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Assessment of blood usage pattern by analyzing blood utilization indices at blood center: A cross-sectional study

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Abstract

Introduction: Blood banks must be able to supply life-saving products efficiently. Simultaneous analysis of the patterns in the ordering of blood units is important to ascertain how frequently patients need blood. Blood consists of both cellular and plasma components, which have their own significance. RBCs, WBCs and Platelets make up the cellular portion. Plasma is fluid portion and 92% of it is only water with the remaining 8% being plasma proteins and coagulation factors.

The aim of study was to assess blood usage patterns by analysing blood utilization indices (BUI).

Methodology: Study was cross sectional study carried out at blood centre, Department of Pathology, RMCH, Bareilly, UP for one year (august 2023 to July 2024)

- C/T ratio = total no. of units cross-matched / total no. of units transfused.
  - Ideally this ratio should be 1.0
  - Value 2.5 and less indicate significant blood usage.
- Transfusion index (TI) = No. of units transfused / No. of patient cross-matched
  - Value 0.5 or above indicates of significant use of blood
- Transfusion probability (T%) = Number of patient transfused / Number of patient cross-matched X 100
  - Value 30% and more is indicative of significant use of blood

Result: A total of 3,888 transfusion requests were sent by various departments for the duration of 1 year from 1 August 2023 to 31 July2024 at blood centre, in medical college in UP.

Maximum cases from age 21 to 30 years of age group. Maximum patient receiving blood were female 51.70% followed by male 48.30%. Maximum cases were of blood group B+ (36.19%) followed by O+ (29.22%). Least cases of requests were of blood group AB+ (0.15%). PRBC CT ratio across departments indicate efficient utilization of PRBC units. Medicine (1.01), Oncology (1.01), Chest and TB (1) and ENT (1) had most optimal ratios. Transfusion probability (TP) reflects percentage of cross-matched patients who were transfused, highlighting efficiency of cross-matching practices. Casualty had highest TI (1.67). Oncology (1.43), Surgery (1.44), Orthopedics (1.47) and OBG (1.45) also demonstrated high efficiency.

Conclusion: The current study provides data on blood unit utilization at tertiary care hospital by using transfusion quality metrics, such as transfusion index, transfusion probability and C/T ratio showed effective blood use.

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Keywords: Blood; C/T ratio; Transfusion index; Transfusion probability

1. Introduction

Blood Transfusion is vital component of modern medical treatment because despite significant advancement in medical technology over years, there is still no blood substitute available.[1]

Blood consists of both cellular and plasma components, which have their own significance. RBCs, WBCs and Platelets make up the cellular portion. Plasma is fluid portion and 92% of it is only water with the remaining 8% being plasma proteins and coagulation factors.[2] The cross match to transfusion (C/T) ratio was initially used by Boral and Henry in the 1970s. They considered normal blood consumption if the ratio was 2.5:1 or below, while 1.0 (all cross-matched blood is transfused) would be ideal. The transfusion probability (TP) for a certain treatment was developed by Mead et al., in 1980. It was calculated by dividing the number of patients who had transfusions by the number of patients who were cross-matched times 100. A blood request and use rate of at least 30% was deemed appropriate. The Transfusion Index (T I), which shows the average number of units needed per patient when cross-matched, is an additional metric. A successful utilization of blood is indicated by a number of 0.5 or greater. It indicates whether the quantity of cross-matched units is appropriate.[3] Blood banks must be able to supply life-saving products efficiently. Simultaneous analysis of the patterns in the ordering of blood units is important to ascertain how frequently patients need blood. The aim of study was to assess blood usage patterns by analysing blood utilization indices (BUI).

2. Methodology

Study was cross sectional study carried out at blood centre, Department of Pathology, RMCH, Bareilly, UP for one year (august 2023 to July 2024)

2.1. Inclusion Criteria

All transfusion requests made by clinicians from different wards of the hospital, irrespective of age and gender.

2.2. Exclusion Criteria

- Proforma with incomplete and improperly filled details on blood transfusion was excluded.
- Blood bags issued for the patients who were not admitted in RMCH.

2.3. Data collection

From collected data, the following quality indicators, to evaluate the appropriateness of blood and blood components utilization were calculated as:

- C/T ratio[4] = total no. of units cross-matched / total no. of units transfused.
    - Ideally this ratio should be 1.0
    - Value 2.5 and less indicate significant blood usage.
- Transfusion index (TI)[4] = No. of units transfused / No. of patient cross-matched
    - Value 0.5 or above indicates of significant use of blood
- Transfusion probability (T%)[4] = Number of patient transfused / Number of patient cross-matched X 100
    - Value 30% and more is indicative of significant use of blood

The presentation of the Categorical variables was done in the form of number and percentage (%). The Statistical Package for Social Sciences (SPSS) software, manufactured by IBM in Chicago, USA, version 25.0, was used to do the final analysis after the data was entered into a Microsoft Excel spreadsheet.

3. Result

A total of 3,888 transfusion requests were sent by various departments for the duration of 1 year from 1 August 2023 to 31 July 2024 at blood centre, in medical college in UP.

Figure 1 shows age distribution of the cases. Maximum cases are in the age group 21- 30 years (20.16%) followed by age group 41-50 years (17.93%) followed by age group 31-40 years (17.64%). Least frequency of blood component usage was > 80 years of Age.

Maximum patient receiving blood were female 51.70% followed by male 48.30%.

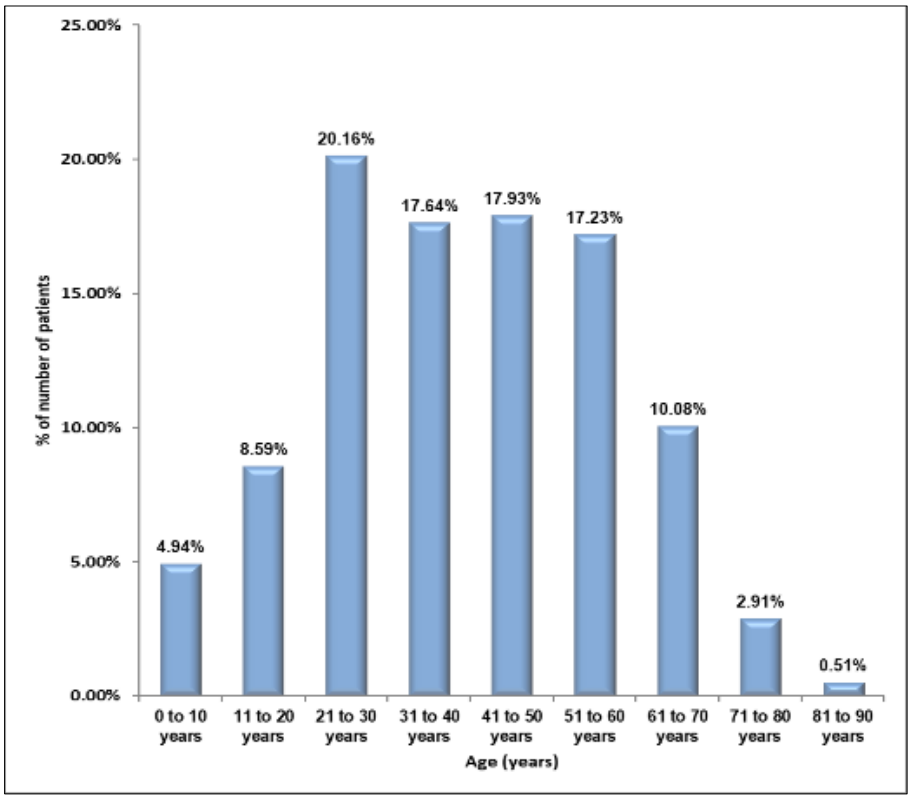

Figure 1 Age wise distribution of cases

Maximum cases were of blood group B+ (36.19%) followed by O+ (29.22%). Least cases of requests were of blood group AB+ (0.15%).

Figure 2 showed Department wise distribution of CT ratio**.** PRBC CT ratio across departments indicate efficient utilization of PRBC units. Medicine (1.01), Oncology (1.01), Chest and TB (1) and ENT (1) had most optimal ratios. Surgery and Orthopedic departments showed slightly higher ratios at 1.04, while ICU, Casualty and Pediatric departments recorded 1.03 and OBG had highest ratio at 1.11. Overall, 4724 units were cross-matched, 4581 were transfused, with overall ratio of 1.03.

Figure 3 showed Department wise distribution of Transfusion probability**.** Transfusion probability (TP) reflects percentage of cross-matched patients who were transfused, highlighting efficiency of cross-matching practices. Chest and TB (100%) and ENT (100%) achieved perfect efficiency, with all cross-matched patients receiving transfusions. Oncology (99.74%), Casualty (99.47%) and Medicine (99.41%) also demonstrated excellent utilization. Orthopedics (97.73%), Pediatrics (97.52%), ICU (97.03%) and Surgery (97.21%) showed very good efficiency. OBG had lowest TP (89.33%). Overall transfusion probability was 97.69.

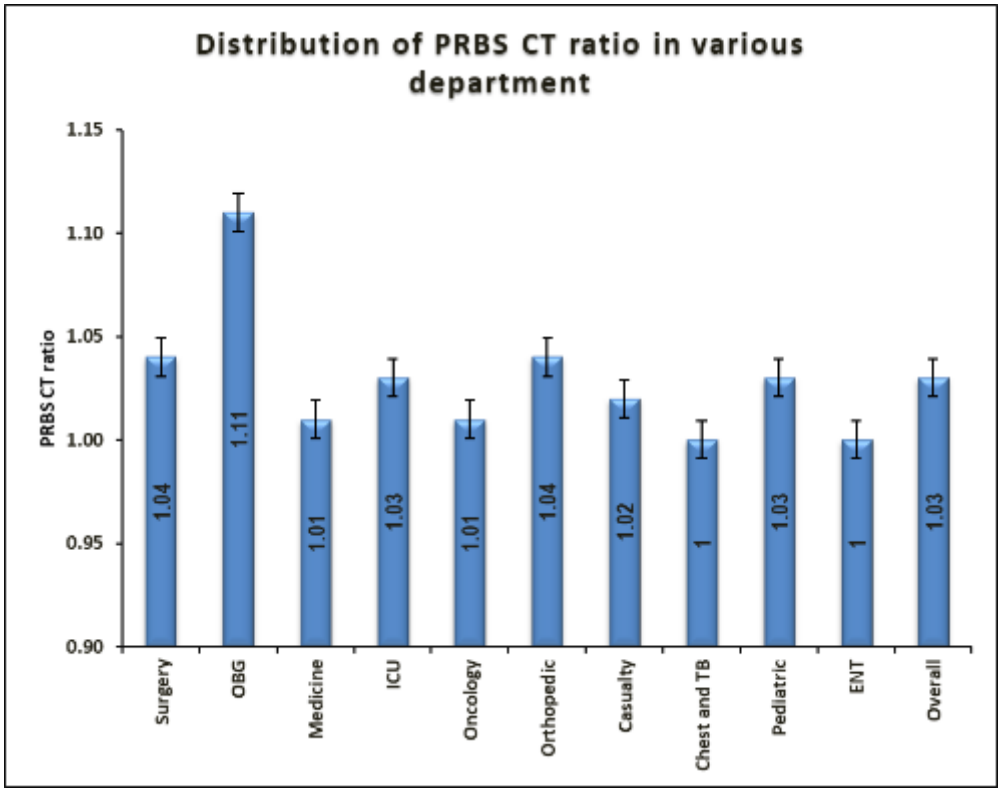

Figure 2 Department wise distribution of CT ratio

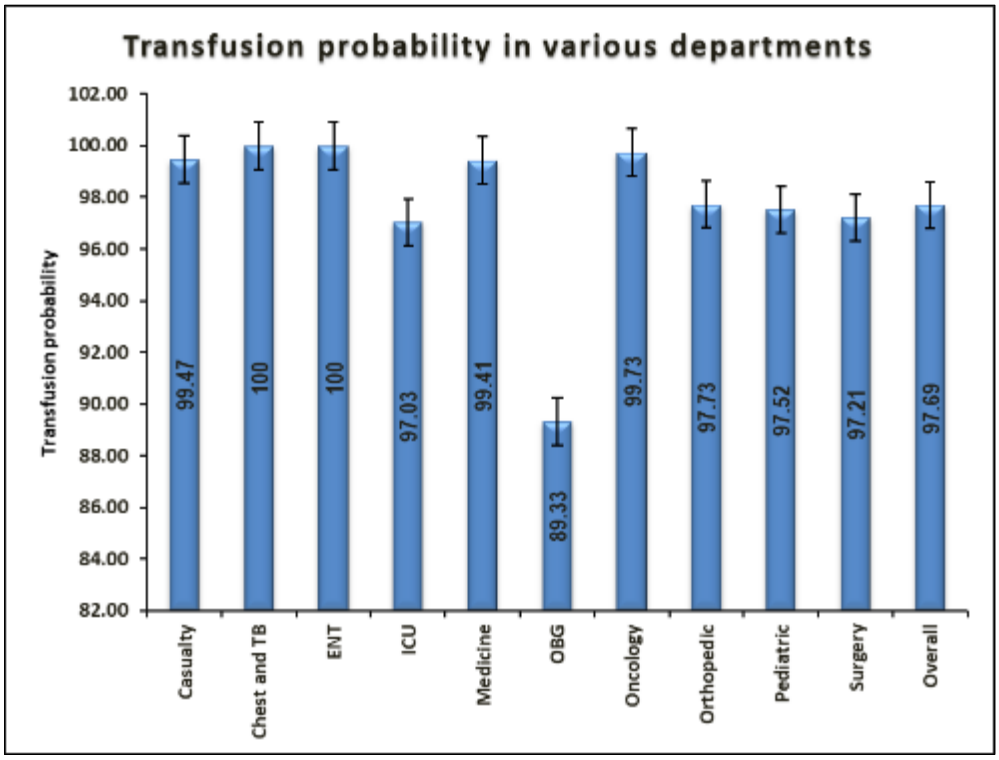

Figure 3 Department wise distribution of Transfusion probability

Figure 4 showed Departments wise distribution of Transfusion index**.** Transfusion index (TI) reflects average number of units transfused per cross-matched patient. Casualty had highest TI (1.67). Oncology (1.43), Surgery (1.44), Orthopedics (1.47) and OBG (1.45) also demonstrated high efficiency. ICU and Medicine both had TI of 1.35. Moderate efficiency was observed in Chest and TB (1.20), ENT (1.15) and Pediatrics (1.09). Overall transfusion index was 1.41.

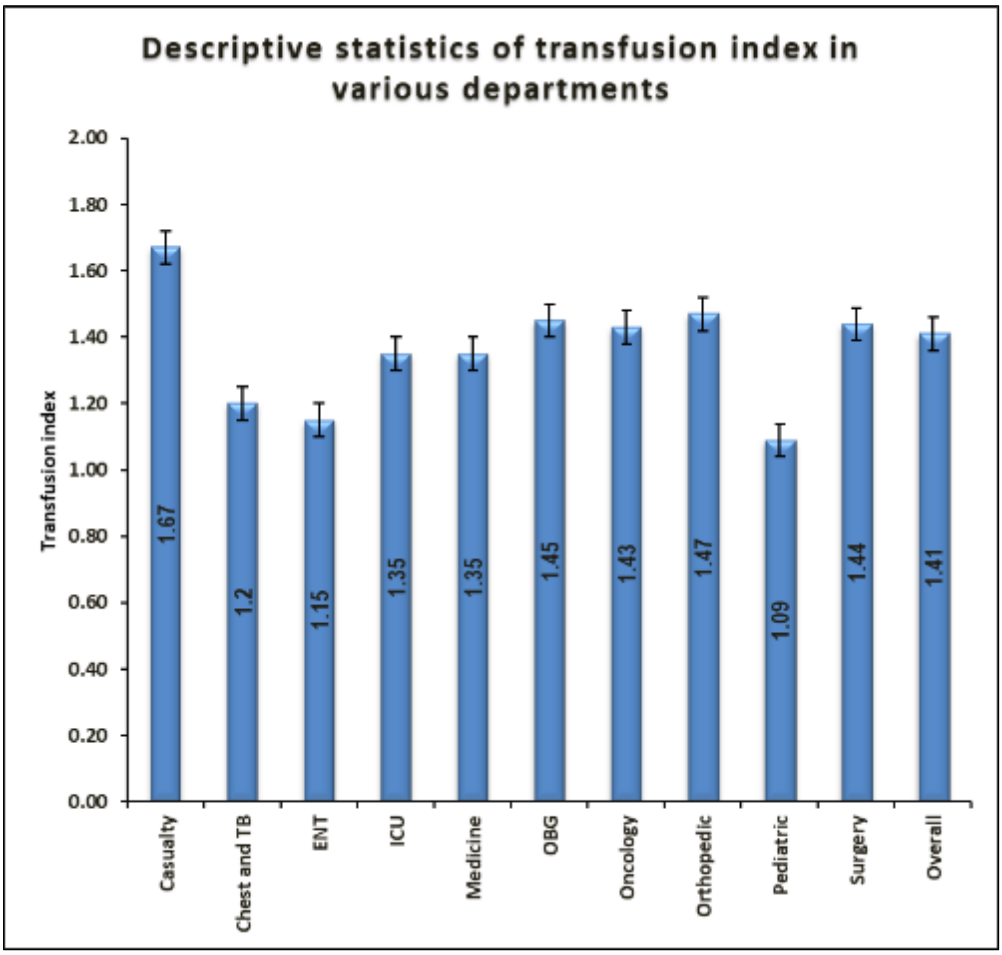

Figure 4 Departments wise distribution of Transfusion index

4. Discussion

In our study, majority of the blood units were utilized among 21 to 70 years with mean age 40.31 +- 18.1 years. Maximum blood units were utilized in 21 to 30 years (20.16%) and least were 81 to 90 years (0.51%). Youngest recipient was 1 day old and oldest recipient was 90 years old. Our study was concordant with the study done by Kumar S *et al*.[1] in which majority of blood units were utilized among 21 to 30 years (38.9%) and least were > 85 years (0.6%) Similarly in other study conducted by Katkoria SK *et al*.[5] found that 27.1% of the recipient study were between 13 to 30 years of age and elderly aged (>50years) patients received 1306 units of blood which constituted 21.7%% of total request.

In our study duration, requests of blood units were slightly more in females (51.70%) compared to males (48.30%), for indication mainly due to obstetrics reasons in female. Our study was concordant with the study of Giriyan SS *et al*.[6] in which majority of transfusion recipient were female (61.8%) followed by male (38.2%). In a study done by Hulwan AB *et al*.[7] shows that there were 55.56% male and 44.44% female recipient of blood and blood components.The result were discordant with our study.

In our study, most common blood group supplied was "B" positive blood group had maximum frequency (35.19%) followed by "O" positive blood group (29.22%) and least were "AB" negative (0.15%) which was similar to the distribution of most common blood group in the area. Our study was concordant with the study conducted by Katkoria SK *et al*.[5] that showed most common blood group for which blood was issued "B" positive (30.84%) and least were "AB" negative (0.68%). In a study done by Halwan AB *et al*. [7] maximum blood group was "O" positive (30.26%) and least used blood group was "AB' negative (0.28%) which was discordant with our study.

Ideal C/T ratio should be 1. However, Cross match transfusion ratio below 2.5 is acceptable. Our study demonstrates efficient blood usage as our overall Cross match transfusion ratio has been measured 1.03.

Table 1 Overall CT ratio in other studies

Studies	Ct ratio
Devi KM *et al*.[8]	1.02
Kaur D *et al*.[9]	1.57
Tadesse B *et al*.[10]	2.3
Present study	1.03

A value of 30% and higher for transfusion probability has been recommended as appropriate. The overall transfusion probability calculated in the current study was 97.69% which is dependent on the number of patients transfused as against the number of patients crossmatched.

Table 2 Overall Transfusion Probability in other studies

Studies	Transfusion Probability (%)
Devi KM *et al*.[8]	97.2
Kaur D *et al*.[9]	79.0
Tadesse B *et al*.[10]	47.0
Present study	97.69

The appropriate number of cross-matched blood units is indicated by the transfusion index. A number of 0.5 or higher indicates effective blood use. Transfusion index of our study is1.41. This signifies overall efficient and appropriate blood usage of our hospital.

Table 3 Overall Transfusion index in other studies

Studies	Transfusion index
Devi KM *et al*.[8]	0.97
Kaur D *et al*.[9]	0.79
Tadesse B *et al*.[10]	0.77
Present study	1.41

5. Conclusion

The current study provides data on blood unit utilization at tertiary care hospital by using transfusion quality metrics, such as transfusion index, transfusion probability and C/T ratio showed effective blood use. This will prove to be helpful in cost analysis, transfusion procedure quality monitoring, the organization of local and regional blood donation campaigns as well as displaying the trend in the use of blood units. Periodically monitoring of blood usage is necessary to prevent misuse or overuse, that can lead to blood shortage. Being aware of these factors promotes a transfusion procedure that is both safe and affordable.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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