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Original Research Article

Wastage of Blood and Blood Components in a Tertiary Care Hospital: A Retrospective Study from Central India

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Abstract

Introduction: Blood and blood components are essential, yet scarce therapeutic resources in modern healthcare. Despite advances in transfusion medicine, their limited shelf life and strict storage requirements lead to significant wastage, driven by expiry, transfusion-transmitted infection (TTI) reactivity, and operational inefficiencies. Monitoring wastage is vital to improve utilization and reduce avoidable losses.

Materials and Methods: A retrospective study was conducted at a tertiary care hospital from January 2023 to December 2025, analyzing 20,000 blood units. Data were extracted from blood bank records to assess wastage, utilization efficiency, and transfusion indicators. Wastage categories and associated factors were analyzed using descriptive statistics and logistic regression.

Results: A total of 20,000 blood units were collected, with 1,165 discarded, giving a 5.8% wastage rate. Packed red blood cells (PRBCs) and platelets contributed most to wastage. Expiry was the leading cause (44.6%), followed by TTI reactivity. Wastage was higher in replacement donors and peripheral storage areas. Logistic regression identified platelet units, replacement donation, and peripheral storage as significant predictors of wastage. Transfusion indicators showed relatively efficient utilization overall.

Conclusion: Blood wastage was 5.8%, mainly due to PRBCs and platelets. Expiry, replacement donation, and peripheral storage were key factors. Improved inventory management, staff training, and voluntary donation can reduce wastage and enhance blood utilization efficiency.

Keywords: Blood Wastage, Blood Components, Crossmatch–Transfusion Ratio, Utilization Efficiency, Platelet Wastage.

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Introduction

Blood and its components are indispensable therapeutic resources in modern healthcare, playing a critical role in the management of trauma, surgical procedures, hematological disorders, and obstetric emergencies. Despite advances in transfusion medicine, human blood remains a scarce and irreplaceable resource, dependent entirely on voluntary donation. The demand for blood and blood components continues to rise globally due to increasing population, expanding healthcare services, and growing numbers of complex medical and surgical interventions [1,2]. However, alongside this rising demand, the issue of blood wastage has emerged as a significant concern affecting both resource utilization and patient care outcomes. Blood component therapy, including packed red blood cells, fresh frozen plasma, platelets, and cryoprecipitate, has improved clinical efficiency and targeted treatment. Nevertheless, these components have limited shelf lives and require stringent storage conditions, making them highly susceptible to wastage [3,4]. Studies conducted in tertiary care settings have reported variable wastage rates ranging from less than 1% to as high as 19%, depending on institutional practices and resource management systems [1,4]. Platelets are particularly prone to wastage due to their short shelf life and sensitivity to storage conditions, while plasma is often discarded after thawing if not utilized within the stipulated time [1,5]. The causes of blood and component wastage are multifactorial and include expiration due to non-utilization, improper storage, transfusion-transmitted infection (TTI) reactivity, leakage or breakage of bags, and

clerical or ordering errors [2,4,6]. Inappropriate requisition practices, over-ordering, and inability to reissue unused blood units further contribute to avoidable losses [1]. Such wastage not only leads to economic burden on healthcare systems but also exacerbates the gap between blood supply and demand, which is already a persistent global challenge [2,7].

Efficient blood utilization and minimization of wastage are considered important quality indicators in transfusion services. Implementation of strategies such as strict adherence to transfusion guidelines, staff training, improved inventory management, and establishment of transfusion committees have shown promising results in reducing wastage rates [3,8]. Recent studies have demonstrated that targeted interventions and systematic monitoring can significantly decrease discard rates and improve overall efficiency of blood banks [4,9]. In the Indian context, where blood donation rates are often insufficient to meet clinical demands, minimizing wastage becomes even more crucial. Tertiary care hospitals, being major referral centers, handle large volumes of blood and blood components, making them ideal settings for evaluating patterns of utilization and wastage. Therefore, the present study aims to analyze the extent and causes of blood and blood component wastage in a tertiary care hospital, thereby identifying gaps in current practices and suggesting measures to optimize resource utilization.

Materials and Methods

This retrospective study was conducted at a tertiary care teaching hospital, from January 2023 to December 2025. The study aimed to analyze the extent and causes of wastage of whole blood and its components and to evaluate utilization efficiency and transfusion practices.

Ethical approval was obtained from the Institutional Ethics Committee, and informed consent was waived due to the retrospective nature of the study. Confidentiality of donor and patient data was strictly maintained throughout the study. All whole blood units collected and processed during the study period were included.

These comprised components such as packed red blood cells (PRBCs), fresh frozen plasma (FFP), platelets, and cryoprecipitate. Both voluntary and replacement donor units were considered. Units that were crossmatched, issued for transfusion, or recorded in the discard register with specified reasons were included. Data were retrieved from donor registers, component preparation logs, crossmatch records, issue registers, and discard registers. A total of 20,000 blood units were analyzed. Units collected outside the study period, those with incomplete or missing records, units transferred between blood banks, and units discarded due to labeling or documentation errors without clearly defined causes were excluded.

Wastage was categorized as expiry (outdating), transfusion-transmitted infection (TTI) reactivity, leakage or breakage, contamination, storage or handling issues, and clerical or technical errors. Component-wise wastage rates and utilization efficiency were calculated annually. Additional variables such as donor type, blood group, and storage location (blood bank, operation theatre, wards/ICU) were also analyzed. Transfusion indicators including crossmatch–transfusion (C:T) ratio, transfusion probability, and transfusion index were calculated using standard formulae. Wastage rate was defined as the percentage of units discarded out of total units collected, while utilization efficiency was the proportion of units utilized out of total units prepared. Analysis was done using SPSS version 20. Descriptive statistics were expressed as frequencies and percentages. Year-wise comparisons were performed to assess trends in collection, utilization, and wastage. Logistic regression analysis was conducted to identify factors associated with wastage. The unit of analysis was individual blood/component units. The outcome variable was wastage (discarded vs utilized). Independent variables included donor type, component type, and storage location. Results were expressed as odds ratios (OR) with 95% confidence intervals (CI), and a p-value <0.05 was considered statistically significant.

Results

A total of 20,000 blood units were collected over the three-year study period (2023–2025), out of which 1,165 units were discarded, resulting in an overall wastage rate of 5.8%. Year-wise analysis showed a progressive increase in blood collection from 6,200 units in 2023 to 7,000 units in 2025 as seen in Table 1. The number of discarded units increased slightly from 372 in 2023 to 408 in 2024, followed by a decline to 385 in 2025. The wastage rate remained constant at 6.0% in 2023 and 2024 but showed a reduction to 5.5% in 2025. This indicates a marginal improvement in blood utilization efficiency during the final year of the study period despite increased collection.

Table 1: Year-wise collection and wastage of blood units (2023–2025)

Year	Total Units Collected	Total Units Discarded	Wastage Rate (%)
2023	6,200	372	6.0
2024	6,800	408	6.0
2025	7,000	385	5.5
Total	**20,000**	**1,165**	**5.8**

As illustrated in Figure 1, the distribution of total blood component wastage revealed that packed red blood cells (PRBCs) constituted the highest proportion of discarded units (34.3%), followed by platelets (32.6%). Fresh frozen plasma (FFP) accounted for 25.8% of the total wastage, whereas cryoprecipitate contributed the least (7.3%). The figure clearly demonstrates that PRBCs and platelets together represent the major share of wastage, indicating the need for focused interventions to optimize their utilization.

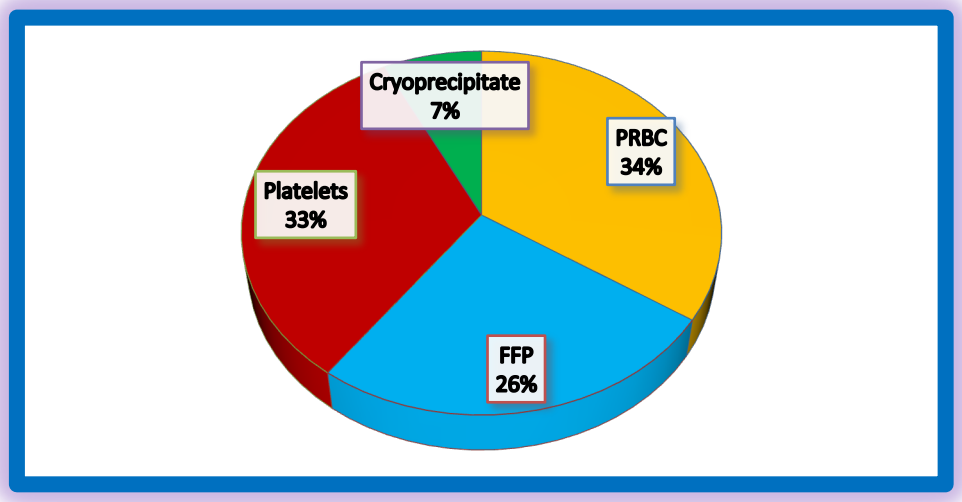

Figure 1: Percentage distribution of total wastage by blood component

Table 2 shows the year-wise trend in component-wise wastage and utilization efficiency from 2023 to 2025. An overall improvement in utilization efficiency with a corresponding decline in wastage rates was observed across all components over the study period. For PRBCs, utilization efficiency increased from 97.8% in 2023 to 98.2% in 2025, while wastage decreased from 2.2% to 1.8%. Platelets demonstrated a notable improvement, with utilization efficiency rising from 96.1% to 97.3% and wastage declining from 3.5% to 2.8%. Similarly, FFP showed a slight increase in utilization efficiency from 98.3% to 98.4%, accompanied by a reduction in wastage from 1.8% to 1.5%. Cryoprecipitate exhibited the highest utilization efficiency throughout the study period, increasing from 98.8% in 2023 to 99.1% in 2025, with a corresponding decrease in wastage from 1.2% to 1.0%. Overall, platelets had the highest wastage rates among all components, whereas cryoprecipitate demonstrated the least wastage and highest efficiency. The findings indicate a consistent trend toward improved blood component utilization over time.

Table 2: Trend analysis of component wastage and utilization efficiency rate

Component		2023 (%)	2024 (%)	2025 (%)
PRBC	Utilization efficiency	97.8	98.0	98.2
	Wastage	2.2	2.0	1.8
Platelets	Utilization efficiency	96.1	97.1	97.3
	Wastage	3.5	3.3	2.8
FFP	Utilization efficiency	98.3	98.4	98.4
	Wastage	1.8	1.6	1.5
Cryoprecipitate	Utilization efficiency	98.8	98.9	99.1
	Wastage	1.2	1.1	1.0

Table 3 presents the distribution of causes of blood component wastage. Expiry (outdating) was the most common cause, accounting for 520 units (44.6%) of total wastage.

This was followed by transfusion-transmitted infection (TTI) reactivity, which contributed to 240 units (20.6%). Leakage or breakage of blood bags accounted for 140 units (12%), while storage and handling issues were responsible for 110 units (9.4%) of wastage.

Clerical and technical errors contributed to 90 units (7.8%), and contamination was the least frequent cause, accounting for 65 units (5.6%). Component-wise analysis showed that platelet units were most affected by expiry (220 units), whereas PRBCs had the highest wastage due to TTI reactivity (150 units). Leakage and storage-related issues were relatively evenly distributed across components. Overall, expiry and TTI reactivity together constituted nearly two-thirds of total wastage, indicating major areas for intervention to reduce blood component loss.

Table 3: Causes of blood component wastage

Cause	PRBC	FFP	Platelets	Cryoprecipitate	Total n (%)
Expiry	120	140	220	40	520 (44.6)
TTI reactivity	150	60	20	10	240 (20.6)
Leakage/ Breakage	60	40	30	10	140 (12)
Storage issues/Handling	40	30	30	10	110 (9.4)
Contamination	10	15	30	10	65 (5.6)
Clerical/Technical errors	20	15	50	5	90 (7.8)

Table 4 shows the wastage pattern according to donor type, blood group, and storage location.

Wastage was higher among replacement donors (8.1%) compared to voluntary donors (5.0%), indicating relatively better utilization of blood collected from voluntary donations.

Among blood groups, AB positive showed the highest wastage rate (8.0%), followed by B positive (6.7%) and A positive (5.8%), while O positive had a lower wastage rate (5.0%). Negative blood groups demonstrated a comparatively lower wastage rate (5.2%). With respect to storage location, the highest wastage was observed in wards/ICU settings (8.2%), followed by the operation theatre (7.4%), whereas the blood bank had the lowest wastage rate (5.0%). These findings suggest that wastage is more likely to occur in peripheral clinical areas compared to controlled blood bank settings, highlighting the need for improved handling and utilization practices outside the blood bank.

Table 4: Donor type, blood group and storage location - wise wastage pattern

Variable		Units Collected	Units Discarded	Wastage Rate (%)
Donor type	Voluntary donors	14,500	720	5.0
	Replacement donors	5,500	445	8.1
Blood group	O positive	7,000	350	5.0
	A positive	5,000	290	5.8
	B positive	4,500	300	6.7
	AB positive	1,500	120	8.0
	Negative groups	2,000	105	5.2
Storage area	Blood Bank	14,000	700	5.0
	Operation theatre	3,500	260	7.4
	Wards/ICU	2,500	205	8.2

Table 5 presents the logistic regression analysis of factors associated with blood component wastage. Replacement donation was significantly associated with higher odds of wastage (OR = 1.8; 95% CI: 1.3–2.5; $p < 0.01$).

Among components, platelet units had the highest likelihood of wastage (OR = 2.2; 95% CI: 1.6–3.0; $p < 0.001$). Storage of blood components outside the blood bank was also found to be a significant risk factor (OR = 1.5; 95% CI: 1.1–2.1; $p < 0.05$). Additionally, involvement of untrained staff was associated with increased odds of wastage (OR = 2.0; 95% CI: 1.4–2.8; $p < 0.01$).

Overall, the analysis indicates that both operational factors (storage location, staff training) and component-specific characteristics (platelets) significantly influence the likelihood of blood component wastage.

Table 5: Logistic regression analysis of factors associated with wastage

Variable	Odds Ratio (OR)	95% CI	p-value
Replacement donation	1.8	1.3–2.5	<0.01
Platelet component	2.2	1.6–3.0	<0.001
Storage outside blood bank	1.5	1.1–2.1	<0.05
Untrained staff	2.0	1.4–2.8	<0.01

Table 6 summarizes the year-wise crossmatch–transfusion (C:T) ratio, transfusion probability, and transfusion index over the study period. A total of 27,200 units were cross matched, of which 19,400 units were transfused, yielding an overall C:T ratio of 1.40, transfusion probability of 71.3%, and transfusion index of 0.71.

Year-wise analysis showed a slight improvement in transfusion practices. The C:T ratio decreased marginally from 1.42 in 2023 to 1.38 in 2025, indicating more efficient utilization of crossmatched blood. The transfusion probability showed a gradual increase from 70.6% in 2023 to 72.6% in 2025. Similarly, the transfusion index improved from 0.71 in 2023 and 2024 to 0.73 in 2025.

Overall, the consistently low C:T ratio and high transfusion probability and index across all years reflect appropriate blood ordering and efficient utilization practices in the study setting.

Table 6: Crossmatch–transfusion (C:T) ratio, transfusion probability, and transfusion index

Year	Units Cross matched	Units Transfused	C:T Ratio	Transfusion Probability (%)	Transfusion Index
2023	8,500	6,000	1.42	70.6	0.71
2024	9,200	6,500	1.41	70.7	0.71
2025	9,500	6,900	1.38	72.6	0.73
Total	**27,200**	**19,400**	**1.40**	**71.3**	**0.71**

Discussion

Efficient management of blood and its components remains crucial for optimal utilization of a limited and life-saving resource. In the present study, the overall wastage rate was 5.8%. This is comparable to values reported in earlier studies, although it is marginally higher than the recommended benchmark of <5% for efficient blood bank performance [7]. Similar ranges have been observed in other tertiary care settings, where differences in inventory management practices and transfusion protocols often influence wastage rates [1,6]. On component-wise analysis, PRBCs (34.3%) and platelets (32.6%) contributed the most to overall wastage. This pattern aligns with previous reports. Chien et al. noted higher wastage in labile components, largely due to their shorter shelf life and variability in clinical demand [1]. Likewise, Haran et al. and Estcourt LJ, et al. reported platelets as the most frequently discarded component in hospital blood banks [2,5]. Study from Indian settings by Kori S et al. has also shown a similar trend, with PRBCs and platelets accounting for the bulk of wastage [10]. However, a few studies have documented higher wastage in plasma components, reflecting differences in institutional demand and storage practices [3].

Expiry (44.6%) emerged as the leading cause of wastage in the present study, followed by TTI reactivity (20.6%). This observation is in line with earlier findings by Haran H et al. and Bashir F et al. where expiry consistently remains the predominant reason for discard [2,11]. Bashir et al. also highlighted seropositivity and expiry as major contributors [11]. These findings suggest that, despite adequate collection, matching supply with real-time clinical demand remains a challenge, particularly for components with shorter shelf lives. Studies by Alshammari et al. have demonstrated that targeted inventory interventions can effectively reduce expiry-related losses [4,9], underscoring the importance of improved stock rotation and demand-based planning. In addition, structured utilization strategies have been shown to enhance overall efficiency and minimize unnecessary wastage [12].

The present study also found higher wastage among replacement donors compared to voluntary donors. This observation supports existing recommendations that emphasize voluntary blood donation as a more efficient and reliable source [7,13]. Similarly, wastage was higher in wards/ICU and operation theatre areas compared to the blood bank, indicating that peripheral storage and handling may contribute to avoidable losses. This has been reported in previous studies as well, where lack of strict monitoring outside the blood bank environment leads to increased discard rates [3,10]. Logistic regression analysis further identified platelet components, replacement donation, storage outside the blood bank, and untrained staff as significant predictors of wastage. These findings are consistent with earlier reports that highlight the role of both operational factors

and component characteristics in influencing wastage [6,11]. In recent years, newer approaches such as machine learning-based inventory systems have shown potential in improving demand prediction and reducing platelet wastage [14]. Additionally, the implementation of dedicated transfusion teams and targeted interventions has been associated with improved utilization and reduced discard rates [3,9].

Despite the observed wastage, transfusion indicators in the present study suggest overall efficient utilization. The C:T ratio of 1.40, transfusion probability of 71.3%, and transfusion index of 0.71 indicate appropriate blood ordering practices. These findings are in line with the principles of patient blood management, which advocate rational and evidence-based use of blood components [8,15]. Previous studies by Goodnough et al. and Tinmouth A et al. have similarly emphasized that adherence to such strategies improves utilization efficiency and reduces unnecessary transfusions [15,16].

Further evidence also supports the role of restrictive transfusion thresholds and conservation strategies in optimizing blood usage [5,17,18].

Overall, while the study demonstrates reasonably efficient blood utilization, there remains scope for reducing wastage. Strengthening platelet inventory management, improving staff training, ensuring better handling in peripheral areas, and adopting modern predictive tools could further enhance efficiency and minimize avoidable losses.

Conclusion:

This study shows that blood utilization in the institution is generally efficient, with an overall wastage rate of 5.8%, though still slightly above the recommended level. Packed red blood cells and platelets were the most commonly wasted components, mainly due to expiry and operational factors.

Higher wastage associated with replacement donation, peripheral storage, and inadequate staff training highlights key areas for improvement, while voluntary donation and centralized storage were linked to better utilization.

Despite this, transfusion indicators remained within acceptable limits, reflecting appropriate blood ordering practices. Strengthening inventory management, staff training, and handling practices—along with promoting voluntary donation—can help reduce avoidable wastage and further improve utilization efficiency.

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