

Blood Component Usage and Discard in the Blood Centre of a Tertiary Care Hospital in a Remote Part of North-east India: A Cross-sectional Study

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ABSTRACT

Introduction: Blood and its various components are valuable resources for sustaining life. They are routinely used and form an integral part of patient care. The judicious use of blood and its components is necessary in low socio-economic countries.

Aim: To estimate the usage of blood and blood components and its discard in a tertiary care hospital.

Materials and Methods: A hospital-based retrospective cross-sectional study was conducted in the Blood Centre, Diphu Medical College and Hospital, Karbi Anglong, Assam, India. Data was retrieved from Blood Centre registers over a period of 12 month, from July 2021 to June 2022. Both replacement and voluntary donors were selected based on donor selection criteria. All collected blood units were stored and subsequently subjected to Transfusion Transmitted Infections (TTI) testing. The data was tabulated using Microsoft Excel sheet.

Results: During the study period, a total of 4,525 units of whole blood were collected, and 7,539 blood units, including both whole blood and blood components, were prepared. The highest number of issues during the period comprised of whole blood at 2,468 units. Among blood components, 1,854 units of Packed Red Blood Cells (PRBCs) were most commonly utilised, followed by 1,824 units of Fresh Frozen Plasma (FFP). A total of 334 units (4.43%) of blood/ blood components were discarded due to various reasons, with the highest discard rate observed for Platelet Concentrates (PC) at 71 (6.28%) units. The major reason for discard was seropositivity, accounting for 212 (63.5%) units.

Conclusion: Adequate blood inventory, along with proper training and sensitisation of hospital staff, should be conducted at timely intervals regarding proper donor selection, collection, and storage of blood/ blood products. Clinicians should also be engaged to optimise the usage of blood/ blood products. These steps can help minimise wastage in resource limited countries.

Keywords: Donors, Platelet concentrates, Seropositivity, Transfusion transmitted infections

INTRODUCTION

Blood and its various components are valuable resources for life. Blood transfusion can save millions of lives and depends on the availability of different blood components. They are routinely used and form an integral part of patient care. It has been estimated that one-third of all patients admitted to intensive care units in the developed world receive a blood transfusion [1]. Blood components such as red cells, platelets and FFP (Fresh Frozen Plasma) are prepared from a single whole blood donation. The blood components can be prepared in a blood centre by conventional centrifugation at a relative centrifugal force in grams for different durations from a standard unit of whole blood or can be obtained by apheresis. The blood should be drawn using a sterile and aseptic technique from either arm free from any skin lesions. PRBCs (Packed Red Blood Cells), PC (Platelet Concentrates), and FFP are routinely transfused. One unit of PRBCs in an adult will increase Haematocrit (Hct) approximately by 3% and Haemoglobin (Hb) by 1 g/dL. The various indications for transfusing PRBCs are as follows: 1) Patient is actively bleeding with Hct <21%; 2) Patient with coronary artery disease, unstable angina, myocardial infarction, or cardiogenic shock with Hct <24%; 3) Rapid blood loss >1.5-2 L not responding to volume resuscitation; 4) Autologous RBCs with Hct <27% [2].

A single dose of PC (adult: apheresis of six concentrates; paediatrics dose: 1 unit/10 kg) will increase the platelet count by 25-35×10⁹/L. The various indications for PC are as follows: 1) Platelet count ≤10×10⁹/L prophylactic in a patient with failure of platelet production; 2) Platelet count ≤20×10⁹/L and signs of

hemorrhagic diathesis (petechiae, mucosal bleeding); 3) Platelet count >50×10⁹/L [2,3]. A single unit of FFP (adult: 10 mL/kg body weight) provides all coagulation factors, approximately 1 IU/mL of each factor, fibrinogen 200-400 mg and plasma.

The indications for transfusing FFP are as follows: Actively bleeding and multiple coagulation factor deficiencies in: 1) Liver diseases; 2) Disseminated intravascular coagulation; 3) Coagulopathy in massive transfusion; 4) Thrombotic thrombocytopenic purpura; 5) Familial factor V deficiency; 6) Deficiency of factors II, VII, IX, and X; 7) Antithrombin III deficiency [4,5].

The risk of viral infections such as Human Immunodeficiency Virus (HIV), Hepatitis C Virus (HCV), Hepatitis B Virus (HBV), etc., has emerged as the major cause of transfusion-related morbidity and mortality, along with bacterial infections [2]. The steps in donor selection and laboratory testing described have resulted in safe blood transfusion practices [6,7]. With the advent of new screening techniques, the number of infectious donors has been reduced and blood transfusion carries a lower risk of infection. The various criteria mentioned in the technical manual by the Directorate General of Health Services (DGHS), Ministry of Health and Family Welfare (MoHFW), Government of India, for donor selection and their deferral, along with the Blood Centre record register, have helped minimise the risk of Transfusion Transmitted Infections (TTI) [8]. There has been a significant improvement in blood transfusion practices following the above measures. However, the risk of acquiring a transfusion-transmitted disease ranges from 1 per 150,000 units for Hepatitis B to 1 per 2,135,000 units for HIV [9,10]. The aim of the present study was to analyse the utilisation pattern of blood and

its components, along with their discard, in a remote tertiary care centre in Diphu, Karbi Anglong, Central Assam, North-east India.

MATERIALS AND METHODS

The study was a hospital-based retrospective cross-sectional study conducted in the Blood Centre, Diphu Medical College and Hospital, a tertiary care Centre in the remote hill district of Karbi Anglong, Central Assam, Northeast India, over a period of 12 months from July 2021 to June 2022. Data regarding donation, issuance, and discard of blood and its components were collected month wise, starting from July 2021 to June 2022. The approval of the Institutional Ethical Committee of the medical college was obtained prior to the study (Ref# DMCH/EC/2022/105/1210).

Inclusion criteria: Donors, replacement and voluntary, from both in-house collection, as well as, voluntary blood donation camps were included in the study, based on donor selection criteria set by National Acquired Immunodeficiency Syndrome (AIDS) Control Organisation (NACO), National Blood Transfusion Council (NBTC) and MoHFW [8].

Exclusion criteria: Donors who did not meet the standard criteria set for blood donors were excluded from the study.

Study Procedure

The information on donors was retrieved from the Blood Centre registers. The authors also collected information on the quantity of daily blood collection, the number and units of whole blood and components that were prepared, the number and units of blood components discarded, and the reasons for discard. Adequate information of donors including their demography, medical history and informed consent for donation was collected using a standard proforma. After the donors were selected, a brief clinical examination on selected donors followed, which was done by a medical officer.

All the blood units collected in the Blood Centres were stored at 2-6°C and subsequently subjected to Transfusion Transmitted Infection (TTI) testing. The accepted blood bags were subjected to component separation within six hours after collection, stored and issued as per the patient's requirement. The blood units collected in voluntary blood donation camps were transported at 2-10°C in blood transport boxes, maintaining proper cold chain. The shelf life of whole blood is 35 days at 2-6°C. The blood components routinely prepared are pRBCs, PC and FFP. The shelf life of pRBCs is 42 days with the additive solution Saline Adenine Glucose Mannitol (SAGM) at 2-6°C, five days for PC at 22-24°C, and one year for FFP at -40°C. Units with suboptimal collection, leakage, clotting, haemolysis during storage, seropositivity on TTI testing, expired with respect to shelf life, or non utilisation after being issued from the Blood Centre were discarded.

STATISTICAL ANALYSIS

The archived data were tabulated using Microsoft Excel. The percentage discard was calculated using the following formula [2]:

$$\text{Percentage of discard} = \frac{\text{No. of units discarded}}{\text{No. of units collected (WB)/Generated by fractionation (For blood components)}} \times 100$$

RESULTS

During the study period, a total of 4,525 units of whole blood were collected. The majority of the donors were replacement donors, accounting for 4,212 (93.08%) units, while the remaining 313 (6.92%) units were voluntary non remunerated blood donors. The collection included blood obtained from both in-house donations and voluntary blood donation camps organised in various parts of the district. Out of the total donors, 4,475 (98.90%) were males and 50 (1.10%) were females.

From the 4,525 units of whole blood collected, a total of 7,539 blood units were prepared during the study period, including both whole

blood and blood components. This comprised 1,959 (43.3%) units of packed red cells, 1,130 (24.9%) units of platelet-rich concentrates, and 1,894 (41.9%) units of FFP. Additionally, 2,556 (56.5%) units were left as whole blood [Table/Fig-1]. The highest number of units issued during the period comprised of whole blood, with 2,468 units. Among the blood components, the highest utilisation was observed for packed red cells, with 1,854 units, followed by 1,824 units of FFP. The least utilised component was platelet concentrates, with 1,059 units issued.

Blood component	No. of units prepared	No. of units discarded	Discard rate (%)
Whole blood	2556	88	3.44
Packed red blood cells	1959	105	5.36
Platelet rich concentrate	1130	71	6.28
Fresh Frozen Plasma (FFP)	1894	70	3.69
Total	7539	334	4.43

[Table/Fig-1]: Blood components prepared and discarded. Values presented as n

In the present study, a total of 334 (4.43%) units were discarded due to various reasons. Among the various components, the highest discard rate was observed for platelet concentrates, with 71 units out of 1,130 (6.28%) being discarded. The lowest discard rate was for whole blood units, with 88 out of 2,556 (3.44%) units being discarded. The various causes for discard in the present study included seropositivity, expiry, suboptimal collection, leakage, haemolysis, and non utilisation after being issued from the Blood Centre. Among these causes, seropositivity accounted for 212 (63.5%) units of the discarded blood units, remaining the major reason for discard in all the accepted blood units and among the various blood components prepared [Table/Fig-2]. The highest seropositivity rate was observed for HCV, accounting for 51.9% of the discarded blood units, followed by HBV at 37.3% [Table/Fig-3].

DISCUSSION

In the present study, a total of 4,525 units of blood were collected from donors. From these donations, 1,959 units of pRBCs, 1,130 units of platelet-rich concentrate, and 1,894 units of FFP were prepared. However, a total of 334 (4.43%) units, including both whole blood and blood components, were discarded due to various reasons.

The present results showed a higher discard rate compared to a similar study conducted by Morish M et al., where the discard rate was reported as 2.3% for whole blood and its components [11]. In another study by Thakare MM et al., the discard rate was 3.58% [12]. However, the current study discard rates were lower compared to studies conducted by Purohit AP et al., (5.58%), Bobde V et al., (6.6%), and Suresh B et al., (7.0%) [13-15].

In the present study, PC recorded the highest discard rate at 6% compared to other components. This high discard rate can be attributed to non utilisation and the short shelf life of five days. These results are consistent with studies conducted by Morish M et al., (6%) and Duarah B et al., (6.17%) [11,16]. On the other hand, the discard rate of fresh frozen plasma (FFP) was the lowest at 3.69% due to higher utilisation in the present centre. This discard rate for FFP is comparable to studies conducted by Navyashree N et al., (2.7%), Morish M et al., (2.5%), and Duarah B et al., (2.68%) [1,11,16].

The discard rate due to seropositivity was 63.5%, with Hepatitis C being the most common TTI at 51.9% [Table/Fig-3,4]. Thakare MM et al., observed that 3.58% of blood bags were discarded, and the main reason was positivity for TTI, constituting 68.86% [12]. Kumar A et al., observed a discard rate of 74.30% due to seropositivity, with Hepatitis B being the most common TTI at 69.6% [17]. In a study by Bashir F et al., the discard due to seropositivity was 32.3%,

Blood component	Total discarded	Expiry	Seropositive	Suboptimal collection	Leakage	Clotted	Haemolysed	Not utilised after issue
Whole blood	88	20	48	12	1	4	2	1
Packed red blood cells	105	47	58	0	0	0	0	0
Platelet rich concentrate	71	33	38	0	0	0	0	0
Fresh Frozen Plasma (FFP)	70	0	68	0	2	0	0	0
Total	334	100	212	12	3	4	2	1

[Table/Fig-2]: Causes of discarding various blood components. values presented as n

Sero-positivity	Whole blood	Packed red blood cells	Platelet rich concentrate	Fresh frozen plasma	Total seropositivity
HBsAg	23	21	12	23	79
HCV	21	30	22	37	110
HIV	2	7	4	8	21
Syphilis	2	0	0	0	2
Malaria	0	0	0	0	0

[Table/Fig-3]: Seropositivity trends of various blood components. values presented as n

Author and year of the study	Place of study	Total units collected (N)	Discard rate (%)	Seropositivity (%)	Discard rate of various blood components			
					Whole blood (%)	pRBC (%)	Platelet (%)	FFP (%)
Navyashree N et al., (2020) [1]	Karnataka, India	13,068	8.9	4.48	8.6	6.9	56.7	2.7
Purohit AP et al., (2018) [13]	Gujarat, India	23,896	5.58	3.47	6.18	3.81	8.99	4.74
Bashir F et al., (2018) [18]	Pakistan	9,308	8.87	32.3	--	15.2	53.9	14.7
Duarah B et al., (2016) [16]	Assam, India	31,655	--	39.97	2.41	1.79	6.17	2.68
Patil P et al., (2016) [19]	Maharashtra, India	14,026	22.45	15.36	7.7	6.74	61.11	14.24
Roy AD and Pal A., (2015) [20]	West Bengal, India	1,241	7.49	25.93	2.18	4.49	32.35	1.5
Suresh B et al., (2015) [15]	Andhra Pradesh, India	5,261	7.4	49	5.7	3.8	16.3	5.5
Bobde V et al., (2015) [14]	Maharashtra, India	31,143	6.6%	18.01	5.2	2	26.2	7.6
Kumar A et al., (2014) [17]	Maharashtra, India	10,582	--	74.3	3.25	2.78	37.11	7.25
Morish M et al., (2012) [11]	Kuala Lumpur, India	1,71,169	2.3	--	3.7	0.6	6	2.5
Thakare MM et al., (2011) [12]	Maharashtra, India	24,547	3.58	68.86	--	--	--	--
Present Study	Assam, India	4,525	4.43	63.9	3.44	5.36	6.28	3.69

[Table/Fig-4]: Comparative analysis of various studies [1,11-20].

with Hepatitis C being the most common TTI at 51.96% [18]. These results were higher compared to the study conducted by Duarah B et al., with a discard rate of 39.97% due to seropositivity [16].

Authors hereby, noticed a high incidence of HCV positivity, probably due to increased incidence in the region or adequate screening. Other causes of discard included suboptimal collection in 12 (3.6%) units, clotting during storage in 4 (1.2%) units, leakage in 3 (0.9%) units, and haemolysis in 2 (0.6%) units [Table/Fig-2]. As the present study hospital is a tertiary care centre, the blood also has to be issued to other healthcare facilities, which accounts for the non specific reasons for utilisation. The authors also noticed that the demand for PRBCs is still lower compared to whole blood, probably because clinicians opt for whole blood in the majority of conditions. A review of the literature on various studies regarding the utilisation of blood components and the various reasons for discard is tabulated in [Table/Fig-4] [1,11-20].

After analysing the present study, the authors found that the reasons for discarding blood components varied depending on the requirements of clinicians, characteristics of the individual components and their storage. Seropositivity emerged as the primary reason for discarding all components. This may be attributed to the fact that, in a remote centre like the present study, the authors heavily rely on voluntary donors from voluntary donation camps. To minimise the discard rate, it is crucial to carefully select donors and organise awareness programs to cultivate a pool of healthy and sustainable donors. Additionally, maintaining an adequate inventory management system with

regular update of database updates is essential. Authors also observed that suboptimal collection, leakage and haemolysis were most prevalent in whole blood. Therefore, it is necessary to provide sensitisation to staff regarding collection techniques, proper storage and periodic checks of blood bags.

Limitation(s)

The current study had some limitations, as it mainly focused on the various reasons for discarding blood within the blood bank. However, other factors such as the delayed return of blood bags to Blood

Centre after non usage or the death of patients prior to transfusion should also be taken into consideration. Further research on this subject should be considered.

CONCLUSION(S)

Blood and its various components are crucial resources, and every effort should be made to ensure their proper utilisation. Wastage of blood can have a significant impact on healthcare. Regular training and sensitisation of the blood centre staff on strict donor selection criteria, utilising sensitive tests for screening infections, employing proper storage techniques, and periodically checking blood and its components to prevent haemolysis and bacterial contamination, along with maintaining adequate blood inventory, can contribute to achieving this goal.

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