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A Cross-Sectional Study on Efficacy and Utilization of Blood Components in 18–40 Years Age Group Adult Patients Admitted Under the Intensive Care Unit of a Tertiary Care Centre, Purba Medinipur

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ABSTRACT

Background: Blood component therapy is a cornerstone of modern critical care. Appropriate utilisation of packed red blood cells (PRBCs), fresh frozen plasma (FFP), platelets, and cryoprecipitate directly impacts patient recovery and resource management in intensive care units (ICUs). However, irrational transfusion practices continue to pose a significant challenge in developing healthcare settings, including those in eastern India.**Objectives:** To assess the pattern and efficacy of blood component utilisation among adult patients aged 18–40 years admitted to the ICU of a tertiary care centre in Purba Medinipur, West Bengal.**Methodology:** A hospital-based cross-sectional study was conducted over six months. A total of 76 patients were enrolled using purposive sampling. Data were collected through structured proformas, patient records, and transfusion registers. Pre- and post-transfusion haematological parameters were recorded and analysed.**Results:** The majority of patients (55.3%) were males. The most commonly transfused component was PRBC (48.7%), followed by FFP (27.6%), platelets (15.8%), and cryoprecipitate (7.9%). Haemoglobin levels showed a statistically significant rise post-transfusion (pre: 6.8 ± 1.2

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g/dL; post: 9.4 ± 1.1 g/dL; $p < 0.05$). Platelet count and INR also improved significantly after transfusion of respective components.**Conclusion:** Blood component therapy was found to be

1clinically efficacious in the ICU setting. PRBCs were the most frequently utilised component. Rational and evidence-based transfusion practices should be promoted to improve patient outcomes and conserve blood resources.

Keywords: Blood components, efficacy, ICU, transfusion, cross-sectional study, Purba Medinipur, PRBC, FFP, platelets

1. INTRODUCTION

Blood transfusion is one of the most commonly performed therapeutic interventions in critically ill patients admitted to the Intensive Care Unit (ICU). In the age group of 18 to 40 years, adult patients with trauma, haematological disorders, obstetric emergencies, and sepsis frequently require blood component support as a life-saving measure[1]. The shift from whole blood transfusion to component therapy over the past few decades has revolutionised transfusion medicine, allowing each blood product to be used in a targeted manner for specific clinical indications.

In India, the demand for blood components is continuously rising owing to a growing burden of road traffic accidents, surgical interventions, obstetric complications, and haematological malignancies. The World Health Organisation (WHO) estimates that approximately 118.54 million units of blood are collected globally every year, of which developing nations account for only a small fraction in terms of voluntary donations. This creates an enormous gap between supply and demand, making rational utilisation of blood components an absolute necessity[2].

A tertiary care centre in Purba Medinipur, West Bengal, caters to a sizeable population from surrounding rural and semi-urban areas. The ICU at such an institution serves as the final referral point for critically ill patients, many of whom arrive in a haemodynamically compromised state necessitating urgent transfusion support. Despite the availability of standardised guidelines, transfusion practices often vary considerably based on clinical judgement, availability of components, and institutional protocols[3].

There is a paucity of published data on blood component utilisation patterns and their clinical efficacy, particularly from tier-two and tier-three health centres in eastern India. The present study was therefore undertaken to evaluate the pattern, adequacy, and clinical efficacy of blood component utilisation among young adult ICU patients aged 18 to 40 years. The findings are expected to provide a foundation for improving transfusion practices at the institutional level[4].

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2. OBJECTIVES 112

Primary Objective: To study the pattern of blood component utilisation (PRBC, FFP, platelets, and cryoprecipitate) in adult ICU patients aged 18–40 years admitted to a tertiary care centre in Purba Medinipur.

Secondary Objectives: (i) To assess the clinical efficacy of each blood component by comparing pre- and post-transfusion haematological parameters. (ii) To analyse the sociodemographic profile of transfused patients. (iii) To identify major clinical indications for transfusion in the ICU setting.

3. METHODOLOGY

Study Design: This was a hospital-based cross-sectional observational study.

Study Setting: The study was conducted at the Intensive Care Unit (ICU) and the Department of Transfusion Medicine of a tertiary care centre, Purba Medinipur, West Bengal, India.

Study Duration: Six months (October 2024 to March 2025).

Study Population: All adult patients aged 18–40 years admitted to the ICU who received at least one blood component during the study period.

Inclusion Criteria: Patients aged 18–40 years, admitted to the ICU, who received blood component transfusion with documented pre- and post-transfusion laboratory values, and whose consent was available (from patient or legally authorised representative).

Exclusion Criteria: Patients with incomplete records, those who did not receive any blood component, those aged below 18 or above 40 years, and patients or guardians who declined to participate.

3.1 SAMPLE SIZE CALCULATION

The sample size was calculated using the following standard formula for estimating a population proportion:

$$n = Z^2 \times P \times (1 - P) / d^2$$ Where:

n = required sample size

Z = 1.96 (Z-value at 95% confidence interval)

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P = estimated prevalence of blood component transfusion in ICU patients = 0.50 (50%, as no prior local data were available; this maximises sample size)

113 d = allowable margin of error = 0.10 (10%)

$$n = (1.96)^2 \times 0.50 \times 0.50 / (0.10)^2 = 3.84 \times 0.25 / 0.01 = 96.04 \approx 96$$

After accounting for potential dropouts (approximately 20%) and constrained feasibility within the six-month duration, the final sample size was fixed at 76 patients, which was also considered statistically adequate for a cross-sectional descriptive study.

3.2 SAMPLING METHOD

A purposive (criterion-based) sampling technique was employed. All patients who fulfilled the inclusion criteria and were admitted to the ICU during the study period were enrolled consecutively until the target of 76 was reached. This ensured that the sample was clinically relevant and representative of the ICU population receiving transfusions at the study centre.

3.3 DATA COLLECTION

Data were collected using a pre-designed, pre-tested structured proforma. Information gathered included patient demographics, primary diagnosis, type and number of blood components transfused, transfusion indication, pre-transfusion and post-transfusion haematological parameters (haemoglobin, platelet count, INR/PT), and any transfusion reactions observed. Data were sourced from patient case records, transfusion request forms, and blood bank issue registers.

Ethical Considerations: The study was approved by the Institutional Ethics Committee (IEC Ref No.: IEC/2024/XXX). Written informed consent was obtained from patients or their legally authorised representatives. Data confidentiality was maintained throughout.

Statistical Analysis: Data were entered in Microsoft Excel and analysed using SPSS version 25.0. Descriptive statistics (frequency, percentage, mean ± SD) were used for sociodemographic and clinical variables. The paired t-test was applied to compare pre- and post-transfusion haematological parameters. A p-value of < 0.05 was considered statistically significant.

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4. RESULTS

A total of 76 patients between 18 and 40 years of age who received blood component transfusion during their ICU admission were enrolled in this study. The findings are summarised below.

4.1 SOCIODEMOGRAPHIC PROFILE

The sociodemographic characteristics of the study participants are presented in Table 1.

Table 1: Sociodemographic Profile of Study Participants (n = 76)

Variable	Category	Number (n)	Percentage (%)
Sex	Male	42	55.3
	Female	34	44.7
Age Group (Years)	18–25	22	28.9
	26–30	20	26.3
	31–35	18	23.7
	36–40	16	21.1
Residence	Rural	48	63.2
	Urban	28	36.8
Education	Illiterate / Primary	30	39.5
	Secondary / Higher Secondary	28	36.8
	Graduate & Above	18	23.7
Occupation	Labourer / Farmer	25	32.9
	Homemaker	20	26.3
	Student	14	18.4
	Service / Business	17	22.4
Religion	Hindu	62	81.6
	Muslim	11	14.5

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Variable	Category	Number (n)	Percentage (%)
	A+	18	23.7
	AB+	8	10.5
	Rh Negative	6	7.9
	Others	3	3.9
Blood Group	O+	24	31.6
	B+	20	26.3

The majority of patients were male (55.3%) and belonged to the 18–25 years age group (28.9%). Most patients were from rural areas (63.2%), reflecting the catchment area of the tertiary care centre. A significant proportion had low levels of education (39.5% illiterate or primary education only). Labourers and farmers constituted the largest occupational group (32.9%). Hindu patients predominated (81.6%), consistent with the demographic composition of Purba Medinipur. The most common blood group was O positive (31.6%).

4.2 PRIMARY CLINICAL DIAGNOSES

The leading indications for ICU admission and transfusion included trauma and polytrauma (22 patients, 28.9%), haematological disorders such as aplastic anaemia and ITP (18 patients, 23.7%), obstetric complications including PPH and severe anaemia in pregnancy (14 patients, 18.4%), sepsis with DIC (12 patients, 15.8%), and other conditions including liver disease and postoperative cases (10 patients, 13.2%).

4.3 PATTERN OF BLOOD COMPONENT UTILISATION

Table 2 shows the distribution of blood components transfused across the study population.

Table 2: Distribution of Blood Components Transfused (n = 76)

Blood Component	Number of Patients	Percentage (%)	Mean Units per Patient

Packed Red Blood Cells (PRBC)	37	48.7	2.4
Fresh Frozen Plasma (FFP)	21	27.6	3.1
Random Donor Platelets (RDP)	12	15.8	4.6
Cryoprecipitate	6	7.9	2.0
Total	76	100	—

PRBC was the most frequently transfused component, accounting for 48.7% of all transfusions. FFP was the second most commonly used (27.6%), primarily in patients with coagulopathy and liver disease. Platelet transfusion was indicated in patients with thrombocytopaenia secondary to haematological disorders and DIC. Cryoprecipitate was used in a smaller proportion (7.9%),

116 mainly for hypofibrinogenaemia.

4.4 PRE- AND POST-TRANSFUSION HAEMATOLOGICAL PARAMETERS

Table 3 presents the comparison of pre- and post-transfusion haematological indices.

Table 3: Pre- and Post-Transfusion Haematological Parameters (n = 76)

Parameter	Pre-Transfusion (Mean ± SD)	Post-Transfusion (Mean ± SD)	p-value
Haemoglobin (g/dL)	6.8 ± 1.2	9.4 ± 1.1	< 0.001*
Platelet Count (×10³/μL)	38.4 ± 12.6	74.2 ± 18.3	< 0.001*
INR (Prothrombin Time Ratio)	2.4 ± 0.8	1.5 ± 0.4	< 0.001*
Fibrinogen (mg/dL)	142 ± 34	198 ± 42	< 0.001*

All haematological parameters showed statistically significant improvement following transfusion ($p < 0.001$ for all parameters). Haemoglobin levels increased by a mean of 2.6 g/dL per transfusion episode. Platelet count nearly doubled after transfusion of platelet concentrates. INR improved significantly following FFP transfusion, and fibrinogen levels rose appreciably after cryoprecipitate therapy.

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4.5 TRANSFUSION REACTIONS

Out of 76 patients, four (5.3%) experienced mild transfusion reactions, all of which were febrile non-haemolytic reactions (FNHTRs). No severe adverse events, haemolytic reactions, or transfusion-related acute lung injury (TRALI) were recorded during the study period.

5. DISCUSSION

The present cross-sectional study analysed the efficacy and utilisation of blood components among 76 adult patients aged 18 to 40 years admitted to the ICU of a tertiary care centre in Purba Medinipur. The findings offer valuable insights into the transfusion practices prevalent at the institution and highlight areas for quality improvement[5].

In the current study, males constituted 55.3% of the study population, which is consistent with the general demographic pattern seen in ICU admissions in Indian hospitals. The higher proportion of

males is attributable to their greater occupational exposure to trauma and road traffic accidents, which was the leading cause of ICU admission (28.9%). Similar observations have been reported by Sharma et al. (2018) and Kaur et al. (2020) from tertiary care centres in northern and eastern India, respectively[6].

Packed Red Blood Cells emerged as the most frequently utilised blood component (48.7%), followed by Fresh Frozen Plasma (27.6%). This pattern aligns with published literature from comparable settings. PRBC transfusion was predominantly indicated for haemorrhagic anaemia secondary to trauma and obstetric blood loss[7]. The mean pre-transfusion haemoglobin of 6.8 g/dL in the study is reflective of a restrictive transfusion trigger, broadly in concordance with the TRICC trial recommendations and WHO guidelines that suggest transfusion when Hb falls below 7–8 g/dL in critically ill patients. A significant rise of 2.6 g/dL in haemoglobin post-transfusion validates the clinical efficacy of PRBC therapy in this cohort[8].

FFP was the second most utilised component, largely in patients with DIC and liver failure presenting with abnormal coagulation indices. The mean INR declined from 2.4 ± 0.8 to 1.5 ± 0.4 following FFP transfusion, a statistically significant improvement ($p < 0.001$), demonstrating the haemostatic benefit of FFP in correcting acquired coagulopathy. It must, however, be noted that FFP is frequently over-utilised in clinical practice, often for non-evidence-based indications such as routine pre-procedural correction of marginally elevated INR. The present study did not detect overt FFP misuse, possibly owing to the well-defined ICU setting; however, institutional audits would be necessary for a comprehensive assessment[9].

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Platelet transfusion accounted for 15.8% of all blood component use, with a mean of 4.6 units per patient. The post-transfusion rise in platelet count from 38,400/µL to 74,200/µL reflects adequate platelet recovery, consistent with expected increments for Random Donor Platelets (RDP). Obstetric complications, particularly post-partum haemorrhage and HELLP syndrome, along with haematological disorders, were the primary indications in female patients.

Cryoprecipitate was transfused in 7.9% of patients, mainly for severe hypofibrinogenaemia in DIC. The rise in fibrinogen from 142 mg/dL to 198 mg/dL following cryoprecipitate therapy supports its targeted use in patients with demonstrated fibrinogen deficiency[10].

The overall rate of adverse transfusion reactions in the present study was low at 5.3%, all being mild febrile non-haemolytic reactions. This is comparable to the reaction rate of 3–8% reported in similar hospital-based studies from India. The absence of severe reactions may be attributed to adherence to pre-transfusion compatibility testing and bedside monitoring protocols[11-13].

The rural predominance in the study (63.2%) underscores the reality that a tertiary care hospital in Purba Medinipur serves as the primary referral destination for critically ill patients from remote areas, many of whom arrive late with advanced disease and severe anaemia. This delay in presentation, compounded by limited access to primary-level blood transfusion facilities, amplifies the volume of transfusion requirements at the ICU level[14].

The study has a few limitations. Being cross-sectional and conducted at a single centre, the findings may not be entirely generalisable. The sample size, while statistically adequate for a descriptive study, limits the power to detect subgroup differences. Long-term clinical outcomes beyond the transfusion episode were not evaluated. Future multicentre studies with larger sample sizes and outcome-based assessment are recommended[15].

6. CONCLUSION

The present study demonstrates that blood component therapy is clinically efficacious and significantly improves haematological parameters in adult ICU patients aged 18 to 40 years admitted to a tertiary care centre in Purba Medinipur. Packed Red Blood Cells constitute the most frequently utilised component, followed by Fresh Frozen Plasma, platelets, and cryoprecipitate. The transfusion practices at the study centre broadly adhere to evidence-based guidelines, and the incidence of adverse transfusion reactions remains low.

It is recommended that standardised institutional transfusion protocols be reinforced, regular audits of transfusion requisitions be conducted, and clinicians be sensitised to rational blood component

therapy to reduce unnecessary transfusions, conserve scarce blood resources, and optimise patient outcomes in the critical care setting.

7.DECLARATION

Conflict of Interest: The authors declare no conflict of interest.

Source of Funding: The study received no external funding. It was conducted as a departmental academic research project.

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