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Cross Sectional Study on the Pattern of Blood Utilization and Quality Indicators at a Tertiary Care Hospital in Karnataka

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ABSTRACT

Background: Blood transfusion services are vital for medical care but require efficient use to ensure patient safety and optimal resource utilization. Quality indicators such as the crossmatch-to-transfusion ratio (C/T), transfusion probability (%T), and transfusion index (TI) help to monitor and improve utilization efficiency. **Aim:** To assess the pattern of blood component utilization and assess quality indicators across various departments in a tertiary care hospital in Karnataka. **Materials & methods:** This retrospective cross-sectional study analyzed transfusion records from January 2023 to December 2024 at the Department of Immunohematology and Blood Transfusion, Victoria Hospital, Bangalore Medical College and Research Institute. Data on patients, units crossmatched, issued and transfused were collected, and C/T ratio, %T, and TI were calculated for each department. **Results:** A total of 21,156 PRBC units were crossmatched, and 15,692 units were transfused. The overall C/T ratio, %T, and TI were 1.34, 76.76%, and 0.98, respectively. Efficient utilization (C/T $\leq$2.5, %T $\geq$30%, TI $\geq$0.5) was observed in most departments, including Burns, Gastroenterology, Nephro-Urology, and General Medicine. Over-ordering of blood was noted in General Surgery followed by Trauma & Emergency Care Centre. **Conclusion:** Overall utilization was efficient, but certain departments demonstrated over-ordering. Implementation of Maximum Surgical Blood Ordering Schedule (MSBOS), Type-and-Screen (T&S) policy, and Institutional transfusion guidelines is recommended to further optimize utilization. Proper communication between the department of Transfusion medicine and other departments as well as regular auditing is necessary to prevent wastage of blood and resources.

INTRODUCTION

Blood transfusion is a critical component of modern medical care, with applications spanning trauma management, major surgeries, obstetric care, haematological disorders, and critical illnesses. As a scarce and costly therapeutic resource, its judicious use is imperative to ensure patient safety, optimize resource utilization, and maintain an adequate blood supply. Inappropriate or excessive transfusions may expose patients to transfusion-related risks such as transfusion reactions, alloimmunization, transfusion-transmitted infections (TTIs), and transfusion-related immunomodulation, while also increasing healthcare costs and straining blood inventories [1,2].

To promote rational blood use, several international and national bodies, including the World Health Organization (WHO), Association for the Advancement of Blood and Biotherapies (AABB), and National AIDS Control Organisation (NACO), advocate evidence-based transfusion practices, component therapy, and regular transfusion audits [3,4]. AABB defines quality indicators as the specific performance measurements designed to monitor one or more processes during a defined time and are useful for evaluating service demands, adequacy of personnel inventory control, and process stability [5]. Auditing blood utilization patterns using objective quality indicators-such as Crossmatch-to-Transfusion (C/T) ratio, Transfusion probability

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(%T), Transfusion index (TI), and wastage rateshas been shown to be an effective strategy for monitoring efficiency and identifying areas for improvement [6,7].

Based on the literature, over-ordering of blood in developing countries ranges from 40% to 70% among patients receiving transfusions [8]. In India, patterns of blood utilization vary according to regional disease burden, surgical workload, hospital type, and institutional transfusion policies. In a recent study done at Madhya Pradesh, the Overall C/T ratio was 1.39 showing efficient blood utilization [9]. In another study done at Bhubaneswar, the C/T ratio was 6.23 indicating gross over-ordering of blood and inefficient utilization [10].

The present study was undertaken to analyze the blood utilization pattern and evaluate key quality indicators in our hospital. The results are expected to provide valuable insights into transfusion practices, highlight opportunities for improving blood usage efficiency, and contribute to strengthening transfusion safety in similar healthcare settings.

AIMS & OBJECTIVES

The objective of this study was to assess the pattern of utilization of blood components using quality indicators and to assess the efficient utilization of blood across various departments at a tertiary care hospital in Karnataka.

MATERIALS AND METHODS

The current study was a retrospective, Cross sectional study done during the period of January 2023 to December 2024 (2 years) at the Department of Immunohematology and Blood Transfusion, Victoria Hospital, Bangalore Medical College and Research Institute. The study was started after obtaining approval and clearance from our Institutional Ethics Committee. Data collection was done retrospectively from previous records and registers such as requisition forms for blood, crossmatch and issue registers during the study period. The total number of patients, units cross matched, units issued and transfused were evaluated among the different surgical and medical departments in our hospital. The following quality indicators were calculated as follows:[11]

1. Crossmatch transfusion ratio (C/T ratio) =

Total number of units cross matched

Total number of units transfused

A value of **2.5 and below** indicates significant blood usage

2. Transfusion probability (T%) =

Total number of patients transfused x 100

Total number of patients cross matched

Value of **30% and above** indicates significant blood usage.

3. Transfusion index (TI) =

Number of units transfused

Number of patients cross matched

Value of **0.5 or more** indicates significant blood usage.

STATISTICAL ANALYSIS

Data about the number of patients, units cross matched, units issued and transfused among the different departments were recorded in the standardized Microsoft excel format. The data was analyzed by descriptive statistics such as ratios and percentages and expressed in the form of tables and graphs.

RESULTS

During the study period, 17043 whole blood units were collected. 21156 PRBC units were crossmatched, out of which 15692 units were transfused. Table 1 shows the blood component utilization pattern among different departments in our hospital.

Table 1: Blood Utilization Pattern and Quality Indicators Among Different Departments

Department	No of Patients Crossmatched	No of Patients Transfused	Units Crossmatched	Units Transfused	C: T Ratio	T%	TI
General Medicine	3708	3402	4944	4420	1.11	91.74	1.19
General Surgery	2138	626	2850	040	**2.74**	**29.27**	**0.48**
Obstetrics & Gynaecology	3880	3006	5164	3856	1.33	77.47	0.99
Paediatrics	1892	1696	2522	1852	1.36	89.64	0.97
Orthopaedics	618	556	826	680	1.21	89.96	1.10
Nephro-Urology	1092	1006	1458	1350	1.08	92.12	1.23
Gastroenterology	1182	1054	1576	1460	1.07	89.17	1.23
Trauma & Emergency Care Centre (Tecc)	1008	496	1344	590	**2.20**	**49.20**	**0.58**
Burns	354	342	472	444	1.06	96.61	1.25
Total	**15872**	**12184**	**21156**	**15692**	**1.34**	**76.76**	**0.98**

Maximum number of units crossmatched was for the department of Obstetrics and Gynaecology followed by General Medicine. The overall C/T ratio, transfusion probability and transfusion index were 1.34, 76.76% and 0.98 respectively in our study. There was efficient blood utilization by the department of Burns, Gastroenterology, Nephro-Urology and General Medicine. Over-ordering of blood was seen in the General Surgery department [C/T – 2.74, T% - 29.27%, TI – 0.48] followed by Trauma and Emergency Care Centre (TECC) [T% - 49.20%].

DISCUSSION

The effective utilization of blood and its components, ensuring high quality and minimal wastage, constitutes the primary objectives of blood utilization management [12]. Continuous monitoring facilitates the provision of safe blood and blood products to patients in need, thereby preventing the overutilization of this limited resource especially in developing countries like India [13].

While numerous quality indicators exist for effective blood utilization, this study focused solely on three specific indicators: the C:T ratio, Transfusion Index and Transfusion probability %. A CT ratio of 2.5 or less, a Transfusion probability of 30% or greater, and a TI > 0.5 are deemed indicative of efficient blood utilization [7]. The C:T ratio is frequently utilized as a measure to assess the efficiency of blood ordering practices. C:T ratio >2.0 indicates that fewer than 50% of cross-matched units are transfused [14]. T% indicates the appropriateness and significance of the transfusion ordered by the department. TI represents the average number of units utilized per patient that has been cross-matched, and it assesses the appropriateness of the number of units requested [8].

The overall quality indicators in our study (C/T ratio - 1.34, % T - 76.76%, TI - 0.98) indicate efficient utilization of blood components, exceeding WHO and AABB-recommended thresholds for significant usage [1,4,6].

Table 2: Comparison with Other Studies

Study	C: T	T%	TI
Trisal M et al [15]	1.4	68.3	1.2
Mondal B et al [16]	1.27	67.52	0.92
Kaur D, Kandwal M [7]	1.57	79	1.18
Remakanth R, Abhishekh B [6]	1.57	79	1.18
Present study	1.34	76.76	0.98

Table 2 shows that the findings observed in the current study were similar to other studies done at different parts of India.

Department-wise analysis revealed variation in efficiency. Burns, Gastroenterology, Nephro-Urology, and General Medicine achieved excellent utilization metrics, comparable to high-performing units in previous Indian audits [7,10]. However, General Surgery and Trauma/Emergency services showed over-ordering, as reflected by elevated C/T ratios and low TI. Similar patterns have been reported by Raghuwanshi et al. [10], where surgical specialities demonstrated C/T ratios as high as 6.23, leading to unnecessary inventory locking and potential wastage.

The high %T in our study suggests strong alignment between crossmatching and actual transfusion needs in most areas, contrasting with earlier Indian studies where %T was below 50% in several departments [8, 9]. These improvements may reflect increasing adoption of component therapy, improved clinician awareness, and better inventory management.

Persistent over-ordering in surgical and emergency services was due to the absence of a locally adapted MSBOS and reliance on precautionary crossmatching for anticipated blood loss. Literature supports that implementing MSBOS and T&S protocols reduces unnecessary crossmatching, shortens turnaround times, and maintains transfusion safety [7].

By applying Mead's criterion (MSBOS=1.5×TI), it can be structured to minimize wastage [17]. AABB and NACO guidelines also emphasize integrating transfusion medicine specialists into perioperative planning to curb over-ordering and ensure evidence-based use [3,4]. Patient Blood Management (PBM) strategies, including the assessment of the appropriateness of transfusion orders and subsequent discussions with the clinical team, the utilization of pharmaceutical products such as intravenous iron and vitamin K, as well as blood-sparing techniques during surgical procedures like acute normovolemic haemodilution or the application of cell salvage, can be effectively implemented [18].

Our findings reinforce the value of regular transfusion audits as a quality assurance measure, enabling targeted feedback to clinical departments. Such continuous monitoring can help maintain efficient utilization, minimize wastage, and align institutional practices with national and international standards.

CONCLUSION

The overall blood component utilization practices were significant at our blood centre. However, over-ordering persists in certain surgical and emergency care settings, highlighting the need for targeted interventions.

Management of patients should be evidence based for efficient blood utilization. Maximal Surgical Blood Ordering Schedule (MSBOS) and Type and Screen (T&S) protocol should be implemented in the case of elective surgeries. Institutional protocols on transfusion guidelines should be implemented. Proper communication between the Transfusion medicine specialists and other departments as well as regular auditing is necessary to prevent wastage of blood and resources.

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