

ORIGINAL ARTICLE

UTILIZATION OF BLOOD AND BLOOD PRODUCTS AMONG PEDIATRIC PATIENTS ADMITTED TO ST. PAUL'S HOSPITAL MILLENNIUM MEDICAL COLLEGE, ADDIS ABABA, ETHIOPIAEphrem Demissie Gurmu¹, Mahlet Abayneh Gezaw², Yemisirach Mekonnen Asfaw²,**ABSTRACT**

Background : *Transfusion of blood components is an integral part of health care practice. Many times there will be injudicious use of blood and its products among physicians. There is limited data on blood product utilization and appropriateness in pediatrics.*

Objective: *To assess the appropriateness of utilization of blood products among pediatric patients.*

Method: *A cross-sectional study was conducted from January 1, 2018 to December 30, 2018 G.C. Data were collected from blood bank log book and patient charts. Pediatrics patients who were transfused with any form of blood product were included. Patient's age, gender, address, type of transfusion ordered, documentation of indications for transfusion, amount of transfusion was assessed based on the Blood Center of Wisconsin transfusion guideline .*

Result: *Five hundred and eleven (511) transfusion episodes were documented. The magnitude of pediatric blood product utilization is 12.5%. From this 31.4% transfusion was PRBC, 20.7% whole blood, 25.6% platelet and 19.6% FFP. From all transfusions, 28% are inappropriately transfused. 34.9% of whole blood, 34.5% of PRBC, 23% of FFP and 17.6% of platelets transfusions are inappropriate. Only 1/5th of the blood products taken for NICU were transfused.*

Conclusion: *There is significant inappropriate usage of blood products. PRBCs and whole blood were inappropriately utilized.*

Keywords: *Blood products, inappropriate utilization, blood discarded amount*

INTRODUCTION

Blood is essential for human survival. Until now, there is no effective substitute for blood. Hence, the transfusion of donated blood is the main stay of treatment in variety of medical/clinical conditions. Appropriate

use of blood and blood products means the transfusion of safe blood products only to treat a condition leading to significant morbidity and mortality that can't be prevented by other means. The indications for transfusion are a major factor in determining blood utilization. (1)

¹ Department of Pediatric and Child Health, ALERT Hospital, Addis Ababa, Ethiopia

² Department of Pediatric and Child Health, St. Paul's Hospital Millennium Medical College (SPHMMC), Addis Ababa, Ethiopia
Corresponding author: Yemisirach Mekonnen , email: yemi@yahoo.com

According to 2020 World Health Organization (WHO) report, 118.5 million units of blood were collected worldwide. Forty percent of this is from high-income countries where 16% of the world population lives in. This makes the rate of donations 31 per 1000 people. Coming to low-income countries, there are only 5 donations per 1000 people. More than half of the donated blood in developing country received by children under the age of 5 years, while older individuals are frequently transfused in developed countries. (2, 3)

In Ethiopia, Annually, an estimated 200,000 units of blood collected by the national blood bank. The daily amount of blood required in the country is 1,100 units; nearly 7900 units of blood shortage. (4).

Inappropriate transfusion practices can lead to serious consequences for recipients, including the transmission of infectious agents, non-infectious complications like allergic reaction and lack of blood, which is a major problem in many parts of the world as blood is a scarce resource. Clinicians should weigh the risks of transfusion against the benefits. (5) High proportion of inappropriate use of blood transfusion in both developed and developing countries is observed. (6-10) Evaluation of the pattern of blood component usage, its demand and good audit management is needed to ensure appropriate utilization of precious resources. Even though there are literatures on the appropriate use of blood and blood products worldwide, specific pedi-

atric blood audit is lacking in Ethiopia, hence this study is done to show the gaps.

Objective

This study was aimed to assess the level of appropriate utilization of blood and blood products among pediatric patients at Saint Paul's hospital millennium medical college (SPHMMC).

Methods

Study setting

This study was conducted at St. Paul's hospital millennium medical college. SPHMMC is a tertiary hospital under the federal ministry of health of Ethiopia. A one year cross sectional study was conducted from January 1, 2018 to December 30, 2018 G.C.

Study design and sampling methods

Using Purposive sampling technique, all pediatric patients who were admitted to pediatric department and transfused with any form of blood product from January 1, 2018 to December 30, 2018 were included in the study.

Inclusion criteria

All admitted pediatric patients (less than 15 years) who took any form of blood transfusion in the study period were included.

Exclusion criteria

Neonates who underwent exchange transfusion and patients with lost medical record were excluded. Exchange transfusion was excluded because the bilirubin cut for exchange transfusion varies based on gestational age, postnatal age in hours and presence of risk factors.

Data collection

Data collection was done by using a structured and pre- tested questionnaire after ethical clearance was achieved from the SPHMMC research institutional review board. Two questionnaires were prepared, one for children above 4 month and the other for children age below 4 month which is based on Blood Center of Wisconsin transfusion guideline. The questionnaire included socio demographic factors like age, sex and weight, the units in the department, the indications for transfusion, type of blood product and amount of blood product taken by the patient. Using the blood bank log book, pediatric patients who received blood and blood products were identified and medical records were retrieved. Data was collected by trained general practitioner and the primary investigator rechecked the data collection form to ensure completeness and accuracy.

Data analysis

Data were entered to statistical package for the social sciences (SPSS) version 25 statistical package. Descriptive statistics were used to describe the independent variable. Blood Center of Wisconsin transfusion guideline was used to assess the appropriateness of transfusion. (Table 1).

If the indication is not according to the criteria and if laboratory results and/or documents which indicate the clinical condition of the patient at the time of transfusion are not available in the medical record, the transfusion will be taken as inappropriate. p-Value less than 0.05 was considered statistically significant. The discarded amount of blood and blood product was calculated by subtracting the amount given to the patient from the amount taken from the blood bank.

Operational definitions

1. Pediatric department: Pediatric emergency, PICU, NICU, pediatric ward, pediatric surgery and POPD.
2. Blood products; are PRBC, platelet, FFP, and cryoprecipitate.
3. Appropriate transfusion; is the transfusion of safe blood products only to treat a Condition leading to significant morbidity and mortality that can't be prevented by other means. (2)
4. Inappropriate blood transfusion; if the indication is not according to Blood Center of Wisconsin Pediatric Transfusion Guideline (11)

Table1: Criteria to level transfusion practice appropriate based on Wisconsin blood transfusion Guideline

		Age less than 4 months	Age above 4 months
Whole blood or PRBC transfusion	indication	A. Massive or acute blood loss B. Hgb \leq 8 C. Hgb \leq 10, with O ₂ requirement of <35% or on CPAP < 6cm H ₂ O, apnea, bradycardia D. Hgb \leq 12, FIO ₂ < 35%, CPAP 6-8, deteriorating resp. Status, hypotension, or shock, recovering from major surgery. E. Hgb \leq 15, HCT < 35% Cyanotic CHD	A. Massive or acute blood loss B. Hgb \leq 4 C. Hgb \leq 8 with urgent or emergent surgery, symptomatic tachycardia, tachypnea, or stable ICU patient D. Hgb \leq 10 and severe brain injury E. Hgb \leq 13 g/dl cyanotic CHD, severe pulmonary disease
	amount	A. 10-20 ml/kg	A. 5ml/kg B. 10-20ml/kg
Platelet transfusion	indication	A. Platelet count \leq 50,000 with active bleeding or prior to invasive procedures B. Platelet \leq 100,000 in critically ill pre-term neonate with active bleeding C. Massive bleeding D. Plt \leq 30,000	A. Platelet count \leq 50,000 with active bleeding or prior to invasive procedures B. Platelet \leq 100,000 in critically ill child with active bleeding C. Massive bleeding D. Plt \leq 30,000
	amount	10-15ml/kg	10-15ml/kg
FFP transfusion	indication	A. DIC B. Coagulopathy C. Correction of vit- k deficiency D. Unexplained bleeding	E. DIC F. Coagulation factor deficiency (liver disease)
	amount	A. 10-20ml/kg	10-20ml/kg

Results

From the hospital blood bank log book registry a total of 6850 units of blood products were distributed to different departments in the hospital. Of which 859/6850(12.5%) were registered as blood taken by different units of pediatrics department. In the pediatrics department log book the number of children

who were registered as transfused with blood or blood products were 511/859(59.5%). 511 units of blood products were transfused to 398 pediatric patients, 20 units were used for exchange transfusion and no documentations were found regarding the remaining units of blood products.

Indications of transfusion

Hemoglobin (Hgb) ≤ 8 g/dl (40.4%), platelet count $\leq 30,000$ (46.8%) and unexplained bleeding (45.2%) were the commonest indications of PRBC/whole blood, platelet and FFP transfusion, respectively, for infants' age ≤ 4 months. (Table 2). Among ages great-

er than 4 months; Hgb 4-8 g/dl with symptoms or admitted to ICU (49.4%), platelet $\leq 30,000$ (51.7%) and disseminated intravascular coagulation (DIC) (66.7%) were the commonest indications of transfusion for PRBC/whole blood, platelet and FFP, respectively. (Table 3)

Table-2: Utilization of blood and blood products among pediatric patients admitted to St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2018: indications of blood and blood product transfusion for age ≤ 4 -months, n= 238

Indication for PRBC/Whole blood	Frequency/percentage
Massive or acute blood loss	6(6.1%)
Hgb ≤ 8 g/dl, HCT $<24\%$	40(40.4%)
Hgb ≤ 10 g/dl, HCT $<30\%$, with O ₂ requirement of $<35\%$ or on CPAP < 6 cm H ₂ O, apnea, bradycardia	34(34.3%)
Hgb ≤ 12 g/dl, HCT $<35\%$, CPAP 6-8cm, deteriorating resp. Status, hypotension, or shock, recovering from major surgery	19(19.2%)
Total	99(100%)
Indication for platelet transfusion	
Plt $<30,000$	36(46.8%)
Plt $\leq 50,000$ with active bleeding or before invasive procedures	24(31.2%)
Plt $\leq 100,000$ in critically ill preterm neonate with active bleeding	16(20.8%)
Massive bleeding	1(1.3%)
Total	77(100%)
Indication for FFP	
DIC	18(29.0%)
Correction of vit-k deficiency	16(25.8%)
Unexplained bleeding	28(45.2%)
Total	62(100%)

Vit-K-vitamin K, DIC-disseminated intravascular coagulopathy, FFP-fresh frozen plasma, Hgb-hemoglobin, Plt-platelet, HCT-hematocrit, CPAP- continuous positive airway pressure

Table-3: Utilization of blood and blood products among pediatric patients admitted to St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2018: indications of blood and blood product transfusion for age more than 4-months n=130

Indication for PRBC/Whole blood	Frequency/ percentage
Massive or acute blood loss	4(4.8%)
Hgb \leq 4 g/dl	27(32.5%)
Hgb \leq 8 g/dl with symptomatic tachycardia, tachypnea or stable ICU patient.	41(49.4%)
Hgb \leq 10 g/dl and severe brain injury	1(1.2%)
Hgb \leq 13 g/dl cyanotic CHD, severe pulmonary disease	10(12%)
Total	83(100%)
Indication for platelet transfusion	
Plt \leq 30,000	15(51.7)
Plt count \leq 50,000 with active bleeding or before invasive procedures	10(34.5%)
Plt \leq 100,000 in critically ill child with active bleeding.	4(13.8%)
Total	29(100%)
Indication for FFP	
DIC	12(66.7%)
The coagulation factor deficiency (liver disease)	6(33.3%)
Total	18(100%)

DIC-disseminated intravascular coagulopathy, FFP-fresh frozen plasma, Hgb-hemoglobin, Plt-platelet, HCT-hematocrit, CHD-congenital heart disease

For adolescent age 92% of the requested blood products were transfused while only 18.4 % were used for neonates the rest was discarded due to large blood volume per weight for neonates. (Table-4)

Table 4: Utilization of blood and blood products among pediatric patients admitted to St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2018: The amount of blood product received from the blood bank and transfused for specific age groups, 2018

Age	Amount Received (ml)	The amount transfused (ml)	Percentage (%)
Birth-28days	65,600	21,045	18.4
29days-1year	18,600	5,120	27.5
1year-10year	23,700	12,990	54.8
>10year	16,650	15,385	92.4

Socio-demographic characteristics

Three hundred six (59.9%) of blood products were taken by pediatric male patients and 205(40.1%) taken by females. Neonates took the higher number of blood product accounting 295(57.7%) of blood products, 60 (11.7%) for age 1month to 1 year, 90 (17.6%) for children age 1 to 10 years and 66 (12.9%) units of blood components were

given to children with age above 10 years.

More than half of the blood product transfusion episodes happened in the neonatal intensive care unit (NICU) 263 (51.5%), and the remaining to pediatric emergency 112 (21.9%), pediatric ward 77 (15.1%), pediatric intensive care unit (PICU) 39 (7.6%), and pediatric surgery 20 (3.9%). (Table 5)

Table -5: Utilization of blood and blood products among pediatric patients admitted to St. Paul's Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2018: Distribution of blood products to specific pediatric department units

Department	PRODUCT (%)				Total
	WHOLE BLOOD	PRBC	PLATLETE	FFP	
EMERGENCY	26.4%	24.7%	20.6%	14.0%	21.9%
WARD	16.0%	17.8%	14.5%	10.0%	15.1%
PICU	7.5%	8.0%	5.3%	10.0%	7.6%
NICU	44.3%	46.0%	55.0%	64.0%	51.5%
SURGERY	5.7%	3.4%	4.6%	2.0%	3.9%

Among the blood products; 174units (34%) of packed red blood cells (PRBC), 131 (25.63%) units of platelets, 106 (20.74%)

units of whole blood and 100 (19.56%) units of fresh frozen plasma (FFP) were used.

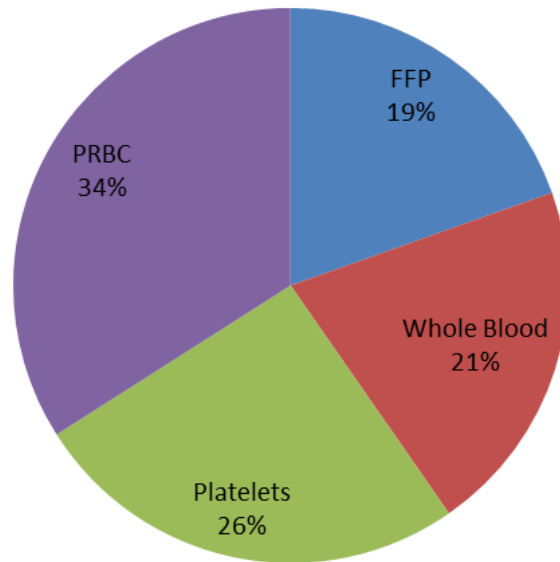


Figure 1: Utilization of blood and blood products among pediatric patients admitted to SPHMMC, Addis Ababa, Ethiopia, 2018: of blood products percentage of utilization

Appropriateness of transfusions

The magnitude of appropriate use of blood products in this study is 72%, Twenty-eight percent of blood product transfusion is inappropriate according to the criteria. Regarding Appropriateness of specific blood products, platelets (82.4%) and FFP (77%) were used

better than PRBC (65.5%) and whole blood (65.1%). Inappropriate utilization was, 17.6%, 23%, 34.5% and 34.9% for platelet, FFP, PRBC and whole blood, respectively. This is statistically significant, with a p-value of 0.002. (Figure 2)

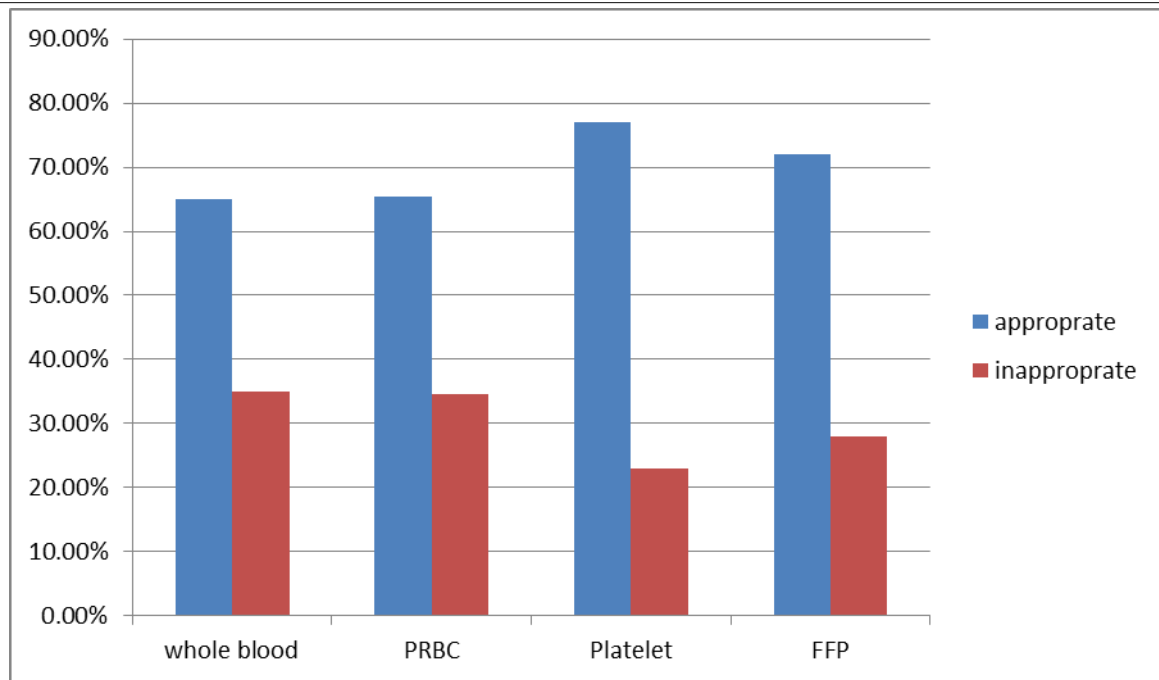


Figure 2: Utilization of blood and blood products among pediatric patients admitted to St. Paul’s Hospital Millennium Medical College, Addis Ababa, Ethiopia, 2018: Distribution of blood products as per their appropriateness in utilization.

From the Specific units in the department, a high rate of appropriate utilization of blood products was seen in pediatric ward 60/77 (77.9%), PICU 30/39 (76.9%). pediatric surgery 15/20 (75%) and pediatric emergency 82/112 (73.2%) respectively, while NICU** is the leading unit in terms of inappropriate utilization 181/263 (68.8%), which is statistically significant with a p-value of 0.05.

DISCUSSION

In sub-Saharan Africa the donation rate of blood is 1-2% below the target set by WHO. (12) Despite this shortage, blood transfusion is among the top five over utilized medical treatments throughout the world.(13-15) Hence, in short of donation, to evaluate our transfusion practices, this study was undertaken.

In this study the consumption of blood products by the pediatric department in relation to other departments is 12.5% .in Zimbabwe a study on theProfiles of blood and blood component transfusion recipients, the magnitude of pediatric blood transfusion rate was documented to be 13.4 %.(16)and another Ethiopian study from southern part ,Jimma also demonstrate the pediatric blood transfusion rate of 15.5 %.(17).Even though the setup and population is quite different from us, in Turkey literature a magnitude of 15.3% reported. (10)More or less the consumption of blood and blood products in pediatrics is similar.

In Our study the most common reasons for blood transfusion is anemia with hemoglobin value of less than 8gm/dl. Transfusion practices in a large cohort of hospitalized children also showed the common reason to prescribe blood was anemia with mean hemoglobin level of 7.9 gm/dl(19)

In our finding, Packed RBC was the major component to be transfused, which is 34.1% followed by platelet 25.6%, which holds true in other countries' profiles too. For instance, two studies from Indian one by Vinayaka P. Hegade, and the other by Mumtaz Sharif, showed the rate of PRBC transfusion is highest 48.9% and 49% respectively. (11, 12) A study from Venezuela also demonstrated same, 53% of the transfusions were PRBC. (13) Unless the cause of anemia is blood loss, Packed RBC is preferred modality of transfusion to avoid volume overload.

In this study more than half of the transfusion episodes (57.7 %) happened in neonatal age groups. Compared to other county reports we have significant neonatal transfusion practice. From the study published by the International Journal of contemporary pediatrics and Indian journal of hematology and blood transfusion, prevalence of neonatal transfusion was 29.5% and 28.8% respectively; which is lower than our study. (11, 14) Hemorrhagic disease of the newborn, the significant rate of birth-related trauma and sepsis may explain the elevated rate of transfusion.

This study shows the practice of inappropriate

blood and blood component transfusion to be 28% and 72 % of the transfusion was considered appropriate based on the criteria. .Which is comparable with a study done by Maaz et al. on blood component therapy in pediatric intensive care unit, which is 24.8%. (8).Mumtaz from Mumbai, India reported one third of the transfusion practice to be inappropriate, of the total 336 episodes of blood component transfusion ,244 episodes were appropriate and 92 episodes were inappropriate.(12)in contrast a report from Karnataka on the prevalence of inappropriate transfusion was 17 % which is lowest than any of the other studies. This could be explained by the nature of the study, it is a prospective date (11) Overall, the inappropriate blood transfusion practice seems to be universally unacceptable. We have to have a standard guideline and health care professionals should adhere to the protocols.

Whole blood (34.9%) and PRBC (34.5%) were the most misused blood components and Platelet (17.6%) was the least inappropriately used blood product. But in other reports, the most inappropriately transfused blood component was FFP. (5, 11, 14, and 15) the high prevalence of anemia in our set-up and sepsis might contribute to specific misuse of whole blood and PRBC.

Among the pediatric units, the higher percentage of inappropriate transfusions was in NICU accounting 31.2%, The least is in pediatric ward accounting 22.1%. According to

the study by Arturo et al. on appropriate use of blood products, NICU accounted for the largest percentage of inappropriate utilization of blood products 54.6% and the least was in pediatric ward 12.2%, similar with our findings. (13) Since ICU patients are more critical there is a tendency to transfuse them and liberal blood transfusion practice happens in critical patients.

We couldn't find similar studies on the average leftover amount of blood products discarded after transfusion, but our finding showed from the number of blood products taken from the blood bank for neonates; nearly 1/5th (18.4%) of it was transfused, and the rest discarded, while 92% of it was properly used for adolescents. This is due to absence of smaller blood bags.

Limitation:

The safety of blood and blood products were not assessed as part of appropriate transfusion and we used a secondary data.

Conclusion:

This study showed that the blood consumption rate by pediatrics department is comparable with other countries profile. Anemia is a common cause of transfusion and Packed RBCs and platelets were the most used blood products. More than half of the transfusion episodes are happening in neonatal age groups. There is a high inappropriate utilization of blood products and inappropriate utilization is highest in NICU among the specific pediatric department units. PRBCs and whole

blood were misused most. Significant amount of blood is being discarded as a left over from the neonatal wards.

Recommendations

There should be a standard written protocol for blood product therapy in all pediatric department units, and it should be followed.

Smaller bag whole blood, PRBCs and FFP preparations are needed to decrease the number of discarded precious blood components.

An additional multicenter prospective study is needed to assess the safety of blood transfusion.

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Authors' contributions

All authors involved in writing the proposal and the manuscript. They have read and approved the final manuscript. Additionally, the first author did the analysis; the second and third author conceptualized the topic.

Disclosures

The authors declare no conflict of interest.

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