Pattern of Blood Products Consumption in a Teaching Hospital

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ABSTRACT

Background: Blood transfusions are lifesaving, but resource limitations and inadequate utilization patterns pose challenges in low- and middle-income countries. In Nepal, detailed analyses of blood use practices, are needed to inform resource allocation and policy decisions. The objective of this study was to study the overall and component-specific use, explore temporal trends in utilization of blood and blood products.

Methods: We conducted an observational study analyzing data from Blood Bank of Tribhuvan University Teaching Hospital (TUTH), a tertiary hospital (January 1st - December 31st, 2019). Data included patient demographics, blood groups, blood products requested and transfused, and facility type. Data analysis was conducted with SPSS v20.

Results: Patients from TUTH had substantially higher blood product requests, requesting 25,716 units compared to only 1855 units across other centers combined. Blood groups A positive (8089, 31.4%) and and O positive (7851, 30.6%) were the most requested blood groups. Whole blood (11358, 44.2%) and packed red blood cells (9565, 37.2%) were most frequently requested. We observed monthly fluctuations in demand with peak of 2742 requests in December with a trough in June (1947 units). Notably, only approximately 46% of blood products requested from patients admitted to TUTH were ultimately transfused.

Conclusions: Whole blood and packed red blood cells were the most frequently requested blood products. Eventhough whole blood was the most frequently requested blood product, the most transfused one was packed red cells. Peak demand was observed in December. Our study provides valuable insights into blood utilization patterns, underscoring the need for specific strategies to improve blood transfusion management practices.

Keywords: Blood banking; blood transfusion; blood utilization; LMICs. Nepal.

INTRODUCTION

Blood transfusion is a cornerstone of modern healthcare, with over 118.5 million donations collected globally each year.[1] In Nepal, limited infrastructure and fragmented regulations result in national blood collection falling short of demand. Moreover, comprehensive understanding of transfusion practices – particularly in resource-constrained tertiary care settings – remains elusive. [2]

Audits often focus on packed red blood cells, ignoring the utilization of fresh frozen plasma, platelets, and cryoprecipitate.[3] This knowledge gap is significant, as suboptimal transfusion practices pose serious risks, which include acute hemolytic reactions, transfusion-related acute lung injury, and pathogen transmission of HIV and hepatitis C.[4] Furthermore, injudicious blood products use contributes to wastage, recall events and million in losses. [5]

Despite the advancements in blood transfusion practices, countries like Nepal face challenges due to limited resources and fragmented regulations. The objective of this study was to explore the patterns and trends of utilization of blood products in a tertiary care setting.

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METHODS

This was an observational study conducted at the Blood Bank of Tribhuvan University Teaching Hospital (TUTH), a 700-bed tertiary care center in Kathmandu, Nepal. We analyzed data from January 1st, 2019, to December 31st, 2019, to provide a representative snapshot of blood and blood products utilization practices.

Data was obtained from the records maintained at Blood Bank. Information was gathered detailing annual figures for the procurement of whole blood, packed red blood cells (PRBCs), platelets (distinguishing between random donor and apheresis-derived), fresh frozen plasma (FFP), and cryoprecipitate. We categorized each component's procurement source as either in-house (organized directly by TUTH) or external (sourced from other blood banks or donation centers).

Additionally, data were collected regarding total annual issuance volumes for each blood component, for precise analysis of utilization patterns. We carefully documented the number of units of each blood component that underwent full cross-matching, compatibility testing according to established protocols, and were ultimately transfused to patients. Further examination included reasons for any units issued but not transfused (e.g., wastage due to expiry, changes in patient condition) to assess potential efficiency gaps. Finally, the primary discharge diagnosis associated with each transfusion was extracted and coded using the International Classification of Diseases, 10th Revision (ICD-10), allowing for assessment of the clinical appropriateness of transfusions within our analysis.

Strict confidentiality protocols were followed, with all patient identifiers removed. Ethical approval for the study was obtained from the Institutional Review Committee of the Institute of Medicine, Maharajgunj (Ref no. 396-611).

Statistical analysis was done with IBM SPSS Statistics v20. Descriptive statistics including means, medians, and frequency distributions, were used to characterize utilization patterns, while line graphs illustrated temporal variations.

RESULTS

A total of 16,334 (7500, 45.9% male and 8834, 54.1% female) patients requests for blood products were received; out of which 15012 (6845 male and 8167 female) were from inside the hospital and 1322 (655 male and 667 female) were from outside the hospital.

The patients requesting blood products from within TUTH were older (mean age 40.3 years, SD=20.48) compared to those from other centers (mean age 31.0 years, SD=25.14). Both group of patients exhibited a broad age distribution; however, notable age group variations existed with maximum requisitions from age group >20-30 years (Table 1).

Table 1. Age Distribution of Patients Requesting Blood Products.

Age Group	TUTH (n = 15012)	Other Centers (n = 1322)
Neonates	94 (0.6%)	93 (7.0%)
>0.1 up to 1	205 (1.4%)	98 (7.4%)
>1 up to 10	597 (4.0%)	203 (15.4%)
>10 up to 20	1395 (9.3%)	115 (8.7%)
>20 up to 30	3558 (23.7%)	214 (16.2%)
>30 up to 40	2420 (16.1%)	141 (10.7%)
>40 up to 50	1916 (12.8%)	118 (8.9%)
>50 up to 60	1914 (12.7%)	131 (9.9%)
>60 up to 70	1608 (10.7%)	107 (8.1%)
>70 up to 80	933 (6.2%)	68 (5.1%)
>80	372 (2.5%)	34 (2.6%)

There were total 27,571 requests for blood and blood products to the blood bank, out of which 25,716 (93.3%) were from inside the hospital and 1855 (96.7%) were from other centers.

The most requested blood group was A positive (30%) and O positive (30%) followed by B positive (26%), while A negative (1%), B negative (1%), and AB negative (<1%) were the rarest(Table 2). On comparison of blood product requests and transfusions by blood group across TUTH and other centers, a similar pattern of blood group distribution was seen in both requested and transfused units with blood groups A+ and O+ as the commonest blood groups.

Table 2. Blood Product Requests and Transfusions by Blood Group.

Blood Group	TUTH Requests (n=25716)	TUTH Transfusions (n=11990)	Other Centers Requests (n=1855)
A+	8089 (31.4%)	3827 (31.9%)	534 (28.8%)
B+	6843 (26.6%)	3264 (27.2%)	478 (25.8%)
O+	7851 (30.6%)	3536 (29.5%)	554 (29.9%)
AB+	2331 (9.1%)	1103 (9.2%)	202 (10.9%)
A-	149 (0.6%)	70 (0.6%)	31 (1.7%)
B-	196 (0.8%)	86 (0.7%)	17 (0.9%)
O-	221 (0.9%)	94 (0.8%)	35 (1.9%)
AB-	36 (0.1%)	10 (0.1%)	4 (0.2%)

Whole blood (TUTH: 11358 units, Other Centers: 945 units) and packed red blood cells (TUTH: 9565 units,

Other Centers: 508 units) were the most frequently requested products across all facilities (Table 3). Fresh frozen plasma, platelets, and fresh whole blood also saw moderate demand. Cryoprecipitate remained the least requested component at both TUTH (54 units) and other centers (0 units).

Table 3. Blood and blood Product Request pattern.

Blood Product	TUTH (n=25716)	Other Centers (n=1855)	Total (n=27,571)
Whole Blood	11358 (44.2%)	945 (50.9%)	12303 (44.6%)
Packed Red Blood Cells	9565 (37.2%)	508 (27.4%)	10073 (36.5%)
Fresh Frozen Plasma	2019 (7.9%)	190 (10.2%)	2209 (8.0%)
Platelet Rich Plasma	1400 (5.4%)	103 (5.6%)	1503 (5.5%)
Platelet Concentrate	503 (2%)	7 (0.4%)	510 (1.8%)
Fresh Whole Blood	817 (3.2%)	102 (5.5%)	919 (3.3%)
Cryoprecipitate	54 (0.2%)	0 (0%)	54 (0.2%)

Despite being in high demand, only 26.9% (3058 units) of requested whole blood and 48.8% (4668 units) of packed red blood cells were ultimately transfused. Despite their moderate demand, 98.1% of requested FFP, 98.7% of PRP and 99.6% of platelet concentrates were transfused. Overall transfusion proportion out of requested blood products was 46.6% (11990/25716) inside TUTH.

Table 4. Blood and blood Product transfusion pattern inside TUTH.

Blood Product	TUTH (n=25,716)	Transfused (n=11,990)	Transfused proportion
Whole Blood	11358 (44.2%)	3058 (25.5%)	26.9 %
Packed Red Blood Cells	9565 (37.2%)	4668 (38.9%)	48.8 %
Fresh Frozen Plasma	2019 (7.9%)	1981 (16.5%)	98.1 %
Platelet Rich Plasma	1400 (5.4%)	1382 (11.5%)	98.7 %
Platelet Concentrate	503 (2%)	501 (4.2%)	99.6 %
Fresh Whole Blood	817 (3.2%)	350 (2.9%)	42.8 %
Cryoprecipitate	54 (0.2%)	50 (0.4%)	92.6 %

Blood product requests and transfusions at both TUTH and other centers exhibited considerable month-to-month variations (Figure 1). TUTH displayed peak requests in December (2742 units) and November (2419 units), with a trough in June (1947 units). Other centers followed a less pronounced pattern, with a smaller peak in Dec (205 units) and July (189 units); and a low point in June (90 units). (Figure 2).
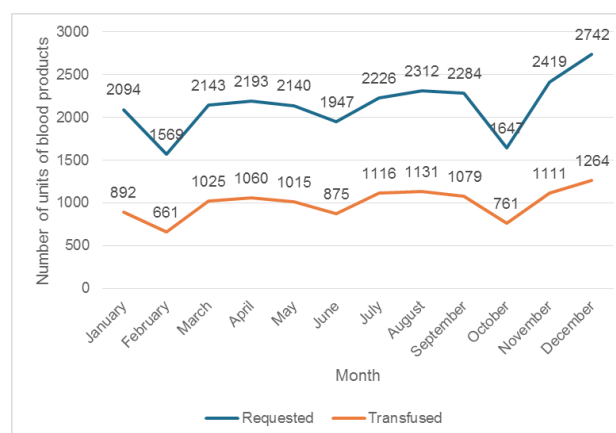

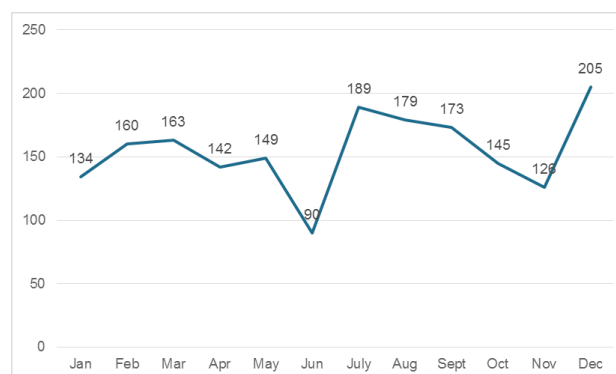**Figure 1.Trend in Blood Products Request and Transfusion in TUTH.**

Figure 2. Trend in Blood Products Request in other centers.

DISCUSSION

Our analysis of blood product utilization patterns in a major tertiary care center of Nepal and a network of other healthcare centers, showed an observed age discrepancy between TUTH (tertiary center, mean 40.3 years) and other healthcare facilities (mean 31.0 years), which likely reflects the differing case complexities and patient populations treated across various levels of care. As a major referral center, TUTH likely manages a higher proportion of chronic conditions like Chronic Kidney Disease (CKD) and age-related complications associated with increased transfusion requirements.[6] Conversely,

the younger demographics at other centers could result from several factors. Limited access to specialized pediatric services might drive families to seek care at tertiary centers.[7] Alternatively, a focus on primary and preventative care at smaller centers could attract a generally younger, healthier patient pool. [7] Comparing discharge diagnoses linked to transfusions across all sites, while controlling for age group, would elucidate these underlying dynamics.

The blood group distribution (predominance of A+, B+, O+) aligns with reported frequencies across Asian and Nepalese populations, [8-10] emphasizing shared genetic ancestry. This consistent pattern suggests that current blood collection practices adequately cater to most of the Nepali population's needs.[11] However, exploring regional variations in blood type distribution and implementing targeted donor recruitment campaigns could optimize inventory management . This is particularly important for rarer blood types or in geographically diverse regions where needs may differ.[11]

During blood transfusion, various blood products can be used as replacement therapy for their specific therapeutic purposes; RBC transfusions to improve tissue oxygenation while FFP, platelets and cryoprecipitate are mainly used for prevention and management of bleeding. [12]

The predominant use of whole blood and packed red cells across all sites are similar to findings in an earlier study in Nepal [13] and India ,[14] other parts of the world , [15] which emphasizes their versatility in managing various acute and chronic conditions requiring volume replacement or oxygen-carrying capacity enhancement . [3] The moderate demand for fresh frozen plasma and platelets further highlights the essential role of these components in coagulopathies, oncologic support, and massive transfusion protocols (2).[2] Interestingly, the near-absence of cryoprecipitate utilization could signify several factors: limited awareness of its applications, a lack of clear clinical guidelines for its use, or infrequent encounter of conditions necessitating fibrinogen replacement . [2] Increased education and research on the appropriate indications for cryoprecipitate could be beneficial.

TUTH's substantially higher blood product consumption corroborates its position as a major tertiary care hub, managing a high proportion of complex cases requiring multi-component transfusion support. This finding resonates with studies from other countries demonstrating elevated product demands at advanced healthcare facilities. [16,17] The observed higher utilization at governmental centers compared to non-governmental

ones outside of TUTH could stem from socioeconomic disparities, with underprivileged populations seeking care at subsidized public governmental institutions. [6] Additionally, it's worth exploring whether referral biases exist, with government centers potentially receiving a disproportionate number of complex cases requiring transfusions compared to non-governmental facilities.

The significant monthly fluctuations in both requests and transfusions, particularly pronounced at TUTH, underscore the dynamic nature of blood product demand (2). [2] Peaks during winter months (November-December) could relate to increased infectious disease burden or elective procedure scheduling, while troughs in warmer periods might reflect seasonal variations in disease epidemiology or changes in healthcare-seeking behaviors (2). [2] These patterns highlight the necessity for responsive blood inventory management strategies to ensure seamless availability throughout the year.

Furthermore, the observed potential seasonality, as evidenced by the non-uniform quarterly distribution of requests, warrants further investigation. Factors such as climatic conditions, cultural practices, or population mobility could influence transfusion needs across different periods.[2,18] Incorporating meteorological data and exploring the underlying reasons for seasonal variations could aid in developing anticipatory measures to meet fluctuating demands effectively.

The congruence between the blood group distributions of requested and transfused units at TUTH suggests that transfusion practices generally align with the natural frequencies within the patient population. However, a more in-depth analysis linking blood groups to specific diagnoses could uncover potential discrepancies or over-utilization patterns for certain blood type.[19] Understanding the specific conditions driving demand for each blood group would allow for more targeted blood collection drives addressing local needs.

Moreover, exploring factors influencing blood donation behaviors and motivations within the Nepali population could guide the development of tailored recruitment strategies. Addressing potential cultural, logistical, or educational barriers could enhance donor engagement and ensure a sustainable blood supply to meet evolving healthcare needs.

While our study provides a comprehensive overview of blood product utilization across various healthcare settings in Nepal, certain limitations should be acknowledged. The incomplete clinical diagnosis data, hinders a thorough

assessment of transfusion appropriateness and linkage to specific medical conditions. Future studies incorporating discharge diagnoses could yield valuable insights into optimizing judicious blood product use. Additionally, department-wise breakdowns (medical, surgical, or ancillary such as radiology and pathology) can be done for precise analysis of utilization patterns. Further studies can be done to explore the reasons for any units issued but not transfused e.g. wastage due to expiry, changes in patient condition to assess potential efficiency gaps.

CONCLUSIONS

The most commonly requested blood products were from Blood groups A positive and O positive. Though whole blood was the most frequently requested blood product, packed red blood cells was the most transfused one. Peak demand for blood products was observed in December. Our analysis of blood product utilization in Nepal highlights key disparities between tertiary and other healthcare facilities, influenced by patient demographics and potential socioeconomic factors. Further research in utilization of blood and blood products consumption integrating clinical diagnoses is crucial to inform policies promoting judicious transfusion practice and safeguarding blood supply across Nepal's healthcare system.

CONFLICT OF INTEREST

Authors declare no conflict of interest

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