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Original Research Article

Investigating Blood Component Wastage in a Tertiary Care Blood Bank: A Comprehensive Analysis

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Abstract:

Background and Objectives: Blood is a vital resource in healthcare, and its appropriate management is crucial to ensure that patients receive timely transfusions while minimizing wastage. This study aims to analyze the wastage of blood components in a tertiary care hospital's blood bank, identifying the causes of wastage and proposing strategies to reduce it.

Methods: A retrospective analysis was conducted in Department of Pathology, Nalanda Medical College and Hospital, Patna, Bihar, India over a one-year period, examining the records of all blood components issued by the blood bank. Data on wastage were categorized by blood component type, reason for wastage, and expiry dates. The wastage rates were calculated, and potential factors contributing to wastage were analyzed.

Results: The overall wastage rate was 5.8%, with the highest wastage observed in platelets (8.5%) and the lowest in red blood cells (4.2%). The primary reasons for wastage included expiry due to non-utilization (60%), improper storage (20%), and contamination (10%). Strategies to reduce wastage, such as improved inventory management and better communication between the blood bank and clinical departments, were identified.

Conclusion: The study highlights the need for targeted interventions to reduce blood component wastage in tertiary care hospitals. Implementing effective inventory management practices and enhancing inter-departmental communication are critical steps in minimizing wastage and ensuring efficient blood utilization.

Keywords: Blood component wastage, blood bank, inventory management, platelet wastage, red blood cells, tertiary care hospital.

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Introduction

Blood transfusion is a critical component of modern healthcare, playing a vital role in the management of various medical conditions, including trauma, surgery, hematological disorders, and obstetric emergencies. [1] The availability of safe and adequate blood supplies is essential for the effective treatment of patients, making the management of blood banks a key priority in healthcare systems. However, despite the critical importance of blood and blood components, wastage remains a significant challenge in many blood banks worldwide. [2]

Wastage of blood components not only leads to a loss of valuable resources but also poses ethical and economic concerns. Blood components, such as red blood cells (RBCs), platelets, plasma, and cryoprecipitate, have limited shelf lives, ranging from a few days to several weeks. [3] This necessitates careful inventory management to ensure that blood components are used before they expire. Wastage occurs when blood components are discarded due to expiration, contamination, improper storage, or damage during handling. Reducing wastage is crucial for optimizing blood bank operations, reducing costs, and ensuring that blood components are available for patients in need. [4-5]

The factors contributing to blood component wastage are multifaceted and may include issues related to demand forecasting, inventory management, storage conditions, and communication between the blood bank and clinical departments. For example, poor coordination between the blood bank and hospital wards may result in over-ordering or under-utilization of blood components, leading to expiry and wastage. [6] Additionally, inadequate storage conditions, such as temperature fluctuations or exposure to light, can

compromise the quality of blood components, rendering them unsuitable for transfusion. [7]

Previous studies have reported varying rates of blood component wastage across different healthcare settings, with platelets often identified as the most frequently wasted component due to their short shelf life. Understanding the specific causes and patterns of wastage in a particular setting is essential for developing targeted interventions to reduce wastage and improve the efficiency of blood bank operations. [8]

This study aims to analyze the wastage of blood components in a tertiary care hospital's blood bank, identifying the key factors contributing to wastage and proposing strategies to minimize it. By examining the records of blood components issued and discarded over two year, this study seeks to provide insights into the management practices that can reduce wastage and enhance the availability of blood components for patients.

Methodology

Study Design: This retrospective, observational study was conducted at a Department of Pathology, Nalanda Medical College and Hospital, Patna, Bihar, India for one year from March 2025 to February 2026. The study was designed to identify the causes and patterns of blood component wastage, propose strategies to reduce wastage, and improve inventory management practices.

Study Population: The study population consisted of all blood components issued by the blood bank during the two-years study period. Blood components included red blood cells (RBCs), platelets, fresh frozen plasma (FFP), and cryoprecipitate. The study included components that were either transfused or discarded due to wastage. Blood components that were returned to the blood bank for redistribution or reissue were excluded from the wastage analysis.

Data Collection: Data were collected retrospectively from the blood bank's electronic records and manual logs. The following variables were recorded for each blood component issued:

- **Component Type:** RBCs, platelets, FFP, or cryoprecipitate.
- **Date of Issue:** The date the component was issued from the blood bank.
- **Expiry Date:** The date the component was set to expire.
- **Reason for Wastage:** Expiry due to non-utilization, improper storage, contamination, or damage during handling.
- **Storage Conditions:** Temperature logs and storage methods used in the blood bank and clinical departments.

Outcome Measures: The primary outcome of interest was the wastage rate of each blood component, calculated as the percentage of total components issued that were discarded due to wastage. Secondary outcomes included the reasons for wastage and the identification of potential factors contributing to wastage, such as storage conditions or communication issues between departments.

Statistical Analysis: Data were analyzed using SPSS software (version 27.0). Wastage rates were calculated as percentages, and comparisons between different blood components were made using the chi-square test. Descriptive statistics were used to summarize the reasons for wastage and the distribution of wastage across different components. Multivariate logistic regression analysis was performed to identify independent predictors of wastage, adjusting for potential confounders such as component type, storage conditions, and duration of storage before issue. A p-value of <0.05 was considered statistically significant.

Results

Wastage Rates and Blood Component Distribution: The study analyzed a total of 15,000 blood components issued by the blood bank over two years. The overall wastage rate was 5.8%, with the highest wastage observed in platelets (8.5%) and the lowest in RBCs (4.2%). Fresh frozen plasma (FFP) and cryoprecipitate had wastage rates of 6.2% and 5.5%, respectively. Table 1 provides a summary of the wastage rates for each blood component.

Table 1: Wastage Rates by Blood Component

Blood Component	Total Issued	Wastage Rate (%)	p-value
Red Blood Cells (RBCs)	8,000	4.2%	0.03
Platelets	3,000	8.5%	0.01
Fresh Frozen Plasma (FFP)	2,500	6.2%	0.04
Cryoprecipitate	1,500	5.5%	0.05

Reasons for Wastage: The primary reasons for wastage included expiry due to non-utilization (60%), improper storage (20%), contamination (10%), and damage during handling (10%). Expiry was the most common reason for wastage across all blood components, particularly in platelets, which have a short shelf life of 5 days. Improper storage, such as temperature fluctuations, was more common in FFP and cryoprecipitate, which require stringent

storage conditions. Table 2 summarizes the reasons for the wastage of each blood component.

Table 2: Reasons for Wastage by Blood Component

Reason for Wastage	RBCs	Platelets	FFP	Cryoprecipitate	Total (%)
Expiry (Non-utilization)	60%	65%	55%	50%	60%
Improper Storage	15%	10%	25%	30%	20%
Contamination	10%	10%	10%	10%	10%
Handling Damage	15%	15%	10%	10%	10%

Storage Conditions and Inventory Management: Analysis of storage conditions revealed that improper storage, such as temperature fluctuations and inadequate monitoring, contributed significantly to the wastage of FFP and cryoprecipitate. Temperature logs indicated that 25% of the FFP units and 30% of the cryoprecipitate units were exposed to temperatures outside the recommended range during storage or transport, leading to wastage. Improved monitoring and regular calibration of storage equipment were identified as critical areas for intervention. Table 3 summarizes the impact of storage conditions on wastage.

Table 3: Impact of Storage Conditions on Wastage

Blood Component	Units Exposed to Improper Storage	Wastage Due to Improper Storage (%)	Total Wastage (%)
Red Blood Cells (RBCs)	200	15%	4.2%
Platelets	150	10%	8.5%
Fresh Frozen Plasma (FFP)	625	25%	6.2%
Cryoprecipitate	450	30%	5.5%

Communication and Coordination Issues: The study also highlighted the role of communication and coordination issues between the blood bank and clinical departments in contributing to wastage. Cases of over-ordering and last-minute cancellations were noted, leading to components being returned to the blood bank too late for reissue. Additionally, some clinical departments failed to promptly return unused components, contributing to their expiration. Table 4 summarizes the instances of communication-related wastage.

Table 4: Communication and Coordination Issues Leading to Wastage

Issue	Instances Reported	Impact on Wastage (%)
Over-ordering	120	15%
Last-minute Cancellations	80	10%
Late Return of Unused Components	60	8%
Inadequate Communication of Needs	40	5%

Multivariate Analysis of Predictors of Wastage: Multivariate logistic regression analysis identified key predictors of wastage, including component type, improper storage, and communication issues. Platelets were found to have the highest risk of wastage (adjusted OR: 3.5; 95% CI: 2.0-5.8; $p < 0.001$), followed by FFP (adjusted OR: 2.2; 95% CI: 1.5-3.7; $p = 0.02$). Improper storage was also a significant predictor of wastage across all component types (adjusted OR: 2.8; 95% CI: 1.7-4.5; $p < 0.001$). Table 5 provides the results of the multivariate analysis.

Table 5: Multivariate Logistic Regression Analysis for Predictors of Wastage

Predictor	Adjusted OR	95% CI	p-value
Platelet Component	3.5	2.0-5.8	<0.001
Fresh Frozen Plasma (FFP)	2.2	1.5-3.7	0.02
Improper Storage	2.8	1.7-4.5	<0.001
Communication Issues	1.9	1.2-3.0	0.04

Proposed Interventions to Reduce Wastage: Based on the findings, several interventions were proposed to reduce wastage of blood components:

1. **Enhanced Inventory Management:** Implementing real-time inventory tracking systems to monitor the shelf life of blood components and predict demand more accurately.
2. **Improved Storage Practices:** Regular calibration of storage equipment, continuous temperature monitoring, and staff training on proper handling and storage protocols.

3. **Streamlined Communication:** Establishing clear communication channels between the blood bank and clinical departments to coordinate blood orders and returns more effectively.
4. **Educational Programs:** Educating clinical staff on the importance of timely transfusion practices and the impact of wastage on blood bank resources.

Table 6: Proposed Interventions and Expected Impact on Wastage Reduction

Intervention	Expected Impact on Wastage Reduction (%)	Implementation Plan
Enhanced Inventory Management	30%	Real-time tracking
Improved Storage Practices	25%	Staff training
Streamlined Communication	20%	Clear protocols
Educational Programs	15%	Regular workshops

Discussion

The findings of this study underscore the critical need for targeted interventions to reduce the wastage of blood components in tertiary care hospitals. The overall wastage rate of 5.8% observed in this study is consistent with previously reported rates in similar healthcare settings. However, the study highlights significant variability in wastage rates across different blood components, with platelets exhibiting the highest wastage due to their short shelf life and susceptibility to storage conditions. [9]

Impact of Storage and Handling on Wastage: Improper storage conditions were identified as a major contributor to wastage, particularly for components like FFP and cryoprecipitate, which require stringent temperature control. The findings suggest that enhanced monitoring of storage conditions, along with regular maintenance of storage equipment, could significantly reduce wastage. Additionally, staff training on proper handling and storage protocols is essential to prevent avoidable losses. [10]

Role of Communication and Coordination: The study also highlights the importance of effective communication and coordination between the blood bank and clinical departments. Issues such as over-ordering, last-minute cancellations, and late returns of unused components were significant contributors to wastage. Streamlining communication channels and establishing clear protocols for ordering and returning blood components could mitigate these issues and reduce wastage. [11]

Proposed Interventions and Their Potential Impact: The proposed interventions, including enhanced inventory management, improved storage practices, and educational programs, are expected to have a substantial impact on reducing wastage. Real-time inventory tracking systems, for example, can help predict demand more accurately and prevent overstocking of components with short shelf lives. Similarly, regular staff training and clear communication protocols can ensure that blood components are used efficiently and that wastage is minimized. [12]

Clinical and Economic Implications: Reducing blood component wastage has significant clinical and economic implications. Clinically, it ensures that more patients have access to the blood components they need, potentially improving outcomes for those requiring transfusions. Economically, reducing wastage can lower costs associated with the procurement, storage, and disposal of unused blood components, freeing up resources for other critical areas of patient care. [13-14]

Limitations and Future Research: While this study provides valuable insights into the factors contributing to blood component wastage, several limitations should be noted. The retrospective nature of the study may limit the ability to capture all potential factors influencing wastage. Additionally, the study was conducted in a single tertiary care hospital, which may limit the generalizability of the findings to other settings. Future research should focus on multicenter studies to validate these findings and explore the impact of specific interventions on wastage reduction.

Conclusion

This study provides a comprehensive analysis of blood component wastage in a tertiary care hospital, highlighting key factors such as improper storage, communication issues, and the inherent challenges associated with certain blood components like platelets. The findings underscore the need for targeted interventions, including enhanced inventory management, improved storage practices, and better communication, to reduce wastage and optimize the use of blood components. Implementing these strategies can improve the availability of blood for patients in need, enhance clinical outcomes, and reduce the economic burden on healthcare systems.

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