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Determination of Blood Components Utilization Pattern in Zahedan City, Southeast of Iran

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Abstract

Background: Predicting future blood requirements and optimizing current transfusion practices require information on blood product utilization.
Objectives: The aims of this study was to determine the utilization patterns of blood components in Zahedan, the capital city of Sistan and Balouchestan province in southeastern Iran.
Methods: This descriptive study was conducted from March to August 2015. Blood bank data were collected from seven hospitals. Moreover, the archived blood request forms were studied for the demographic data of blood receivers.
Results: Overall, 13,312 blood request forms (30,418 requested blood units) were studied. The mean age of the recipients was 24.3 $\pm$ 20 year and 38.9% of them were of the O blood group, followed by B (28.8%). Packed cell (PC) units were the most commonly used products (36.7%), followed by leuko-reduced red cells (25.4%), fresh frozen plasma (FFP) (16.8%), platelets (15.2%), cryoprecipitate (3.2%), and washed red cells (2.5%). The major users of blood components were the thalassemia wards (38.7%). Among the blood components, the highest wastage was related to PC with 32.3%, followed by FFP with 22.5%. The highest rate of wastage was recorded in the surgery (1,081 units) and emergency (784 units) wards for PC products and CCUs (376 units) and ICUs (167 units) for FFP products.
Conclusions: A high rate of blood wastage was observed in the use of PC and FFP units. Increased awareness of physicians and medical students leads to proper blood consumption in the future. The Hospital Blood Transfusion Committee should review blood transfusion guidelines to optimize blood consumption.

Keywords: Blood Transfusion, Blood Component, Packed Cell, Fresh Frozen Plasma, Platelets, Cryoprecipitate

1. Background

Blood and blood-derived products are used frequently as therapeutics, especially in hospitalized patients. Sufficiency in blood products needs appropriate recruitment of blood donors, as well as optimized collection and storage systems. Serious shortcomings are observed in blood management facilities regarding the delivery of sufficient blood units to patients in need, especially in third world nations. According to a report by the World Health Organization, in a sample of 1000 people, the blood donation rates were only 8.1 and 4.4 in lower-middle-income and low-income countries, respectively (1). In addition to limited blood resources, unnecessary blood derivative transfusion is a major cause of insufficient blood available for patients who are in need (1). Among the most common reasons for leaving blood units unused are inappropriate storage conditions (such as compromised blood bags), expiration of blood units, and unsafe blood products (discoloration, clotting, etc.) (2). Furthermore, the expense of blood derivative preparation increases constantly and an unnecessary financial burden is imposed on the health care system in case of the inappropriate use of blood components (3). Population aging will make the number of eligible blood donors inadequate in the near future. Researchers' efforts have been directed toward the safety and proper utilization of blood products to overcome these problems.

Providing an adequate amount of blood derivatives to meet the high demands of the population needs a sophisticated system to optimize all blood management procedures from resources to receivers. Implementing a program to increase efficiency in the blood management system initially requires an understanding of the current condition and information about practical blood usage. The

wastage of blood units due to these factors can be dramatically reduced by appropriate education.

The Iranian Blood Transfusion Organization (IBTO) has provided a sophisticated system for blood banks in Iran, including volunteer donor recruitment, testing of blood units, and their safe delivery to hospitals (4, 5). However, the fate of blood units in our hospitals is not adequately audited, resulting in a shortage in this sphere. The epidemiology of blood consumption information should be updated in our region. We aimed to evaluate the rate of utilization and wastage of different blood components in seven hospitals in Zahedan city, the capital of the Sistan and Balouchestan province in southeastern Iran.

2. Methods

This retrospective study was conducted from March to August 2015 and included data related to the ordering and infusion of blood products in seven hospitals in Zahedan city. Data resources for collecting data were the blood banks of the hospitals. We recorded the types of blood and blood products and the reasons for using these products. The demographic data of the receivers of the products were collected from the archived request forms of hospital blood banks.

3. Results

In this study, 13312 transfusion requests issued for 30418 units of different blood components were examined. The mean age of blood receivers (54.1% male, 45.9% female) was 24.3 $\pm$ 20.6 years, with a median age of 20 (range, 0 - 93) years old. The highest number of requests (11255; 37%) was issued for subjects in 21 - 35 years of age and the lowest number (2464; 8.1%) for those aged 6 - 10 years. Of the total requisitions received, 11832 (38.9%) were for the O blood group, followed by B (8760; 28.8%), A (7392; 24.2%), and AB (2464; 8.1%) (Table 1).

Out of the requested forms, 11211 (36.7%) units were related to packed cells (PC), 7718 (25.4%) units to Leuko-reduced red cells (LRC), 5099 (16.8%) units to fresh frozen plasma (FFP), 4639 (15.2%) units to platelets (PLT), 983 (3.2%) units to cryoprecipitate (CP), and 768 (2.5%) units to washed red cells (WRC) (Tables 2 and 3).

Overall, the thalassemia ward used the majority of the blood components (9831 of 25425; 38.7%), including 7649 units of LRC, 1417 units of PC, 761 units of WRC, one unit of FFP, and three units of PLT, followed by the internal medicine ward with 4601 of 25425 (18.1%) units, ICU ward with 4268 of 25425 (16.8%) units, and the emergency ward with 2083 of 25425 (8.2%) units (details shown in Table 4).

In red cell blood components, 7711 LRC units, 7595 PC units, and 768 WRC units were cross-matched. Of all the 30418 transfusion units that were requested, 25425 (83.6%) units were transfused (ratio of request/consume = 1.2), while 4993 (16.4%) units were wasted at this time (ratio of cross-match/waste = 1.83) (details shown in Table 5). The highest rates of wastage were related to PC (32.3%), which occurred mostly in the surgery (1081 units) and emergency (784 units) wards, followed by FFP with (22.5%), with the maximum wastage occurring in the CCU (376 units) and ICU (167 units) wards (Tables 2 and 3).

4. Discussion

The use of blood services as an effective and vital therapeutic strategy has progressively increased in health care centers. One of the important goals of the blood utilization management system is the wastage reduction and effective use of high-quality blood components. We evaluated the usage and wastage of blood components in hospitals of Zahedan city, the capital of the Sistan and Balouchestan province, in southeastern Iran.

Out of total requests, blood components PC, LRC, FFP, PLT, CP, and WRC were demanded, in sequence, in our study. In a study in Qazvin, a central province of Iran, PC (58.6%) was the most frequently demanded product, followed by PLT, FFP, and CP (6). Also, PC and FFP were the most frequent products used in a hospital-based study in Guyana (2). In a study in central Iran, PC, PLT, and FFP were the common blood products consumed (7). Of the total 17634 units of blood components issued in a study in India, 58.1% were PC, 29.4% FFP, 12.2% PLT, and 0.18% CP (8). The percentage of transfusion recipients of PC was 42% in Brazil (9) and 43.3% in Korea (10). In most of the studies, PC was the most common blood product that had been requested. The distribution of the blood component is not uniform and depends on clinical specialties. However, we recorded LRC as the second major component before FFP that probably was due to the type of patients and hospitals evaluated. This province is one of the most prevalent areas of thalassemia in Iran with the routine use of LRC and WRC products (11-13).

The results showed that 54% and 46% of the blood component's users were males and females, respectively. In a study in India, 57% and 43% of users were reported to be male and female, respectively (8). In a retrospective study carried out from January to December 2015 in Karnataka institute hospitals, 62% and 38% of transfusion recipients were females and males, respectively (14). In a study in all UKM in-patient cases in Germany from 2009 to 2011, male patients (54.4% - 63.9%) used more blood components than

Table 1. Rate of Request for Each Blood Component with Respect to Age Groups, Gender, and Blood Groups in the Different Wards of Zahedan Hospitals Between March and August 2015[a]

	PC	FFP	PLT	CP	WRC	LRC	Total
Age group, y							
1 - 5	931 (8.3)	612 (12)	404 (8.7)	78 (7.9)	251 (32.7)	779 (10.1)	3072 (10.1)
6 - 10	1009 (9)	102 (2)	455 (9.8)	20 (2)	136 (17.7)	695 (9)	2464 (8.1)
11 - 15	583 (5.2)	66 (1.3)	204 (4.4)	16 (1.6)	232 (30.2)	1219 (15.8)	2494 (8.2)
16 - 20	796 (7.1)	250 (4.9)	459 (9.9)	16 (1.6)	60 (7.8)	980 (12.7)	2677 (8.8)
21 - 35	3296 (29.4)	1790 (35.1)	1322 (28.5)	407 (41.4)	85 (11)	4029 (52.2)	11255 (37)
36 - 60	2769 (24.7)	1270 (24.9)	1123 (24.2)	331 (33.6)	2 (0.3)	6 (0.08)	5110 (16.8)
> 60	1828 (16.3)	1009 (19.8)	672 (14.5)	115 (11.7)	2 (0.3)	10 (0.12)	3346 (11)
Sex							
Male	5707 (50.9)	2641 (51.8)	2477 (53.4)	519 (52.8)	412 (53.6)	3797 (49.2)	15544 (51.1)
Female	5504 (49.1)	2458 (48.2)	2162 (46.6)	464 (47.2)	356 (46.4)	3921 (50.8)	14874 (48.9)
Blood group, Rh							
A	2915 (26)	1163 (22.8)	946 (20.4)	269 (27.4)	227 (29,6)	1891 (24.5)	7392 (24.2)
B	3251 (29)	1142 (22.4)	1160 (25)	143 (14.5)	326 (42.5)	2670 (34.6)	8760 (28.8)
AB	785 (7)	749 (14.7)	427 (9.2)	54 (5.5)	36 (4.7)	455 (5.9)	2464 (8.1)
O	4260 (38)	2045 (40.1)	2106 (45.4)	517 (52.6)	179 (23.2)	2701 (35)	11832 (38.9)
D+	10111 (90.2)	4599 (90.2)	4189 (90.3)	878 (89.3)	694 (90.4)	6854 (88.8)	27315 (89.8)
D-	1099 (9.8)	500 (9.8)	450 (9.7)	105 (10.7)	74 (9.6)	864 (11.2)	3103 (10.2)

Abbreviations: CP, cryoprecipitate; FFP, fresh frozen plasma; LRC, leuko-reduced red cells; PC, packed cells; PLT, platelet; WRC, washed red cells.
[a]Values are expressed as No. (%).

Table 2. The Frequency of Requested Red Blood Cell Components, Consumed, and Wasted in the Different Wards in Zahedan Hospitals Between March and August 2015[a]

Wards	Packed Red Cells			Washed Red Cells			Leuko-Reduced Red Cells		
	Requests Units	Consumed Units	Wastage Units	Requests Units	Consumed Units	Wastage Units	Requests Units	Consumed Units	Wastage Units
Thalassemia	1417	1,417 (100)	0	761	761 (100)	0	7649	7649 (100)	0
Surgery	1964	883 (45)	1081 (55)	-	-	-	2	2 (100)	0
Emergency	1879	1095 (58.3)	784 (41.7)	1	1 (100)	0	7	6 (85.7)	1 (14.3)
Internal MED.	1452	1138 (78.4)	314 (21.6)	2	2 (100)	0	38	34 (89.5)	4 (10.5
ICU	1630	1252 (76.8)	378 (23.2)	2	2 (100)	0	5	5 (100)	0
CCU	730	450 (61.6)	280 (38.4)	-		-	-	-	-
Maternity	566	355 (62.7)	211 (37.3)	2	2 (100)	0	1	1 (100)	0
Pediatrics	225	154 (68.4)	71 (31.6)	-	-	-	12	10 (83.3)	2 (16.7)
NICU	219	143 (65.3)	76 (34.7)	-	-	-	-	-	-
Obstetrics	262	179 (68.3)	83 (31.7)	-	-	-	-	-	-
Dialysis	149	139 (93.3)	10 (6.7)	-	-	-	-	-	-
Renal	35	20 (57.1)	15 (42.9)	-	-	-	4	4 (100)	0
Hemophilia	-	-	-	-	-	-	-	-	-
Orthopedic	640	338 (52.8)	302 (47.2)	-	-	-	-	-	-
Burns	43	32 (74.4)	11 (25.6)	-	-	-	-	-	-
Total	11211	7595 (67.7)	3616 (32.3)	768	768 (100)	0	7718	7711 (99.9)	7 (0.1)

[a]Values are expressed as No. (%).

female patients (36.1% - 45.6%) (15). In a study in four geographical regions of the US from January 1, 2013, to Decem-

Table 3. The Frequency of the Platelet and Plasma Components Requested, Consumed, and Wasted in the Different Wards of Zahedan Hospitals Between March and August 2015[a]

Sections	Platelet Cells			Fresh Frozen Plasma			Cryoprecipitate		
	Requests Units	Consumed Units	Wastage Units	Requests Units	Consumed Units	Wastage Units	Requests Units	Consumed Units	Wastage Units
Thalassemia	3	3 (100)	0	1	1 (100)	0	-	-	-
Surgery	215	200 (93)	15 (7)	233	180 (7.7)	53 (22.7)	52	46 (88.5)	6 (11.5)
Emergency	602	586 (97.3)	16 (2.7)	486	329 (67.7)	157 (32.3)	66	66 (100)	0
Internal MED.	2044	2018 (98.7)	26 (1.3)	1234	1130 (91.6)	104 (8.4)	297	279 (93.9)	18 (6.1)
ICU	1262	1162 (92.1)	100 (7.9)	1606	1410 (87.8)	196 (12.2)	452	437 (96.7)	15 (3.3)
CCU	71	68 (95.8)	3 (4.2)	518	142 (27.4)	376 (72.6)	-	-	-
Maternity	194	180 (92.8)	14 (7.2)	276	196 (71)	80 (29)	35	35 (100)	0
Pediatrics	77	61 (79.2)	16 (20.8)	111	64 (57.7)	47 (42.3)	6	6 (100)	0
NICU	56	54 (96.4)	2 (3.6)	381	277 (72.7)	104 (27.3)	3	3 (100)	0
Obstetrics	51	51 (100)	0	62	50 (80.6)	12 (19.4)	14	14 (100)	0
Dialysis	17	17 (100)	0	19	15 (78.9)	4 (21.1)	11	11 (100)	0
Renal	4	4 (100)	0	79	66 (83.5)	13 (16.5)	6	6 (100)	0
Hemophilia	37	37 (100)	0	72	72 (100)	0	37	37 (100)	0
Orthopedic	6	6 (100)	0	21	18 (85.7)	3 (14.3)	4	4 (100)	0
Burns	-	-	-	-	-	-	-	-	-
Total	4639	4457 (96.1)	182 (3.9)	5099	3950 (77.5)	1149 (22.5)	983	944 (96)	39 (4)

[a]Values are expressed as No. (%).

Table 4. The Frequency of Blood Components Requested, Consumed, and Wasted in Different Wards of Zahedan Hospitals Between March and August 2015[a]

Wards	Requested Units	Consumed Units	Wastage Units
Thalassemia	9831	9831 (100)	0
Surgery	2466	1311 (53.2)	1155 (46.8)
Emergency	3041	2083 (68.5)	1958 (31.5)
Internal MED.	5067	4601 (90.8)	466 (1.2)
ICU	4957	4268 (86.1)	689 (13.9)
CCU	1319	660 (50)	659 (50)
Maternity	1074	769 (71.6)	305 (28.4)
Pediatrics	431	295 (68.4)	136 (31.6)
NICU	659	477 (72.4)	182 (27.6)
Obstetrics	389	294 (75.6)	95 (24.4)
Dialysis	196	182 (92.9)	14 (7.1)
Renal	128	100 (78.1)	28 (21.9)
Hemophilia	146	146 (100)	0
Orthopedic	671	366 (54.5)	305 (45.5)
Burns	43	32 (74.4)	11 (25.6)
Total	30418	25425 (83.6)	4993 (16.4)

[a]Values are expressed as No. (%).

ber 31, 2014, transfusion incidence, when stratified by age, was the same in male and female inpatients (16). In a Zimbabwe study, 63.2% of transfusion recipients were female of whom, 65.3% were in the reproductive age group, (15 - 49 years) (17). The blood consumption may vary with age, sex, and age-related diseases and in developed countries, men receive blood transfusion more than women (15, 18). Moreover, improvements in health care services and management practices during pregnancy in most countries have reduced the need for blood transfusion in women.

Thalassemia and internal medicine wards, were the most common wards that used more than half of all blood components. Moreover, 18% of PC and more than 90% of LRC and WRC units were consumed by thalassemia patients. This province is located in an area where malaria was once endemic and G6PD deficiency had a high prevalence (19).

Most recipients were aged 21 - 35 years while patients over 65 years of age comprised 16% of blood receivers. In line with this finding, patients over 60 years gave transfusion less than other age groups and the majority of recipients were 21 - 50 years old in Ambroise et al. study in South India (20). In the UK, however, Beckwith et al. reported that 56% of transfusions were related to patients above 65 years of age (21). This was also reproduced in a Spanish study in which half of the PC recipients were above 70 years of age

Table 5. The Frequency of Requested Blood Product Units, Transfused, Wasted, and the Cross-Matched-Transfused Ratio in Zahedan Hospitals Between March and August 2015.

Blood Products	Requested Unit	Transfused Unit[a]	Wasted Unit[a]	Cross-Matched/Transfused Ratio
PC	11211	7595 (67.7)	3616 (32.3)	1.48
FFP	5099	3950 (77.5)	1149 (22.5)	1.29
PLT	4639	4457 (96.1)	182 (3.9)	1.04
CP	983	944 (96)	39 (4)	1.04
WRC	768	768 (100)	0 (0)	1
LRC	7718	7711 (99.9)	7 (0.1)	1
Total	30418	25425 (83.6)	4993 (16.4)	1.2

Abbreviations: CP, cryoprecipitate; FFP, fresh frozen plasma; LRC, leuko-reduced red cells; PC, packed cells; PLT, platelet; WRC, washed red cells.
[a]Values are expressed as No. (%).

(22). Based on Cobain et al., who reported the use of blood components in four countries including the USA, UK, Australia, and Denmark, it was revealed that the majority of PC units were given to older patients (23). The indication for blood transfusion varies in different countries. According to the WHO reports, 75% of all blood transfusions occur in the patient group of over 65 years in high-income countries while children under the age of five years are the most common users of blood components in low-income countries (1). Sistan and Balouchestan is the youngest province in Iran; according to Iran's statistics, the mean age of the province population is 23.5 years. Moreover, according to the Iranian Forensic Medicine Organization, accidental injury is common in the province. The most common reason for blood utilization was thalassemia and most of the thalassemia patients were aged less than 30 years.

Overall, the results indicated that the rate of wastage of blood units was 16.4%; the highest wastage rate belonged to PC (32.3%) in the surgery and emergency wards, followed by FFP (22.5%) in the CCU and ICU wards. In a report from Iran, blood wastage was 9.8% and the highest rate of wastage was related to PC (59.4%) and FFP (22%) (6). In a study by Javadzadeh et al., blood wastage was reported to be 12.8% (PC 21.5% and FFP 11%) (7). Kurup et al. studied the wastage rate of blood products in 2012, 2013, and 2014; they reported an overall rate of 25.4% and the rates according to the years were 30.1%, 26.4%, and 23.4%, respectively (2). Blood component wastage in a study in the UK was recorded as 3.2% (24).

Our results also indicated that the cross-match-to-transfusion (C/T) ratio was 1.2 for all blood components and it varied in different blood components from one in washed cells to 1.4 in packed cells. The C/T ratio was first suggested by Boral Henry in 1975 and is an important national quality indicator used to gauge the appropriate use of services offered by the transfusion laboratory service (25). The C/T ratio varied in different studies in Iran; in Yazd hospitals, it varied between 2.9 and 8 (7); in Besat Hospital in Hamadan city, it was 2.44 (26); in Rasht city, this ratio was reported to be 1.9 (27); in three Kerman hospitals, it was 1.3 (28). The C/T ratio correlates with the actual blood usage (29). A C/T ratio of more than 2.5 is an index of poor blood usage and the hospital must try to keep the ratio less than 2 (30).

A high rate (nearly 80%) of packed cell outdating occurs as a result of time expiration (with 35 or 42 days of shelf life) (6). Other reasons for PC wastage are said to be the inappropriate temperature of the products during handling, as well as insufficient knowledge of transporting personnel about shipping requirements (31). For FFP and CP, as the shelf life after thawing is 24 hours, a clear decision on the use of FFP may remarkably lower the wastage of this product. In other words, a clinician should be considerate in ordering FFP and CP units after assuring that the products will be used. This is also applicable to other blood units; however, it seems that blood preservers should pay more attention to PC and FFP units in hospitals.

Reestablishing blood transfusion criteria should also be considered to minimize blood misapplication in hospitals. It has been argued that greater awareness of the reduction of blood ordering and a more restrictive application may be needed. In this context, the use of a two-layer monitoring system in a hospital in New York City, USA, led to a significant fall in the use of blood products including PC, FFP, PLT, and CP (32). In this protocol, blood bank technologists, as well as a group of qualified technicians, were responsible for maintaining appropriate transfusion criteria for blood requests (32). The role of audit, along with appropriate education in improving blood usage, has also been highlighted in a similar study in Australia (33). The results of these studies highlight the impacts of an effective supervising system to optimize blood usage.

Based on the current criteria of blood product infusion, there is a high rate of inappropriate use (either

overuse or misuse). For example, it has been noted that the infusion of PC out of a certain hemoglobin threshold cannot increase oxygen delivery to tissues (34). For platelets, prophylactic use has been proposed to have a minute role in the prevention of active surgical bleeding (35, 36). Considering this, a greater procurement of blood substitutes may be an effective way of managing allogenic transfusions (37). Transfusion practices vary from hospital to hospital; therefore, blood transfusion should be evidence-based to optimize patient care.

One of the limitations of this study was the lack of sufficient information in the blood and blood component request forms, which had to be fully completed by the physician. We recommend following the MSBOS (maximum surgical blood ordering schedule) instruction to reduce the loss of blood derivatives. This could be addressed by educating clinicians and other staff about policies and difficulties in providing each unit. Given the high social and instrumental expenses for obtaining each unit of blood and its derivatives, leaving blood products unused in hospitals exposes an uneven strategy that may lead to management drawbacks in providing appropriate blood banking services for healthcare facilities. To avoid this, the Hospital Blood Transfusion Committee should design and apply methods to reduce blood wastage. Educational programs for physicians, medical students, nurses, and the staff in charge of transportation and transfusion of blood units may improve blood ordering and utilization.

5. Conclusions

It is proposed to provide a coordinated system of collection, storage, and transportation of blood products from blood banks and hospital blood banks to surgical operating rooms.

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Footnotes

Authors' Contribution: Atefe Tahmasemi, Shaghaygh Khedria, and Sohaila Khosravi contributed to performing the research, data analysis, and drafting the manuscript. Ebrahim Miri-Moghaddam contributed to study design, manuscript writing, and project supervision.

Conflict of Interests: The authors declare that they have no competing interests.

Ethical Approval: The study was approved by the Ethics Committee of Zahedan University of Medical Sciences (IR.ZAUMS.REC.1394.144).

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