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Blood Components Management: An Analysis on the Blood Transfusion Medicine in Zabol, Sistan and Baluchistan Province of Iran

Omolbanin Sargazi-Aval[1], Ali Bazi[1], Hojat Shahraki[2,3*], Ahmad Ali Jalali Nezhad[4], Hanieh Bakhshi[5], Fatemeh Mirasghari[5], Ahmad Sohrabi[6], Leila Jafari[7]

[1]Faculty of Allied Medical Sciences, Zabol University of Medical Sciences, Zabol, Iran
2Cellular and Molecular Research Center, School of Allied Medicine, Zahedan University of Medical Sciences, Zahedan, Iran
3Department of Laboratory Sciences, School of Allied Medicine, Zahedan University of Medical Sciences, Zahedan, Iran
4Department of Physiology, Faculty of Medicine, Zabol University of Medical Sciences, Zabol, Iran
5Student Research Committee, Zabol University of Medical Sciences, Zabol, Iran
6Neonatal and Children's Health Research Center, Golestan University of Medical Sciences, Gorgan, Iran
[7]Department of Hematology and Blood Transfusion, School of Allied Medicine, Shahid Beheshti University of Medical Sciences, Tehran, Iran

***Correspondence to**
Hojat Shahraki
Email:
hojat93.shahraki@gmail.com
Tel: +989106763357

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Abstract

Introduction: Blood components are commonly used during surgical operations; however, limited sources are globally available in this regard. The present study aimed to assess blood product usage and wastage in Amir-Almomenin hospital, Zabol, Iran.

Methods: A total of3883 ordered blood components were retrospectively analyzed in Amir-Almomenin hospital, Zabol, Iran (January) 2017-(July)2018. The data were analyzed using the SPSS software, version 18.

Results: The results demonstrated that the most frequent ordered blood products included packed red blood cells (PRBCs, 2097 units, 54%), followed by fresh frozen plasma (823 units, 21.2%), platelet concentrates (757 units, 19.5%), and cryoprecipitate (206 units, 5.2%), respectively. Intensive care unit department had the highest records of orders (34.2%) and the ratio of cross-matched blood to transfused blood (C/T) was 1.73. In addition, based on the results, the total amount of component wastage was 2.03% with the highest and lowest percentage for PRBCs (59.6%) and cryoprecipitate (4.35%), respectively. The highest rate of wastage was related to the delivery ward (8.23%). There was no return from pediatrics, dialysis, pediatric critical care unit, critical care unit, and gastroenterology wards. Further, a significant difference was observed between the returned rates of D-positive and D-negative blood components with higher rates belonging to D-negative products ($P=0.001$).

Conclusion: In general, due to the 2.03% wastage rate, there is an indispensable need regarding implementing sufficient supervision and assigning vigilant policies on the hospital-based transfusion policies in order to optimize the blood product management.

Keywords: Blood components, Blood usage, Surgery operation, Blood wastage

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Introduction

For several decades, blood and its components have been resuscitative sources and lifesaving materials for a range of human disorders.[1] Thus, the transfusion of blood products including the whole blood, packed red blood cells (PRBCs), fresh frozen plasma, cryoprecipitate, coagulation factors, and platelets plays an integral role in the interventional medicine. The diverse spectrum of invasive surgeries such as open heart surgery, traumatic patients, and many pathological conditions including cancer, blood disorders, and preterm infants require a blood transfusion.[2,3] There is an urgent need for blood transfusion every three seconds in the hospitals of Iran.[4,5] This medicinal intervention requires theoretical and practical knowledge over the blood components and their

applications for a vigilant blood transfusion.[6] The majority of blood transfusion procedures are conducted by the surgery teams and, particularly, anesthesiologists, thus, all the physicians and nurses should acquire adequate proficiency on the blood transfusion indications and its adverse consequences.[4]

The major aim of blood transfusion organizations is to supply enough healthy blood for the affected patients, and a great deal of costs and efforts is paid to pave this path.[7] In addition, the purpose of blood donor screening is to minimize the risk of infections transmitted by the blood products.[8] The overall costs of cross-matched processes, the transportation of blood, and the storage of the products under desire ambient conditions are considerably high, as such the World Health Organization has estimated the cost of a single unit of the processed product to be nearly $40.[5] This highlights the importance of the precise recognition of blood transfusion consumption and its management.[5] Therefore, the indications for blood transfusion should be limited to those cases with an urgent need for blood supplies. Furthermore, inappropriate and excess blood transfusion imposes high expenses for the national health system which include processing and keeping of blood products, pre-transfusion examination costs, the treatment of unwanted reactions following blood transfusion, and the charges of increased time of the patient hospitalization.[6] In addition, the extra storage of blood and its components in surgeries, as well as the probability of being unused can augment the wastage of these valuable components.[9]

A diverse range of factors can potentially contribute to the wastage of blood components. These factors include impaired blood bags, expired units, long-term storing in unsuited ambient temperature, the formation of blood clots in bags, insufficient knowledge of physicians on the blood order requirements, a request for excessive blood supplies for the possible over bleeding during the surgeries, poor blood management policies, and the lack of knowledge.[1,5] The rate of blood wastage in hospitals of the United States is reported from 0.1% to 6.7%.[10] Further, cross-matched blood units for each surgery are typically much more than the requested units thus recording the ratio of cross-matched blood to the number of transfused blood (C/T) is essential in blood transfusion facilities. This ratio is an efficient criterion for assessing the blood order compared to the blood usage with the standard value of 2.5. In other words, the C/T ratio of more than 2.5 indicates that only 40% of the cross-matched blood is transfused.[11,12] This criterion was first described by Boral and Henry in 1970.[11-14] Importantly, the review of Maximum Surgical Blood Ordering Schedule, presented in 1990 for preceding the maximum blood order for surgeries,[12,13] is designed for transfusion correction and seems to be of great importance.[11] In this schedule, based on the available reports in the hospitals, a special guideline is prepared for different kinds of surgeries regarding the amount of blood usage for each center.[11-14]

Nevertheless, other studies demonstrated higher ratios of C/T compared to the standard ratios in most of the hospitals of Iran, that confirm a large amount of unused ordered blood units for various reasons.[15-17] Considering the importance of blood and blood components, blood ordering requires an appropriate scientific schedule, hence, the present study sought to evaluate the usage and wastage rates of blood and blood components in the hospital settings in Amir-Almomenin general hospital, Zabol, Iran.

Materials and Methods

The current retrospective-descriptive study was performed at the hospital setting in Zabol, Iran, from January 2017 to July 2018. A total of 4459 ordered blood components were collected out of which 576 (12.9%) cases were excluded from the final analysis due to the incomplete ordered profile. Accordingly, 3883 blood transfusion request forms were analyzed in Amir-Almomenin hospital of Zabol. Furthermore, the registered records from the blood transfusion service of the hospital were explored to gather the required complete information of the ordered products and transfused units. Moreover, an entire list of the donor and recipient data were collected including the blood types (i.e., ABO & Rh), blood components, hospitalization wards, the rate of utilized blood, the rate of returned blood components, and the reasons for the returns in order to perform a comprehensive analysis. The frequency of blood orders and the maximum amounts of usage in each ward were assessed as well. Additionally, the rate of blood component orders, wastages, and their reasons were analyzed by descriptive statistic (i.e., frequency percentage) and chi-square tests using SPSS software, version 18. Ultimately, the number of cross-matched units to the number of transfused units were divided to calculate the C/T ratio.

Results

In general, 3883 blood order forms were evaluated based on the purpose of the present study. The distribution of the ordered blood components based on blood groups was 33.8%, 31.9%, 24.4%, and 9.9% blood groups of O, A, B, and AB, respectively. In addition, 90.7% of the blood units were Rh D positive while 9.3% of them were Rh D negative. Table 1 demonstrates the distributions of the blood component based on ABO and Rh blood groups.

The frequency of blood component request in various hospital wards are presented in Table 2. As shown, among different hospital departments, the highest orders belongs to intensive care unit (ICU) (34.2%), emergency (13.6%), neonatal intensive care unit (10.6%), operation room (9.8%), internal department (6.1%), obstetrics (4.3%), delivery (4.2%), women surgery (3.2%), men surgery (3.1%), pediatrics (2.8%), infectious (2.5%), neonatal (2%), dialysis (1.4%), coronary care unit (CCU)

Table 1. The Distribution of Blood Components Based on Different Blood Types and According to ABO and Rhesus Systems

Blood Groups		Blood Components (N = 3883) No. (%)
ABO blood types	O	1312 (33.8)
	A	1239 (31.9)
	B	948 (24.4)
	AB	384 (9.9)
Rhesus blood types	Positive	3522 (90.7)
	Negative	361 (9.3)

Table 2. The Frequency of Blood Component Request in the Hospital Departments

Hospital Sections	Component Request (N=3883) No. (%)
ICU	1329 (34.2)
Emergency	528 (13.6)
NICU	412 (10.6)
Operating room	380 (9.8)
Internal department	237 (6.1)
Obstetrics	167 (4.3)
Delivery	163 (4.2)
Women surgery	124 (3.2)
Men surgery	120 (3.1)
Pediatrics	109 (2.8)
Infectious	97 (2.5)
Neonatal	78 (2)
Dialysis	54 (1.4)
CCU	47 (1.2)
PCCU	19 (0.5)
Gastroenterology	19 (0.5)
Total	3883 (100)

Abbreviations: ICU, Intensive care unit; NICU, Neonatal intensive care unit; CCU, Coronary care unit; PCCU, Pediatric critical care unit.

(1.2%), pediatric critical care unit (PCCU) (0.5%), and gastroenterology (0.5%).

As shown in Table 3, the frequencies of the ordered blood components encompass PRBCs (2097 cases, 54%), fresh frozen plasma (823 cases, 21.2%), platelets (757 cases, 19.5%), and cryoprecipitate (206 cases, 5.3%). Based on the results provided in Table 3, the pRBC is the most frequently transfused blood component in all the departments except for the NICU where fresh frozen plasma (20.2%) is considered as the major used product. Furthermore, ICU departments have the highest order for cryoprecipitate (55.46%) and platelets (48.05%).

Moreover, a significant difference is observed in the distribution of returned D + components versus D – components ($P = 0.001$). As illustrated in Figure 1, among all the hospital wards, the highest return rates belong to delivery, operating room, and emergency sections each with 8.23%, 6.36%, and 4.56%, respectively. The most common reasons for the returns are shown in Table 4.

Discussion

The importance of evaluating usage and wastage of blood components is increasing due to the large amounts of expenditures for providing and storing these components. Therefore, blood banks should attempt to present high-quality blood components with a minimum number of wastages. This can be fulfilled by appropriate management of blood transfusion with a prerequisite of comprehensive knowledge over blood transfusion conditions in different departments of the hospitals. As previously mentioned, the present study aimed at investigating the usage and wastage rate of blood components in Amir-Almomenin hospital of Zabol, Iran. The results showed that PRBCs were the most requested blood components from different hospital departments. Other most used blood components included fresh frozen plasma, platelets, and cryoprecipitate. However, no entire blood units were recorded in the current study since nearly all the blood donated units were processed to blood components in order to meet the regional blood requirements, which is in line with the results of previous studies in this regard.[1,18,19]

Additionally, O+ was found to be the most ordered blood type and the ICU department was ranked first as having the highest volume of blood product orders. Consistently, Karami et al concluded that most of the orders were from the ICU department.[20] Notably, other studies reported that at least 50% of the patients underwent blood transfusion during their hospitalization in the critical care department.[21,22] According to the findings of previous studies, large amounts of blood ordering from the ICU department was due to the systemic diseases, as well as the patients with anemia manifestations who were hospitalized in this ward.[23] Furthermore, it was found that in some cases, the physicians decided to order PRBCs regardless of the hemoglobin levels for the patients in the ICU department. In this context, Kouchek et al revealed that only 19% of the blood recipients had hemoglobin levels of less than 7 g/dL.[24] Given the role of hemoglobin in oxygen supply, the maintenance of tissue metabolism, and the proper function of different organs of the body, the blood transfusion is considered as a life-saving material since most of the blood transfusion are highlighted to improve oxygen delivery.[14]

The rate of blood and blood components wastage was reported to be 0.1% to 6.7 % by the Johns Hopkins University while it was found to be 2.03 and 4.4% in the present study and that of Heitmiller et al.[10,25] In addition, most of the returned products were attributed to the delivery department. Bleeding during and after the delivery is the leading cause of total mortality in gynecology wards across Asia (31%) and Africa (34%), which explains the high rates of blood ordering in this department.[25] Further, a significant difference between the number of cross-matched products to the transfused

Table 3. Blood Components Requests in Separate Hospital Units

Unit	PRBCs (N=2097) No. (%)	FFP (N=823) No. (%)	Platelet (N=757) No. (%)	Cryoprecipitate N=206 No. (%)	Total (N=3883) No. (%)
Delivery	82 (3.9)	32 (3.9)	19 (2.51)	30 (14.5)	163 (4.2)
Operation room	278 (13.25)	81 (9.84)	17 (2.24)	4 (1.94)	380 (9.8)
Emergency	331 (17.21)	87 (10.57)	90 (11.88)	20 (9.7)	528 (13.6)
ICU*	565 (26.94)	275 (31.23)	371 (49)	118 (57.28)	1329 (34.2)
Internal	138 (6.58)	37 (4.5)	46 (6.07)	16 (7.76)	237 (6.1)
Men surgery	102 (4.86)	12 (1.46)	6 (0.79)	0	120 (3.1)
Women surgery	112 (5.34)	4 (0.49)	4 (0.53)	4 (1.94)	124 (3.2)
Infectious	48 (2.29)	14 (1.7)	32 (4.22)	3 (1.45)	97 (2.5)
Pediatrics	56 (2.67)	31 (3.77)	22 (2.9)	0	109 (2.8)
NICU	109 (5.2)	170 (20.7)	133 (17.57)	0	412 (10.6)
Obstetrics	130 (6.2)	28 (3.4)	2 (0.26)	7 (3.39)	167 (4.3)
Neonatal	47 (2.24)	20 (2.43)	11 (1.45)	0	78 (2)
PCCU	8 (0.38)	11 (1.34)	0	0	19 (0.5)
Dialysis	50 (2.38)	2 (0.24)	2 (0.26)	0	54 (1.4)
CCU	33 (1.57)	10 (1.21)	0	4 (1.94)	47 (1.2)
Gastroenterology	8 (0.38)	9 (1.09)	2 (0.26)	0	19 (0.5)

ICU: Intensive care unit; NICU: Neonatal intensive care unit; CCU: Coronary care unit; PCCU: Pediatric critical care unit; FFP: Fresh frozen plasma.

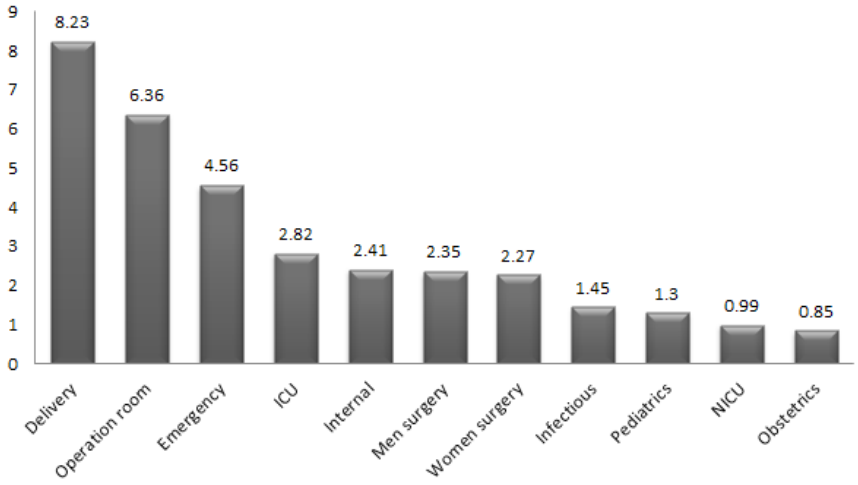

Figure 1. The Rate of Blood Component Returns in Different Hospital Departments.

products in the gynecology department of Shariati Hospital in Tehran verified a high rate of blood wastage in this department.[26]

Furthermore, the unused remaining of blood components was regarded as the main cause of blood components return, which may be due to the excess orders from the physicians. This highlights the significance of understanding the best time schedules of blood ordering, the principals of keeping, and the transportation of blood components. Moreover, the major causes of blood components wastage included disregarding to sustain cold chain during the transportation of blood bags from the blood bank to the hospital and the blood bag corruption.

Additionally, Khoshrang et al indicated that extreme blood ordering before the surgical operations was one of the most frequent reasons for blood wastages.[22] However, Ghafleh et al reported that the highest rate of blood component wastages (86.4%) pertained to expiration, as well as the rise in product temperatures (0.3%) and the presence of clots in the blood bags (0.1%).[5] Similarly, approximately 7400 pRBC products were found to be wasted annually in academic hospitals of Zahedan.[20] According to the reports by the current study and several other studies, there is no standard schedule for ordering the blood components in the hospitals. In fact, the ordered blood bags for pediatrics are the same as those used for the adults in the majority of hospitals while applying pediatric bags can significantly reduce the wastage of

Table 4. The Distribution of Blood Component Return Rates in Each Product

Blood Components	No Consumption No. (%)	Other Reasons[a] No. (%)
pRBCs (Number=885)	823 (93)	62 (7)
FFP (n=18)	6 (33.3)	12 (66.6)
Platelets (n=19)	14 (73.7)	5 (26.3)
Cryoprecipitate (n=12)	12 (100)	0 (0)

FFP, Fresh frozen plasma.
Other reasons: remaining at ambient temperature for more than 30 minutes (for pRBCs), broken seals, broken bags, broken cold chain, and blood clots.

blood components.[27] Furthermore, Beckmann et al investigating the adult patients for two years, concluded that colloid materials (colloid serums) can serve as efficient substitutes for lowering the amount of blood and blood component transfusion.[28]

Based on the findings of the present study, the ratio of cross-matched blood to transfused blood (C/T) was 1.73, which is in agreement with that of the study by Abbasi et al who analyzed the blood management for the gastric cancer patient undergoing gastrectomy surgery.[27] On the other hand, the results of a two-year study in surgery departments in academic hospitals of London demonstrated a decrease in C/T ratio from 2.25 to 1.71, which could effectively reduce the number of product wastage (102 blood units during 15 months) after implementing Maximum Surgical Blood Ordering Schedule (MSBOS) instructions.[29] Therefore, the importance of allegiance to MSBOS instructions is recommended to decrease the blood component wastages. In addition, the results revealed the incomplete order forms as one of the defects in the blood ordering process. The absence of complete necessary data including the disease diagnosis, the name of physicians who ordered the bloods, and the exact time of ordering were among the main defects complicating the patient blood management. Moreover, the lack of distinction between anemia and bleeding can possibly disturb the accurate assessment of blood components ordering. Thus, the blood transfusion institutes should take action regarding monitoring and managing the performance of blood and blood component usage, which can thus prevent blood wastages by means of proper management of ordering and usage.

Ethical Approval

Not applicable.

Conflicts of Interest

None to declare.

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