A COMPARATIVE ANALYSIS OF BLOOD COMPONENT USAGE AND WASTAGE IN NUKEM BLOOD BANK & ROTARY SUZLON BLOOD COMPONENT CENTER

Manish Patel[1], Devesh Kapoor[2], Dalal Mittal[3], Manmohan Singhal[4]

[1]Dr Dayaram Patel Pharmacy College, Bardoli, Surat, Gujrat
[2]College of Healthcare and Allied Sciences, MJRP University, Jaipur, Rajasthan
[3]ROFEL, Shri GM Bilakhia College of Pharmacy, Vapi, Gujarat
[4]School of Pharmaceutical Sciences, Jaipur National University, Jaipur, Rajasthan

Summary

An analysis of Blood and Blood Component Usage was performed in the Nukem Blood Bank & Rotary Suzlon Blood Component Center, Haria L. G. Rotary hospital (Vapi) during 2007-2008. To find out the ways for reducing the blood component wastage, the trends and reasons for wastage were analyzed. We have analyzed the comparative utilization of different components of blood along with the reasons for usage of blood components and reasons for wastage (discard) of blood components from January 2007 to December 2008 by reviewing the collection, use and wastage statements. Questions about the reasons for wastage and the methods for reducing such wastage were created to help the Staff of the Blood Bank to improve utilization of blood. The collection and utilization of blood and its components had a tendency to increase from 2007 to 2008. There was found to be a great degree of variation in the percent wastage, particularly in the Rh –ve blood type, leading to incense of non availability as well as discarded due to expiry. The most frequent reason for wastage was breakage and RBC contamination (for FFP) and expiry (for PC and for pRBCs).The most encountered reason for utilization were anemia, Thrombocytopenia (especially for PC), Surgery, accidently injury and hepatitis (especially FFP). Blood and its components are very important resource due to shortage. A proper inventory management system and up gradation of facilities and training of staff is necessary to ensure optimum utilization and minimize wastage.

Key words: Blood, hematocrit, packed red blood cells, transfusion, Nukem blood bank

Author for correspondence

Email: manu_mpharm@yahoo.co.in
Mobile: +91-9829153193

Introduction

Blood is a specialized bodily fluid that delivers necessary substances to the body's cells such as nutrients and oxygen and transports waste products away from those same cells. Blood must be collected into single-use, sterile, FDA-licensed containers. The containers are made of plasticized material that is biocompatible with blood cells and allows diffusion of gases in order to provide optimal cell preservation. However, no evidence indicates that transfusion of this material causes clinical problems[1].

Preparation of the Venipuncture

The blood should be drawn from an area free of skin lesions, and the phlebotomy site should be properly decontaminated. The site is scrubbed with a soap solution, followed by the application of tincture of iodine or iodophor complex solution. The selection of the venipuncture site and its decontamination are important steps because bacterial contamination of blood can be a serious or even fatal complication of transfusion[2,3]. The venipuncture is done with a needle that should be used only once in order to prevent contamination. The blood must flow freely and be mixed with anticoagulant frequently as the blood fills the container to prevent the development of small clots.

Collection and Production of Blood Component by Apheresis

Blood components can be obtained by apheresis rather than prepared from a standard unit of whole blood. In apheresis, the donor's anticoagulated whole blood is passed through an instrument in which the blood is separated into red cells, plasma, and a leukocyte/platelet fraction[4]. All of these instruments use centrifugation to separate the blood components[5].

Fractionation

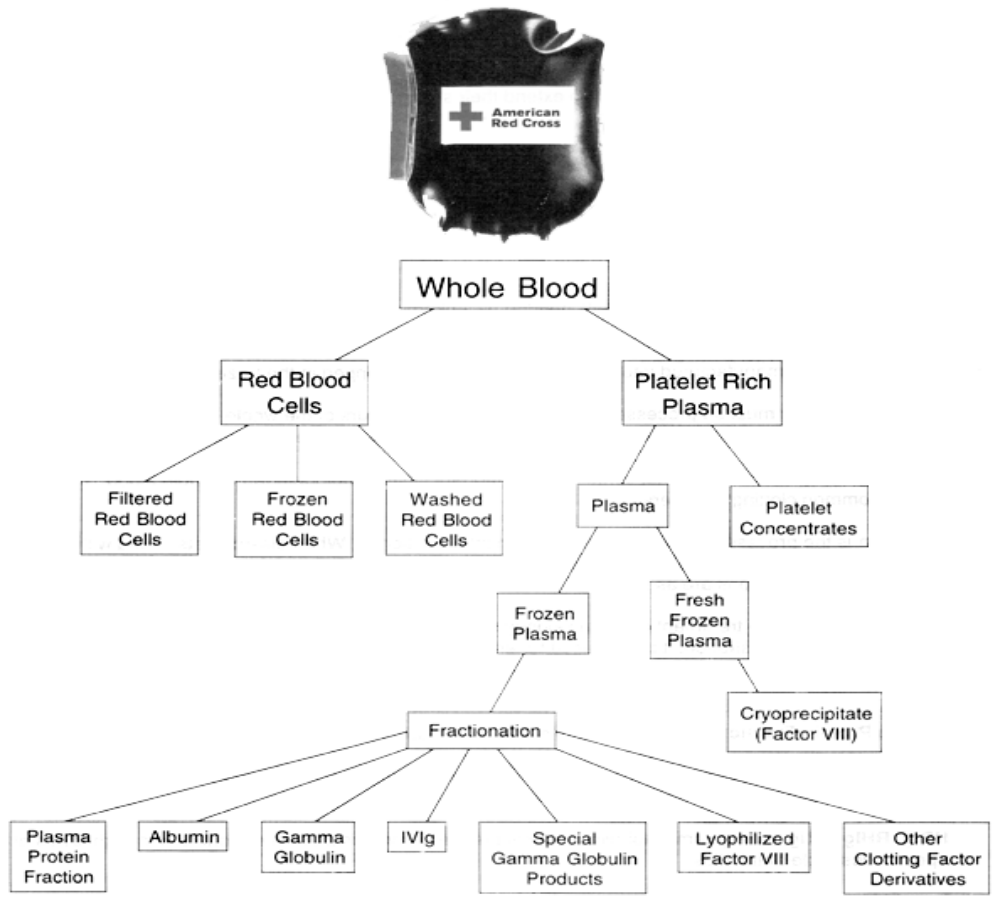

Figure 1: Fractionations of blood components from whole blood

Human plasma is a source of important medicinal products which are obtained by a combination of large-scale processing steps called "fractionation". Different steps of blood fractionation are depicted in figure 1.

Indication for blood transfusion

Red blood cells (RBC):
1 unit of packed red blood cells in and adult will increase hematocrit (Hct) approximately 3% and hemoglobin (Hgb) by 1 g/dL.
Indication[6,7]

Patient is actively bleeding.

1. Hct < 21%
2. Hct< 24% in patient with coronary artery disease, unstable angina, myocardial infarction, or cardiogenic shock.
3. Rapid blood loss >1.5 L to 2 L; not responding to volume resuscitation.
4. Autologous RBC: Hct <27%.

Platelets
A single dose (adult: aphaeresis of 6 concentrates; Pediatrics dose: 1 units /10 Kg) will increase the platelet count by 25-35 x 10^9 /L.
Indication[6,7]

1. Platelet count ≤ 10x 10^9 /L prophylactic in a patient with failure of platelet production.
2. Platelet count ≤ 20x 10^9 /L and signs of hemorrhagic diathesis (petechia , mucosal bleeding).
3. Platelet count > 50x 10^9 /L.

Transfusion-Transmitted Infections
The risk of bacterial infection has emerged as the major cause of transfusion related morbidity and mortality, in part due to the reduction of other risks [8-10]. Bacterial contamination is more frequent in platelet concentrates (PLT) than in red blood components most likely because many microorganisms can survive and propagate under the storage conditions typically used for PLT (20–24°C), but less so for RBC (1–6°C)[10,11]. Like bacterial infections the risk of viral infection has emerged as the major cause of transfusion related morbidity and mortality like HIV, HCV, HBV etc.
The improvements in blood safety have occurred at a time of the public's increased fear of transfusion and the more cautious use of blood components by physicians. The steps in donor selection and laboratory testing described have resulted in the nation's blood supply being safer than ever[12,13]. The introduction of new tests for transmissible diseases has further reduced the proportion of infectious donors. Screening of the donor's identity against donor deferral registries detects individuals who previously were deferred as blood donors but who for various reasons attempt to donate again. These and many other changes have resulted in improved blood safety. The risk of acquiring a transfusion-transmitted disease ranges from 1 per 150,000 U for hepatitis B to 1 per 2,135,000 U for HIV[14,15].

Materials and Methods

It is a retrospective study in which data relating to Collection and Usage of blood and its component from January 2007 to December 2008 at Haria L. G. Rotary hospital's Nukem Blood Bank & Rotary Suzlon Blood Component Center, Vapi was collected and analyzed.

Data Collection and Analysis

Data for last 2 years were collected from the data base at Nukem Blood Bank & Rotary Suzlon Blood Component Center of Haria L. G. Rotary hospital, Vapi. Microsoft access was used for generation of database and analysis. Data regarding Donation, Issue and Discard of blood and its components was collected month wise for 24 months starting from January 2007 to December 2008.

Than the collected data was processed and categorized as below:

1. Comparative Utilization of Components.
2. Reasons for Usage (Issue) of Blood Components.
3. Reasons for Wastage (Discard) of Blood Components.

After analysis and review of above data, suggestion was generated with the help of staff of blood bank and hospital to improve utilization of Blood and Blood Components.
The percentage discard was calculated by following formula -

$$\frac{\text{Number of unit discarded}}{\text{Number of units collected (WB)/generated by fractionation (For blood components)}} \times 100$$

Results

Comparative Usage of different components of blood

Here, the total utilization of different components and WB was compared for the entire period (Nov2007-Dec2008). Highest number of units issued was for WB. Among the various components, pRBCs was the maximum utilized followed by FFP and PC as shown in figure 2.

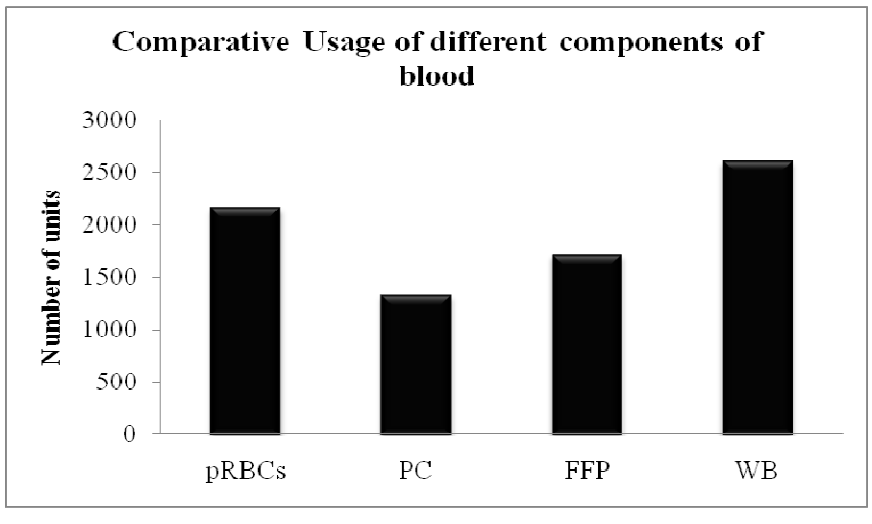

Figure 2: Comparative Usage of different components of blood

Comparative wastage of different blood components

Here the total wastage of different components and WB was compared for the entire period (Nov2007-Dec2008). The maximum wastage was found to be for PC, followed by FFP and pRBCs. Wastage of WB was more than pRBCs, however less than PC & FFP as shown in table 1.

Table 1: Comparative wastage of different blood components

Components	Units
pRBCs	2161
PC	1319
FFP	1709
WB	2603

Comparative usage/wastage of different blood components

Here, the percentage utilization and wastage for different blood components (table 2) was compared for the entire period (Nov 2007-Dec2008). The percentage wastage (%discard was highest for PC (25.1%) followed by FFP (19.37%) and pRBCs (5.09%). The percentage wastage of WB (7.53%) was lower than PC and FFP but higher than pRBCs.

Table 2: Comparative usage/wastage of different blood components

Components	Donor	Issue	Discard	% Discard
pRBCs	2271	2161	110	5.09%
PC	1761	1319	442	25.1%
FFP	2040	1709	331	19.37%
WB	2799	2603	196	7.35%

Reasons for Usage of pRBCs

The table 3 shows the reason for utilization of pRBCs. pRBCs was mainly utilized for anemia followed by thrombocytopenia, Thalessemia, Accident and Surgery.

Table 3: Reasons for Usage of pRBCs

Reasons of Usage	pRBCs
Anaemia	1471
Accident	50
Thalessemia	58
Thrombocytopenia	61
Dialysis	22
Surgery	37
Burns	1
Injury	2
Bleeding	15
Sickle cell Anaemia	11
Hepatitis	5
RTA	7
Not recorded	26
Others	393

Reasons for Usage of FFP

The table 4 shows the reason for utilization of FFP. The major reason was again Anaemia followed by thrombocytopenia, Hepatitis and accident. In 77 instances, the reason was not recorded.

Table 4: Reasons for Usage of FFP

Reasons of Usage	FFP
Anaemia	526
Accident	40
Thalessemia	0
Thrombocytopenia	290
Dialysis	0
Surgery	20
Burns	7
Injury	0
Bleeding	19
Sickle cell Anaemia	2
Hepatitis	69
RTA	17
Not recorded	77
Others	649

\

Reasons for Usage of PC

The table 5 shows the reasons for utilization of PC .The most common reason for use of PC was Thrombocytopenia followed by Anaemia.

Table 5: Reasons for Usage of PC

Reasons of Usage	PC
Anaemia	220
Accident	1
Thalessemia	1
Thrombocytopenia	751
Dialysis	2
Surgery	7
Burns	0
Injury	0
Bleeding	0
Sickle cell Anaemia	1
Hepatitis	7
RTA	6
Not recorded	5
Others	318

Reasons for Usage of WB

The figure 3 shows the reasons for utilization of WB. The major reason was again Anaemia followed by surgery, accident, dialysis and bleeding.

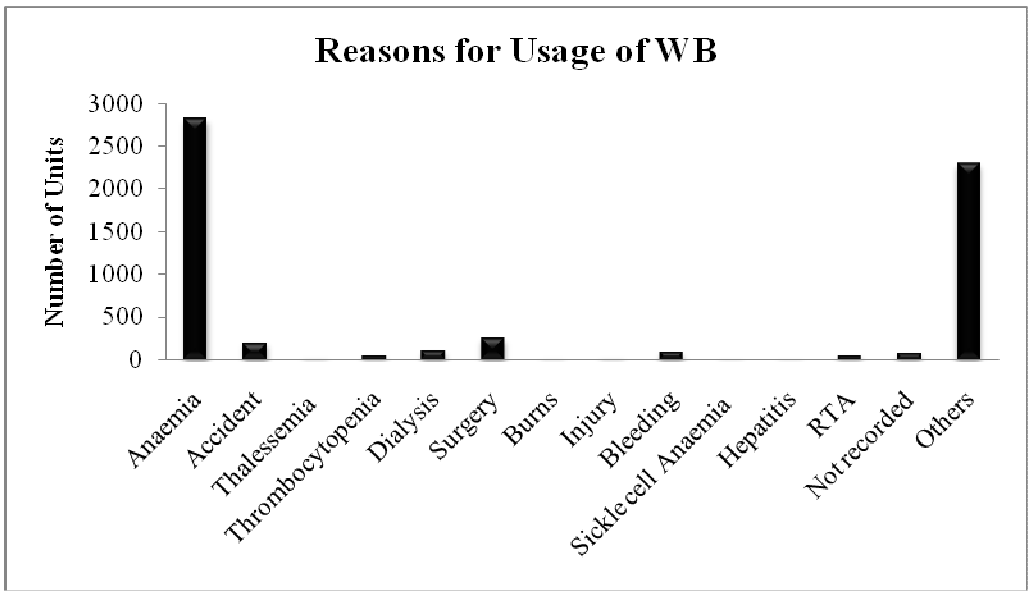

Figure 3: Reasons for Usage of WB

Reasons for wastage (Discard) of Blood Components

Wastage of different components according to reasons are shown in table 7 and figure 7.

Reasons for wastage of pRBCs

Here, the reasons for discard of pRBCs are shown in the figure 4. The major reason for discard of pRBCs was expiry followed by +ve detection of HBs Ag and high Bilirubin content.

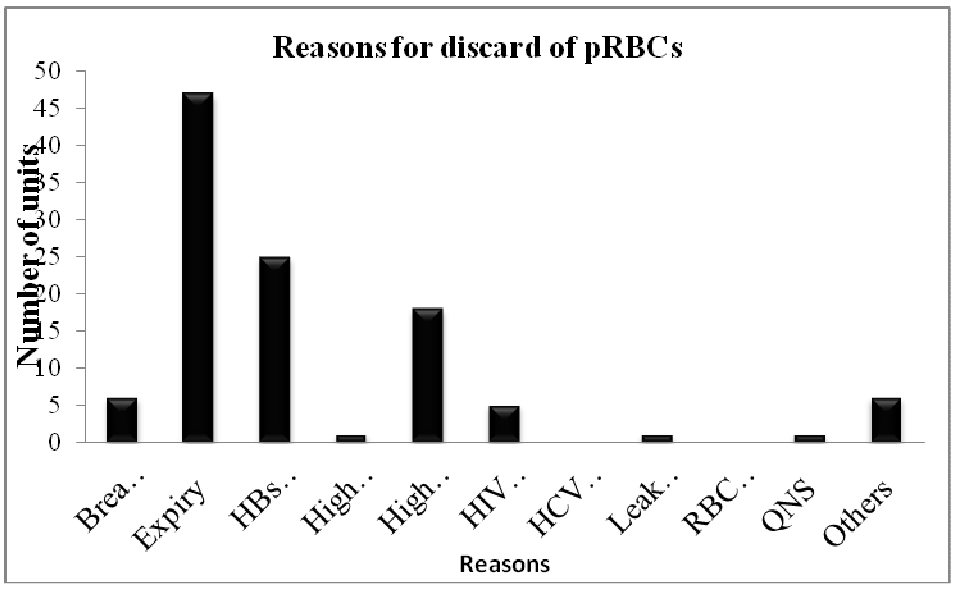

Figure 4: Reasons for wastage of pRBCs

Reasons for wastage of FFP

Here, the reasons for discard of FFP are shown in table 6. The most common reason for discard of FFP is breakage followed by high lipid, RBC contamination, HBs Ag +ve and high Bilirubin.

Table 6: Reasons for wastage of FFP

Reasons of Discard	FFP
Breakage	160
Expiry	20
HBs Ag +ve	35
High Lipid	48
High Bilirubin	22
HIV +ve	5
HCV +ve	0
Leakage	2
RBC Contamination	33
QNS	3
Others	13

Reasons for wastage of PC

Here, the reasons for discard of PC are shown in the figure 5. The maximum numbers of units discarded are due to expiry (82.01%) followed by HBs Ag +ve, high Bilirubin and high lipid content.

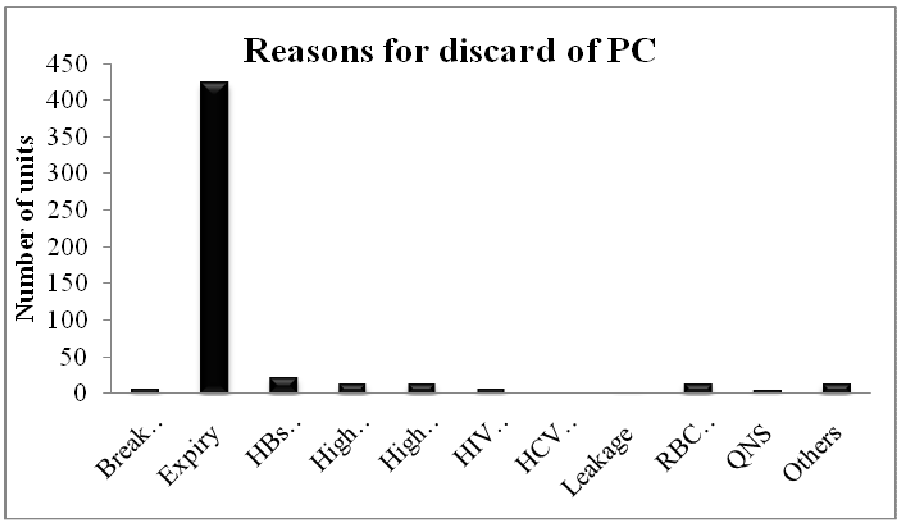

Figure 5: Reasons for wastage of PC

Reasons for wastage of WB

Here, the reasons for discard of WB are shown in the figure 6. The main reason Quantity Not Sufficient (QNS), Expiry, detection of HBs Ag +ve and HCV +ve.

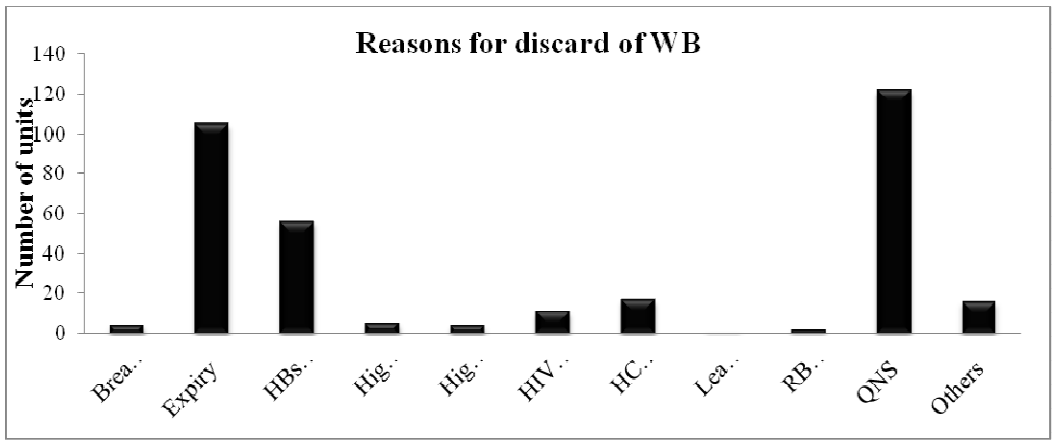

Figure 6: Reasons for wastage of WB

Table 7: Wastage of different Components according to reasons

Reasons of Discard	pRBCs	PC	FFP	WB
Breakage	6	6	160	4
Expiry	47	424	20	105
HBs Ag +ve	25	22	35	56
High Lipid	1	13	48	5
High Bilirubin	18	14	22	4
HIV +ve	5	6	5	11
HCV +ve	0	0	0	17
Leakage	1	1	2	1
RBC Contamination	0	14	33	2
QNS	1	4	3	122
Others	6	13	13	16

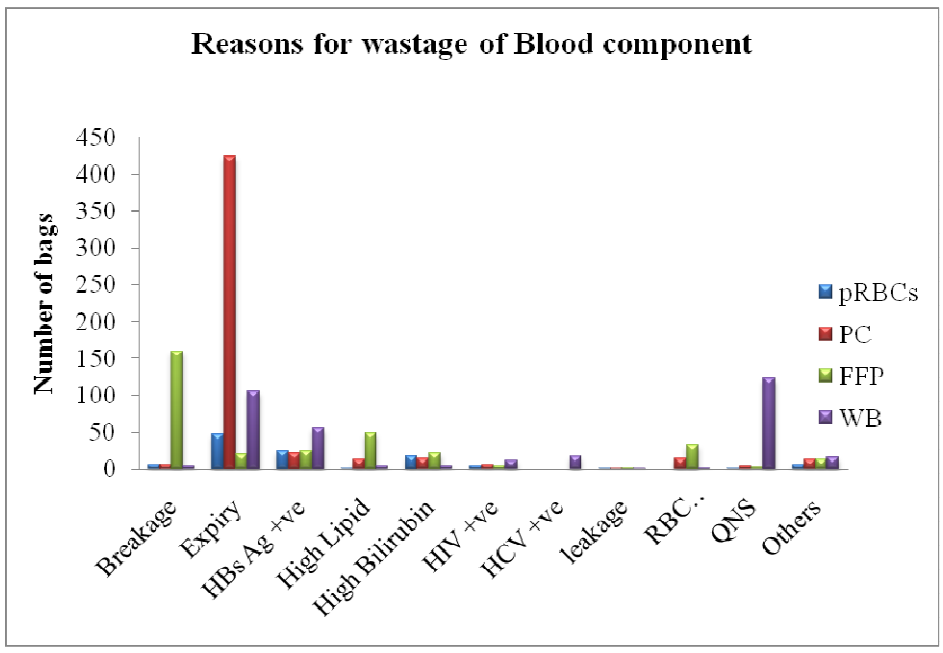

Figure 7: Wastage of different Components according to reasons

Discussion

At the site of study (the Nukem blood bank), even after the short of fractionation, WB is used many a times. A comparison of the number of units issued during November 2007 to December 2008, indicates that among the components pRBCs was most utilized followed by FFP and PC. Since, the Practice here involves an option of storing blood in the form of WB or fractionating in to either by pRBCs and FFP or by pRBCs, PC and FFP. Accurate inventory and analysis of utilization of different components would be useful in the deciding on mode of fractionation. An analysis of the wastage of different blood components showed that a lot of units of PC were discarded – this could be due to a very short expiry period. A higher demand coupled with a longer expiry period (relative to PC) might have caused the discarded rate of pRBCs to be lowest. On the other hand, despite the longest expiry, the lower utilization leads to a higher discarded for FFP. This was found to be coupled with other technical reasons like breakage, RBC contamination etc.

The major reason for wastage of different components was found to very depend on the pattern of its utilization, shortage and individual characteristics. Expiry was the major reason for discard of PC and pRBCs, whereas technical faults like breakage and RBC contamination were most common reasons for discard of FFP. On reviewing with staff of the blood bank, it was identified that a modified and larger shortage set up along with more trained and equipped staff could minimize breakage and other technical faults leading to wastage of FFP. A surprisingly large number of cases were found to be HBsAg +ve. More careful screening and awareness program the donors and staff could help to minimize this. Another reason for discard was detection of high Bilirubin and high lipid content. This is an additional practice followed here which although increases discard rates would be beneficial to the patients receiving the blood or its component.

As far as utilization is concerned, the most common reason for WB or components was found to be anemia for hereditary anemia like thalassemia and sickle cell anemia, mostly pRBCs were used. Most common indication for PC was thrombocytopenia. The utilization of PC other than thrombocytopenia and anemia was very rare.The use of FFP was for anemia, thrombocytopenia and hepatitis (probably to maintain protein and blood volume). Besides anemia, the use of WB was for surgery, accidental cases and patients suffering from hemorrhage or undergoing dialysis.

There were many instances where the reason for use was not specified. In many of these, the blood was issued to other hospitals.

After analysis of the available data, review of the staff and facilities at the blood bank and discussions with the concerned staff, the following suggestions were generated to optimize utilization of blood and its components.

1. Upgradation of storage and other facilities at the bank to deal with more inventories.
2. A software based system for monitoring stock and predicting utilization.
3. Using the above information to screen donors for collection of optimum amount of blood of required blood groups.
4. Generating a list of donors to be used in cases of shortage, to avoid instances of non-availability (the existing practice of replacement if possible to be continued).
5. To record instances of denial because of non-availability and ensure appropriate entry of all information regarding collection, utilization and wastage.
6. Continual education programs to improve performance of related staff.
7. Use of more advanced materials to increase expiry of pRBCs and PC.

Conclusion

Blood and its components are a very important resource and hence should be used in a justifiable manner. The pattern of utilization and wastage is different from other reports of

monitoring of Blood and its Components, as the Blood bank is attached to the hospital. This helps in minimizing wastage by case of reallocation of reserved but unutilized Blood Components. A proper inventory management system with accurate and timely data base formation is necessary to minimize wastage. There is an increase in utilization of Blood and Blood components from year 2007 to 2008. However, there is a lot of variation in usage/wastage over the same period

References

1. Rubin RJ, Ness PM. What price progress? An update on vinyl plastic blood bags. Transfusion 1989; 29(4):358-61.
2. Sazama K. Reports of 355 transfusion-associated deaths: 1976 through 1985. Transfusion 1990; 30:583-590.
3. Morduchowicz G, Pitlik SD, Huminer D, et al. Transfusion reactions due to bacterial contamination of blood and blood products. Rev Infect Dis 1991; 13:307-14.
4. McCullough J. Transfusion Medicine. 2nd ed. Elsevier Churchill livingstone; Philadelphia, PA, 2005; 1–584.
5. McLeod BC, Price TH, Drew MJ (editors). Apheresis: Principles and Practice. AABB press, Bethesda MD 1997; 45-65.
6. Goodnough LT. Aneamia transfusion and mortality. N Engl J Med 2001; 345:1272-1274
7. Hebert PC, wells G, Blajchman MA, et al. A multicenter, randomized, controlled clinical trial of transfusion requirement in critical care. N Engl J Med 1999; 340:409-417.
8. Andreu G, Morel P, Forestier F, Debeir J, Rebibo D, Janvier G, Herve P. Hemovigilance network in France: organization and analysis of immediate transfusion incident reports from 1994 to 1998. Transfusion 2002; 42(10):1356-1364.
9. Wagner SJ. Transfusion-transmitted bacterial infection: risks,sources and interventions. Vox Sang 2004; 86(3):157-163.
10. Hillyer CD, Josephson CD, Blajchman MA, Vostal JG, Epstein JS, Goodman JL. Bacterial contamination of blood components: risks, strategies, and regulation: joint ASH and AABB educational session in transfusion medicine. Hematology (Am Soc Hematol Educ Program) 2003; 1:575-589.
11. Blajchman MA, Goldman M, Baeza F. Improving the bacteriological safety of platelet transfusions. Transfus Med Rev. 2004 Jan;18(1):11-24
12. Busch MP, Young MJ, Samson SM, Mosley JW, Ward JW, Perkins HA. Risk of human immunodeficiency virus (HIV) transmission by blood transfusions before the implementation of HIV-1 antibody screening. The Transfusion Safety Study Group. Transfusion. 1991; 31:4-11
13. Donahue JG, Munoz A, Ness PM, et al. The declining risk of post-transfusion hepatitis C virus infection. N Engl J Med 1992;327:369–73
14. Lackritz EM, Satten GA, Aberle-Grasse J, et al. Estimated risk of transmission of the human immunodeficiency virus by screened blood in the United States. N Engl J Med 1995; 333:1721-1725.
15. Schreiber GB, Busch MP, Kleinman SH, Korelitz JJ. The risk of transfusion-transmitted viral infections. N Engl J Med 1996;334:1685-1690