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PATTERNS AND CAUSES OF BLOOD COMPONENT DISCARD AT THE REGIONAL BLOOD CENTER, QUETTA: A PROSPECTIVE STUDY

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Abstract

Background: *Blood transfusion is a critical intervention in life-saving medical care, serving both to replace lost blood and to manage various hematological conditions. However, the wastage of this irreplaceable resource poses significant challenges to maintaining a consistent supply of blood and its components. The situation is particularly acute in resource-limited settings where disposal rates are high. Data on blood discard patterns in Balochistan remain scarce. This study therefore aims to evaluate the pattern of blood component discard at the Regional Blood Center, Quetta.*

Objective: *To investigate the patterns and underlying causes of blood component discard at the Regional Blood Center (RBC), Quetta, and to propose evidence-based recommendations for reducing blood wastage.*

Materials and Methods: *A prospective, cross-sectional, descriptive study was conducted over a three-month period from November 11, 2025, to February 11, 2026. A structured blood component discard proforma was developed and utilized for data collection on all units designated for disposal. Data were entered and analyzed using Microsoft Excel 2016.*

Results: *During the study period, a total of 18,240 blood components were prepared from 6,080 donations. Of these, 1,469 components were discarded, yielding an overall discard rate of 8.1%. The leading cause of discard was positivity for transfusion-transmitted infections (TTI), accounting for 32.8% of discarded units. Delayed processing (18.9%) and shelf-life expiration (14.5%) were the second and third most common causes, respectively. Among component types, platelets represented the highest proportion of discards (44.7%), followed by plasma (including FFP) at 43.5%, and packed red blood cells (PRBCs) at 11.8%.*

Conclusion: *To mitigate unnecessary wastage and ensure optimal utilization of this valuable resource, targeted interventions including enhanced staff training, improved inventory and product management, and strengthened donor screening protocols are essential.*

Keywords: *Blood component discard, Blood transfusion, Donor screening, Resource-limited settings, Transfusion-transmitted infections*

INTRODUCTION

Blood is composed of plasma, red blood cells, white blood cells, and platelets, vital to human health. Each of these is unique in its structure and function, contributing to maintaining homeostasis, defense, oxygen transport, and coagulation. These components are also essential in saving the lives of patients through their therapeutic use. Moreover, blood transfusion services are a vital part of a healthcare system, playing a role in the treatment of blood loss arising due to trauma or surgery, or due to a long term blood related condition, such as anemia and hemoglobinopathies (1, 2).

When the wastage of blood and its components occurs, it makes it more challenging to maintain a steady supply of blood. This wastage not only affects the healthcare system but also highlights ineffective ways of utilizing this valuable resource (3-6).

As indicated by the World Health Organization, most recent global data, in terms of blood donation, the underdeveloped, low income nations are lagging with just 5.0 donations per 1000 people, compared to high income countries that receive 31.5 donations per 1000 people (7). This difference indicates a great difficulty for nations with fewer resources to collect and maintain a sustainable blood supply.

Blood related illnesses and the frequent need for blood during medical emergencies are among the reasons increasing the need for blood transfusions in Pakistan. With over 200 million people, it is difficult to ensure that blood and its products are always available and accessible (6). It gets more difficult to meet the needs for blood supply when different reasons, such as improper collection, lack of proper storage, handling, transportation, and management, lead to the discard of blood products due to Expiry, TTI positivity, coagulation, leakage or breakage of blood bags and other miscellaneous reasons. All these factors are commonly occurring due to the lack of awareness and proper training (8).

In resource limited regions like Balochistan, the problem of blood wastage can worsen if not taken into consideration. There is no published research on the causes of blood wastage in Quetta, Balochistan. Though crucial, the topic is still ignored. The study aims to fill the gap by studying the causes and issues, particular to Quetta's blood bank, and to recommend strategies to reduce the loss of blood products. This study will also serve as the foundation for future studies resulting in further understanding and improvement of maintaining blood supply.

MATERIALS AND METHODS

STUDY DESIGN AND SETTING

This prospective, cross-sectional, descriptive study was conducted at the Regional Blood Center, Quetta, over a three-month period from November 11, 2025, to February 11, 2026. Administrative approval was obtained from the center's management prior to data collection.

INCLUSION AND EXCLUSION CRITERIA

A non-probability consecutive sampling technique was employed. All blood component units discarded during the study period regardless of the underlying cause, including shelf-life expiry, transfusion-transmissible infection (TTI) reactivity, or technical issues were included in the analysis. Units with missing essential information particularly those lacking a documented reason for discard were excluded from the analysis.

DISCARD CONFIRMATION AND DISPOSAL PROCEDURE

Each unit designated for disposal underwent thorough visual inspection to detect obvious causes of wastage, such as leakage, clots, or abnormal coloration. For technical or screening-related reasons (e.g., TTI positivity, delayed processing, temperature excursions, or volume insufficiency), verification was sought from laboratory staff. Once the exact cause of discard was confirmed and documented on the proforma, the unit was discarded following the center's standard operating procedures.

A structured Blood Component Discard Proforma was designed to capture relevant data for each unit marked for disposal, including the unit identification number, ABO and Rh blood group, component type (packed red blood cells [PRBCs], platelets, or plasma [including fresh frozen plasma]), date of discard, and the primary reason for discard, which was categorized into transfusion-transmissible infections (HIV, HBsAg, HCV, syphilis, and malaria), expired shelf life, insufficient volume, hemolysis, damaged bag/leakage, temperature variation, clotted unit, lipemic appearance, or other miscellaneous reasons.

DATA MANAGEMENT AND STATISTICAL ANALYSIS

Following the completion of the three-month data collection period, all information from the discard proformas was compiled and entered into Microsoft Excel 2016 for analysis. Descriptive statistics were employed, with categorical variables summarized as frequencies and percentages.

The overall blood component discard rate was calculated using the following formula:

Discard rate (%) = (Total number of discarded blood components / Total number of blood components prepared during the study period) × 100. This calculation followed the methodology described by Chien *et al.* (9).

RESULTS

During the study period, a total of 6,080 donations were obtained. Based on standard laboratory preparation, where each whole blood unit is separated into individual components, particularly packed red blood cells (PRBCs), plasma (including fresh frozen plasma [FFP]), and platelets, a total of 18,240 components were prepared. Out of these prepared components, 1,469 products were discarded, resulting in an overall discard rate of 8.1%.

An evaluation of the discarded products showed that platelets accounted for the largest proportion of total waste, representing 44.7% (n=656) of the discarded volume, due to their short shelf life, Plasma products (inclusive of FFP) were the second most discarded at 43.5% (n=639), whereas packed red blood cells (PRBCs) accounted for just 11.8% (n=174) of the total component waste (Table I).

Table I. Component-wise distribution and proportion of discarded blood components

Component	Total Discarded Units (n)	Proportion of Total Discard (%)
Platelets	656	44.7%
Plasma (FFP included)	639	43.5%
PRBCs	174	11.8%
Total	1,469	100.0%

*PRBCs = Packed Red Blood Cells; FFP = Fresh Frozen Plasma (plasma post-freezing)

Among the discarded units of blood, the blood group analysis revealed that A positive blood group was the most discarded one (28.4%, 417 units). Following it, units with O positive (27.4%, 402 units) and B positive blood group (24.7%, 363 units) were discarded more frequently. Of the negative blood groups, A negative was the most discarded, contributing to 2.7% (n=39) of the waste rate and AB negative was the least discarded, contributing 1.0% (n=14) of the discard rate. For 1.7% (25 units) of the discarded units, the blood group was not recorded, as these bags were disposed of due to procedural technical reasons before screening and grouping (Table II).

Table II. Distribution of blood groups among discarded units

Blood Group	Frequency	Percentage (%)
A Positive (A+)	417	28.4%
O Positive (O+)	402	27.4%
B Positive (B+)	363	24.7%
AB Positive (AB+)	137	9.3%
A Negative (A-)	39	2.7%
B Negative (B-)	37	2.5%
O Negative (O-)	35	2.4%
AB Negative (AB-)	14	1.0%
Unknown	25	1.7%
Total	1,469	100.0%

Among the major causes of blood component discard observed during the study period, TTI positivity resulted in the largest proportion, 32.8% (n=483) of the discard rate. Hepatitis B Surface Antigen (HBsAg) was most commonly found in blood units (n=288), constituting 59.6% of the waste. Following it, 22.4% (n=108) of the TTI related discard was due to Hepatitis C Virus (HCV) positivity, 9.3% (n=45) due to Syphilis, 8.7% (n=42) due to Human Immunodeficiency Virus (HIV), and with no discard contribution from Malaria (Table III).

After TTI positivity, delayed blood processing was the second most common reason, constituting 18.9% (n=278) of the overall discard rate. With a contribution of 14.5% (n=213), shelf life expiry was the third most common reason for discarding blood components. It majorly affected platelets due to the short shelf life of the component (n=209) compared to PRBCs (n=4). Temperature variation (out of temperature units), mainly affecting fresh frozen plasma (FFP) components (n=207), remained another reason,

contributing to 14.4% (n=211) of the overall discard rate. It was mainly due to the lack of electricity backup and shortage of FFP storage equipment (Table IV).

Table III. Frequency and proportion of transfusion transmissible infections (TTIs) among discarded units (n=483)

TTI Marker	Platelets	Plasma	PRBCs	Total (n)	Percentage (%)
Hepatitis B (HBsAg)	96	96	96	288	59.6%
Hepatitis C (HCV)	36	36	36	108	22.4%
Syphilis	15	15	15	45	9.3%
HIV	14	14	14	42	8.7%
Total	161	161	161	483	100.0%

Insufficient volume (5.4%, n=79), red blood cell contamination (5.2%, n=76), lipemic units (4.8%, n=70), and bag breakage or leakage (2.4%, n=35) were the minor reasons noted. Less common causes included overweight units (0.8%, n=12), returned blood units from clinical wards (0.3%, n=5), clotted units (0.2%, n=3), bacterial contamination (0.2%, n=3), and icteric units (0.1%, n=1) (Table IV).

Table IV. Comprehensive analysis of causes of blood component discard

Cause of discard	Platelets	Plasma	FFP	PRBCs	Total (n)	Percentage (%)
Seropositive (TTI)	161	161	0	161	483	32.8%
Delayed processing	139	139	0	0	278	18.9%
Shelf-life expiry	209	0	0	4	213	14.5%
Out of temperature units	3	0	207	1	211	14.4%
Insufficient volume	42	34	0	3	79	5.4%
Red blood cell contamination	61	2	13	0	76	5.2%
Lipemic units	26	12	32	0	70	4.8%
Leakage/Breakage	0	0	35	0	35	2.4%
Overweight units	12	0	0	0	12	0.8%
Returned units	2	1	0	2	5	0.3%
Clotted units	0	0	0	3	3	0.2%
Bacterial contamination	0	0	3	0	3	0.2%
Icteric units	1	0	0	0	1	0.1%
Total	656	349	290	174	1,469	100.0%

DISCUSSION

It is mandatory for any healthcare system especially in Balochistan, with limited resources, to effectively manage blood and its components. The wastage of this resource leads to problems, such as affecting the blood availability for patients, and having an impact on both human and economic efforts required for the whole process of blood collection.

The results of the current study showed a total discard rate of 8.1%, which can be compared to findings from other regions of Pakistan. For example, Bashir *et al.* (10) reported a discard rate of 8.87% while Sultan et al. (17) in Karachi reported a higher rate of 10.9%. Azeem *et al.* (11) found a lower rate of 7.3%, and Qureshi *et al.* (8) from Peshawar and Khalid *et al.* (6) from Islamabad reported further lower rates of 5.13% and 4.29%. This variation in discard rates could be due to the management of blood and its products and particular settings unique to each blood bank across different regions of the country. Beyond the national context, studies from India report higher discard rates ranging from 10.04% to as high as 27.9% (3, 4). However, some Indian studies have reported lower discard rates ranging between 4.43% and 6.7% (12, 13), highlighting that proper management and improved methods can reduce the wastage of blood and its products.

Similarly, regional comparisons with Iran also show variability. Tahmasebi *et al.* (5) observed a 16.4% discard rate in the Zahedan hospitals in southeastern Iran. While Mohebbi Far *et al.* (14) reported a

discard rate of 9.8% from Iran's Qazvin province. Globally, Benghazi, Libya (45.4%), and Guyana (25%) had extremely high discard rates, which were associated with handling errors and systemic inefficiencies (15, 16).

However, in Taiwan, a very low waste rate of 0.08% was observed, indicating efficient blood banking infrastructure and effective utilization of blood and its components (9).

It is indicated through these regional and worldwide studies that, although the Regional Blood Center in Quetta performs better than many centers in India and Libya, there is still a need for improvement to achieve the high efficiency standards shown in Taiwan through improved infrastructure and inventory management.

The higher proportion of the A positive blood group (28.4%) among discarded units is likely due to its high occurrence among blood donors. However, the AB negative blood group accounted for the lowest proportion of discarded units (1.0%), which may result from its uncommon occurrence in the donor population and from fewer donations from this group.

The primary reason for discarding blood components in the current study was transfusion-transmissible infections (TTIs), which accounted for 32.8% of the total discarded units. Among the transfusion-transmissible infections, hepatitis B marker (HBsAg) was the most common (59.6%), followed by hepatitis C (HCV) (22.4%), syphilis (9.3%), and HIV contributed 8.7% of the discard rate, and no cases of malaria were reported. TTI positivity remains one of the frequently reported reasons for the wastage of blood in many studies conducted across Pakistan. Qureshi *et al.* (8) reported a 43.84% of discard rate due to TTI positivity, with HBsAg and syphilis being the most common infections. Furthermore, Azeem *et al.* (11) and Bashir *et al.* (10) reported TTI-related discard rates of 53.6% and 32.3%, respectively. In contrast, Sultan *et al.,* (17) reported a lower TTI-related discard rate of 5.6%. Similarly, Khalid *et al.* (6) observed a low prevalence of TTIs, which was the result of the implementation of more effective screening protocols. The reason for viral hepatitis being the most common may be attributed to limited public health awareness regarding infectious diseases and their routes of transmission. Additionally, the improper screening of blood can lead to excess discard due to the delay in screening and due to the inaccurate information provided by blood donors regarding their health during the pre-donation selection process. It has been suggested that rapid screening methods and proper history taking of blood donors before the collection of the complete blood unit could minimize the discard rate due to TTI positivity.

Another main factor that led to the wastage of blood products was delayed processing (18.9%). Plasma and platelet components are more sensitive to time and temperature variations, and their quality may be affected if whole blood is not separated into components within the required time period after collection. However, packed red blood cells (PRBCs) are less affected compared to other components because they have a longer storage period and can still be processed even if component separation is slightly delayed. While most national studies report TTI positivity and expiration as the primary causes of blood component wastage, delayed processing is less commonly reported. However, a study conducted in Tanzania also reported delayed processing as one of the reasons for discard. In this study, plasma prepared after 24 hours of collection was reported as a major reason contributing to 17.4% of the total discard rate (18).

Shelf-life expiry remained the most common reason after delayed processing. It was observed that among the blood components, 98.1% of platelets were discarded due to expiration, while overall, expiry accounted for 14.5% of the discard rate. Due to its short shelf life of 5 days, this blood component was mostly expired before utilization compared to other blood components with longer shelf lives. Studies conducted across various regions of Pakistan have reported variability in discard rates due to expiry, ranging from 3.7% to 62.2% (8,10,11,17).

Temperature variation (out of temperature units) remained another operational reason for the discard of blood components in the present study. It accounted for 14.4% of all discarded units. The majority of these were FFP units. Due to the shortage of equipment and lack of electricity backup, leading to temperature fluctuations and eventual thawing, the quality of coagulating factors is affected, making the

units unsuitable for transfusion. This cause, particularly due to the shortage of resources, was not consistently reported in other studies. However, in the present study, this reason at the Regional Blood Center, Quetta, is attributed to the local resource limitations.

In addition to the major reasons described, although they accounted for a very small proportion of the discard rate, several minor reasons such as insufficient volume (5.4%), red blood cell contamination (5.2%), lipemic units (4.8%), leakage or breakage of bags (2.4%), overweight units (0.8%), returned units (0.3%), bacterial contamination (0.2%), clotted units (0.2%), and ictericity (0.1%) were also observed that contributed to the wastage of blood components at the Regional Blood Center, Quetta.

Although these factors, due to technical errors, account for a smaller portion of the discard rate, they consistently appear across multiple studies, indicating that they are common and avoidable causes of blood component wastage. Similar findings were reported in Pakistan, where insufficient quantity, leakage, clot formation, red cell contamination, and lipemia were noted among the causes of blood component discard (6, 8, 10, 11, 17).

Therefore, these preventable losses can be decreased by improving staff training, paying close attention to standard operating procedures, and carefully selecting donors by improving the selection criteria.

CONCLUSION

To maximize the utilization of blood and its components and to lower the wastage, screening protocols, inventory management, availability of resources, and staff training must be improved at the Regional Blood Center, Quetta. It will lead to efficient transfusion services, the availability of blood, and improved patient health.

Limitations:

There were some limitations in the current study. It did not account for blood wastage that took place outside the blood bank, such as in hospital wards where blood components might not be transfused on time before patient expiry, improper transfusion practices leading to wastage, or inadequate storage conditions affecting the quality of blood components. Instead, its primary focus was on the discard rate of blood components and their causes within the blood bank setting.

Additionally, the study was limited to the morning shift, due to which the blood components that may be discarded in other shifts were not recorded.

Therefore, thorough research for longer time duration, covering all the shifts and hospital settings as well, are required to fully understand the wastage of blood components and to propose solutions for it.

Recommendations:

To reduce blood wastage and to maintain a uniform, safe supply of blood, these steps are recommended based on the findings of the study:

Strict adherence to donor screening: Correct documentation of the donor's medical history and testing before donating blood is needed to reduce the rate of TTI positive units.

Platelet expiry management: It is recommended to coordinate with nearby hospitals or blood banks to transfer platelet units nearing expiry to centers with higher demand.

Audit system and staff availability: To identify the causes of delayed component formation, a strict audit system should be implemented. Moreover, to avoid processing delays, there must always be a sufficient number of staff members available.

Continuous staff education: Ongoing education programs should be implemented to address standard operating procedures for blood collection, component processing, storage, handling, and transportation.

Monitoring team implementation: For developing strategies to reduce losses and improve resource utilization, a monitoring team should supervise blood component preparation and evaluate the causes of wastage.

Availability of resources: To minimize the avoidable errors such as delayed processing and temperature variation, the availability of sufficient equipment, electricity supply, and trained staff must be ensured by the blood bank management.

Attendant Awareness and Guidance: Instructing the patient attendants on the the appropriate handling, storage, and timely delivery of blood products to ensure the effectiveness and safety of the blood provided by the blood bank.

By following these recommendations, the Regional Blood Center, Quetta, can reduce avoidable wastage of blood and improve the overall blood supply chain in Quetta.

Conflict of interest:

The authors report no conflicts of interest

Author's contributions:

Sa Conceptualization, methodology, writing original draft; AI Conceptualization and methodology; GM Methodology, investigation, visualization and formal analysis; PI Formal analysis, investigation and visualization; RK Data curation, writing, review and editing; NR Data curation, writing, review and editing.

Declaration of generative AI-Assisted Tools:

No AI-assisted tools were used.

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