

# Blood Transfusion Practices in Neonatal Intensive Care Unit at a Tertiary Care Hospital, Guntur, Andhra Pradesh, India: A Retrospective Study

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## ABSTRACT

**Introduction:** Neonates admitted to intensive care frequently require blood transfusions because of their limited physiological reserves, rapid clinical fluctuations, and multiple sampling needs. Understanding existing transfusion trends is essential to ensure evidence-based and rational use of blood components in this vulnerable group.

**Aim:** To evaluate blood transfusion practices in the NICU by analysing indications, utilisation patterns, and outcomes of blood component administration.

**Materials and Methods:** This retrospective observational study was conducted in the Neonatal Intensive Care Unit and the Department of Pathology and associated blood centre at Guntur Medical College and Government General Hospital, Guntur, Andhra Pradesh, over one year (August 2024 to July 2025). The study included 190 neonates who received at least one blood component transfusion. Neonates admitted during the same period without any transfusion exposure were excluded. Demographic details, birth weight, gestational age, clinical

diagnosis, type and frequency of components transfused, timing of transfusion, and documented indications were obtained from NICU records and blood centre archives. Data were analysed using Microsoft Excel 2020 and Statistical Package for Social Sciences (SPSS) version 26.0, with categorical variables summarised as frequencies and percentages, and continuous variables as mean±standard deviation.

**Results:** Out of the 190 neonates, the mean age at first transfusion was 2.5±0.8 days, with 58.9% males. Very low-birth-weight infants constituted the largest subgroup requiring transfusion (87 neonates, 45.8%). Packed red blood cells were the most frequently administered component (158 transfusions, 50.6%). No major transfusion-related adverse events were observed. Inappropriate transfusions accounted for 8.4% of cases.

**Conclusion:** The findings of the present study highlight a predominant transfusion burden among low birth weight neonates. Continuous monitoring and periodic audit of neonatal transfusion practices help ensure rational and safe use of blood components.

**Keywords:** Anaemia, Birth weight, Blood components, Coagulation profile, Packed red blood cells, Platelet concentrates

## INTRODUCTION

Blood transfusion remains a life-saving treatment modality in modern medicine, even in neonates. Extended hospital stay and repeated sampling are chief contributory factors for repeated transfusions in sick neonates [1]. Many physiological changes occur during the newborn's adaptation to the extrauterine life. The blood volume of a preterm neonate is about 100 mL/kg body weight, and this reduces to 85 mL/kg body weight in a full-term neonate and further reduces to about 70 mL/kg body weight in an adult [1-3].

Blood transfusion practices vary in neonates for several reasons, such as immature organ systems, small blood volumes, and the absence of antibodies in infants' serum [2]. However, transfusion practices are still mostly based on expert clinical opinion rather than specified documented guidelines in most institutions [3]. Several studies have highlighted inconsistencies in neonatal transfusion thresholds and documentation practices, as well as the need for periodic audits to evaluate appropriateness and safety [4,5]. However, available literature continues to show gaps regarding neonatal-specific transfusion indications, crossmatch-to-transfusion ratios, and component utilisation efficiency. Earlier audits from different regions have demonstrated widely varying inappropriate transfusion rates and outcomes, underscoring the need for region- and Institution-specific data to support rational transfusion strategies [4-7].

Hence the present study was aimed to document transfusion practices in NICU, assess the pattern and frequency of blood component use, identify and catalogue the indications of transfusions, and evaluate overall transfusion utilisation trends. This audit may provide some insights to the blood centres attached to neonatal intensive care units about blood product demands and limit wastage of components.

## MATERIALS AND METHODS

This retrospective observational study was carried out at the blood centre attached to the Department of Pathology, Guntur Medical College and Government General Hospital, Guntur, over a one-year period from August 2024 to July 2025, involving retrospective review of NICU records and blood centre archives for neonates who received blood product transfusions. The collected data were subsequently compiled and analysed during the period from August 2025 to September 2025. The study was steered after ethical approval from the Institutional Ethics Committee (Certificate Number: GMC/IEC/010//2025, dated: 20<sup>th</sup> January 2025).

**Inclusion criteria:** All neonates admitted to the NICU during the study period who received one or more blood product transfusions were included, irrespective of the underlying pathological condition or indication for admission.

**Exclusion criteria:** Neonates admitted in NICU, during the study period, with no exposure to any blood products were excluded.

**Sample size:** A universal sampling method was employed in the present study. All neonates admitted to the NICU during the study period were screened, and all eligible cases meeting the inclusion criteria were included, without any prior sample size restriction or random selection.

### Study Procedure

Data, including gender, gestational age, birth weight, mode of delivery, blood groups, time of transfusion, diagnosis, etc., for the neonates were obtained from the NICU medical records. Type of product transfused and number of transfusions done for each neonate were retrieved from the blood centre's departmental archives.

### STATISTICAL ANALYSIS

All the data obtained were tabulated in Microsoft excel 2020 and SPSS version 26.0 (IBM, Armonk, New York, USA.). Frequencies and percentages were calculated for discrete data, means and standard deviations were calculated for continuous data.

### RESULTS

A total of 190 neonates were included in the present study, 112 (58.9%) were males, 125 (65.8%) were delivered by caesarean section, and 182 (95.8%) were singleton deliveries. Very low birth weight babies were the most common group which received transfusions (87 cases, 45.8%). Most neonatal transfusions occurred before 48 hours of birth (102 cases, 53.7%). The most common blood group of the cohort was O positive (91 cases, 47.9%). There were no transfusion related complications in any of the neonates [Table/Fig-1].

Parameters	Subgroups	n (%)
Gender	Males	112 (58.9)
	Females	78 (41.0)
Number of foetuses	Singleton	182 (95.8)
	Twin	8 (4.2)
Gestational age	Preterm	83 (43.7)
	Term	107 (56.3)
Mode of delivery	Normal vaginal delivery	65 (34.2)
	Caesarean section	125 (65.8)
Birth weight	Normal birth weight (>2.5 kg)	20 (10.5)
	Low birth weight (1.5 to 2.5 kg)	61 (32.1)
	Very low birth weight (1 to 1.5 kg)	87 (45.8)
	Extremely low birth weight (<1 kg)	22 (11.5)
Neonatal age at the time of first transfusion	<48 hours	102 (53.7)
	>48 hours-7 days	45 (23.7)
	7 days-28 days	43 (22.6)
Blood group	A+	31 (16.3)
	B+	52 (27.4)
	O+	91 (47.9)
	AB+	10 (5.3)
	A-	1 (0.5)
	B-	4 (2.1)
	O-	1 (0.5)

**[Table/Fig-1]:** Demographic distribution of neonates included in the present study (N=190).

In the present study, it was found that of the 190 neonates, 145 (76.3%) received multiple transfusions. Most neonates required 2-4 transfusions. A maximum of 9 transfusions were given to a neonate with meningitis. A total of 312 blood component transfusions were administered to 190 neonates during the study period. Packed red blood cells were the most commonly transfused component, accounting for 158 transfusions (50.6%), followed by Fresh Frozen Plasma (FFP) with 120 transfusions (38.5%). Platelet concentrates

constituted the least frequently transfused component, accounting for 34 transfusions (10.9%) [Table/Fig-2].

Type of blood components	N (%)
Packed Red Cells (PRBC)	158 (50.6)
Fresh Frozen Plasma (FFP)	120 (38.5)
Platelet Concentrate (PC)	34 (10.9)
Total transfusions for 190 neonates	312 (100)

**[Table/Fig-2]:** Depicts the type and distribution of blood component transfused.

The distribution of transfusions was further analysed according to neonatal birth weight. Of the total 312 transfusions, the majority were administered to very low birth weight neonates (123/312, 39.4%), followed by extremely low birth weight neonates (94/312, 30.2%) [Table/Fig-3]. Packed red blood cells were most frequently transfused in very low birth weight neonates (76 transfusions of the total 123 transfusions given), whereas FFP transfusions were highest among extremely low birth weight neonates (49 transfusions of the total 94 transfusions given). Platelet concentrate transfusions were also predominantly administered to neonates weighing less than 2.5 kg at birth.

Distribution based on weight of neonate	Number of neonates	PRBC	FFP	PC	Total number of transfusions (%)
Normal birth weight (>2.5 kg)	20	8	12	4	24 (7.6)
Low birth weight (1.5 to 2.5 kg)	61	42	22	7	71 (22.8)
Very low birth weight (1 to 1.5 kg)	87	76	37	10	123 (39.4)
Extremely low birth weight (<1 kg)	22	32	49	13	94 (30.2)
Total	190	158	120	34	312

**[Table/Fig-3]:** Distribution of blood components transfused based on neonatal birth weight.

PRBC: Packed red blood cells; FFP: Fresh frozen plasma; PC: Platelet concentrate; Values represent number of transfusions administered

When neonates who required transfusions were categorised according to the major organ system involved, it was found that most neonates had haemorrhagic and haematological disorders (67, 35.3%) followed by respiratory system (51, 26.8%) ailments. The distribution of cases based on their diagnosis is depicted in [Table/Fig-4]. Moderate to severe anaemia (18.4%), respiratory distress syndrome (17.4%) and sepsis (6.8%) were the most commonly neonatal diagnoses which required blood component transfusions in the present study.

S. no	Diagnosis	n (%)
<b>A</b>	<b>Respiratory system</b>	<b>51 (26.8)</b>
1	Respiratory distress syndrome	33 (17.4)
2	Birth/perinatal asphyxia	4 (2.1)
3	Apnea of newborn	1 (0.5)
4	Neonatal aspiration of meconium	5 (2.6)
5	Pulmonary haemorrhage	1 (0.5)
6	Pneumonia/pneumothorax	3 (1.6)
7	Bronchopulmonary dysplasia	1 (0.5)
8	Transient Tachypnoea of the Newborn (TTNB)	1 (0.5)
9	Persistent Pulmonary Hypertension of newborn	1 (0.5)
10	Hyaline Membrane Disease	1 (0.5)
<b>B</b>	<b>Haemorrhagic and haematological disorders</b>	<b>67 (35.3)</b>
1	Disseminated intravascular coagulopathy	1 (0.5)
2	Anaemia of prematurity	10 (5.2)
3	Intracerebral/subdural haemorrhage	1 (0.5)
4	Blood incompatibility	8 (4.2)

6	Intraventricular haemorrhage	1 (0.5)	
7	Thrombocytopenia	5 (2.6)	
8	Hypovolemic shock	5 (2.6)	
9	Moderate/Severe anaemia	35 (18.4)	
10	Dengue	1 (0.5)	
<b>C</b>	<b>Gastrointestinal disorders</b>	<b>10 (5.3)</b>	
1	Gastro-oesophageal reflux disease	1 (0.5)	
2	Intestinal perforation/obstruction	1 (0.5)	
3	Necrotising enterocolitis	2 (1.0)	
4	Underfeeding of newborn	1 (0.5)	
5	Ascending colon atresia	1 (0.5)	
6	Umbilical hernia	1 (0.5)	
7	Malrotation of gut	1 (0.5)	
8	Hirschsprung disease	2 (1.0)	
<b>D</b>	<b>Genitourinary system disorders</b>	<b>3 (1.6)</b>	
1	Acute renal failure	1 (0.5)	
2	Hydronephrosis	2 (1.0)	
<b>E</b>	<b>Neurologic disorders</b>	<b>22 (11.6)</b>	
1	Meningitis	7 (3.7)	
2	Hypoxic ischaemic encephalopathy	Grade I- 7, Grade II- 3, Grade III- 2	6.3
3	Neonatal seizures	3 (1.6)	
<b>F</b>	<b>Infections</b>	<b>13 (6.8)</b>	
1	Sepsis	13 (6.8)	
<b>G</b>	<b>Transitory endocrine or metabolic disorders</b>	<b>4 (2.1)</b>	
1	Electrolyte imbalance	1 (0.5)	
2	Hyperglycaemia/MOD	1 (0.5)	
3	Metabolic acidosis	1 (0.5)	
4	Hypoglycaemia	1 (0.5)	
<b>H</b>	<b>Disturbances of temperature regulation</b>	<b>1 (0.5)</b>	
1	Hypothermia	1 (0.5)	
<b>I</b>	<b>Developmental anomalies</b>	<b>16 (8.4)</b>	
1	Septal defects/VSD	1 (0.5)	
2	Patent ductus arteriosus	1 (0.5)	
3	Tracheoesophageal fistula	1 (0.5)	
4	Meningomyelocele	2 (1.0)	
5	Cleft lip and palate	3 (1.6)	
6	CHD	8 (4.2)	
<b>J</b>	<b>Certain Disorders originating in the perinatal period; unspecified</b>	<b>3 (1.6)</b>	
1	Failure to thrive	1 (0.5)	
2	Neonatal jaundice	2 (1.0)	
	<b>Total</b>	<b>190 (100%)</b>	

**[Table/Fig-4]:** Distribution of neonates who received transfusions based on final diagnosis.

Out of the 190 neonates who received transfusions, 167 (87.9%) survived and were discharged in stable condition. Mortality was observed in three neonates (1.6%), primarily related to severe underlying clinical conditions. A total of eight neonates (4.2%) left against medical advice, while 12 (6.3%) were referred to higher centres for advanced care [Table/Fig-5].

In the present audit, eight exchange transfusions were given due to blood group incompatibility. Of this, eight cases, five cases were due to ABO incompatibility, two cases were due to RH incompatibility and one case was due to hyperbilirubinemia causing kernicterus in a baby with uncontrolled neonatal jaundice.

A total of 670 blood units were cross-matched, of which 312 units were transfused, resulting in a cross-match to transfusion ratio of  $2.15 \pm 0.46$ , indicating efficient blood utilisation and minimal wastage.

S. no.	Category	n (%)
1	Survived	167 (87.9)
2.	Did not survive	3 (1.6)
3.	Left against medical advice	8 (4.2)
4	Referred to higher center	12 (6.3)

**[Table/Fig-5]:** Distribution of neonates who received component transfusions based on survival outcomes.

All transfused blood components were screened for transfusion-transmissible infections including HIV, hepatitis B, hepatitis C, syphilis, and malaria as per national guidelines. No cases of transfusion-transmitted infections were identified during the study period.

## DISCUSSION

Although the last few decades have witnessed rapid advancements in the field of transfusion medicine resulting in increased standardisation and accessibility to blood components, in India, the standard recommendations for usage of blood products especially in neonates and paediatric age groups is still not widely established. Most institutes follow their own recommendations and protocols. The results of the present study point out that 8.4% of transfusions that occurred in the current audit did not have any documented evidence for need of transfusions based on global recommendations like haematocrit levels for packed Red Blood Cell (RBC) or active bleeding manifestations for FFP. Clinicians' choices and deranged coagulation profile in the absence of active bleeding manifestations were the most commonly associated factors for transfusions. Various studies have pointed out that inappropriate transfusions are between 10 to 39% in different age groups [8-10].

Inappropriate transfusions not only increase resource liabilities but also result in exposure to unwarranted transfusion risks like infections, alloimmunisations and adverse reactions [8]. Large-scale audits are required to design restrictive transfusion guidelines especially in neonates owing to their miniature organs and immature immune systems [3]. Implementations of point-of-care testing to make transfusion decisions, reducing the number of blood draws for laboratory testing, standard protocols to use only irradiated blood products, and the use of cytomegalovirus-negative blood products for neonates can be a few useful steps for reducing inappropriate transfusions and related complications [11].

In the present study, neonates with a birth weight of less than 2.5 kg accounted for the majority of blood component transfusions, with an inverse relationship observed between birth weight and the number of transfusions required. Similar trends have been reported in earlier studies. Dogra K et al., demonstrated a significantly higher transfusion requirement among very low and extremely low birth weight neonates, attributing this to physiological anaemia, frequent laboratory sampling, and prolonged NICU stay [2]. Khuntar BK et al., also reported increased transfusion frequency in lower birth weight neonates, emphasising the role of prematurity-related morbidities and immature hematopoietic response [3]. These findings collectively underscore the vulnerability of low birth weight neonates to repeated transfusion exposure.

The most frequently transfused blood components in the present study were PRBC, followed by FFP. Our results are similar to studies by Wade M et al., and Bhat A et al., [9,12]. However, Butale PR et al., audit study showed that platelets were more frequently transfused when compared to FFPs [13]. A 76.3% of the neonates included in this current audit received multiple transfusions. This is in concordance with the study by Deb P and Swarup D [14]. However, Butale PR et al., stated a much less incidence of multiple transfusions in neonates in their study (58%) [13].

The cross match to transfusion ratio in the present study is  $2.15 \pm 0.46$  which is close to the recommended target ratio of  $\leq 2.5$  [15] and

implies that there has been a significant blood usage. Comparable studies by Wade M et al., Bhat A et al., and Butale PR et al., have reported similar trends in PRBC predominance and cross-match ratios ranging from 2.0 to 2.8, supporting the findings of the present study [9,12,13].

In the present audit, eight exchange transfusions were given and ABO blood group incompatibility was the most common cause. The current study findings are in agreement with Patel AS et al., and Elnaggar AM et al., studies [16,17].

The most frequent cause was moderate to severe anaemia for PRBC transfusion, deranged coagulation profile for FFP and thrombocytopenia for PC transfusions in different clinical diagnoses. Documented evidence was found for improvement of haematocrit post PRBC transfusion in all cases. However, platelet count improvement after PC transfusion and coagulation profile improvement observed in 94.1% and 88.3% of cases that received transfusion, indicating that some of the transfusions may not have been appropriate clinical decisions. The current study findings are in contrast to that of Khuntar BK et al., who found a significant change in platelet count and coagulation profiles pre and post transfusion [3].

Even though no adverse transfusion reactions were documented in the present audit, neonates, owing to their immature organ systems are always at a higher risk of metabolic derangements, hypothermia, coagulopathies and cardiac dysfunction [18]. Rare and fatal complications like necrotising enterocolitis after PRBC transfusions and cardiac failure after large volume transfusions have also been documented [19].

As stated by Amrutiya RJ et al., in most neonatal intensive care units, blood transfusion practices are based mainly on clinical opinion, component availability and response to treatment [1]. Large-scale, multicenter, prospective, dedicated audits for neonatal transfusion practices are required as neonates have extremely dynamic complete blood counts which change on a daily basis in the first month of life. Additionally, neonates have higher levels of foetal haemoglobin, which have a different oxygen dissociation curve [1].

### Limitation(s)

The small sample size and single-centre retrospective design are important limitations of the study.

### CONCLUSION(S)

The present retrospective audit reflects the existing transfusion practices in the study setting and highlights that the most common product utilised in these age groups are packed red cells and that there is a predominant transfusion requirement among very low birth weight neonates. It also highlights that, while transfusions are often life-saving interventions in the neonatal intensive care

setting, there remains variability in indications, timing, and volume of transfusions administered. Further multicentric, prospective studies with standardised transfusion protocols are required to validate these findings and to establish evidence-based neonatal transfusion guidelines. Improved continued surveillance and periodic audits are essential to ensure optimal outcomes, minimise transfusion-related risks, and promote judicious use of blood products in this vulnerable population.

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#### AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

#### PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Aug 01, 2025
- Manual Googling: Feb 19, 2025
- iThenticate Software: Feb 23, 2025 (1%)

#### ETYMOLOGY: Author Origin

#### EMENDATIONS: 6

Date of Submission: **Jul 17, 2025**  
Date of Peer Review: **Nov 15, 2025**  
Date of Acceptance: **Feb 24, 2026**  
Date of Publishing: **Apr 01, 2026**