Original Article

Estimation of donor blood component wastage in the blood bank of a tertiary care hospital

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ABSTRACT

Objective: To estimate the donor blood component wastage in the blood bank of a tertiary care hospital.

Material and Methods: This cross-sectional study was done at Blood Bank Rehman Medical Institute, Peshawar from November 2021 to August 2023. However, since FFP and CP prepared in August 2023 will not expire until August 2024, their data cannot be fully assessed for wastage within this study period. Written consent was obtained before enrolling all donors. Depending on the need from various departments, the collected units of whole blood are fractionated into various components. The donors' names, ages, genders, contact information, and kinds of donors (voluntary or replacement) were recorded using a structured proforma. The donors who were selected had to meet a few requirements, including their age (≥ 18 years old), weight (≥ 50 g/dL), having hemoglobin levels of at least 12.5 g/dL, a hematocrit level (PCV) of at least 38%, and having normal blood pressure and a pulse rate between 50 and 100 beats per minute. Various reasons for the blood wastage were noted and recorded.

Results: A total of 18397 blood donations were received. Out of which 12870 (69.95%) units were utilized as whole blood and 5527 (30.04%) were separated into different components. Among 12870 blood bags (whole blood), 661(5.13%) were wasted. 655(99.1%) wasted whole blood bags were of male donors and 6 (0.9%) blood bags were of female donors. 202 (30.56%) wasted blood bags were of blood group B^+ TTI positivity accounting for the majority of whole blood bag wastage, making up 85.17% of cases. Among the total number of cases that were TTI positive, VDRL was detected in 20.78% of the blood bags, while HBsAg was found in 50.44% of them. The highest percentage of discarded components was platelets (7.99%), followed by RCC (4.84%), CP (3.23%), and FFP (2.11%).

Conclusions: To ensure the proper utilization of blood, it is important to establish and adhere to appropriate blood transfusion guidelines. Collaborative efforts between hospital and blood bank personnel should also be made to reduce blood wastage.

Keywords: Blood discarded, Blood components. Expired blood, Blood products.

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INTRODUCTION

Transfusion of blood and blood components is essential for managing patients in modern healthcare. The provision of sufficient amounts of safe blood and its components is the primary goal of blood centers all around the world [1]. The availability of appropriate blood transfusion services prevents millions of deaths annually in routine and emergency scenarios for surgical and medical purposes. Additionally, it considerably extends and improves the quality of life for patients with a wide range of chronic and acute illnesses [2,3]. According to numbers from the World Health Organization (WHO), more than 70% of countries with limited resources only collect half the blood needed to satisfy their needs [4].

Blood shortage is an unresolved problem in our nation. Hospitals worldwide face a significant challenge in preventing the needless loss of all blood components, such as RBCs, platelets (PLT), and plasma. This issue of

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waste extends beyond blood products and is present across the healthcare system. Research on the inefficiencies of healthcare systems has analyzed the significance of procedures and protocols [5,6]. Lack of cooperation and coordination between blood donors, blood banks, hospitals, and recipients contribute to the wastage of blood. Data shows that loss of blood is attributed to inadequate inventory management, unsatisfactory manufacturing practices, and improper storage and shipment [7]. The improper management of blood products can also result in their wastage due to various reasons such as expired units, broken packaging, clotted blood, serology-positive units, and other miscellaneous factors. This is often caused by a lack of sufficient knowledge, awareness, and training. It is advised by the College of American Pathologists (CAP) to keep track of unused blood as it can lead to financial loss in the healthcare system [8]. Low blood reserve can be addressed by reducing the incidence of blood loss through the effective use of stock management and standard procedures for blood usage [9]. More strict policies should be available and utilized to make the best use of this inadequate reserve in order to address the demand for the supply of both blood and its components. Effective collaboration between healthcare professionals and blood bank personnel can minimize blood wastage resulting from expiration. In resource-limited areas, the preparation of blood components may not be optimized, underscoring the importance of maximizing available resources, human capital, and reducing waste [10].

The aim of the study was to analyze the wastage of the donor blood component in the blood bank of Rehman Medical Institute, Peshawar.

MATERIAL AND METHODS

This prospective cross-sectional study was performed at the Blood bank RMI, Peshawar after obtaining approval from the Institutional Review Board (IRB), vide reference number RMI/RMI-REC/Article Approval/143. After a thorough literature search, we calculated a sample size of 18357 via the WHO calculator, keeping the margin of error at 5%, a confidence level at 95%. Sampling was done using a non-probability consecutive sampling technique.

All collected samples were taken through screening tests after blood donation to ensure its safety and the blood's suitability for transfusion. According to the written protocol, the collected samples were tested for infectious diseases such as HIV, hepatitis B, hepatitis C, syphilis, and malaria by ELISA and CLIA. The tests were carried out on Abbott ARCHITECT i1000SR.

Nucleic Acid Testing (NAT) with Roche Cobas 6800 System was used to increase the yield of detection of viral pathogens for HIV, HCV, and HBV. This can detect a window period of infection. The blood was collected in sterile, single-use blood bags of 350 mL to 450 mL, depending on the eligibility criteria of the donor. The blood bags used in the present study were of Terumo Penpol known for high-quality leak-proof bags. An anticoagulant solution of CPDA-1 for preserving blood up to processing was attached to each blood bag.

Each blood bag, before its use, was inspected for any visible damage or contamination. After collection, the bags were again checked for any breakage, leakage, or clot formation. Any compromised bags were immediately discarded and the donor was informed.

After blood collection, the whole blood was processed into its components using

Off-centrifugation. Centrifugation was done on whole blood using a high-speed centrifuge, like the Sorvall RC3BP Plus, to separate it into red blood cells, plasma, and platelets. All the conditions for the centrifugation process were very controlled, with all specific conditions stipulated based on the diverse components that were to be attained on 4000 RPM for 10 minutes in the case of plasma separation.

Separated components were transferred into corresponding storage bags. The red blood cells were stored at a temperature of 2-6°C, plasma was frozen at -30°C, and platelets were stored at 20-24°C with continuous agitation.

Each component was examined for any visible aberration, such as discoloration or clots, and then tested further. The measurement of pH for platelets to check that it met the standard requirements. Those that did not come up to the mark were discarded.

Written consent was obtained before enrolling all donors, and their confidentiality was ensured at all levels. The donors' names, ages, genders, contact information, and kinds of donors (voluntary or replacement) were recorded using a structured proforma.

The donors who were selected had to meet a few requirements, including their age (≥ 18 years old), weight (≥ 50 g/dL), having hemoglobin levels of at least 12.5 g/dL, a hematocrit level (PCV) of at least 38%, and having normal blood pressure and a pulse rate between 50 and 100 beats per minute. All components, including the whole blood unit (WBU), RCC, PC, FFP, CP, and CPP, that were discarded or wasted because of TTI positivity, hemolysis, expired shelf life broken or leaked units, QNS (quantity not sufficient), broken segments expired QC bags, lipemia, or waste as a result of leakage were also included in the study. Donors who engaged in high-risk behavior and had a history of jaundice, non-marital sexual contacts, intravenous drug abuse, recent blood transfusion, tattooing, or recent surgery were deferred and excluded from the study. Since single donor platelets (SDP) are manufactured on demand and after the donor has been screened for transfusion-transmitted infections, their incidence of wastage was minimal and they were therefore excluded from the research.

Records of Donor, TTI, Component preparation, and Wastage were collected. Upon selecting a donor for blood donation, the phlebotomy process is conducted while adhering to strict aseptic precautions outlined in the standard operating procedure of phlebotomy. TTI testing for HIV, HBsAg, HCV, syphilis, and malaria is performed on each unit. The TTI testing for HIV, HBsAg, and HCV as well as syphilis were carried out by a senior technician and verified by a pathology consultant assigned.

The data was logged onto a Microsoft spreadsheet and later analyzed using IBM Statistics SPSS version 25 (IBM Corp., Armonk, NY). The mean (± SD) was used to report results for quantitative variables, while frequency and percentages were calculated for categorical variables. A Chi-Square test was performed to check the association between gender and blood discard due to TTIs.

RESULTS

During the study period, a total of 18397 blood donations were received from November 2021 to August 2023. Out of which 12870 (69.95%) units were utilized as whole blood and 5527 (30.04%) were separated into different components.

Out of a total of 12870 blood bags (whole blood), 661(5.13%) were wasted for different ages, genders, and reasons. Out of 661 wasted blood bags, 655(99.1%) blood bags were of male donors and 6 (0.9%) blood bags were of female donors. Out of a total of 661 wasted blood bags maximum numbers, 202 (30.56%) wasted blood bags were of blood group B^+, and the minimum number, 7(1.06%) blood bags were of blood group AB Negative as seen in Table-I.

TTI positivity accounted for the majority of whole blood bag wastage, making up 85.17% of cases. Other causes included shelf-life expiration, leakage/breakage, QNS, QC, and hemolysis/contamination, which made up 14.83% of cases as seen in Table-II.

Among the total number of cases that were TTI positive, VDRL was detected in 20.78% of the blood bags, while HBsAg was found in 50.44% of them. HCV was detected in 27.35% of the bags, while only 1.42% of them were positive for HIV. No cases of malaria parasite were detected in the sample. Table-III showed the gender distribution and incidence of TTIs in discarded blood bags. According to the p-values, there is no significant association between gender and the incidence of transfusion transmitted infections (TTIs).

A Total of 13807 blood components were prepared during this study period out of which 609 components were discarded. The most

common blood component discarded were platelets (7.99%) followed by RCC (4.84%), CP (3.23%), and FFP (2.11%) as seen in Table-IV.

A total of 609 blood components were discarded in which the most common cause was positivity for transfusion transmitted diseases (TTI) constituted 43.84% followed by expiry of blood components constituted 21.02% as seen in Table-V.

Table-I: Wastage frequency in different blood groups.

Blood Group	Wastage Frequency n (%)
A^+	170 (25.7%)
A^-	19 (2.9%)
B^+	202 (30.6%)
B^-	9 (1.4%)
AB^+	60 (9.1%)
AB^-	7 (1.1%)
O^+	169 (25.6%)
O^-	25 (3.8%)

Table II: Analysis of reasons for wastage of blood bag (Whole Blood).

Reason of Wastage	Frequency n (%)
TTI positive	563 (85.17%)
Shelf Life Expired	37 (5.59%)
Quality Control (QC)	13 (1.96%)
Quantity Not Sufficient (QNS)	20 (3.02%)
Hemolysis/Contamination	3 (0.45%)
Leakage/Breakage	25 (3.78%)

Table-III: Analysis of discarded blood bags by gender and transfusion transmitted infections (TTIs).

TTIs		Gender		p-Value
		Male	Female	
VDRL	Positive	115 (17.4%)	2 (0.3%)	0.288
	Negative	540 (81.7%)	4 (0.6%)	
HBsAg	Positive	283 (42.8%)	1 (0.2%)	0.189
	Negative	372 (56.3%)	5 (0.8%)	
HCV	Positive	152 (23.0%)	2 (0.3%)	0.426
	Negative	503 (76.1%)	4 (0.6%)	
HIV	Positive	8 (1.2%)	0	0.929
	Negative	647 (97.9%)	6 (0.9%)	

Table-IV: Analysis of Wastage of Different Blood Components against Total Prepared Components

Types of Components	Components Prepared	Wastage of Components
RCC	5527	268 (4.84%)
FFP	5124	108 (2.11%)
PC	2753	220 (7.99%)
CP	403	13 (3.23%)
Total Components	**13807**	**609 (4.41%)**

Table-V: Analysis of reasons for discarding blood components

Blood Components	Reasons for discarding blood Components					
	TTI Positive	Expired	Leakage	QC	QNS	Hemolysis
RCC	121	53	40	32	17	5
FFP	33	24	23	19	6	3
PC	109	49	25	18	9	10
CP	4	2	2	1	3	1
Total	**267**	**128**	**90**	**70**	**35**	**19**

*Red Cell Concentrate (RCC), Fresh Frozen Plasma (FFP), Platelet Concentrate (PC), and Cryoprecipitate (CP).

DISCUSSION

Blood transfusions play a crucial role in modern healthcare. The increase in demand for blood and its components is driven by various factors, including the development of new treatment methods, the aging population, and improved identification of complex disorders that require transfusions. As a result, the need for blood transfusions is steadily rising [11]. To reduce wastage of blood and its components in blood banks, it is essential to practice effective blood management. Conducting a self-audit of whole blood and discarded blood components can help us comprehend the various reasons for their disposal.

Over the course of our investigation, a total of 12870 units of whole blood were gathered. Out of a total of 12870 blood bags (whole blood), 661 were wasted for different ages, genders, and reasons. Out of 661 wasted blood bags, 655(99.1%) were male donors and 6 (0.9%) were female donors. The blood donor statistics from this study are similar to those from studies by Bobde *et al*.8, Lakum *et al*. [2], Patil. P [14]. Out of 661 wasted blood bags, 202 (30.56%) were of blood group B+ while there were only 7 (1.06%) blood bags of blood group AB Negative.

Our study found that an average of 4.48% of blood units were discarded. In previous studies by Patil *et al*. [14], Bobde *et al*. [8], Sharma *et al*. [15]**,** Ghaflez *et al*. [16], and Deb *et al*. [17], Morish *et al*. [20], Kora *et al*. [6], Kumar *et al*. [19], Thakare *et al*. [18], Suresh *et al*. [18], the discard rates were 22.45%, 6.63%, 8.69%, 12%, 14.61%, 2.3%, 4.3%, 8.4%, 3.6%, and 7.0% respectively.

The WB discard rate in the current study was slightly lower at 5.13% compared to the discard rates recorded by Suresh *et al*.18(5.7%) and Bobde *et al*.8 (6.63%). Joshi *et al*., report the rate at which whole blood is wasted in a large blood bank to be about 4-6%, which looks very much the same as the findings in this study of 5.13%. This uniformity is indicative of some problem which is common in the working of a blood bank [12]. The most common reason for discarding whole blood was a positive TTI result, accounting for 85.17% of cases. Other reasons included expired shelf life, leakage or breakage, inability to obtain enough blood during phlebotomy due to collapsed veins, and acute donor reactions such as nausea, vomiting, perspiration, hematoma formation, or fainting during donation. Quality control and hemolysis or contamination were also contributing factors. Out of the 12,870 units of whole blood, 661 were wasted, which accounts for 5.13%. That nearly 99.1% of the blood bags were from male donor's raises questions as to whether there are problems per se with male donations or whether other factors are at work. Further investigation might be necessary to determine if there are inherent problems in the collection, storage, or processing procedures that disproportionately affect male donations. According to the study by Ravikanth *et al*., wastage may relate to demographic factors of whether the donor is male or female. Their findings showed that male donors would have high wastage rates due to a number of donations and some health-related conditions. There was a predominance of wasted male donor blood in the study, thus supporting these findings. It is therefore imperative to continue the study on certain donor-related factors [12]. The distribution of wasted blood bags by blood group indicates that the highest wastages were with blood group B+, 30.56%, while AB Negative had the least at 1.06%. This implies that the blood group B+ may be more predisposed to wastage, probably due to higher volumes of donations, mismatch between supply and demand, or some other challenge peculiar to its management. The low wastage for AB Negative may indicate that this is a rare blood group either of high demand or managed effectively within the system.

The fact that AB Negative comes back as waste in the maximum number compared to the groups of B+ only adds the relatively less frequency as another variable to studies of such kind. Xian *et al*., found that the blood groups that are more commonly found, like B+ and A+, are

wasted more because of the sheer volume of donation and demand variations. By virtue of its rarity and lesser incidence of wastage, the AB Negative group must have something to do with the lesser incidence of its donation as well as the possibility of its better demand management efficiency.

Malakar *et al*., conducted a comprehensive study on blood transfusion practices and reported that TTIs were a leading cause of blood bag discards. Their findings showed that hepatitis B and C were the most frequently detected infections, aligning with the current study's results where HBsAg and HCV were the predominant TTIs [13].

In the present study, the rate of discarding packed red cell concentrate was 5.18%. The most common reason for discarding was transfusion-transmitted infection (TTI), which accounted for 45.1% of the discarded red cell concentrate. Expiration was the second most frequent cause, comprising 9.3% of discards. In the trial conducted by Simon *et al*. [1], the rate of discarding due to expiration was significantly higher at 59%. The process of obtaining whole blood to create random donor platelets was one of the causes of expiration.

Our study found that the percentage of discarded fresh frozen plasma (FFP) was 2.03%, which is lower than the rates reported by Bobde *et al*. [8] (7.6%), Sharma *et al*.[15] (6.2%), and Simon *et al*. [1] (5.5%). Among the reasons for discarding FFP, TTI-positive cases accounted for 31.4%, followed by discarding FFP due to expiry (22.8%) and leakage (20%) which is lower than the 48% reported in the studies conducted by Simon, *et al*. [1] and Kanani, *et al* [21].

Throughout the study, PCs were the most common discarded component. PC had a lower discard rate (7.99%) than Bobde *et al*. [8] (26.2%), Kanani [21] (28.39%), Sharma, *et al*. [15] (43.6%), and Ghaflez *et al*. [16] (58.1%). TTI positive (49%) was the most frequent cause of PC discarding again, followed by leakage and expiration.

Handling and preparing blood components can contribute to a significant reduction in discarded blood units. Increasing the knowledge of blood recipients about appropriate transfusion techniques also plays a role in lowering the discard rate. Additionally, the practice of submitting fresh frozen plasma (FFP) for fractionation has further aided in reducing waste. These improvements in transfusion practices have been achieved through the implementation of appropriate policies and their consistent execution over the years.

LIMITATIONS

The study solely focused on the discard rate and its causes within the blood bank, without considering the blood that was never administered to patients due to various reasons. This could be due to patients passing away before the blood could be administered, malfunctioning cannulae systems or lack of refrigeration systems in the wards to store the blood temporarily leading to wastage of the released blood. Hence, more research is required to address this issue.

CONCLUSION

Adhering strictly to the donor selection criteria based on standard operating procedures, obtaining proper pre-donation history, giving proper counseling, identifying donors who are positive for transfusion-transmitted infections, deferring suspected professional donors who have been previously screened, using antiseptic solutions appropriately, and performing proper serological testing can minimize the wastage of blood and blood components due to TTI. Additionally, proper inventory management and knowledge of the day-to-week basis of blood requirement can reduce wastage due to expiration and outdated components.

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CONFLICT OF INTEREST

Authors declare no conflict of interest.

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Declared none

AUTHORS CONTRIBUTION

Iqra Zeb: Data collection, data analysis and literature search and manuscript drafting, accountable for all aspects of the work

Hina Mushtaq: Study design and concept, data interpretation, accountable for all aspects of the work

Hamid Iqbal: Revised the manuscript thoroughly for important intellectual content.

Fuad Ahmad Siddiqui: reviewed the results and approved the final version of the manuscript, accountable for all aspects of the work

Imran Khan: Literature search and critical analysis, accountable for all aspects of the work

Bilal Zeb: Questionnaire design and manuscript drafting, accountable for all aspects of the work

REFERENCES

1. Simon K, Ambroise MM, Ramdas A. Analysis of blood and blood components wastage in a tertiary care hospital in South India. J Central Res Med Sci. 2020; 6(1): 39-44. DOI: http://dx.doi.org/10.4103/jcrsm.jcrsm_9_20
2. Lakum NR, Makwana H, Agnihotri A. An analytical study of discarded units of whole blood and its components in a blood bank at a tertiary-care hospital in Zalawad region of Saurashtra. Int J Med Sci Public Health. 2016 ; 5:318-21. DOI:https://doi.org/10.5455/ijmsph.2016.06102015122
3. Joshi HJ, Patel KB, Dholu M. An analysis of wastage of blood components in blood bank at tertiary care hospital. Int J Clin Diagnostic Pathol. 2021;4(1):138-42. DOI:https://doi.org/10.33545/pathol.2021.v4.i1c.336
4. World Health Organization. Availability, safety and quality of blood products. Report by the Secretariat. Sixty-Third World Health Assembly A 63, 2009.
5. Collins RA, Wisniewski MK, Waters JH, Triulzi DJ, Yazer MH. Effectiveness of multiple initiatives to reduce blood component wastage. Am J Clin Pathol. 2015; 143(3): 329-35. DOI:https://doi.org/10.1309/AJCP42WMHSSTPHXI
6. Kora SA, Kulkarni K. An analysis of donor blood wastage in a blood bank in rural Karnataka. J Clin Diagn Res. 2011; 5(7): 1393-6.
7. Mishra S, Daga A, Gupta A. Inventory management practices in the blood bank of an institute of national importance in India. Fam Med Prim Care Rev. 2021; 10(12): 4489-92. DOI:https://doi.org/10.4103%2Fjfmpc.jfmpc_1000_21
8. Bobde V, Parate S, Kumbhalkar D. Analysis of discard of whole blood and blood components in government hospital blood bank in central India. J Evid Based Med Healthc 2015; 2(9): 1215-19. DOI: http://dx.doi.org/10.18410/jebmh/176
9. Sultan S, Jaffri SA, Irfan SM, Usman SM, Nadeem S, Waheed U, *et al*. An Insight into donor blood unit's wastage in a hospital-based blood bank from Pakistan. Int J Med Res Health Sci. 2021; 10(5): 91-5.
10. Far RM, Rad FS, Abdolazimi Z, Daneshi Kohan MM. Determination of rate and causes of wastage of blood and blood products in Iranian hospitals. DOI: https://dx.doi.org/10.4274/tjh.2012.0105
11. World Health Organization. Quality systems for blood safety: introductory module guidelines and principles for safe blood transfusion practice. Geneva: World Health Organization. 2002:65-75.
12. Ravikanth C, Babu BS, Arun R, Babu KVS. Analysis of blood and blood component wastage and its reasons among various departments in a tertiary care teaching hospital in Southern India. Nat J Lab Med. 2022; 11(2): 37-9. DOI:https://doi.org/10.7860/NJLM/2022/51736.2606
13. Malakar PC, Sharma A, Sharma S, Tiwari D, Sharma V, Dadhich N. Investigating the causes of whole blood and blood components discarded at a tertiary care hospital blood center along with discard rate detection: A prospective study. Asian J Transfus Sci. 2023; 37-9. DOI: https://doi.org/ 10.4103/ajts.ajts_162_22
14. Patil P, Bhake A, Hiwale K. Analysis of discard of whole blood and its components with suggested possible strategies to reduce it. Int J Res Med Sci. 2016; 4(2): 477-81. DOI: https://doi.org/10.18203/2320-6012.ijrms20160299
15. Sharma N, Kaushik S, Kumar R, Azad S, Acharya S, Kudesia S. Causes of wastage of blood and blood components: A retrospective analysis. Platelets. 2010; 878: 43-6. DOI: https://doi.org/10.7759%2Fcureus.59493
16. Ghaflez MB, Omeir HK, Far J, Saki N, Maatoghi JT, Naderpour M. Study of rate and causes of blood components discard among Ahwaz's hospital. Sci J Iran Blood Transfus Organ. 2014; 11(3): 197-206.
17. Deb P, Swarup D, Singh MM. Audit of blood requisition. Med J Armed Forces India. 2001; 57(1): 35-8. DOI: https://doi.org/10.1016%2FS0377-1237(01)80087-3
18. Suresh B, Babu KS, Arun R, Chandramouli P, Jothibai DS. Reasons for discarding whole blood and its components in a tertiary care teaching hospital blood bank in South India. J Clin Sci Res. 2015; 4(3): 213-9.

DOI: http://dx.doi.org/10.15380/2277-5706.JCSR.14.052

19. Kumar A, Sharma SM, Ingole NS, Gangane N. Analysis of reasons for discarding blood and blood components in a blood bank of tertiary care hospital in central India: A prospective study. Int J Med Pub Health. 2014; 4(1): 72-4. DOI: http://dx.doi.org/10.4103/2230-8598.127161
20. Thakare MM, Dixit JV, Goel NK. Reasons for discarding blood from blood bank of government medical college, Aurangabad. Asian J Transfus Sci. 2011; 5(1): 59-60. DOI: https://doi.org/10.4103%2F0973-6247.76009
21. Morish M, Ayob Y, Naim N, Salman H, Muhamad NA, Yusoff NM. Quality indicators for discarding blood in the National Blood Center, Kuala Lumpur. Asian J Transfus Sci. 2012; 6(1): 19. DOI: https://doi.org/10.4103%2F0973-6247.95045
22. Kanani A, Vachhani J, Dholakiya S, Upadhyay S. Analysis on discard of blood and its products with suggested possible strategies to reduce its occurrence in a blood bank of tertiary care hospital in Western India. Global J Transfus Med. 2017; 2(2): 130. DOI:http://dx.doi.org/10.4103/GJTM.GJTM_34_17