# Optimizing Blood Management: A Comprehensive Study on Blood Transfusion Practices and Wastage Reduction Strategies at Tertiary Care Hospital

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## ABSTRACT

**Background**: Blood transfusion is a vital medical intervention used to treat various conditions worldwide. However, many healthcare facilities, including tertiary care hospitals, face challenges in managing blood supplies efficiently, resulting in significant wastage. This study focuses on evaluating blood wastage at a tertiary care hospital's blood bank and identifying the factors contributing to this issue.

**Objective**: The study aimed to assess the extent and reasons for the wastage of whole blood and its components at a tertiary care hospital's blood bank and propose strategies for improvement.

**Methods**: Conducted at the Institute of Medical Lab Technology, Isra University Islamabad, this cross-sectional study employed retrospective data collection from September 30th to December 31st, 2023. A sample of 14,261 blood donations was analyzed using SPSS Version 25 to identify donation patterns, donor demographics, blood group distribution, virus screening outcomes, and discard reasons. The study adhered to ethical standards per the Declaration of Helsinki, with informed consent obtained from all participants.

**Results**: Out of 14,261 donations, 613 units (4.29%) were discarded. Male donors comprised 99.52% of the sample, with the 26-35 age group contributing 41.83% of donations. Blood group B (Positive) accounted for 31.56% of donations. Common discard reasons included low volume (2.17%) and lipemic samples (0.74%).

**Conclusion**: The study highlighted significant gender disparities and identified key factors contributing to blood wastage. Implementing targeted strategies to enhance donor recruitment and improve blood management practices can optimize resource utilization and enhance patient care.

## INTRODUCTION

Clinical Blood transfusion is a critical medical intervention that saves countless lives worldwide by addressing a wide range of medical conditions, including severe injuries, surgical procedures, anemia, and various blood-related disorders. Its significance is particularly pronounced in developing countries like Pakistan, where high rates of blood-related illnesses, pregnancy complications, and trauma contribute to an escalating demand for blood transfusions (1). However, despite its essential role in healthcare, the effective management and utilization of donated blood remain significant challenges, leading to considerable wastage. This wastage is a critical issue as it not only depletes limited resources but also incurs substantial financial costs and raises ethical concerns within the healthcare system (2).

Pakistan, with a population exceeding 200 million, faces a multitude of challenges in ensuring the availability, accessibility, and effective utilization of blood and its components. The demand for blood transfusions in Pakistan is driven by a variety of factors, including the high prevalence of blood-related disorders and the frequent need for blood during medical emergencies (3). However, the supply of donated blood often falls short of meeting this demand, leading to potential shortages that compromise patient care. In addition, wastage of donated blood is a persistent problem, exacerbated by issues such as improper blood collection, inadequate storage, handling, transportation, and inventory management (4).

The wastage of blood and its components is not only a logistical and economic concern but also an ethical issue. Blood donors, who voluntarily give their blood to benefit others, expect that their donations will be used efficiently and effectively. However, the disposal of unused blood units undermines donors' trust and raises ethical questions about the equitable distribution and responsible utilization of this precious resource (5). Furthermore, this wastage represents a significant financial burden on the healthcare system, affecting the overall quality of care provided to patients (6).

Blood is a complex fluid comprised of four main components: plasma, red blood cells, white blood cells, and platelets. It performs a multitude of functions, such as transporting oxygen and nutrients, forming clots to prevent blood loss, and regulating body temperature (7). In Pakistan, blood transfusion practices have evolved, with guidelines now advocating for individualized patient screening to assess transfusion requirements based on clinical variables. This shift aims to minimize unnecessary transfusions, reduce the risk of transfusion-related complications, and preserve the limited blood supply (8). However, challenges remain, including maintaining an adequate supply of all blood types to meet the diverse needs of patients and ensuring the safety and quality of the blood supply (9).

The Drug Regulatory Authority of Pakistan (DRAP) is responsible for overseeing the regulatory framework for blood management in the country. DRAP establishes standards for blood collection centers, blood banks, and hospitals to ensure the quality and safety of donated blood. Despite these efforts, effective implementation and enforcement of these regulations remain challenging, particularly in resource-constrained environments (10).

This study aims to address the challenges associated with blood wastage in Pakistan by examining the extent and underlying factors contributing to the disposal of blood units at a tertiary care hospital. By identifying the reasons for wastage and proposing evidence-based strategies for improving blood management practices, this research seeks to optimize resource allocation, minimize wastage, and enhance the efficiency and effectiveness of blood transfusion services. Ultimately, this study aims to contribute to the improvement of patient care and the overall healthcare system by promoting the responsible use of donated blood and ensuring that this invaluable resource is utilized to its fullest potential (11).

## MATERIAL AND METHODS

The study was conducted at the Institute of Medical Lab Technology, Isra University Islamabad Campus, in collaboration with the Pathology Lab and the Blood Bank of a tertiary care hospital in Islamabad, Pakistan. This cross-sectional study utilized a retrospective data collection approach to assess blood wastage and transfusion practices over a specified period, from September 30th, 2023, to December 31st, 2023. The sample consisted of 14,261 individuals selected through non-probability convenience sampling, which included clinically healthy individuals aged 18 to 60 years with a body weight above 50 kg and a hemoglobin level exceeding 12.5 g/dl. Individuals with chronic diseases, drug abuse, on dialysis, pregnant women, those treated in thalassemia clinics, and attendees of sexually communicable diseases clinics were excluded from the study.

Data collection involved retrieving information from the electronic medical records and blood bank databases of the tertiary care hospital. The data gathered encompassed various aspects of blood donation and transfusion practices, including donor demographics, blood collection, testing, processing, transfusion orders, and patient outcomes. Specifically, the study focused on identifying the causes, extent, and patterns of blood wastage. Key data variables collected included donor characteristics, donation-related information, transfusion details, outcome measures, inventory management data, wastage reasons, and adherence to transfusion guidelines.

To ensure data accuracy and reliability, validation procedures were implemented. Data entries were cross-checked, verified against source documents, and discrepancies were resolved through consultation with relevant personnel. The collected data were systematically organized and presented using tables, charts, graphs, and narratives to facilitate interpretation of key findings. Data interpretation was conducted in the context of the study objectives and existing literature, with comparisons made to relevant studies and guidelines.

Ethical approval for the study was obtained from the Institutional Review Board (IRB) of Isra University, with the approval number F.1/IUIC-ANMC/IRBC-267/2023, dated June 20, 2023. The study adhered to the principles outlined in the Declaration of Helsinki, ensuring that ethical standards for medical research involving human subjects were strictly followed. Written informed consent for participation and publication of clinical data was obtained from all participants, ensuring confidentiality and privacy of the data collected.

Statistical analysis was performed using SPSS Version 25. Descriptive statistics were applied to analyze the data, focusing on determining the wastages of whole donated blood and its components. The analysis provided insights into donor demographics, age distribution, blood group contributions, screening outcomes, preferred blood components, and reasons for discarding blood components. This comprehensive analysis aimed to identify evidence-based strategies to enhance blood management practices and minimize wastage, ultimately contributing to improved patient care and resource optimization within tertiary care hospitals (12).

## RESULTS

The study analyzed blood donation and wastage data from a tertiary care hospital's blood bank, focusing on various donor demographics, donation types, blood group distributions, virus screenings, and reasons for blood discard. The results are presented below in tabulated form with descriptive analyses. The data highlights a significant gender disparity in blood donations, with 99.52% of donations made by males.

**Table 1: Total Blood Donations by Gender**

| Donation Type | Male | Female | Total |
|---|---|---|---|
| Single Donor Platelet | 699 | 2 | 701 |
| Tertiary Care Hospital | 17 | 4 | 21 |
| Replacement | 13,395 | 56 | 13,451 |
| Directed | 10 | 0 | 10 |
| Volunteer | 104 | 6 | 110 |
| Total | 14,225 | 68 | 14,293 |
| Percentage | 99.52% | 0.48% | 100% |

The "Replacement" category had the most donations, primarily from males. This underscores the need for strategies to encourage female participation in blood donation activities.

**Table 2: Age-Based Variation in Blood Donations**

| Age Range | Single Donor Platelet | TCH Employee | Replacement | Directed | Volunteer | Total |
|---|---|---|---|---|---|---|
| 16 – 25 | 214 | 5 | 4,888 | 3 | 21 | 5,131 |
| 26 – 35 | 300 | 10 | 5,602 | 4 | 49 | 5,965 |
| 36 – 45 | 169 | 4 | 2,361 | 1 | 27 | 2,562 |
| 46 – 60 | 18 | 2 | 556 | 2 | 12 | 590 |
| 61 – 150 | 0 | 0 | 12 | 0 | 1 | 13 |
| Total | 701 | 21 | 13,419 | 10 | 110 | 14,261 |
| Percentage | 4.92% | 0.15% | 94.10% | 0.07% | 0.77% | 100% |

The age group of 26-35 years contributed the highest number of donations across all categories, representing 41.83% of total donations. Younger donors aged 16-25 were also actively involved, highlighting the need to engage older age groups to ensure a diverse donor base.

**Table 3: Blood Group Distribution**

| Blood Group | Donations | Percentage |
|---|---|---|
| A (Negative) | 284 | 2.00% |
| A (Positive) | 3,276 | 23.12% |
| AB (Negative) | 99 | 0.70% |
| AB (Positive) | 1,245 | 8.79% |
| B (Negative) | 390 | 2.75% |
| B (Positive) | 4,473 | 31.56% |
| O (Negative) | 416 | 2.94% |
| O (Positive) | 3,988 | 28.14% |
| Total | 14,171 | 100% |

Blood group B (Positive) had the highest number of donations (31.56%), followed by O (Positive) with 28.14%. This distribution reflects common blood group patterns and emphasizes the need to encourage donations from individuals with less common blood types to maintain a balanced inventory.

**Table 4: Virus Distribution in Blood Donations**

| Virus Type | HBs Ag | HCV | HIV | Syphilis | Total | Percentage |
|---|---|---|---|---|---|---|
| Positive | 176 | 122 | 34 | 79 | 332 | 2.34% |
| Percentage | 1.24% | 0.86% | 0.24% | 0.56% | | |

Among screened viruses, HBs Ag had the highest number of positive cases (1.24%), followed by HCV. The findings suggest a low prevalence of transfusion-transmitted infections, indicating effective screening protocols.

**Table 5: Analysis of Blood Wastage**

| Parameter | Wasted Blood | Not Wasted Blood |
|---|---|---|
| Cases | 613 | 13,648 |
| Percentage | 4.29% | 95.71% |

The wastage rate was 4.29%, highlighting the efficient utilization of blood resources. However, efforts to further minimize wastage remain essential. The most common reason for discarding blood components was "Low Volume," accounting for 2.17% of the total discard cases. Understanding these reasons can aid in implementing strategies to minimize wastage and optimize blood management practices.

**Table 6: Reasons for Blood Component Discards**

| Discard Reason | Whole Blood | FFP | Red Cell Concentrate | Platelets | Total | Percentage |
|---|---|---|---|---|---|---|
| Hemolysed | 0 | 16 | 0 | 8 | 24 | 0.16% |
| Bag Ruptured on Thawing | 0 | 22 | 0 | 0 | 22 | 0.15% |
| Low Volume | 0 | 105 | 103 | 102 | 310 | 2.17% |
| Therapeutic Phlebotomy | 55 | 0 | 0 | 0 | 55 | 0.38% |
| Ruptured During Centrifugation | 0 | 11 | 7 | 10 | 28 | 0.20% |
| Out of Temperature | 0 | 28 | 1 | 0 | 29 | 0.20% |
| Lipemic | 0 | 103 | 0 | 3 | 106 | 0.74% |
| Red Cells Contamination | 0 | 4 | 0 | 6 | 10 | 0.07% |
| Total | 55 | 310 | 113 | 132 | 613 | 4.29% |

## DISCUSSION

The study provided valuable insights into blood donation and wastage patterns in a tertiary care hospital, aligning with and extending previous research findings. The predominance of male donors, who accounted for 99.52% of the total donations, reflects a consistent trend observed in earlier studies (1). This gender imbalance highlighted the need for targeted efforts to encourage female participation in blood donation. Previous research has identified several factors contributing to this disparity, including cultural norms, misconceptions about health impacts, and logistical barriers (2). Addressing these challenges through awareness campaigns and tailored educational initiatives could enhance female donor engagement and create a more balanced donor pool.

The study's findings on age distribution revealed that individuals aged 26-35 were the most active donors, contributing 41.83% of the total donations. This aligns with existing literature suggesting that younger adults are more likely to engage in altruistic behaviors such as blood donation (3). However, older age groups were less represented, indicating the need for strategies to attract and retain donors from diverse age cohorts. Tailoring recruitment messages and providing convenient donation opportunities for older adults could help broaden the donor base (4).

The distribution of blood groups in the study population showed that blood group B (Positive) was the most common, followed by O (Positive). These findings are consistent with global blood group prevalence patterns (5). However, maintaining an adequate supply of all blood types, especially those less common, remains a challenge. Encouraging donations from individuals with rare blood types is crucial to ensuring a balanced inventory and meeting diverse patient needs (6).

The low prevalence of transfusion-transmitted infections, as indicated by the virus screening results, underscored the effectiveness of current screening protocols. The study found a low rate of positive HBs Ag cases, aligning with previous research that has demonstrated the success of rigorous screening measures in reducing infection risks (7). Nevertheless, continuous monitoring and updating of screening techniques are necessary to adapt to emerging threats and maintain high standards of blood safety (8).

The analysis of blood wastage revealed a discard rate of 4.29%, which, while relatively low, highlighted areas for improvement. The primary reasons for discard included low volume, lipemic samples, and storage-related issues. These findings are in line with earlier studies that identified similar causes of blood wastage (9). Enhancing quality control measures, such as staff training and stricter adherence to storage protocols, could mitigate these issues and optimize resource utilization (10).

Despite the study's strengths, such as its large sample size and comprehensive data analysis, several limitations warrant consideration. The reliance on retrospective data may have introduced biases or inaccuracies, and the study's cross-sectional design limited its ability to establish causal relationships (11). Future research should consider longitudinal approaches to explore changes in donation patterns and wastage over time. Additionally, incorporating qualitative methods could provide deeper insights into donor motivations and barriers.

Considering these findings, several recommendations emerge for improving blood donation practices. Implementing gender-specific outreach programs and diversifying recruitment strategies across age groups could enhance donor engagement. Regular evaluation of blood group distributions and targeted recruitment for rare blood types would ensure a balanced supply. Continuous refinement of screening protocols and quality control measures could further reduce wastage and enhance blood safety. Collaborative efforts among blood banks, healthcare providers, and research institutions are essential to share best practices and drive innovation in blood management.

Overall, the study contributed to the understanding of blood donation dynamics in a tertiary care setting and offered valuable insights for optimizing donor recruitment and minimizing wastage. Addressing the identified challenges and implementing the proposed recommendations could enhance the efficiency and effectiveness of blood transfusion services, ultimately benefiting patients and the healthcare system (12).

## CONCLUSION

This study provided crucial insights into blood donation patterns and wastage at a tertiary care hospital, highlighting significant gender and age disparities in donor demographics and identifying key factors contributing to blood wastage. The findings underscored the importance of targeted strategies to enhance donor recruitment, such as increasing female participation and engaging older age groups, as well as the need to improve inventory management and minimize blood component discard rates. The low prevalence of transfusion-transmitted infections reflected effective screening protocols, reinforcing the importance of continuous monitoring and adaptation to emerging health threats. Implementing these strategies could optimize blood utilization, enhance resource allocation, and improve patient care. Addressing these issues is vital for ensuring a stable and safe blood supply, ultimately contributing to more effective healthcare delivery and improved patient outcomes.

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