leukocytes, irradiated erythrocyte concentrate, fresh frozen plasma, platelet concentrate, platelet concentrate with reduced number of leukocytes, irradiated concentrate platelets, platelet apheresis concentrate and cryoprecipitate.

MATERIAL AND METHODS

This retrospective study was carried out at the Polyclinic for Transfusion, University Medical Center Tuzla data from the Renovatio information system in the period from July 1, 2022 to December 31, 2022. Data were analyzed on voluntary blood donors (age and gender), who donated blood during that period. Then data on the number of blood doses collected, as well as the number and type of medicines produced from blood (whole blood, erythrocyte concentrate, erythrocyte concentrate with reduced number of leukocytes, irradiated concentrate platelets, fresh frozen plasma, cryoprecipitate, platelet concentrate, platelet concentrate with a reduced number of leukocytes, irradiated platelet concentrate, irradiated platelet concentrate with reduced number of leukocytes, as well as platelet concentrate produced by the apheresis method using of the Amicus cell separator. Also, data was collected for patients who received blood preparations: age, gender, diagnosis, type of blood preparation indicated, name of the clinic where the patients were hospitalized, and the type and quantity of blood products issued.

RESULTS

In the six-month analyzed study period from July 1 to December 31, 2022 Polyclinic for transfusion of the University Clinical Center Tuzla from 835 healthy women of healthy blood donors median age 36.8 (IQR: 24-46) years and 4962 male volunteers blood donors with a median age of 40.3 (IQR: 31-50) collected 5797 units of blood. The largest number of donated blood units was used in the preparation of fresh frozen plasma, 5742 units, then 5498 units of platelet concentrate, 797 units of cryoprecipitate, and 308 units of concentrate platelets with a reduced number of leukocytes, 200 units of irradiated platelet concentrate and 119 units irradiated platelet concentrate with a reduced number of leukocytes, which is visible on chart 1.



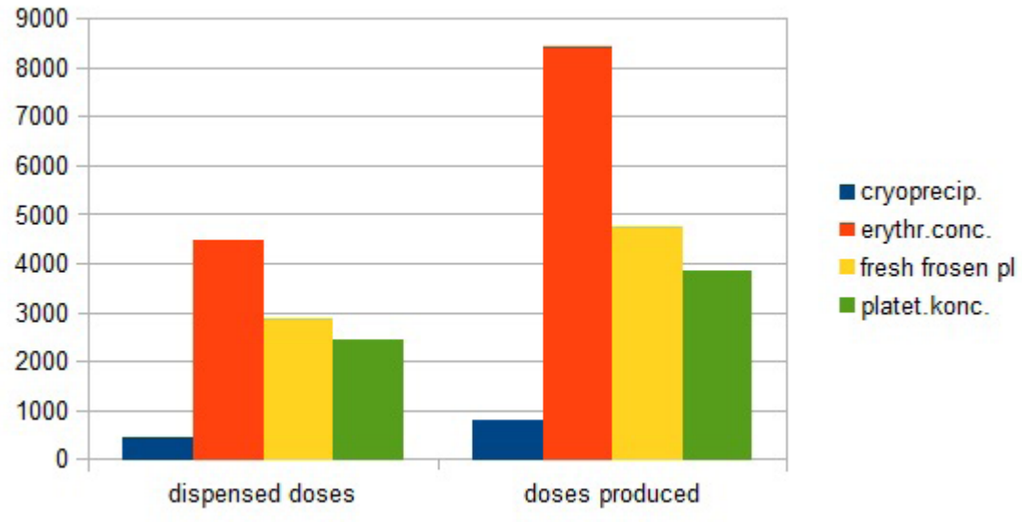
Graph 1.: Type of produced blood products

Analyzing the production segment of platelet preparations, we find that different numbers of blood units, that is, the number of donors provides a certain number of platelet concentrates, as a therapeutic dose, with observed significant statistical difference shown in table 1.

Table 1. Number of donors/units of blood for the production of a therapeutic dose of platelets

Leukoreduc. platelets conc.		Apheresis plateles conc.		P
Number of platelets donors	Number of therapeutic doses	Number of platelets donors	Number of therapeutic doses	p
536	26	39	39	<0.001

Analyzing total product volumes for 2626 patients who required substitution blood derivatives in the analyzed period, we find that the production of blood products is in full responded to requests. Namely, 8450 units of erythrocyte concentrate were produced, and 4500 were issued unit; 4735 units of fresh frozen plasma were produced, and 2891 units were issued; concentrate 3852 units of platelets were made, and 2455 units were issued, and 797 units of cryoprecipitate were made, and 458 units were issued. The results speak in favor of good usability and production strategy blood preparations according to the needs of the clinical center, which can be seen in Graph 2.



Graph 2: Ratio of the number of manufactured and issued preparations

An analysis was made, in the observed period, of the need for blood products, correlation of demand andrealized, issued units of preparations, at individual clinics, which is shown in table 2.

Table 2. Ratio of requested and issued types of blood products at individual clinics

	ERYTHROCITES CONCENTRATES			FRESH FROZEN PLASMA			THROMBOCYTES CONCENTRATES		
Clinic	Wanted	Issue	p	Wanted	Issue	p	Wanted	Issue	p
Clinic for hematology	1033	577	004	39	77	<0.0001	2148	1521	1
Clinic for chirurgie	1238	409	0.43	1343	1340	<0.0001	25	17	0.07
Clinic for neurosurgery	895	103	0.72	52	49	<0.0001	4	4	<0.0001
Clinic for infection deaseases	163	134	<0.0001	293	191	<0.0004	265	151	<0.0001
Clinic for gynecology	1428	724	<0.001	126	90	0.009	25	20	0.145
Clinic for plastic surgery	414	87	0.96	90	79	<0.0001	7	7	<0.0001

	ERYTHROCITES CONCENTRATES			FRESH FROZEN PLASMA			THROMBOCYTES CONCENTRATES		
Clinic for oncology	265	239	<0.001	7	7	<0.0001	306	200	0.067
Clinic for internal deaseases	623	525	<0.0001	270	224	<0.0001	134	81	<0.0001
Clinic for urology	272	687	<0.0001	363	297	<0.0001	16	15	<0.0001
Clinic for pediatric deaseases	301	298	<0.0001	415	434	<0.0001	313	434	<0.0001

DISCUSSION

Stable blood reserves are one of the prerequisites for the functioning of the health system of a country [16,17]. Increasing consumption of this biological drug and its ingredients in all medical disciplines recently enabled it to be added to the WHO's Essential Medicines List, confirming a large importance and importance of this irreplaceable medicine [18,19]. In this study we intended to assess the needs for blood and its preparations at the level of our entire Institution of the University Hospital of Tuzla and individually by clinic, analyzing the number of reserved blood units and issued, i.e. realized. In the six-month period, the results of the study showed 5797 collected units of blood, which at annually, it has an estimate of about 12,000 units and confirms good transfusion practice despite numerous aggravating factors, such as the departure of youth, as the healthiest category of donors, unemployment, low standard of living [12]. The results of our study showed that whole blood was the starting point for the production of different types in 97% blood medicines, which were planned and made in accordance with the requirements of all clinics. In the preparation of this manuscript, we searched the literature related to global availability and needs for blood. We found detailed evidence of national transfusion practices in many high-income countries, however, in low-income countries there was little evidence of blood use except for studies of individual hospitals [20]. In 2019, Nicholas Roberts BS and colleagues analyzed the global need and availability of blood products, and proved that out of 195 countries, 119 (61%) did not have enough blood to satisfy their needs [18]. Given that the results of our study related to the needs for blood products at the level of UKC Tuzla, i.e. Tuzla Canton, not the whole country, ours the results were encouraging and confirmed well-managed strategies in the planning and implementation of production and consumption of this medicine. Analyzing the total need for transfusion of blood components at the level of the entire institution, it was proven that 2,626 patients were treated with transfusions, and that the production of blood products fully met the requirements, which once again confirms a well-managed transfusion practice. The most wanted the blood product was concentrated erythrocytes, where the differences between the number reserved and issued dose were significant. In this regard, there was no correlation at the Clinic for Hematology and Transplantation stem cells, Surgery Clinic, and the biggest discrepancy was at the Neurosurgery Clinic. That shows a discrepancy in the number of reserved and actually needed blood doses, which indicates the fact that it is necessary to change the current practice of reservations. Also, hematology patients are the largest consumers of blood, and daily dependent on blood products, which often makes it difficult to make a reservation, especially when it comes to rare blood group preparation. Studies published by Begić Dž and associates in 2016, analyzing blood consumption during of surgical interventions have confirmed the importance of the study for estimating large savings in levels and supplies, and reducing additional steps to ensure stable reserves of blood and blood derivatives [21]. By demand the second blood product was fresh frozen plasma, where there was generally a correlation between number of requested and issued units, while at the Clinic for Hematology and Stem Cell Transplantation was a statistically significant correlation, where twice as many doses were issued than requested, due to significantly higher doses need than planned. Platelet concentrate, as the most sensitive blood preparation, both because of the deadline duration, and due to the complex preparation, it did not adequately respond to the needs of the Hematology Clinic and stem cell transplantation when it comes to the total number of required units, and statistically it is not there was no correlation between the requested and issued doses of this preparation. What is extremely significant is that are platelet concentrates produced in two ways, the classic way, where 206 platelets concentrates (one therapeutic dose) if necessary 841 blood donors, and by apheresis, where for 57 platelet concentrates (one therapeutic dose) 57 donors were necessary, which shows statistically significant difference between the number of required donors. In this way, the safety of the patient was far increased with the use of apheresis platelet concentrates, because it was foreign exposure minimal antigens, considering that the preparation was produced from only one person, unlike classic platelet concentrates, where more than 6 different ones were included for each therapeutic dose blood donors, which increases the degree of sensitization and reduces the effectiveness of treatment [22]. Similar results were published by NH Heddle et al. in 2008 in a study in which they proved the clinical advantage of apheresis of produced platelet concentrates compared to platelet concentrates obtained by the classical method [23]. The advantage was related to a smaller number of blood units for production, reducing the risk of development of acute transfusion reactions, and refractoriness to administration [24]. RS Mallhi et al. In 2014, in the results

of similar studies, they proved a reduced development of febrile non-hemolytic of transfusion reactions using apheresis concentrates of platelets, and a significantly lower transfer cytomegalovirus infections and the development of HLA immunization [25,26]. Our results showed a lot simpler and faster product production, fewer blood donors, and reduced sensitization of the transfused patient.

CONCLUSION

In the analyzed period, the production of blood products fully met the requirements and needs of clinics. Platelet concentrates did not adequately meet the needs of certain Clinics due to the complexity of the production process and short shelf life. Platelet concentrates produced by apheresis have shown significantly greater safety for the patient because exposure to foreign antigens is minimal. Our results showed a much simpler and faster production of the product, a smaller number of blood donors, and reduced sensitization of the transfused patient.

REFERENCES

1. Balint B**. Transfusiolo**gy. Institute for textbooks and teaching aids: Belgrade, 2004.
2. Grgičević D. Transfusion medicine in clinical practice. Medical Publishing House: Zagreb, 2006.
3. Begić Dž, et al. Analysis of blood consumption for surgical programs. Med Arch. 2016;70 (4): 248-251.
4. Kovač M, Balint B, Bogdanović G. Basic and clinical transfusiology. University of Belgrade. Faculty of Medicine: Belgrade, 2020; 3-7.
5. Roberts BS et al. The global need and availability of blood products: a modeling study. The Lancet Haematology. 2019; 6 (12): 606-615.
6. DJ Roberts et al. Problems and approaches for blood transfusion in the developing countries. Hematol Oncol Clin North Am. 2016; 30 (2) :477-495.
7. Erhabor et al. From whole blood to component therapy: the economic, supply/demand need or implementation of component therapy in sub-Saharan Africa. Transfus Clin Biol. 2011; 18 (5-6): 516-526.
8. A Gayet-Ageron et al. Effect of treatment delay on the effectiveness and safety of antifibrinolytics in acute severe haemorrhage: a meta-analysis of individual patient-level data from 40 138 bleeding patients. Lancet. 2018; 391: 125-132.
9. Blake JT, Hardy M. A generic modeling framework to evaluate network blood management policies: the Canadian Blood Services experience. Research for Health Care. 2014; 3 (3): 116-128.
10. KJ Foreman et al. Forecasting life expectancy, years of life lost, and all-cause and cause- specific mortality for 250 causes of death: reference and alternative scenarios for 2016– 40 for 195 countries and territories. Lancet. 2018; 392: 2052-2090.
11. Hemmelmayr V, Doerner KF, Hartl RF, Savelsbergh MWP. Delivery strategies for blood product supplies. OR Spectr. 2019; 31: 707–725.
12. HU Okoroiwu et al. Demographic characteristics of blood and blood components transfusion recipients and pattern of blood utilization in a tertiary health institution in southern Nigeria. BMC Hematol. 2018; 18: 16-18.
13. Custer B et al. Addressin g gaps in international blood availability and transfusion safety in low- and middle- income countries: a NHLBI workshop Transfusion. 2018; 58 (5): 1307-1317.
14. CJL Murray et al. Global, regional, and national disability-adjusted life years (DALYs) for 306 diseases and injuries and healthy life expectancy (HALE) for 188 countries, 1990 2013: quantifying the epidemiological transition. Lancet. 2015; 386: 2145-2191.
15. N Mafirakureva et al. The costs of producing a unit of blood in Zimbabwe Transfusion. 2016; 56 (3): 628-636.
16. Grgičević D. Transfusion medicine. Medical Publishing House: Zagreb, 1995.
17. Grgičević D, Skodlar J, Šarlija D. Recommendations for transfusions of blood and blood products in clinical practice medicine. Zagreb, 1998: 17–73.
18. Roberts BS et al. The global need and availability of blood products: a modeling study. Lancet Haematol. 2019; 6 (12): 606-615.
19. Lowalekar H, Ravichandran N. Blood bank inventory management in India. Opsearch. 2014; 51: 376–99.
20. Katsaliaki K, Brailsford SC. Using simulation to improve the blood supply chain. Oper Res Emerg Plann Healthc. 2016; 1: 219–27.
21. Begić D. et al. Analysis of blood consumption for surgical programs. Med Archiv. 2016; 70 (4): 248-251.
22. Singh RP, Marwaha N, Malhotra P, et al. Quality assessment of platelet concentrates prepared by platelet rich plasma-platelet concentrate, buffy coat poor-platelet concentrate (BC-PC) and apheresis-PC methods. Asian J Transfusion Sci. 2009; 3: 86–94.
23. NM Heddle, DM Arnold, D Boye, KE Webert, I Resz, and LJ Dumont. Comparing the efficacy and safety of apheresis and whole blood-derived platelet transfusions: a systematic review. Transfusion. 2008; 48 (7): 1447-1458.
24. Gavva C, Barroso J, Gernsheimer T, et al. Response to random apheresis platelets versus HLA selected platelets versus pooled platelets in HLA-sensitized patients. Transfusion. 2019; 59 (7): 2276–2281.
25. RS Mallhi, Sudeep Kumar, and Joseph Philip. A Comparative Assessment of Quality of Platelet Concentrates Prepared by Buffy Coat Poor Platelet Concentrate Method and Apheresis Derived Platelet Concentrate Method. Indian J Hematol Blood Transfus. 2015; 31 (4): 453–459.
26. Gurkan E, Patah PA, Saliba RM, et al. Efficacy of prophylactic transfusions using single donor apheresis platelets versus pooled platelet concentrates in AML/MDS patients receiving allogeneic hematopoietic stem cells transplantation. Bone Marrow Transplant. 2007; 40: 461–464.

Scan this QR code with your mobile device for instant access to the current Issue of Acta Medica Saliniana