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Discard Rates and Causes of Discard of Blood and Blood Components at a Tertiary Care Hospital Blood Center: A Retrospective Cross-Sectional Study

Dr. Moullik Pachori[1], Dr. P Pachori[2], Dr Sharukh[3]

Abstract: ***Background: Blood and its components are precious yet perishable resources, making effective utilization essential for optimal healthcare delivery. Despite advances in transfusion medicine, the discard of blood components continues to be a significant challenge owing to transfusion-transmissible infections (TTIs), short shelf life, leakage, hemolysis, and under-collection. Understanding the root causes of discard is vital to minimize wastage and improve patient outcomes. Aim: To evaluate the discard rate of whole blood and its components and to analyze the reasons for discard at a tertiary care hospital blood center. Methodology: A retrospective cross-sectional study was conducted at the Trauma Blood Center, SMS Medical College & Hospital, Jaipur, Rajasthan, covering the period from 1st November 2024 to 30th April 2025. A total of 20,699 blood components prepared during this period were analyzed for discard patterns and causes. Results: Out of 20,699 components prepared, 2,353 were discarded, yielding an overall discard rate of 11.4%. Primary causes included platelet expiry (1,907 units; 9.2%), punctured/leaked Fresh Frozen Plasma (FFP) (162 units; 0.8%), hemolysis of Packed Red Blood Cells (PRBC) (84 units; 0.4%), and insufficient quantity in whole blood (76 units; 0.4%). TTI positivity accounted for 124 discarded units: HBsAg (91; 73.4%), HCV (26; 21.0%), HIV (6; 4.8%), and VDRL (1; 0.8%). Conclusion: Platelet expiry and TTI positivity were the leading contributors to component discard. Implementation of stricter donor screening protocols, enhanced inventory management, adoption of apheresis for platelet collection, and systematic staff training are recommended to significantly reduce discard rates and improve overall blood utilization.***

Keywords: Blood discard; blood components; transfusion-transmissible infections; wastage management; platelet expiry; blood bank; inventory management.

1. Introduction

Blood transfusion is a life-saving medical intervention that supports the management of a wide range of clinical conditions, including trauma, surgical blood loss, hematological malignancies, and obstetric emergencies (Murphy et al., 2019). Blood and its components- packed red blood cells (PRBCs), fresh frozen plasma (FFP), platelet concentrates (PCs), and cryoprecipitate- are irreplaceable biological products derived from voluntary human donors. Their collection, processing, storage, and distribution are resource-intensive processes governed by stringent regulatory and quality standards (National Blood Transfusion Council [NBTC], 2020).

Despite the critical importance of blood products, wastage remains a persistent and significant challenge for blood banking systems worldwide, particularly in low- and middle-income countries (LMICs) (World Health Organization [WHO], 2021; Markovic-Denic et al., 2020). The discard of blood components not only represents a direct loss of a limited biological resource but also carries economic, logistical, and public health implications. Every discarded unit represents a missed opportunity to save or improve a patient's life, and the cumulative effect of high discard rates can strain blood supply systems and compromise the availability of blood in emergency situations.

Blood component discard arises from multiple causes, broadly classified as: (i) infectious causes- transfusion-transmissible infections (TTIs) detected through mandatory donor screening (Jog et al., 2022); (ii) non-infectious causes- expiry, hemolysis, leakage, clotted units, and inadequate volume. Among TTIs, hepatitis B surface antigen (HBsAg), hepatitis C virus (HCV), human immunodeficiency virus (HIV), and Venereal Disease Research Laboratory (VDRL) reactivity are the primary screen-reactive causes mandating discard in India, as per National Blood Transfusion Council (NBTC) guidelines (NBTC, 2020).

Studies from various Indian blood centers report overall discard rates ranging from 5% to over 20% (Sharma et al., 2021; Kulkarni et al., 2022; Agarwal et al., 2023; Gupta et al., 2020), with platelet concentrate expiry being a consistently predominant cause due to the short 5-day shelf life of platelets stored at room temperature under continuous agitation (Kapoor et al., 2021). This study was undertaken to determine the discard rate and analyze the specific causes of discard at a high-volume tertiary care blood center, with the aim of identifying actionable areas for quality improvement.

2. Aims and Objectives

Primary Objective:
To determine the overall discard rate of whole blood and blood components at the Trauma Blood Center, SMS Medical College & Hospital, Jaipur, over a six-month study period.

Secondary Objectives:
1) To categorize and analyze the specific causes of discard of individual blood components (PRBCs, FFP, platelet concentrates, and whole blood).
2) To propose evidence-based recommendations to minimize preventable blood component wastage.

3. Materials and Methods

Study Design and Setting

This was a retrospective, cross-sectional, observational study conducted at the Trauma Blood Center, Department of Pathology and Transfusion Medicine, SMS Medical College & Hospital, Jaipur, Rajasthan, India. SMS Medical College & Hospital is a premier tertiary care government hospital with over 3,000 beds, serving as a referral center for Rajasthan and neighbouring states. The blood center is a high-volume facility that caters to diverse clinical departments including trauma surgery, oncology, haematology, obstetrics, and paediatrics.

Study Period

The study covered a six-month period from 1st November 2024 to 30th April 2025. All blood donations received and all components prepared during this period were included in the analysis.

Inclusion and Exclusion Criteria

All blood components prepared during the study period were included. Components that were returned after issue but prior to expiry were re-entered into the inventory and analyzed separately if subsequently discarded. Bags that were discarded before 1st November 2024 and bags after 30th April, 2025 were excluded from studies.

Blood Collection and Component Preparation

Blood donations were collected following standard NBTC-recommended donor selection criteria. Whole blood was collected in CPDA-1 triple/quadruple blood bags (450 mL ± 10%) under aseptic conditions. Component preparation was carried out within 4–6 hours of collection using standard centrifugation protocols: PRBCs were stored at 2–6°C (shelf life: 35 days in CPDA-1), FFP was stored at ≤ –18°C (shelf life: 12 months), and platelet concentrates were stored at 20–24°C under continuous agitation (shelf life: 5 days). All mandatory TTI testing was performed using ELISA-based methods for HBsAg, anti-HCV, anti-HIV 1 & 2, and VDRL.

Data Collection

Data were collected retrospectively from the blood center's Blood Bank Management System (BBMS) and physical registers maintained as per statutory requirements. Information extracted included: total components prepared per category, total components discarded per category, and reason(s) for each discarded unit. TTI serology results were retrieved from the laboratory information system.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using descriptive statistics. Discard rates were calculated as the percentage of discarded units relative to total components prepared in each category. Frequencies and percentages were used to present categorical data. No inferential statistics were required given the descriptive nature of the study.

4. Results

Overview of Blood Component Preparation and Discard

During the six-month study period (1stNovember 2024 – 30thApril 2025), a total of 20,699 blood components were prepared at the Trauma Blood Center. Of these, 2,353 units were discarded, yielding an overall discard rate of 11.4%. This rate encompasses all components including PRBCs, FFP, platelet concentrates, and whole blood. The distribution of components prepared and discarded is detailed in Table 1.

Table 1: Overview of Blood Component Preparation and Discard (November 2024–April 2025)

Blood Component	Units Discarded (n)	Reason for Discard	Discard Rate (%)
Platelet Concentrates	1,907	Expiry	9.2
Fresh Frozen Plasma (FFP)	162	Leakage/Puncture	0.8
Packed Red Blood Cells (PRBC)	84	Hemolysis	0.4
Whole Blood	76	Insufficient Quantity	0.4
TTI-Reactive Units	124	Transfusion-Transmitted Infection (TTI) Reactivity	0.6
Total	2,353	—	11.40%

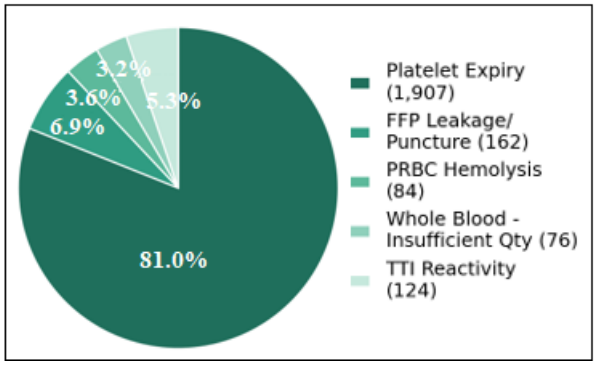

Figure 1: Distribution of Discarded Units by Cause (n= 2,353 Total Discards)

Causes of Discard: Non-Infectious

The majority of discarded units (2,255/2,353; 95.8%) were attributed to non-infectious causes. Platelet concentrate expiry was the single largest contributor, accounting for 1,907 units (81.0% of all discards; 9.2% of all components prepared). This reflects the inherently short 5-day shelf life of platelet concentrates stored under standard blood bank conditions, compounded by the unpredictable nature of platelet demand.

Punctured or leaked FFP bags accounted for 162 discards (6.9% of all discards; 0.8% of all components). This may be attributed to mechanical stress during storage at ultra-low temperatures (≤–18°C), improper handling during freezing or transport, or manufacturing defects in blood bag integrity. Hemolysis of PRBC units accounted for 84 discards (3.6% of all discards; 0.4% of all components), likely related to temperature excursions during storage or transport. Insufficient volume collection (whole blood <300 mL, per NBTC minimum-draw criteria; NBTC, 2020) resulted in 76 discards (3.2% of all discards; 0.4% of all components).

Causes of Discard: Transfusion-Transmissible Infections (TTIs)

TTI-reactive units constituted 124/2,353 discards (5.21% of all discards), representing 0.6% of all components prepared. Among TTI-positive discards, HBsAg was the most

prevalent, accounting for 91 units (0.44% of total components prepared; 73.4% of TTI discards). HCV reactivity was detected in 26 units (0.13%), followed by HIV reactivity in 6 units (0.03%), and VDRL reactivity in 1 unit (0.005%). These findings are presented in Table 2.

Table 2: Distribution of TTI-Reactive Discards

TTI Marker	Units Discarded	% of Total Components	% of TTI Discards
HBsAg	91	0.44%	73.40%
Anti-HCV	26	0.13%	21.00%
Anti-HIV 1 & 2	6	0.03%	4.80%
VDRL (Syphilis)	1	0.01%	0.80%
Total TTI Discards	124	0.60%	100%

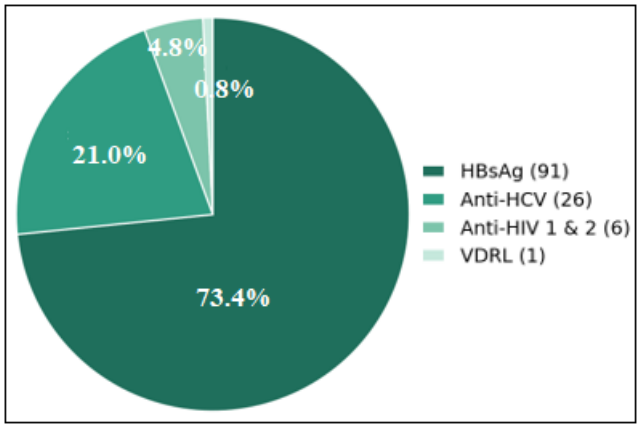

Figure 2: Distribution of TTI- Reactive Discards
(n= 124 TTI- Reactive Units)

5. Discussion

The overall discard rate of 11.4% observed in this study is broadly consistent with reports from other tertiary care blood centers in India, where rates typically range from 5% to 17%, though some high-volume urban centers report rates exceeding 20%. The WHO recommends an ideal discard rate of less than 2%, a benchmark that most developing countries struggle to achieve due to infrastructure limitations, demand unpredictability, and challenges in voluntary non-remunerated donor recruitment.

Platelet concentrate expiry emerged as the overwhelmingly dominant cause of discard in this study (9.2%), a finding mirrored in studies from across India. Sharma et al. (2021) reported platelet expiry rates of 8.3–10.1% at a tertiary care center in North India, while Agarwal et al. (2023) documented similar trends at a Mumbai-based center. The fundamental challenge is the 5-day shelf life of platelet concentrates, which is far shorter than other components and necessitates precise demand forecasting. Strategies to address this include: the implementation of pathogen reduction technology (PRT) where feasible (which may extend shelf life indirectly through improved bacterial safety), the adoption of single-donor apheresis platelets (SDPs) with standardized doses for more predictable utilization, and inter-blood-center platelet sharing protocols to redistribute surplus units.

The contribution of TTI-positive serology to discard (0.6%) reflects the donor pool seroprevalence at this center. HBsAg positivity (0.44%) was the leading TTI cause of discard, consistent with India's intermediate HBV endemicity (HBsAg prevalence in blood donors: 0.5–1.5%). The relatively low HIV positivity rate (0.03%) reflects the impact of decades of HIV awareness campaigns and improved donor screening. However, any TTI-positive discard represents a preventable loss if robust pre-donation counseling, self-deferral mechanisms, and confidential unit exclusion (CUE) programs are in place.

Punctured or leaked FFP bags (0.8%) represent a quality and process control concern. Unlike in many Western blood centers where automated bag integrity checks are routine, resource-limited settings may rely on visual inspection, which is less sensitive. Investment in visual inspection training and improved storage racking systems to prevent mechanical bag damage can mitigate this cause. Similarly, hemolysis in PRBC units (0.4%) is preventable through strict cold chain monitoring, maintenance of uninterrupted 2–6°C storage, and prompt return of unused units within regulated time windows.

Under-collection (short draws) resulting in whole blood volume <300 mL accounted for 76 discards (0.4%). This is multifactorial: donor-related causes (small-gauge vessels, donor movement, vasovagal responses) and operator-related factors (inadequate site preparation, incorrect needle placement). Enhanced phlebotomy training, use of donor comfort protocols, and pre-donation hydration guidance may reduce this category of discard.

Compared to international benchmarks, the TTI discard rate at this center (0.6%) is higher than that reported in high-income countries (<0.1%), underscoring the need for strengthening voluntary non-remunerated donation, which is associated with lower TTI prevalence compared to replacement donation. The push toward 100% voluntary donation- as mandated by India's National Blood Policy- is therefore directly relevant to reducing TTI-related discard.

6. Recommendations

Platelet Inventory Management
Platelet expiry accounts for over 80% of all component discards, making this the top priority. Key strategies:

- Demand-based procurement: use utilization data and clinical census to guide collection scheduling.
- Inter-departmental ordering protocol: require requests within a defined window before anticipated need.
- Apheresis collection: single-donor units reduce pooling and improve shelf-life predictability.
- Redistribution network: share surplus near-expiry units with neighbouring facilities.

Donor Screening and TTI Reduction
Strengthen the voluntary, non-remunerated donor base through education campaigns for students, corporates, and community groups. Structured deferral questionnaires help identify at-risk donors pre-donation. Nucleic acid testing (NAT), though resource-intensive, would shorten the window period for HIV/HCV and catch seronegative but viremic units.

Cold Chain and Quality Control
Strengthen monitoring with continuous temperature loggers and alerts, regular equipment calibration, and SOPs for

temperature excursions. Standardize FFP bag integrity checks at preparation, freezing, and thawing.

Phlebotomy Training
Implement competency-based training with regular skills assessments. Improve donor prep (hydration, arm checks) to reduce short draws, and track short-draw rates per phlebotomist to flag those needing further training.

7. Limitations

This study has several limitations inherent to its retrospective design. First, the study was conducted over a single six-month period at a single center, limiting its generalizability to other blood banking settings or seasons. Demand patterns for blood components may vary seasonally and by clinical case mix. Second, the study did not capture detailed sub-analyses of individual component types across all discard categories (e.g., precise breakdown of FFP vs. PRBC vs. PC prepared), which would have enabled more granular component-specific discard rates. Third, as a purely descriptive study, causality between identified factors and discard events cannot be established. Future prospective studies with component-specific tracking and root cause analysis for each discarded unit are recommended.

8. Conclusion

This retrospective cross-sectional study of blood component discard at a high-volume tertiary care blood center in Jaipur, Rajasthan, reveals an overall discard rate of 11.4% over a six-month period. Platelet concentrate expiry (9.2%) and TTI seropositivity (0.6%) were the two leading causes of discard. While TTI-related discard reflects donor pool seroprevalence and underscores the importance of strengthening voluntary blood donation, the dominant burden of platelet expiry represents a highly preventable form of wastage amenable to targeted quality improvement interventions.

Implementing evidence-based platelet inventory management, adopting apheresis technology, enforcing rigorous cold chain protocols, and investing in phlebotomy training are high-yield strategies to reduce component discard. These measures will not only conserve a precious and scarce biological resource but will directly improve the availability of blood products for patients in need, contributing to better clinical outcomes and more efficient healthcare delivery.

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Authors' Contributions: [Author initials]: Study design, data collection, manuscript preparation. [Author initials]: Data analysis, manuscript review.

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