



# INTERNATIONAL JOURNAL OF CURRENT MEDICAL AND PHARMACEUTICAL RESEARCH

ISSN: 2395-6429, Impact Factor: SJIF: 4.656

Available Online at [www.journalcmpr.com](http://www.journalcmpr.com)

Volume 8; Issue 09; September 2022; Page No. 383-389

DOI: <http://dx.doi.org/10.24327/23956429.ijcmpr20220088>

## RETROSPECTIVE STUDY OF DISCARD RATE IN DEPARTMENT OF TRANSFUSION MEDICINE OF A UNIVERSITY MEDICAL COLLEGE OF NORTH INDIA

Ronit<sup>1</sup>, Jappreet Kaur<sup>2</sup>, Amit Kumar Singh<sup>3</sup> and Manbeer Singh<sup>4</sup>

<sup>1,4</sup>Assistant Professor, Department of Medical Lab Technology, Chandigarh University, Mohali

<sup>2</sup>Assistant Professor, Department of Medical laboratory Science, Gulzar Group of Institutions, Ludhiana

### ARTICLE INFO

#### Article History:

Received 10<sup>th</sup> June, 2022

Received in revised form 18<sup>th</sup>

July, 2022

Accepted 25<sup>th</sup> August, 2022

Published online 28<sup>th</sup> September, 2022

#### Key words:

Blood and blood components, transfusion medicine, discard rate, quality indicator.

### ABSTRACT

**Background:** This study was conducted in the blood centre at MMDU, Mullana. The aim of study was to calculate the discard rate during the study period and finding out the reasons responsible for them in order to provide suggestions for further improvisation in blood transfusion techniques.

**Design:** Study was carried out over a period of 6 months i.e. August, 2019 to January, 2020. The conducted study was retrospective. Data for study period was collected from the blood centre records. The testing protocol was followed in the blood centre in accordance to NABH guidelines.

**Result:** During the study period of 6 months, a total of 4311 units were collected, which were later subjected to component preparation. Out of the components prepared, 4114 units were issued and 643 were discarded due to various reasons, resulting in discard rate of **15.62%**. Outdating was the leading cause of wastage, followed by seropositivity. Platelet concentrates and PRBC's were the most discarded components, respectively. **Conclusion:** A closer look on the handling and usage of blood and its components would aid in focusing the various causes of blood wastage. Additionally, it would help in planning reformative measures to minimize blood wastage in future, as well as spreading awareness of the same. Simple and economical methods of improvement such as staff education, improved handling and transportation of blood units can have a tremendous influence in reduction of blood wastage as it always was, and for the foreseeable future, will be an issue for blood centres.

Copyright © The author(s) 2022. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

### INTRODUCTION

Blood transfusion services (BTS) play an indispensable role in patient's health care services. The high quality of blood and blood products, in addition to their injudicious use may additionally have an effect on the health care facility.<sup>[1]</sup> Safe and sufficient supply of blood and its components should be the aim of BTS. More and more provisions for safe blood are demanded by advances made in medical sciences for the welfare of patients.<sup>[2]</sup> Increase in the means essential for the collection and management of blood and its components can improve the efficiency of BTS. This can also be achieved by using existing resources more cautiously in order to subjugate the supply and demand difference. Therefore, every blood unit is indispensable and must be utilized with caution to reduce wastage.<sup>[3]</sup> The supply of blood in numerous countries fall short of the demand for blood. The data from World Health Organization (WHO) points out that less than half of the required collection is made by 87.5% of developing countries to meet the transfusion demands.<sup>[4]</sup> This demand-supply gap can either be filled by providing more resources into collection or by utilizing the present resources judiciously. Reduction of discard rate is an example of using the resources judiciously.<sup>[5]</sup> It is notable that only a few countries today have improvised upon necessary structures required for the betterment of BTS. Utilization of economic and material resources, preparation and implementation of a practical plan of

action based on actual descriptions, analysis of current status of particular country, blood supply, standard and proper storage conditions, appropriate clinical conditions in treatment involving use of blood products and following the guidelines of blood and its product's prescriptions are keystones of success.<sup>[6]</sup> Processes and manuals should be profoundly centered around creating quality blood components that are increasingly effective and safe. The essential segment in the quality control framework is blood donation, which is collected from prospective donors of different ages with different socioeconomics, wellbeing profiles and this blood collection in most parts of the world relies upon manual procedures which may have technical variations. In this way, these donations will be screened, stored and shipped under a variation of ecological circumstances.<sup>[7]</sup> An efficient and coherent BTS would improve patient care and further promote the progress of medical sciences in the country.<sup>[8]</sup> Therefore, it is necessary for any blood centre to encourage high standards of quality in all regards of blood transfusion managements. Internal Quality Control (IQC) is the foundation of quality administration program in the blood centre.<sup>[9]</sup> In the modern times, quality control of blood and its components guarantee the auspicious accessibility of a blood unit of high quality yield with the most extreme adequacy and insignificant hazard to potential recipients.<sup>[10]</sup> Blood products with short shelf life are bound to have a certain level of wastage, which is both inevitable and necessary to ensure safety and good quality of blood products.<sup>[11]</sup> The efficiency of

\*Corresponding author: Amit Kumar Singh

Assistant Professor, Department of Medical laboratory Science, Gulzar Group of Institutions, Ludhiana

BTS can be monitored by considering discard rate as a quality indicator. High wastage rate leads to decrease in efficiency and increase in the cost of production of blood and its components.<sup>[12]</sup> Because blood utilization practices vary widely, information is needed to determine areas of blood management that can be reformed to reduce wastage of blood in developing countries. The paediatrics and gynecology departments make most requests for blood in most hospitals.<sup>[13]</sup> These variations may compromise the basic control guides which are planned towards the improvisation of the nature of the blood products. A great deal of medical and surgical specialties rely upon the constant blood supply. The main task for a newly set up blood centre is to administer quality management system in all levels of collection, processing and storage of blood.<sup>[14]</sup> Various reasons of discard of blood and its components are transfusion transmitted infection (TTI) reactivity, expiration, insufficient volume, leakage, clot formation, hemolyzed and return back unused after issue. Platelets have the highest incidence of discard because of their short shelf life, followed by packed red blood cell (PRBC) and fresh frozen plasma (FFP).<sup>[15]</sup> Preferably, expiration of blood and its components should be avoided. Nonetheless, due to imminent requirement to have stock available at all times and frequent uncertain emergencies allow the acceptance of low expiration rates imminently.<sup>[16]</sup> Units requested by wards, that are neither transfused, nor returned to blood bank (within defined time period and temperature as per the component issued) and units that have exceeded their shelf life are the two prime reasons behind wastage of blood in hospitals. The units (that are issued, but not transfused) kept between a temperature range of 1-6°C, can be accepted in compliance with one of the criteria's of U.S. Food and Drug Administration and AABB guidelines. The "30-minute" rule is still applicable in some blood centres, according to which RBC units can be accepted back by blood centres, if they are kept in temperature controlled containers since the time of issue to the time unit is returned and the unit is received back to blood centre inventory within 30 minutes. National Accreditation Board for Hospitals and Health care providers list wastage/discard rate 3<sup>rd</sup> among the 10 quality indicators. Regular transfusion audits should be carried out in the blood centre to know the utilization trends. Unnecessary transfusions may contribute to shortage of blood products and each indication for requisition of blood products should be justified. Blood centres should carry out routine audits in order to be up to date with blood usage trends.<sup>[17]</sup> Finding out the reasons for wastage of blood and its products, so that the preparation and use of blood and its components can be optimized through staff education and training was the objective of this study. This aids in developing guidelines for donor screening, preparation of components and their storage.<sup>[18]</sup> Study of discard rate and its aspects is an under-valued point in regards to the improvement of BTS and concerning literature is sparse.

## **AIM AND OBJECTIVE**

1. To evaluate the overall discard/wastage rate of blood and its components in blood centre of a deemed to be University teaching and tertiary care hospital of North India.
2. To compare the result with other similar studies done in India and Abroad.
3. To understand the different factors that lead to blood wastage, and use the knowledge gained from this to :
4. Observe the future trend of blood discard
5. Take remedy actions necessary to prevent excessive blood wastage

## **MATERIAL AND METHOD**

### **Study area**

Department of Transfusion Medicine in tertiary care hospital of Northern India

### **Study population**

This study is a hospital based study; it was conducted in hospital

### **Study design**

Observational Retroprospective study.

### **Study duration**

Study was carried out over a period of 6 months i.e. 1 Aug, 2019 to 31 Jan, 2020.

### **Study analyzed**

Various reasons of discarded blood and blood components bags.

### **Inclusion criteria**

Blood bags donated by donors, fulfilling NACO criteria for donor selection, discarded for different reasons were included in this study after checking medical history and brief clinical examination by the medical officer. The donors were either voluntary or replacement. Replacement donors were either relatives or friends of the patients. The whole blood was collected in single, double, triple and quadruple bags and components were prepared as per Drugs & Cosmetic Act, 1940 and Rules 1945. Citrate Phosphate Dextrose Adenine anticoagulant blood bags were used for WB collection and Saline Adenine Glucose Mannitol additive solution as preservative for PRBC. The components were prepared by Platelet rich plasma method. The quality of WB and blood components was evaluated as per the National Accreditation Board for Hospitals and Healthcare Providers (NABH) Guidelines.<sup>[14]</sup> All the blood units were subjected to Enzyme linked immune sorbent assay (ELISA) for TTI testing. Only seronegative products meeting the quality parameters were issued and the rest were discarded. 1% of individual blood bags (WB, PRBC, PC, FFP) were subjected for QC.<sup>[35]</sup>

### **Data analysis**

Data was collected after obtaining ethical clearance before the study from authorities concerned. It was collected from the blood bank data record. The present study includes blood units discarded for different reasons, which include transfusion transmitted infection (TTI) reactivity, expired, insufficient volume, leakage, clotted, hemolysis and return back unused after issue. Blood components (Packed RBC (PRBC), Platelet concentrate (PC), and (FFP) Fresh frozen plasma) were prepared from 350/450 ml blood bags under aseptic conditions according to Drug And Cosmetic Act guidelines as per demand and staff available in the blood centre.<sup>[36]</sup>

$$\text{Discard rate} = \frac{\text{Total number of blood or components discarded}}{\text{Total number of blood or components issued}} \times 100$$

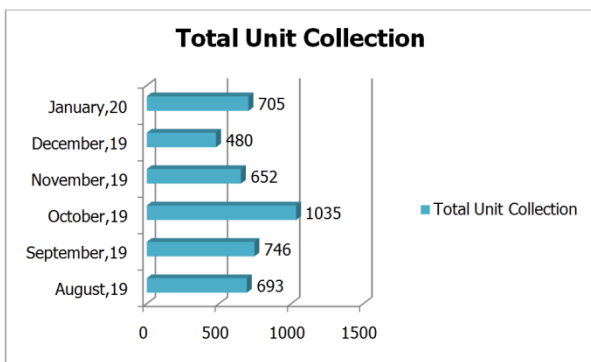
Method of discarding blood: Bags to be discarded due to any reason mentioned above are autoclaved at temperature of 121° C for 20 minute. Autoclaved bags are directly handed over to biomedical waste staff.

**Observations**

**Table I** Total No. of Blood/Components Collected

Months	Total Unit Collection
August,19	693
September,19	746
October,19	1035
November,19	652
December,19	480
January,20	705
<b>Total</b>	<b>4311</b>

In the above table, total collection of blood units during the study period of 6 months from August, 19 to January,20 is recorded 4311 units. Maximum units were collected in the month of October, 19 i.e. 1035 units while December, 19 recorded the lowest collection of 480 units. Number of blood units collected in the months of August, 19, September, 19, November, 19 and January, 20 were 693, 746, 652 and 705, respectively.

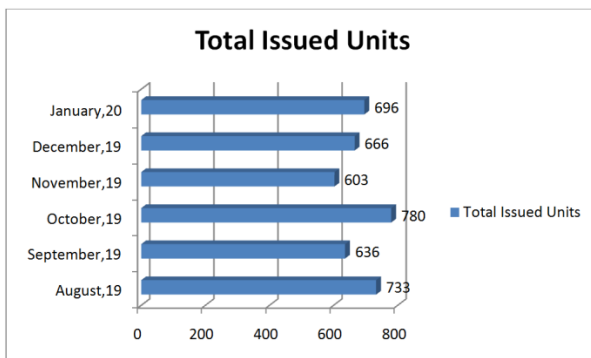


**Figure I** Bar Chart Shows Total Unit Collection Month Wise

**Table II** Total No. of Blood/Components Issued

Months	Total Issued Units
August,19	733
September,19	636
October,19	780
November,19	603
December,19	666
January,20	696
<b>Total</b>	<b>4114</b>

Total number of units issued from August, 19 to January, 20 are 4114, as shown in this table. The highest number of units were issued in the month of October, 19, i.e. 780 while November, 19 recorded the least number of issued units, i.e. 603. Units issued in the months of August, September, December and January are 733, 636, 666 and 696, respectively.

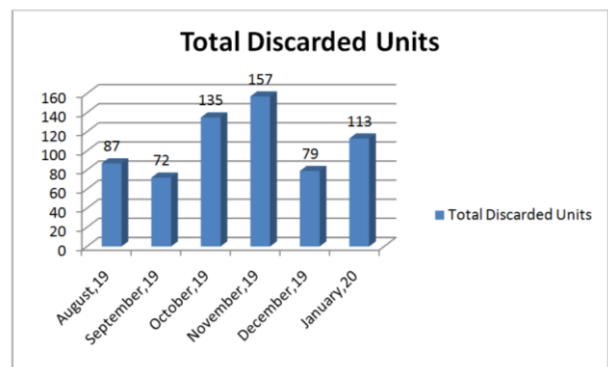


**Figure II** Bar Chart Shows Total Issued Units Month Wise

**Table III** Total No. of Blood/Components Discarded

Months	Total Discarded Units
August,19	87
September,19	72
October,19	135
November,19	157
December,19	79
January,20	113
<b>Total</b>	<b>643</b>

The above table shows the number of discarded blood units in the months of August, 19 to January, 20. The total units discarded in 6 months are 643 (includes both Whole Blood and Components). November, 19 recorded the highest no of discarded units i.e.157 units, followed by 135 units in October, 19 and 113 units in January, 20. August, September and December of 2019 recorded comparatively lesser number of discarded units than the months mentioned above. The number of units discarded in these months are 87, 72 and 79, respectively.

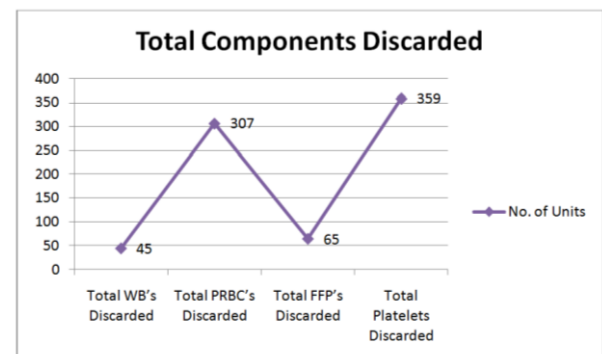


**Figure III** Column Chart Shows Total Discarded Units Month Wise

**Table IV** Total No. Units of Discarded Blood/Component Wise

Months	Total WB's Discarded	Total PRBC's Discarded	Total FFP's Discarded	Total Platelets Discarded
August,19	10	6	2	74
September,19	17	13	11	53
October,19	3	129	26	29
November,19	3	143	15	27
December,19	8	9	4	67
January,20	4	7	7	109
<b>Total</b>	<b>45</b>	<b>307</b>	<b>65</b>	<b>359</b>

This table provides information about the type of blood component ( WB, PRBC, FFP AND PL ) discarded during the study period in each month. Platelets contributed the most to the discard rate in blood bank, followed by PRBC'S and FFP's, while Whole Blood units contributed the least.



**Figure IV** Linear Chart Shows Total Components Discarded

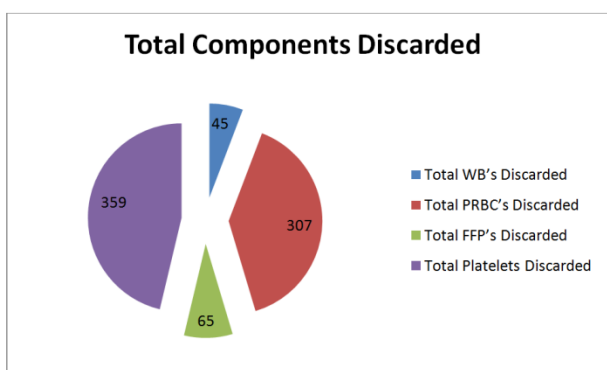


Figure V Pie Chart Shows Total Components Discarded

Table V Discard Rate Component Wise

Type of Blood Unit / Component	No. of Units	Discard Rate
WB	45	1.09 %
PRBC	307	7.46 %
FFP	65	1.57 %
Platelets	359	8.72 %

This table shows the discard rate of individual components in our study period. Platelets contributed 8.72%, most to the total discard rate, followed by 7.46% PRBC's, 1.57% FFP's and 1.09% WB units.

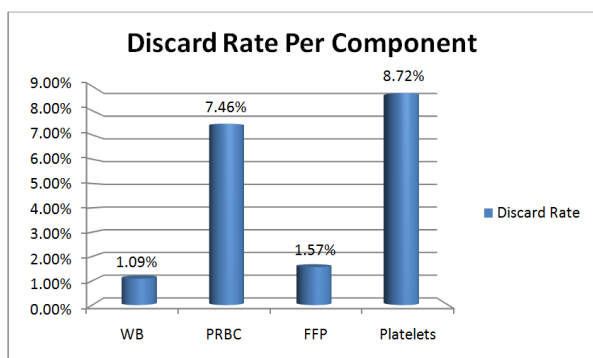


Figure VI Column Chart Shows Discard Rate Component Wise

Table VI Various Reasons for Discard Month-Wise

Months	Total Expired Units Discarded	Total TTI Positive Units Discarded	Total Units Discarded Due to Leakage	Total Units Discarded Due to Haemolysis
August,19	81	4	0	3
September,19	58	14	0	1
October,19	106	26	0	3
November,19	140	16	0	2
December,19	71	5	1	2
January,20	103	9	0	1
<b>Total</b>	<b>558</b>	<b>73</b>	<b>1</b>	<b>12</b>

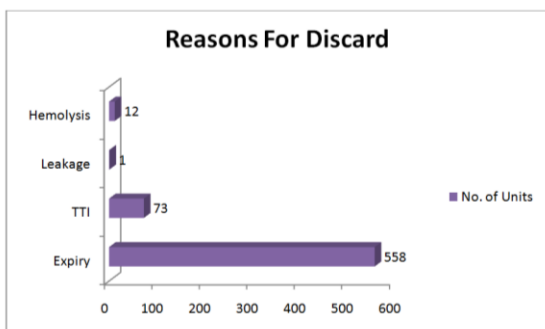


Figure VII Bar Chart Shows Reasons for Discard

This table provides an insight into various major reasons for blood wastage. In our study, expiry and TTI positivity of blood units turned out to be the 2 leading causes of blood discard. Most expiration of blood happened in the months of October and November of 2019. 12 units were discarded due to hemolysis while one unit was discarded due to leakage..

Table VII Various Reasons of Discard in Total

Reasons For Discarding	No. of Units	Discard Rate
Expiry	558	13.56%
TTI	73	1.77%
Leakage	1	0.02%
Hemolysis	12	0.29%

This table shows the various reasons responsible for the wastage of blood. Expiration, without doubt, is the leading cause because of the short shelf life of platelets. A total of 558 units were wasted due to expiration. TTI is the second leading cause of wastage in our study, contributing 73 units. Hemolysis accounted for 12 units and one unit was lost due to leakage.

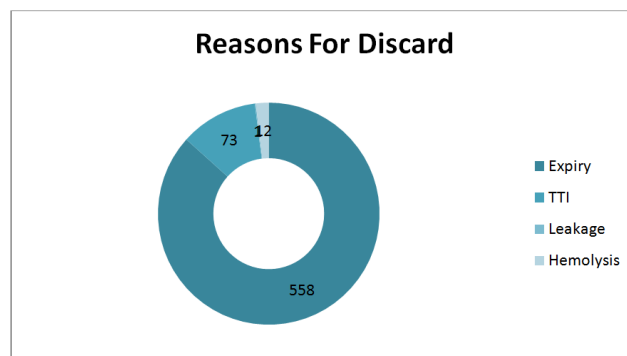


Figure VIII Doughnut Chart Shows Reasons For Discard

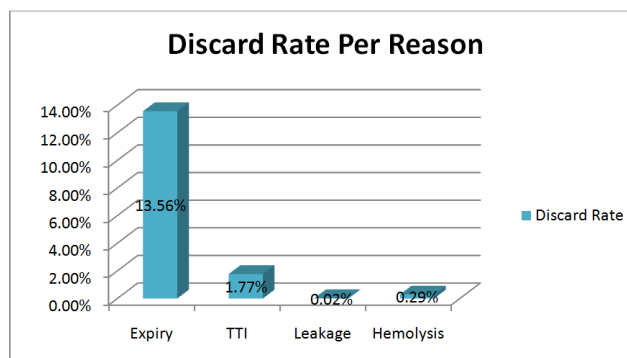


Figure IX Column Chart Shows Discard Rate Reason Wise

Table VIII Total Discard Rate during Study Period

Months	Total Discarded Units	Total Issued Units	Discard Rate
August,19	87	733	11.86%
September,19	72	636	11.32%
October,19	135	780	17.30%
November,19	157	603	26.03%
December,19	79	666	11.86%
January,20	113	696	16.23%
<b>Total</b>	<b>643</b>	<b>4114</b>	<b>15.62 %</b>

This table marks the number of discarded units in each month and in totality of 6 months. November was the highest contributor to the wastage rate with 157 units and 26.03 %. October, 19 was a close second in terms of number of units as

135 of its units were discarded, marking the month for 17.30 % wastage rate. Wastage of 113, 87 and 79 units in the months of January, August and December, marked the months for 16.23 %, 11.86 % and 11.86 %, respectively. September was the month with least number of units discarded in terms of number, as well as percentage, as 72 of its units with a monthly wastage rate of 11.32 % were discarded.

A total of 643 units were discarded in the span of 6 months from August, 19 to January, 20 and 4114 units were issued during this period. So, from the formula of calculating wastage rate, total discard rate of 6 months turned out to be **15.62 %**.

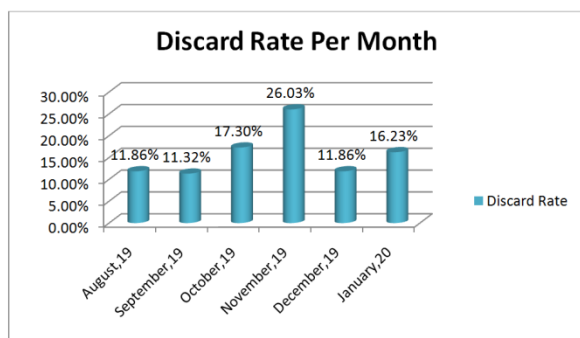


Figure X Column Chart Shows Discard Rate Month Wise

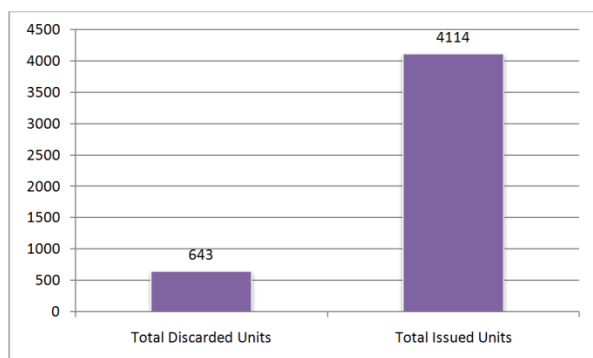


Figure XI Column Chart Shows Comparison Between Total Discarded Units and Total Issued Units

$$\text{Discard rate} = \frac{\text{Total number of blood or components discarded}}{\text{Total number of blood or components issued}} \times 100$$

$$\begin{aligned} \text{Total Discard Rate} &= \frac{643 \times 100}{4114} \\ &= 15.62\% \end{aligned}$$

## DISCUSSION

In recent years, most countries have emphasized towards implementing various strategies in order to further a step towards reduction in discard rate at their blood centres. With new and better treatment techniques developing every day, precise and improved diagnosis of disorders requiring transfusions are being made possible. Efficient and thoughtful management at blood centres is the first step towards reducing wastage of blood, which can save countless lives. Recent Patient Blood Management is the key to reduce discard of blood.

A balance is required between supply and demand in order to provide sufficient supply of blood. At current rate, the supply of blood doesn't catch up with the demand for blood. The best way to keep a check on this balance in blood centres is to conduct self audits to find out reasons for discard of blood and its components over a defined time period and assess if the

reasons are avoidable. It helps in formulating different strategies to reduce the blood wastage.<sup>[3]</sup>

The aim of this study was to evaluate the discard rate and its various causes in the blood centre of a University Medical College in North India. This retrospective study was done for a period of 6 months i.e. Aug,19 to Jan, 20. There are different perspectives when it comes to comparison of different studies with this one. Overall wastage rate, most common reasons of discard and contribution of TTI to the total wastage are the primary comparative aspects to this study.

Overall discard rate in this study was 15.62%, which is comparatively lower than studies no. [27], [32] and [37], while it was higher than studies numbered [24], [13], [2], [31], [30] and [34], as shown in table - IX.

Table IX Comparison Of Overall Discard Rate Among Various Studies In Last Few Years

Sr. No.	Year	Study	Discard rate
1	2014	Study of rate and causes of blood components discard among Ahwaz's hospital <sup>[24]</sup>	12 %
2	2015	Blood Wastage Rate in a Sub-Saharan African Hospital Based Blood Bank <sup>[13]</sup>	11.73 %
3	2016	Blood discard rate in a blood center in Curitiba – Brazil. Ten years of study <sup>[27]</sup>	10.2%
4	2016	Analysis of discard of whole blood and its components with suggested possible strategies to reduce it <sup>[2]</sup>	22.45 %
5	2017	Study of Utilization of Blood and Blood Components in a Tertiary Care Hospital <sup>[31]</sup>	6.2 %
6	2017	Analysis on Discard of Blood and Its Products with Suggested Possible Strategies to Reduce Its Occurrence in a Blood Bank of Tertiary Care Hospital <sup>[30]</sup>	6.95%
7	2018	Discard of Blood and blood Components With Study of Causes – A Good Manufacture Practice <sup>[32]</sup>	1.60 %
8	2019	Reasons and Recommendations to Reduce Wastage Pattern of the Blood Components in the Newly Started Tertiary Care Hospital Based Blood Center in East India <sup>[37]</sup>	22.8%
9	2019	Pattern of Utilization of Blood and Blood Products <sup>[34]</sup>	17.9 %
10	2020	Retro prospective Study of Discard Rate in Department of Transfusion Medicine of a University Medical College of North India	15.62 %

Outdating was the leading cause of wastage in this study, followed by seropositivity, hemolysis and leakage. Platelet concentrate were the most expired units, followed by PRBC's. Constant and proportional production of PC is necessary because of their short shelf life, which often leads to expiry. Maximum discard of PRBC's was in the months of October and November of 2019. These months are attributed to the admission of dengue cases, when PC are prepared in advance and in comparatively higher quantities to fulfill the needs of patients. PRBC's are prepared in order to obtain RDP, but not used to that extent, which leads to their expiration, causing high discard rate of PRBC's in these particular months.



Studies, in which expiration was the leading cause of discard, were compared with this study. Expiration rate in this study was higher than studies numbered [6], [26] and [23], while it was almost same to study numbered [24].

Studies in which seropositivity played the most prominent role were compared to this study. This comparison shows that seropositivity contributed much lesser to the total wastage rate in this study, as compared to other studies [19], [12], [18] and [28].

Hemolysis and leakage as leading causes of discard were not seen in any other studies compared.

## **SUMMARY AND CONCLUSION**

A closer look on the handling and usage of blood and its components would aid in focusing the various causes of blood wastage. Additionally, it would help in planning reformative measures to minimize blood wastage in future, as well as spreading awareness of the same. Simple and economical methods of improvement such as staff education, improved handling and transportation of blood units can have a tremendous influence in reduction of blood wastage as it always was, and for the foreseeable future, will be an issue for blood centres.<sup>[4]</sup> There is no liberty for technical or administrative leniency when handling an invaluable commodity like blood. Availability of more resources or improved efficiency of present ones can overcome the shortage of blood.

### **Recommendations**

- Education and counseling of donors can help with self-deferral among donors, that can lead to a decline in no. of seropositive cases.
- Stock management and other records in blood centres should be maintained on computers through specific software that can help in detection of units before their expiration for efficient use.
- Daily checks through the stock of blood must be administered to ensure the detection of units that are about to expire, so that they can be issued before other units.
- Regular training of staff and audits should be conducted in blood centres to keep the staff prepared for any possible scenarios.
- More Plasma fractionation centres should be setup so that excess plasma can be sent for plasma separation.
- Wards requesting blood units must be aware of their need of blood, and fill requisitions more cautiously, as issued but not transfused blood is a very prominent reason for discard in most blood centres.
- Patient Blood Management should be implemented in clinical wards.

## **References**

1. Varshney, L. and Gupta, S. (2017). Quality Indicators-Performance Tools of Blood Transfusion Services. *Journal of Evolution of Medical and Dental Sciences*, 6(90), pp.6348-6352.
2. Patil, P., Bhake, A., & Hiwale, K. (2016). Analysis of discard of whole blood and its components with suggested possible strategies to reduce it. *International Journal Of Research In Medical Sciences*, 477-481
3. Goel, N., & Sudhakar, D. (2019). An analysis on blood product usage and wastage in a rural tertiary care hospital, Konkan belt of Maharashtra, India. *Medpulse - International Journal Of Pathology*, 9(3), 144-149
4. Kurup, R., Anderson, A., Boston, C., Burns, L., George, M., & Frank, M. (2016). A study on blood product usage and wastage at the public hospital, Guyana. *BMC Research Notes*, 9(1)
5. Transfusion Update, 1<sup>st</sup> Edition, 2015, Jaypee Publishers
6. Far, R., Rad, F., Abdolazimi, Z., & Kohan, M. (2014). Determination of Rate and Causes of Wastage of Blood and Blood Products in Iranian Hospitals. *Turkish Journal Of Hematology*, 31(2), 161-167
7. Liumbruno G, D'Amici G, Grazzini G, Zolla L. Transfusion medicine in the era of proteomics. *Journal of Proteomics*. 2008; 71(1):34-45.
8. Roy A, Pal A. Evaluation of 'Wastage Rate' of Blood and Components – An Important Quality Indicator in Blood Banks. *British Journal of Medicine and Medical Research*. 2015; 8(4):348-352.
9. Sultan, S., Zaheer, H., Waheed, U., Baig, M., Rehan, A. and Irfan, S. (2018). Internal quality control of blood products: An experience from a tertiary care hospital blood bank from Southern Pakistan. *Journal of Laboratory Physicians*, 10(1), p.64.
10. Franchini, M., Capuzzo, E., Turdo, R. and Glingani, C. (2014). Quality of Transfusion Products in Blood Banking. *Seminars in Thrombosis and Hemostasis*, 40(02), pp.227-231.
11. National blood and blood product wastage reduction strategy 2013-2017. National Blood Authority, Australia
12. Cobain TJ. Fresh blood product manufacture, issue, and use: a chain of diminishing returns? *Transfus Med Rev*. 2004; 18(4): 279-92.
13. Atinuke, F., Adebola, S., & Rachael, K. (2016). Blood Wastage Rate in a Sub-Saharan African Hospital Based Blood Bank. *International Blood Research & Reviews*, 4(4), 1-6
14. National Accreditation Board for Hospitals and Healthcare Providers (NABH). Accreditation standards on Blood banks/ Blood centers and Transfusion Services: 2nd Edition:2013; 72-75
15. Morish M, Ayob Y, Naim N, Muhamad N, Salman H, Yusoff N. Quality indicators for discarding blood in the National Blood Center, Kuala Lumpur. *Asian Journal of Transfusion Science*. 2012;6(1):19.
16. Collins, R., Wisniewski, M., Waters, J., Triulzi, D., & Yazer, M. (2015). Effectiveness of Multiple Initiatives to Reduce Blood Component Wastage. *American Journal of Clinical Pathology*, 143(3), 329-335.
17. Amini Kafi-Abad, S., Omidkhoda, A., & Pourfatollah, A. (2019). Analysis of hospital blood components wastage in Iran (2005-2015). *Transfusion And Apheresis Science*, 58(1), 34-38. doi: 10.1016/j.transci.2018.11.001

18. Sreedhar Babu K, Suresh B, Arun R, Chandramouli P, Jothibai D. Reasons for discarding whole blood and its components in a tertiary care teaching hospital blood bank in South India. *Journal of Clinical and Scientific Research*. 2015;4(3):213.
19. Thakare MM, Dixit JV, Goel NK. Reasons for discarding blood from blood bank of government medical college, Aurangabad. *Asian J Transfus Sci* 2011;5:59-60
20. Kora, S.A. & Kulkarni, K.. (2011). An analysis Of donor blood wastage in a blood bank in rural Karnataka. *J Clin Diagn Res*. 5. 1393-1396
21. Gauravi D, Agravat A, Krupal MP. Seroprevalance of HIV, HBV, HCV and syphilis in blood donors Saurashtra region of Gujarat: Declining trends over a period of 31/2 years. *Online J Health Allied Sci*, 2012; 11: 5.
22. Singhal, M., Patel, M., Kapoor, D., & Mittal, D. (2013). A research analysis on blood component usage and wastage in blood bank and blood component center. *Journal Of Physiology And Pathophysiology*, 4(2), 23-28. doi: 10.5897/JPAP2013.0075
23. Kumar A, Sharma S, Ingole N, 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. *International Journal of Medicine and Public Health*. 2014;4(1):72
24. Arora, I., Singh, S., & Singh, S. (2018). Donor blood wastage: a study from blood bank Chamba (H.P). *International Journal Of Community Medicine And Public Health*, 5(7), 3016
25. Maramazi Ghaflez B, Kaab Omeir H, Jalali Far M, Saki N, Torabizadeh Maatoghi J, 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
26. Sharma, Neetika & Kaushik, Sanjay & Kumar, Rajnish & Azad, Sheenam & Acharya, Seema & Kudesia, Sandip. (2014). Causes of Wastage of Blood and Blood Components: A Retrospective Analysis. *IOSR Journal of Dental and Medical Sciences*. 13. 59-61. 10.9790/0853-131285961.
27. Bobde, V., Parate, S., & Kumbhalkar, D. (2015). Analysis of Discard of Whole Blood and Blood Components in Government Hospital Blood Bank in Central India. *Journal of Evidence Based Medicine And Healthcare*, 2(9), 1215-1220
28. Monich, A., Dantas, T., Fávero, K., Almeida, P., Maluf, E., Capeletto, C., & Nisihara, R. (2017). Blood discard rate in a blood center in Curitiba – Brazil. Ten years of study. *Transfusion And Apheresis Science*, 56(2), 130-134
29. Puneer K, Rupinder K, Victor M, Aikaj J. Incidence and Causes of Wastage of Blood & Blood Components in a Blood Bank of Tertiary Care Hospital: A Retrospective Study. *IOSR Journal of Dental and Medical Sciences*. 2016;15(09):108-110.
30. Javadzadeh Shahshahani, H., & Taghvai, N. (2017). Blood wastage management in a regional blood transfusion centre. *Transfusion Medicine*, 27(5), 348-353.
31. 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 Journal of Transfusion Medicine*. 2017;2(2):130.
32. SS, G., HD, C., N, S., A, A., NK, N., & R, B. (2017). Study of Utilization of Blood and Blood Components in a Tertiary Care Hospital. *Journal of Blood & Lymph*, 07(02).
33. Mahapatra S, Ray G, Panigrahi R, Mishra D, Sahoo B, Parida P. Platelet audit: To weigh the rationality between requirement and uses in blood transfusion. *International Journal of Research in Medical Sciences*. 2016;:4548-4551.
34. Mukherjee, G., Ghosh, S., Halder, S., & Mondal, S. (2018). Study of “Discard Rate” of Whole Human Blood: Useful Blood Center Quality Indicator. *Journal Of The Scientific Society*, 45(3), 116
35. Vimal, M. (2019). Pattern of Utilization of Blood and Blood Products in a Tertiary Care Hospital. *Recent Advances in Pathology & Laboratory Medicine*, 05(02), 14-17.
36. Drug and Cosmetic Act, 1940.
37. Kumari, N., Maheshwari, A., Kumar, N., & Rabab, S. (2019). Reasons and Recommendations to Reduce Wastage Pattern of the Blood Component in the Newly Started Tertiary Care Center Blood Bank in East India. *International Journal of Contemporary Medical Research [IJCMR]*, 6(5). doi: 10.21276/ijcmr.2019.6.5.60

\*\*\*\*\*