UTILITY OF BLOOD COMPONENTS IN PEDIATRIC PATIENTS – AN AUDIT

By

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IN

PATHOLOGY

Under the Guidance of

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LIST OF ABBREVATIONS USED

WB	Whole Blood
RBC	Red Blood Cell
WBC	White Blood Cell
CPDA	Citrate Phosphate Dextrose Adenine
RPM	Rotation per minute
AP	Anticoagulant preservative
TBV	Total Blood Volume
Hb	Hemoglobin
HLA	Human leukocyte antigen
FNHTR	Febrile non-hemolytic transfusion reaction
TA-GVHD	Transfusion associated graft versus host disease
PC	Platelet concentrate
SDP	Single-donor platelet
DIC	Disseminated intravascular coagulation
PI	Platelet increment
CCI	Calculated count increment
BSA	Body surface area
CMV	Cytomegalovirus
TPV	Total plasma volume
CPAP	Continuous positive airway pressure
FiO2	Fraction of inspired oxygen

PaO2	Partial pressure of oxygen
Hct	Hematocrit
PRBCs	Packed Red Blood Cells
TACO	Transfusion associated circulatory overload
TRALI	Transfusion related acute lung injury
HTR	Hemolytic transfusion reaction
ARDS	Acute respiratory distress syndrome
vCJD	Variant of Creutzfeld Jacob Disease
BSE	Bovine spongiform encephalopathy
CXR	Chest X-ray
SHOT	Serious hazards of transfusion
PEM	Protein energy malnutrition
ALL	Acute lymphoblastic leukemia
VWF deficiency	Von willebrand factor deficiency
WHO	World Health Organization
PDA	Patent ductus arteriosus
ITP	Idiopathic thrombocytopenic purpura
TTP	Thrombotic thrombocytopenic purpura
HUS	Hemolytic uremic syndrome
PT	Prothrombin time
APTT	Activated partial thromboplastin time
INR	International normalized ratio

ABSTRACT

BACKGROUND

The blood component implies separation of whole blood into various potential components like packed red cells, platelet rich plasma, fresh frozen plasma, cryoprecipitate and leucocytes. It is now a standard practice of all blood banks to manufacture different blood components from donated whole blood units and supply only components thereafter to patients. Hence, regular audit of blood and its component usage is essential to assess the blood utilization pattern and set ideal policies in all the blood using specialities.

OBJECTIVE

To analyze patterns and appropriateness of transfusion of blood and blood products using predetermined criteria in children of age group 1-18 years.

MATERIALS AND METHODS

A prospective study was carried out on patients fulfilling the inclusion and exclusion criteria requiring transfusion of blood and blood products in BLDEU Shri B.M. Patil Medical College, Hospital and Research Centre, Vijayapur.

Study period: 1st December 2014 to 30th June 2016

All the patients between 1-18 years receiving blood and blood components were included in the study. A detailed history and examination of patients were recorded in a predesigned proforma. Reports of investigations like pretransfusion / postransfusion

hematological parameters, coagulogram and peripheral smear were recorded. Each transfusion episode was assessed based on the predetermined criteria.

RESULTS

The present study recorded transfusion details of 149 pediatric patients receiving whole blood and blood components. Out of the total 214 episodes of transfusions of blood and blood components among 149 patients, 102 episodes (47.7%) were of whole blood transfusions, 67 episodes (31.3%) were of packed red cell transfusions, 26 episodes (12.1%) were of platelet transfusions, 19 episodes (8.9%) were of fresh frozen plasma transfusions. Out of the total 214 transfusion episodes, 126 (58.5%) were appropriate and 88 (41.5%) were inappropriate. Whole blood was most frequently inappropriately used, followed by platelets, fresh frozen plasma and packed red cells. The inappropriateness of whole blood was for achieving hemostasis in bleeding patients.

CONCLUSION

Educational programmes addressing appropriate use of blood products should be continued in order to decrease the risk of inappropriate transfusions. The requirements to meet established criteria is an effective mechanism to improve transfusion practices.

KEY WORDS:

Blood components, pediatric patients, transfusion audit

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INTRODUCTION

Blood transfusions are frequently life-saving. Blood and its components forms a significant part of patient management treatment protocols and like drugs have property to cause adverse reactions in the recipients.[1-3]

Blood transfusion has proved its efficacy in saving life in the primary and secondary health care settings in developing countries and thus, forms an essential part of modern therapy. Clinicians and intravenous therapists should be knowledgeable about the potential risk of blood component therapy to maximize the effectiveness, safety and utility of these transfusions.[2,3]

It is important for the blood bank to be able to fulfill the demand for this life-saving product and at the same time, evaluate and access the existing trends of blood ordering.[2]

It is always essential to weigh the risks of transfusion against the risks of not transfusing, before prescribing blood or blood products for a patient. Liberal use of blood and its components is associated with increased morbidity due to fluid overload, increased risk of infection and an unnecessary increase in the duration of hospital stay.[1]

Clinical audit is a management tool for the assessment and justification of appropriateness and efficiency of transfusion therapy and an important part of quality assurance programme which can provide necessary information for the improvement of transfusion medicine practice.[3]

The importance of an internal audit and educational programme is to emphasize on proper selection of blood components for patients and avoiding their overuse.[2]

Hence, regular audit of blood and its component usage is essential to assess the blood utilization pattern and set ideal policies in all the blood using specialities.[2,3] Judicious implementation of guidelines for use of various blood components may help to decrease their inappropriate use and will ensure availability of components to needy patients.[1]

This study will be useful to plan strategies to reduce unnecessary blood and components transfusion and ensure the safe and appropriate use of blood and blood products in children.

OBJECTIVE OF THE STUDY

To analyze patterns and appropriateness of transfusion of blood and blood products in children of age group 1-18 years.

REVIEW OF LITERATURE

Historical Review :

The use of blood as a product can be traced back to the 17th century, although the advancement in its therapeutic usage were incited by the worldwide conflicts of the first half of the 20th century.[4]

James Blundell, a british obstetrician in 1818 performed the first successful transfusion of human blood to a human for the treatment of postpartum hemorrhage (Figure 1).[4]

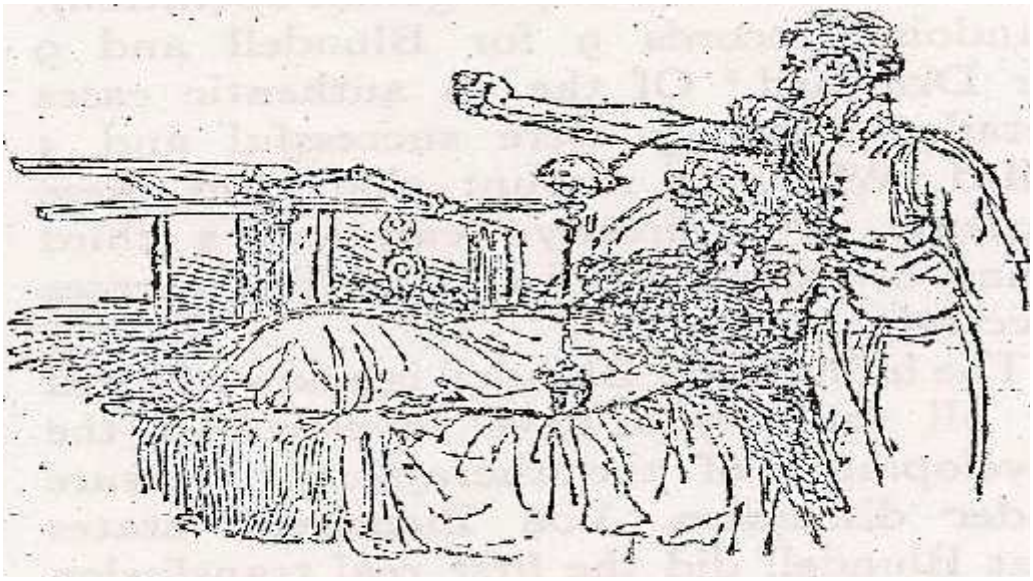


Figure 1: James Blundell's Gravitator from 'Observations in Transfusion of Blood'

Landsteiner in 1901, described three different human blood types A, B and O. In the following year, AB blood group was defined by Alfred von Decastello and Adriano Sturli. In 1940, Landsteiner and Alexander Weiner described the first Rhesus (Rh) blood group.[5]

The new knowledge of matching different blood groups and the use of an anticoagulant lead to the advancement in the practice of blood transfusion with the outbreak of the First World War.[6]

Adolph Hustin in 1914, did first transfusion of citrated blood and discovered that sodium citrate in tolerable quantities could anticoagulate blood for transfusion. In 1953, Robertson following the outbreak of First World War, sought a substitute that might of use in emergency and introduced the addition of glucose to the citrated anticoagulant for blood collection.[6]

BLOOD COMPONENT THERAPY

Blood component therapy forms an essential part of the treatment of many infants and children cared for by general pediatrician, intensivists, surgeons and hematologists-oncologists. Technological advances in blood collection, separation, anticoagulation, and preservation have resulted in component preparation of red blood cells (RBCs), platelets, white blood cells (WBCs) and plasma, which are superior to whole blood (WB) used in the past.[7]

Carl Walter and W.P. Murphy in 1950 introduced the plastic bag for Blood collection. This replaced breakable glass bottles with rugged plastic bags. It enabled the evolution of a collection system capable of safer and easier preparation of multiple blood components from a single unit of whole blood.[7]

There are two methods for collection of blood for preparation of blood components: Whole blood donation and apheresis.

(1) Component preparation from whole blood donation- one unit of WB contains approximately 450 ml of blood collected from a healthy adult donor into a sterile plastic bag containing 63 ml of anticoagulant/preservative solution (citrate-phosphate-dextrose-adenine/CPDA1).[7]

RBCs, platelets and plasma due to their difference in specific gravity can be separated from each other via centrifugation. Soft spin (centrifugation at 1500 RPM for 14 mins at 22°C) is performed initially which separates the heavier RBCs from platelet rich plasma. The typical volume of one unit of plasma collected from WB is approximately 250ml. Hard spin (centrifugation at 2700 RPM for 14 mins) is then performed, to separate platelets from plasma.[7]

(2) Component preparation by apheresis- In this process, an automated apheresis instrument is used which draws blood into an external circuit, the component is then separated by centrifugation or filtration, the required component is collected, and the remaining blood components are returned back to the donor.[7]

Large quantities of the required component are provided by apheresis than WB collection method. Depending on the component that is separated and removed, the procedure is called as leukapheresis, plateletpheresis or plasmapheresis. "Double" collections are also possible for platelets and RBCs.[7]

Apheresis provides the advantage of decreasing the risk for alloimmunization and transfusion-transmitted diseases in chronically transfused patients, as it exposes the recipient to fewer donors. Regarding donors, due to minimal loss of RBC during platelet apheresis, donation can be performed more often than with WB collection.[7]

RBCs should be preserved in solutions that support their metabolic demand to maintain their viability and functional activity. For these reasons, anticoagulant/preservative (AP) solutions came into play.

Anticoagulant/preservative solutions- All anticoagulant solutions contain citrate, phosphate, and dextrose (CPD). These constituents function as an anticoagulant, a buffer, and a source of metabolic energy for the RBCs, respectively. Some AP solutions uses mannitol as it stabilizes RBC membrane, and adenine enters RBCs and is incorporated within the nucleotide pools resulting in higher levels of ATP within the RBC products. The AP solutions are used to increase the shelf life of RBCs from 21 days for CPD to 35 days for citrate-phosphate-dextrose-adenine (CPDA)-1 and to 42 days for the newer AP solutions (Adsol, Optisol, and Nutricell). For most children and neonates receiving simple transfusions, the concentration of the additives of products licensed for use are safe. However, extremely ill premature neonates requiring massive transfusion or those who have significant renal or hepatic insufficiency may be at risk for metabolic abnormalities. [7]

BLOOD COMPONENTS

These can be divided into cellular components and plasma components:[8]

I. Cellular components –

- Red cells: Packed red cells, leukocyte-poor red cells, washed red cells, frozen red cells and irradiated red cells.
- Platelets: platelet concentrate, apheresis platelets
- Granulocytes: granulocyte concentrate

II. Plasma components –

- Fresh frozen plasma
- Cryoprecipitate

These components are prepared from whole blood using multiple satellite bags in a component separator as demonstrated in Figure 2 and 3.

RED CELL COMPONENTS:

(i) Packed red cells are prepared by the removal of about 200-250ml of plasma from 1 unit of whole blood, which is about 450 ml in volume. Approximately 250ml of RBCs collected in citrate-phosphate-dextrose-adenine (CPDA)-1 have a hematocrit of 70%-80%. When supplementation with additional preservative solutions (Adsol, Optisol, or Nutricell) is done, the volume of RBCs is increased to approximately 350ml and the hematocrit is reduced to 50%-60%. These RBC components flow more rapidly than the traditional CPD and CPDA components due to their lower viscosity. All red blood cell units must be stored at a temperature of 4°- 6°C.[7,9]

Volume of RBCs to be transfused = TBV x ([desired Hb]-[actual Hb])/ [Hb] of RBC unit

TBV (Total blood volume) is 70 to 75 ml/kg by 3 months of age.

The Hb concentration increases by 3g/dl for individuals receiving approximately 10ml/kg RBCs in CPDA (hematocrit 69%) and to attain the same Hb concentration increment for individuals receiving RBCs in AS-1 (hematocrit 54%), approximately 12.5 to 15 ml/kg is necessary.[7]

(ii) Leukocyte-poor red cells- According to the American association of Blood Bank, fewer than $5x10^6$ total WBCs per unit must be present in a blood product to label it as 'leukoreduced'. Methods for leukocyte depletion are (i) removal of buffy coat (ii) leukocyte reduction filters. Third generation leukocyte reduction filters provide 99.9% reduction of WBC content to fewer than $5x10^6$ WBCs and some filters provide fewer than $1x10^6$ per product. Leukocyte reduction reduces the incidence of HLA alloimmunization, febrile non hemolytic transfusion reactions (FNHTR), and reduce the transmission of cytomegalovirus.[7]

(iii) Washed red cells- RBC products can be washed using sterile saline to rinse away remaining plasma proteins within an RBC unit. RBC washing removes plasma proteins, cytokines and microaggregates and is indicated for severe, recurrent allergic reactions to blood components despite premedication with antihistamines.[7]

Washed RBCs may benefit patients who have IgA deficiency and anti-IgA and are at risk for anaphylaxis from donor IgA within the plasma. Approximately 20% of the RBCs are removed by the washing process to attain a final volume of 180 to 200ml and hematocrit of 70% to 80%. The unit should be transfused as soon as possible after being washed as the washing process itself causes electrolyte leakage from the RBCs.[7]

(iv) Frozen red cells- Red cells may be frozen and cryopreserved by the use of glycerol in conditions where RBC unit is found to have a unique phenotype. Once frozen, these units have a shelf life of 10 years at less than or equal to -65°C. The unit is deglycerolized along with defrosting and washing when needed. Defrosted-deglycerolized RBCs transfusion must be done within 24 hours of preparation.[7]

(v) Irradiated red cells- When an immunosuppressed or immunodeficient patient receives cellular blood products that possess immunologically competent lymphocytes, Transfusion associated graft-versus-host disease (TA-GVHD) occurs. Gamma-irradiation of red cells inactivates lymphocytes and thus, prevents graft vs host disease. Irradiated red cells are indicated in individuals with immunodeficiency, for intrauterine or premature neonate transfusions and in those receiving blood from first-degree relative donors.[7]

PLATELETS:

Platelet concentrates (PC) are usually prepared from whole blood via centrifugation or may be collected by apheresis. Random-donor platelets is referred to platelets that are prepared by centrifugation of whole blood. Each PC usually contains approximately $7.5x10^{10}$ platelets, but must contain at least $5.5x10^{10}$ platelets in 50-70 ml of plasma.[9,10]

Apheresis platelets (called as single-donor platelets(SDP)) – These are collected from a donor by selectively removing platelets from a volume of approximately 200-400 ml of plasma, whereas the rest of the blood components are returned back to the donor. This technique allows collection of platelets with a minimum of $3x10^{11}$ platelets/U as compared to $5.5x10^{10}$ platelets/U for random donor whole blood collected platelets. This limits the amount of donor exposure per platelet transfusion because this technique collects the equivalent of a pool of six to eight random donor platelets.[7,9]

Platelets express intrinsic ABO antigens but do not express Rh antigens. There are reports of intravascular hemolysis after transfusion of ABO incompatible platelets. To avoid this, whenever possible, ABO compatible platelets should be administered. Low isoagglutinin (anti-A, anti-B) titer units should be considered, if ABO-incompatible

platelets are to be transfused. But approximately 20% of platelets are lost in the final product with volume reduction. To prevent agglutination of platelets which otherwise make the platelets inactive, platelets can be stored for up to 5 days at 20–24°C on a constant agitator.[7,9,10] (Figure 4: Wheecon platelet agitator incubator)

While assessing the need for platelet transfusion, clinical factors which are to be considered include primary diagnosis; bone marrow function and its ability to compensate or recover; presence of uremia or medications that may alter platelet function and presence of fever, sepsis or splenomegaly which increases platelet consumption.[7]

Platelet increment of 50,000/μL to 100,000/μL occurs with the calculated platelet dose of 5-10ml/kg for neonates and 0.1-0.2 U/kg for children over 10 kg. Difference exists in the platelet increment that result from the use of apheresis versus Platelet concentrates. An attenuated result can be due to immune related or non-immune related causes. Non-immune causes include sepsis, fever, splenomegaly, bleeding, disseminated intravascular coagulation(DIC), antibiotic therapy and use of immunosuppressive agents. Immune causes include autoantibodies to HLA class I antigens or to platelet specific antigens or autoantibodies such as immune thrombocytopenic purpura. By evaluating platelet increment(PI) at 1 hour and 24 hours post transfusion and calculation of calculated count increment(CCI), evaluation of platelet refractoriness can be done.

CCI = (PI x BSA)/ number of platelets transfused (in units of 10^{11})

BSA is body surface area

Refractory state is evidenced by two consecutive transfusions with CCI less than 7500/μL. Minimal increment at 1 hour and 24 hours post transfusion is suggestive of

immune-mediated refractoriness, whereas initial increment at 1 hour but with poor platelet increment at 24 hours post transfusion is suggestive of non-immune mediated refractoriness.[7]

PLASMA:

Plasma is prepared from whole blood by centrifugation or by apheresis. One unit contains a volume 200-250 ml when collected by centrifugation, whereas a volume up to 500 ml can be collected from one donor when prepared by apheresis. Plasma will contain approximately 1 unit/ml each of coagulation factors, immediately following collection from a normal donor. Fresh frozen plasma (FFP) refers to the plasma that is frozen at −18°C within 8 h of collection. FFP can be stored at this temperature for upto 1 year. In the blood bank, FFP should be thawed at 37°C in the water-bath for 20 min. Cryoprecipitate will form, if thawed at 4°C. The majority of WBCs in FFP are killed or nonfunctional, as FFP undergoes a freezing process in the absence of a cryoprotectant. Therefore, leucoreduction and irradiation are unnecessary for prevention of CMV reactivation and TA-GVHD, respectively, in high-risk patients. FFP should be ABO compatible with recipient RBCs; however, the Rh type does not need to be considered nor does a cross match need to be done before administering. [7,9]

Volume of FFP to be transfused = TPV (desired factor in % – initial factor in %)

TPV is total plasma volume

It is evident that 20ml/kg of FFP replaces approximately 50% of most factors immediately after transfusion. FFP is contraindicated for correction/prevention of protein malnutrition, intravascular volume expansion and when specific factor concentrates are available. [7]

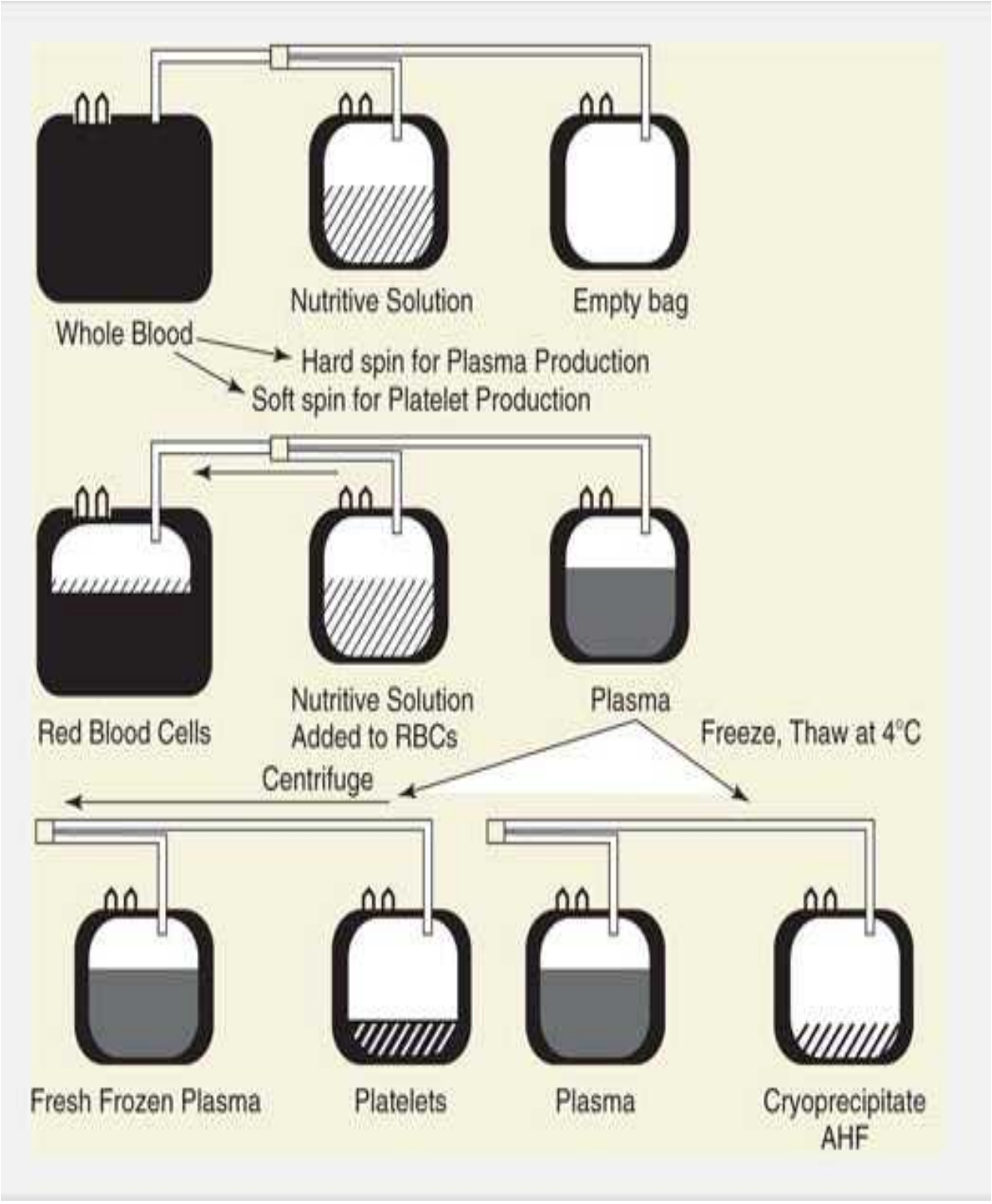


FIGURE 2: COMPONENT SEPARATION OF WHOLE BLOOD.[11]

FIGURE 3: HETTICH ZENTRIFUGEN COMPONENT SEPARATOR

FIGURE 4: WHEECON PLATELET AGITATOR INCUBATOR

Indiscriminate use of blood products is rising due to easy availability of sophisticated blood banking services. Therefore, auditing of blood transfusion practices has become necessary. First audit of transfusion practices was done by Bock as early as 1936.[2]

It is now a standard practice of all blood banks to manufacture different blood components from donated whole blood units and supply only components thereafter to patients.[2]

The medical practice audit was performed as part of an ongoing institutional quality assurance programme that monitors the use of blood and blood component therapy.[12]

Blood transfusion audit practices enabled to come up with various guidelines, regarding transfusion of RBCs, platelets and plasma.

Transfusion of red blood cells

RBC transfusions are usually given to critically ill children when their Hb concentrations are considered to be too low. However, the decision to give an RBC transfusion should not be based solely on hemoglobin concentration.[9]

According to a survey, other conditions for which RBC transfusion should be done are low cardiac output (poor DO2), low SaO2, low central venous (ScVO2) or mixed venous saturation of O2 (SVO2), poor VO2, high blood lactate level and severity of illness.[9,13]

The overall baseline hemoglobin transfusion threshold that would have prompted

transfusion in a patient ranged from 7 to 13 g/dl. There is evidence that using restrictive RBC transfusion strategy of a threshold of 7 g/dl can decrease transfusion requirements without increasing adverse outcomes.[14]

Minal W, Alverson D and Strauss R included the following **Criteria for RBC transfusion** in their study**:** [1,15,16]

- Acute blood loss > 25% of blood volume
- Hemoglobin < 6gm/dl
- When hemoglobin 6-10gm/dl; note vital signs and tissue oxygenation
- Hemoglobin < 8gm/dl in perioperative period, chronic symptomatic anemia or anemia due to chemotherapy
- Hemoglobin < 13gm/dl with severe cardiopulmonary disease
- Bone marrow failure syndrome with hemoglobin < 8gm/dl
- Chronic hemolytic anemia such as thalassemia/sickle cell disease
- Refractory anemia not corrected by pharmacological agents (such as Vitamin B_{12}, folic acid, iron)
- Hematocrit < 30%, requiring CPAP or mechanical ventilation >0.35 FiO_2

According to Uppal P *et al*[9] and Nahum E *et al*[17], anemic children with Hb less than 3.9 gm/dl and who were not transfused had increased mortality when compared with similar group with Hb less than 3.9 gm/dl who were transfused. They stated the following **Guidelines for RBC transfusion** in their study :

- Hemoglobin 4 g/dl or less (Hematocrit 12%) irrespective of clinical condition

- Hemoglobin 4-6 g/dl (Hematocrit 13%-18%) with features of hypoxia, acidosis causing dyspnea or impaired consciousness
- Hyperparasitemia in malaria (>20%)

The indications of packed red cell transfusion as mentioned by Brien WF *et al*[12] were active documented hemorrhage, lack of response to hematinic therapy, chemotherapy-induced bone marrow suppression, marked anemia with evidence of cardiorespiratory decompensation, and transfusion dependent hematologic disorders.

Nine clinical determinants of RBC transfusion other than Hb concentration are: age and gender of the patient; low PaO2; lactic acidosis; active bleeding; nonbleeding thrombocytopenia; non bleeding disseminated intravascular coagulation; and need for surgery.[13]

There is evidence that in stable, critically ill children, using restrictive RBC transfusion strategy of a threshold of 7 gm/dl can decrease transfusion requirements without increasing adverse outcomes.[14]

Nahum E *et al*[17] concluded that a higher threshold may be indicated for patients with cardiovascular disease, hemodynamic instability, cyanotic heart disease or children with severe hypoxemia, active blood loss.

In pediatric patients, a volume of packed red cells of 10 ml/kg (with a Hct of 70-75%) can be expected to raise Hb concentration by 2.5 g/dl. In very severe anemia with Hb< 4 g/dl, RBC transfusions should be given slowly or in small quantities to avoid cardiac failure from circulatory overload.[18]

Transfusion containing leukocytes through stimulation of the inflammatory

cascade might result in organ dysfunction. Universal leukocyte reduction, may decrease the pro inflammatory effects of transfusion. Therefore, restrictive transfusion strategy with the use of pre-storage leukocyte reduced red cell units (i.e., red cells that have been first filtered to remove leukocytes and have been stored in the usual manner) in stable, critically ill children would substantially decrease the exposure to transfusions without worsening organ dysfunction.[14]

Transfusion of Platelet concentrates

According to the survey of Transfusion Practice Committee of the American Association of Blood Banks in 1992, more than 70% of hospitals transfused platelets primarily for prophylaxis. More than 80% of these hospitals set the threshold at 20 x 10^9 /L or even higher.[19,20]

Risk of hemorrhage increases in conditions that compromise the number and function of platelets. Since Duke's initial 1910 description of attributing patients with bleeding to thrombocytopenia and a subsequent good response to blood transfusion, it was not until the last 50 years or so that platelet transfusion have emerged as an intervention against hemorrhage.[20]

Most **Guidelines** recommend:

- For prophylaxis, Platelet count should be maintained greater than 10,000/mm^3
- For invasive procedure, Platelet count should be greater than 20,000/mm^3
- Platelet count greater than 50,000/mm^3 is indicated for major surgeries/ invasive procedure with significant bleeding risk

- Platelet count should be maintained greater than 1 lakh/mm^3 for central nervous system bleeding/ surgery

Transfusion of plasma products

Criteria for fresh frozen plasma transfusion which are used in the study done by Wade M and Alverson DC *et al* are :[1,15]

- Coagulation disorder associated with active bleeding
- Coagulation disorder preoperative state
- Emergency reversal of warfarin effect
- Following transfusion of more than one blood volume over several hours
- Anticoagulant proteins antithrombin III and protein C and S
- Plasma exchange replacement fluid for thrombotic thrombocytopenic purpura

Fasano R, Uppal P, Pervaiz A *et al* included the following **guidelines for fresh frozen plasma transfusion** :[7,9,21]

- DIC with bleeding
- Dilutional coagulopathy from massive blood transfusion
- Multiple coagulation factor deficiency
- Replacement of C1 esterase inhibitor in patients with hereditary angioedema

Uppal P *et al*[9] analyzed that FFP is often misused as volume expander and concluded that it should not be used for intravascular volume expansion, correction or prevention of protein malnutrition and when specific factor concentrates are available;

alternative products that have undergone viral inactivation through complex manufacturing processes are preferable.

Wade M *et al*[1] conducted a study on 85 paediatric patients who received 184 transfusions. Out of the total 184 transfusions, 110 episodes (59.78%) were of packed red cell transfusions, 28 episodes (15.22%) of platelet transfusions, 41 episodes (22.28%) of fresh frozen plasma and 5 episodes (2.72%) were of cryoprecipitate transfusions. Out of the total transfusion episodes 153(83.1%) were appropriate and 31(16.9%) were inappropriate. Fresh frozen plasma was the most frequent inappropriately used blood component, followed by packed red cells and platelet. FFP was given inappropriately for coffee brown gastric aspirates without derangement of coagulation tests.The reason for inappropriate PRBCs transfusion were apprehension of immediate risks to the patients.

Bhat AW *et al*[2] studied 688 transfusion episodes for different blood components in paediatric patients at Sher-I-Kashmir Institute of medical sciences, Kashmir. Out of 688 transfusion episodes for different components 170 (24.7%) episodes were found inappropriate. Highest inappropriate use was detected for FFP in 90 (46.4%). Paediatric surgery had the highest inappropriate use of blood components and were present in 45 (32%) episodes. FFP was given inappropriately for coffee brown gastric aspirates without derangement of coagulation tests and cases of nephrotic syndrome.

Venkatachalapathy TS *et al*[3] did a prospective audit of 1694 episodes of transfusion in 796 patients for different blood components over a period of 3 months. Out of the 1694 episodes of transfusion, 145 were whole blood, 912 were packed cells, 306 were platelet concentrate, and 331 were fresh frozen plasma. Single unit requisitions were 456, and two unit requisitions were 354, and 3 or more unit requisitions in 110 requests.

222 requests contained >10 gm% as indication, 330 requests had 7.1-9.9 gm%, and 250 requests with <7 gm%.

Brien WF *et al*[12] analyzed 479 patients who received 813 episodes of transfusion. Out of the 520 episodes of packed red cell transfusion, 88% (455) were deemed appropriate. Of 106 episodes of FFP transfusion, 90% (95) were deemed appropriate, and of 187 episodes of albumin transfusion, 64% (119) were considered appropriate. The transfusions of PRBCs were inappropriate in patients with evidence of bleeding but without significant changes in Hb level or in patients who had received a transfusion during surgery but the postoperative Hb levels did not reflect a significant blood loss.

Laverdière C *et al*[13] did a survey wherein pediatric intensivists were asked to report their decisions regarding transfusion practice with respect to four scenarios: cases of bronchiolitis, septic shock, trauma, and the postoperative care of a patient with Fallot's tetrad. The response rate was 71% (163 of 230). The overall baseline transfusion threshold that would have prompted intensivists to transfuse a patient ranged from 7 to 13 gm/dl within almost all scenarios. This survey documented a significant variation in transfusion practice patterns among pediatric critical care practitioners with respect to the threshold Hb concentration for red blood cell transfusion.

Lacroix J *et al*[14] studied 637 stable, critically ill children who had hemoglobin concentrations below 9.5 g per deciliter within 7 days after admission to an intensive care unit. Patients in restrictive strategy group (hemoglobin threshold of 7 g per deciliter for red cell transfusion) received 44% fewer transfusions; 174 patients (54%) in that group did not receive any transfusions, as compared with 7 patients (2%) in the liberal strategy group (hemoglobin threshold of 9.5 g per deciliter).

Nahum E *et al*[17] conducted a study wherein 26 certified paediatric intensivists from Israeli society of paediatric intensive care medicine were asked to denote the haemoglobin threshold at which they would prescribe a blood transfusion and the transfusion volume they would use for four hypothetical clinical common scenarios. There was a wide variation in both the suggested hemoglobin thresholds for transfusion (varying by 20-50 gm/dl) and the transfusion volume (varying by 10-20 ml/kg).

Kurukularatne C *et al*[20] did a prospective analysis of 98 patients (2147 study days) and demonstrated major bleeding in 1.39% (30/2147) of study days when platelet counts were $<10 \times 10^9$/L; in 2.3% (50/2147) of study days when platelet counts were 10-20 x 10^9/L, and in 5.4% (117/2147) of study days in patients with platelet counts $>20 \times 10^9$/L. In the absence of additional bleeding risk factors, major hemorrhage was noted in 0.51% (11/2147) of study days when platelet counts were greater than or equal to 10 x 10^9/L.

Pervaiz A *et al*[21] evaluated 100 patients who received 350 episodes of FFP transfusions at Pakistan Institute of Medical Sciences, Islamabad. Out of the total 350 transfusion episodes, 225 (81%) episodes were inappropriate. Paediatric medicine had the highest number of inappropriate transfusions.

Marti Carvajal AJ *et al*[22] conducted a cross-sectional study on 404 paediatric patients who received 522 transfusions. 86.4% (349/404) were transfused only once, 9.9% (40/404) from 2 to 5 times, and 3.7% (15/404) from 6 to 10 times. Packed red cell was the blood component more transfused at a single time: 53%. On the other hand, platelets and cryoprecipitate were transfused in several occasions. Of the patients who were transfused at a single time, 53% received PRBC, followed by FFP, platelets, and

whole blood and cryoprecipitate, respectively.

Precautions during blood /blood component transfusion

It is important that the decision to transfuse blood or blood product is taken carefully. While sending the requisition check for the transfusion history and blood group of the patient and calculation of the total volume/units is required. Before transfusion, product check, blood group, total volume etc. should be done carefully. Baseline condition and vital parameters should be recorded carefully and should be monitored every 5-10 min for half an hour and subsequently every 30-60 min, till transfusion is over.[9]

Reactions following transfusion of Blood components

In addition to the many benefits to transfusion therapy; risks may incur acutely or in the long term. In pediatric patients, most of the acute reactions are immune related but non-immune-related complications such as bacterial contamination, thermal / mechanical hemolysis and transfusion-associated circulatory overload (TACO) must be expected in a few cases. The acute reactions vary from mild hypersensitivity, allergic reactions and urticaria to moderately severe febrile non-hemolytic transfusion reaction to life threatening reactions like anaphylactic reaction, acute intravascular hemolysis, sepsis, Transfusion Related Acute Lung Injury (TRALI) and fluid overload. There may be delayed Hemolytic Transfusion Reaction, iron overload and transmitted infections.[9]

HEMOLYTIC TRANSFUSION REACTIONS:

The most serious complication of blood transfusion results from interactions between the antibodies in the recipient's plasma and surface antigens on donor RBCs.[23]

There are four broad categories of transfusion reactions:

1. Acute immunologic(<24hrs)

2. Acute non immunologic(<24hrs)

3. Delayed immunologic(>24hrs)

4. Delayed non immunologic(>24hrs)

Hemolytic transfusion reactions (HTR) can occur in the *first three* categories mentioned above. HTR occurs due to the accelerated clearance or lysis of transfused red cells because of immunologic or non-immunologic mechanisms. Red Blood Cell (RBC) transfusion results in the great majority of HTRs. However, transfusion of plasma-containing blood components, such as Fresh Frozen Plasma or Platelets, which contain red cell antibodies but very few, if any, red cells may also result in HTRs. [23]

A few signs and symptoms that are typically associated with transfusion reactions can aid in their recognition[23]:

- Fever with or without chills associated with transfusion
- Pain at the infusion site or in the chest, abdomen or flanks
- Shaking chills
- Hypertension or hypotension
- Nausea and vomiting

- Skin changes like urticaria, flushing, angioedema or pruritis
- Respiratory distress including dypnea, tachypnea, wheezing or hypoxemia
- Bleeding or other manifestations of a consumptive coagulopathy
- Darkened urine or jaundice

Hemolytic transfusion reactions may either be immediate or delayed.

FEBRILE NON-HAEMOLYTIC TRANSFUSION REACTIONS:

A common adverse reaction to the transfusion of blood products is febrile non hemolytic transfusion reaction (FNHTR). Its main manifestation, namely, fever, is a feature that is shared by other more dangerous complications of blood transfusions, such as acute red cell hemolysis, transfusion-related acute lung injury (TRALI) or sepsis from a contaminated product and thus, its prevention is important**.**[13,24]

A FNHTR can occur either from leukocyte antibodies in the patient or in the donor units, or from cytokines generated by donor leukocytes during storage of the blood component. As a result, it is advocated that universal leukoreduction of blood components should be done and apheresis platelets should be used only in part for this purpose, despite the extra costs involved.[24]

Febrile non hemolytic transfusion reaction–mediating cytokines are also generated by patient leukocytes, and in fact, FNHTRs have been observed in patients with elevated levels of cytokines after the transfusion of platelet concentrates. In the pretransfusion serum samples of patients whose red cell transfusions were subsequently complicated by FNHTR, elevated levels of cytokines have been demonstrated.[24]

Ezidiegwu CN *et al*[24] study reflected that administration of antipyretic medication prior to transfusion decrease the incidence of FNHTR.

ALLERGIC REACTIONS:

Allergic reactions are common and usually mild. The majority are IgE-mediated and because of the presence of foreign proteins in donor plasma. The most common features are pruritus and urticaria, with or without fever. The transfusion should be stopped and anti-histamines administered. The transfusion may be restarted, if symptoms resolve in less than 30 min and there is no cardiovascular instability. Administration of that particular unit of blood should be abandoned, if the symptoms recur.[25]

Anaphylactic reactions are rare after transfusions. They occur most often in patients in whom a hereditary IgA deficiency, and pre-existing anti-IgA antibodies, predisposes to an antibody– antigen interaction and subsequent anaphylaxis. This reaction is not dose-related and occurs immediately after commencement of transfusion. Clinical features include urticaria, bronchospasm, dyspnoea, laryngeal oedema and cardiovascular collapse.[25]

TRANSFUSION RELATED ACUTE LUNG INJURY:

The most common cause of major morbidity and death after transfusion is TRALI. It presents as an acute respiratory distress syndrome (ARDS) either during or within 6 h of transfusion. Clinical features include dyspnoea, hypoxaemia, fever, cyanosis, hypotension and tachycardia which result from non-cardiogenic pulmonary oedema. Radiographic appearance is suggestive of bilateral pulmonary infiltration which is characteristic of pulmonary oedema. TRALI needs to be differentiated from other causes of ARDS such as myocarditis, circulatory overload or valvular heart disease.[25,26]

TRANSFUSION-RELATED INFECTIONS:

Bacterial: An infrequent complication of transfusion is bacterial contamination of blood components. However, if it does occur, the potential for fulminant sepsis in the recipient is associated with high mortality. It can result if an asymptomatic donor is bacteraemic at the time of donation or from contamination during venepuncture. Symptoms occur during or shortly after transfusion of the contaminated unit and include rigors, high fever, erythema and cardiovascular collapse.[27]

RBCs are stored at 4°C. Contamination with Gram-negative bacteria such as Pseudomonas species and Yersinia enterocolitica is more likely as they proliferate rapidly at this temperature. Gram-positive bacteria such as Bacillus species, Staphylococcus aureus and Staphylococcus epidermidis proliferate more readily at room temperature and so are more commonly seen as platelet contaminants. Visual inspection of the bag before transfusion is important, as there are no screening tests currently available for detection of bacterial contamination. Contaminated bags may contain gas bubbles or seem unusually dark in colour. Diagnosis rests with culture of the same organism from both the patient and the implicated blood component.[27]

Viral: Currently, donor blood is screened for hepatitis B, hepatitis C, HIV 1 and 2, cytomegalovirus, syphilis and human T cell lymphotrophic virus.[28]

Prion: Variant Creutzfeldt-Jakob disease (vCJD) is a human prion disease caused by infection with the bovine spongiform encephalopathy (BSE) agent. There is a theoretical risk that vCJD might be transmitted through blood transfusion. Precautionary measures undertaken by the National Blood Service include leucodepletion of blood, obtaining plasma for fractionation from countries other than the UK and exclusion of donors who

themselves received transfusions before 1980. At present, no treatment or test exists for vCJD.[25]

TRANSFUSION ASSOCIATED CIRCULATORY OVERLOAD:

TACO is the second most common cause of transfusion-related morbidity and mortality. It presents with features of pulmonary oedema and respiratory distress due to increased central venous pressure and pulmonary blood volume resulting in extravasation of fluid into the alveolar space secondary to transfusion. It also happens during or within few hours of transfusion. Patients develop tachypnea, hypoxemia, tachycardia, and CXR shows bilateral infiltrates.[26]

In some instances, TACO could be difficult to distinguish from TRALI. TACO is hydrostatic pulmonary edema- a pressure phenomenon, whereas TRALI occurs due to increased permeability of blood vessels. The two conditions can be differentiated with the help of B-natriuretic polypeptide. An echocardiogram or more invasive means to measure heart pressures could also aid in differentiation. Sepsis itself can lead to myocardial dysfunction, possibly secondary to the effect of inflammatory mediators on the myocardium. Whether this higher prevalence of myocardial dysfunction in sepsis is associated with a higher incidence of TACO in sepsis is unknown.[26]

TRANSFUSION-ASSOCIATED GRAFT-VS-HOST DISEASE:

Transfusion-associated graft-vs-host disease (GvHD) is a very rare complication of blood transfusion. In the most recent serious hazards of transfusion (SHOT) report, there are no identifiable cases. The implementation of universal leucodepletion has reduced the incidence of GvHD. GvHD can complicate allogenic bone marrow transplants, but in those who are immunocompromised, it can occur after simple blood

transfusion. Ninety percent of cases are fatal. Donor derived immune cells, particularly T lymphocytes, mount an immune response against host tissue. Clinical features include abdominal pain, diarrhea, a maculopapular rash (typically affecting the face, palms and soles) and abnormal liver function tests. Destruction of bone marrow stem cells by donor T lymphocytes causes a pancytopenia. Irradiation of blood products which inactivates any donor lymphocytes can prevent the occurrence of GvHD.[25]

IMMUNOMODULATION:

The potential to modulate the immune system of transfusion recipients remains an exciting but controversial area of transfusion medicine. This effect is evidenced by the prolonged survival of renal allografts in patients who have received pre-transplantation blood transfusions. Transfusion-related immune suppression manifests as activation of latent viral infection, increased tumor recurrence after surgical resection, an increased risk of postoperative infections, prevention of recurrent miscarriage and improvement in immune inflammatory disease. These effects are thought to be initiated by donor leucocytes and are related to the Class I and Class II HLA antigens which they express. As laboratory studies have shown a reduction in natural killer cell activity, IL-2 production, CD4/CD8 ratios and macrophage function, it is possible that the aetiology of immunomodulation is multifactorial.[25]

MATERIALS AND METHODS

Source of data:

A prospective study was carried out on patients fulfilling the inclusion and exclusion criteria requiring transfusion of blood and blood products in BLDEU Shri B.M. Patil Medical College, Hospital and Research Centre, Vijayapur.

Study period: 1st December 2014 to 30th June 2016

Methods of collection of data:

All the patients between 1-18 years receiving blood and blood components were included in the study. A detailed history and examination of patients were recorded in a predesigned proforma. Reports of investigations like pretransfusion / postransfusion hematological parameters, coagulogram and peripheral smear were recorded. Each transfusion episode was assessed based on the predetermined criteria as mentioned below:[1,9,15]

1. **Criteria for packed red blood cell (PRBC) transfusion**:
    - Acute blood loss > 25% of blood volume
    - Hemoglobin 4 g/dl or less (Hematocrit 12%) irrespective of clinical condition
    - Hemoglobin 4-6 g/dl (Hematocrit 13%-18%) with features of hypoxia, acidosis causing dyspnea or impaired consciousness
    - When hemoglobin 6-10gm/dl; note vital signs and tissue oxygenation
    - Hemoglobin < 8gm/dl in perioperative period, chronic symptomatic anemia or anemia due to chemotherapy

- Hemoglobin < 13gm/dl with severe cardiopulmonary disease
- Bone marrow failure syndrome with hemoglobin < 8gm/dl
- Chronic hemolytic anemia such as thalassemia/sickle cell disease
- Refractory anemia not corrected by pharmacological agents (such as Vitamin B_{12}, folic acid, iron)
- Hematocrit < 30%, requiring CPAP or mechanical ventilation >0.35 FiO_2
- Hyperparasitemia in malaria (>20%)

2. Criteria for platelet transfusion:

- For prophylaxis, Platelet count should be maintained greater than 10,000/mm^3
- Platelet count greater than 20,000/mm^3, in presence of bleeding
- Platelet count greater than 50,000/mm^3 is indicated for major surgeries/ invasive procedure with significant bleeding risk
- Platelet count should be maintained greater than 1 lakh/mm^3 for central nervous system bleeding/ surgery

3. Criteria for fresh frozen plasma transfusion:

- Coagulation disorder associated with active bleeding
- Coagulation disorder preoperative state
- Emergency reversal of warfarin effect
- Following transfusion of more than one blood volume over several hours
- Anticoagulant proteins antithrombin III and protein C and S
- Plasma exchange replacement fluid for thrombotic thrombocytopenic purpura

- DIC with bleeding
- Dilutional coagulopathy from massive blood transfusion
- Multiple coagulation factor deficiency
- Replacement of C1 esterase inhibitor in patients with hereditary angioedema

If the transfusion was given on the basis of presence of any one or more of the above preset criteria for individual component the transfusion was termed as appropriate or else was judged as inappropriate.

Statistical analysis:

Data was analyzed using-

1. Mean ± standard deviation
2. Odd's ratio, 95% confidence interval
3. Diagrams

Inclusion criteria:

1. Patients of age 1-18 years receiving blood and its components.

Exclusion criteria:

1. Patients <1 year.
2. Patients receiving cryoprecipitate transfusion.

RESULTS

The study covered 149 pediatric patients between the ages of 1 year to 18 years who presented to Shri BM Patil Medical hospital between December 2014 to June 2016. A total of 214 episodes of component were transfused to these children, at time one child receiving multiple transfusions.

DISTRIBUTION OF BLOOD COMPONENT

Out of the total 214 episodes of blood and component transfusion, 102 (47.7%) episodes were of whole blood, 67 (31.3%) episodes were of packed red cells, 26 (12.1%) episodes were of platelets and 19 (8.9%) episodes were of fresh frozen plasma transfusion.

TABLE 1: PERCENTAGE DISTRIBUTION OF BLOOD COMPONENT

BLOOD COMPONENT	NO. OF TRANSFUSION EPISODES	PERCENTAGE (%)
Whole blood	102	47.7
Packed red blood cell	67	31.3
Platelet	26	12.1
Fresh frozen plasma	19	8.9
Total	214	100

FIGURE 5: PIE CHART DISTRIBUTION OF BLOOD COMPONENT

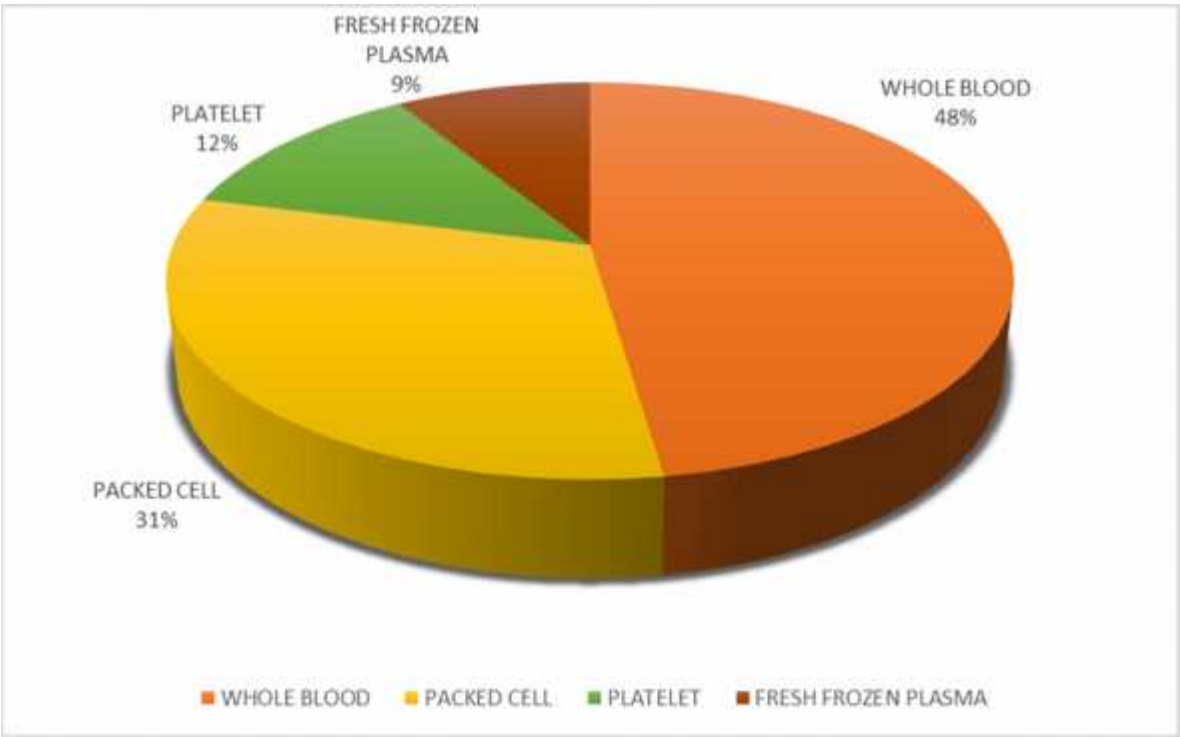
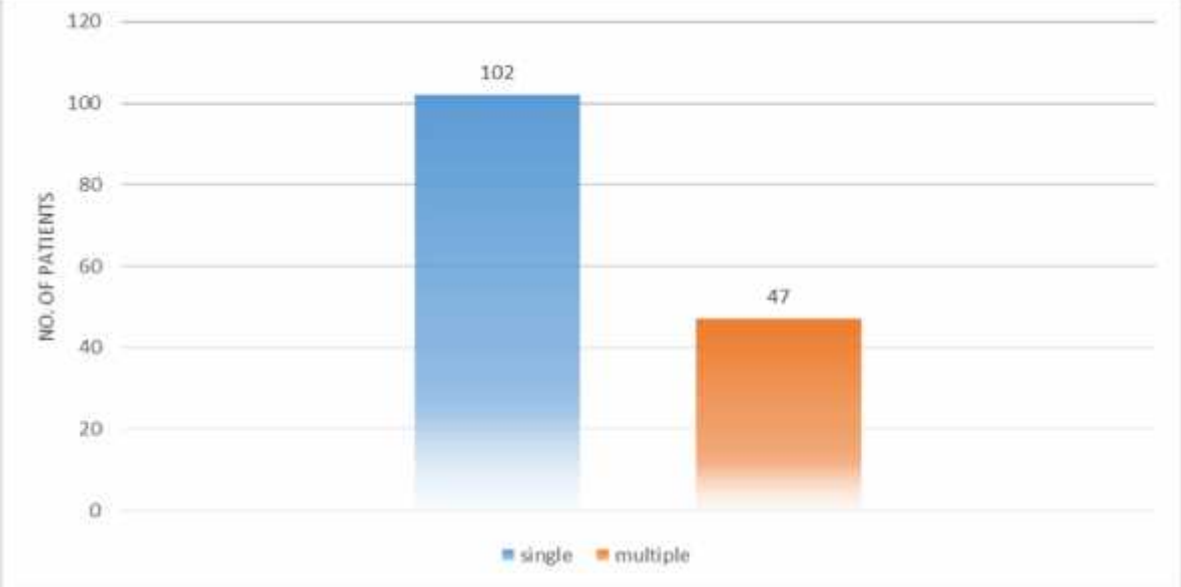


TABLE 2: NUMBER OF PATIENTS RECEIVING SINGLE/MULTIPLE TRANSFUSION

In our study, out of the total 149 patients receiving transfusion, 102 patients received single transfusion and 47 patients received multiple transfusions.

SINGLE/MULTIPLE TRANSFUSION	NO. OF PATIENTS
Single	102
Multiple	47
Total	149

FIGURE 6: NUMBER OF PATIENTS RECEIVING SINGLE/MULTIPLE TRANSFUSION



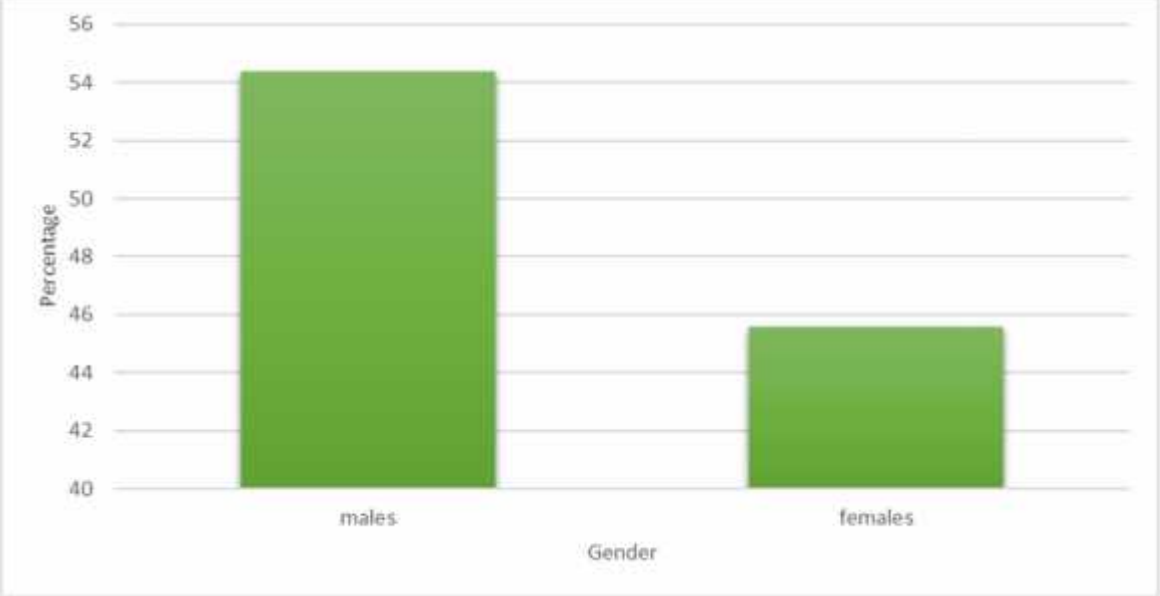
DISTRIBUTION OF PATIENTS BY GENDER

In the present study, out of the total 149 patients, total number of males receiving component transfusion were 81 (54.4%) and females were 68 (45.6%).

TABLE 3: GENDER DISTRIBUTION OF PATIENTS STUDIED

GENDER	NUMBER (%)
Males	81 (54.4%)
Females	68 (45.6%)
Total	149 (100%)

FIGURE 7: GENDER DISTRIBUTION OF PATIENTS STUDIED



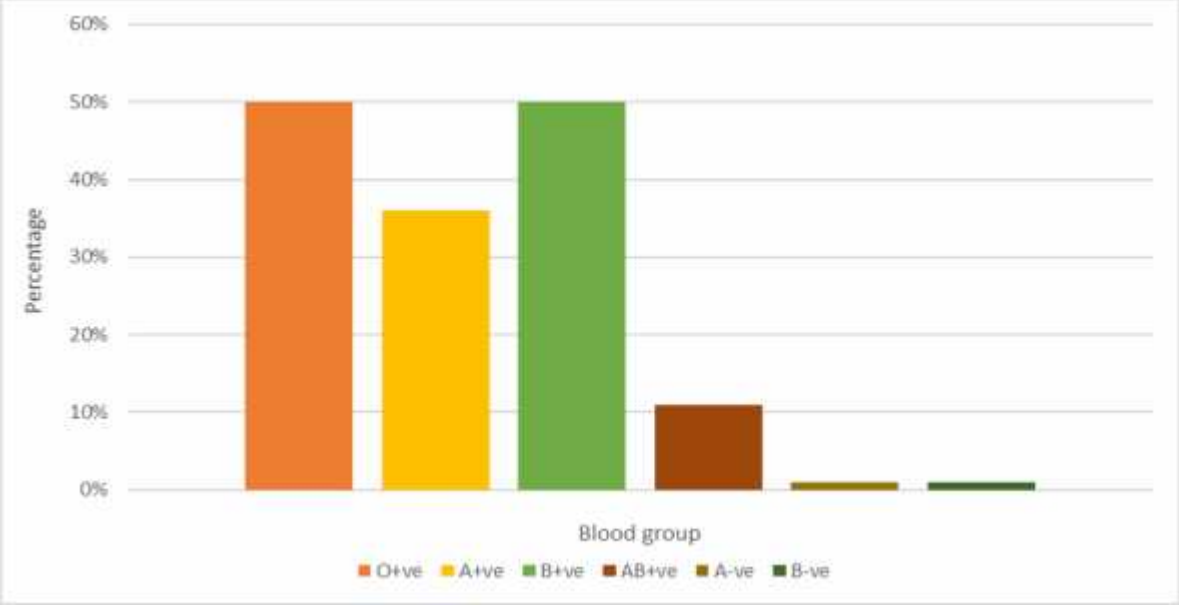
BLOOD GROUP DISTRIBUTION

Current study shows equal percentage of cases with O+ve and B+ve blood group. 36% cases had A+ve and 11% cases had AB+ve blood groups. Least no. of cases had A-ve and B-ve blood group.

TABLE 4: BLOOD GROUP DISTRIBUTION OF PATIENTS STUDIED

BLOOD GROUP	N (%)
O+ve	50%
A+ve	36%
B+ve	50%
AB+ve	11%
A-ve	1%
B-ve	1%

FIGURE 8: BLOOD GROUP DISTRIBUTION OF PATIENTS STUDIED



DISTRIBUTION OF PATIENTS BY AGE

In the current study, the age ranged from 1-16 years. The mean age of patients in our study was 8.5± 10.6 years. Majority of the patients were in the age group of 1-5 years.

TABLE 5: AGE DISTRIBUTION OF PATIENTS STUDIED

AGE IN YEARS	NO. OF CASES	PERCENTAGE (%)
1-5 years	102	68.5
6-10 years	32	21.5
11-15 years	12	8
16-18 years	03	2

FIGURE 9: PIE CHART DISTRIBUTION OF PATIENTS STUDIED BY AGE

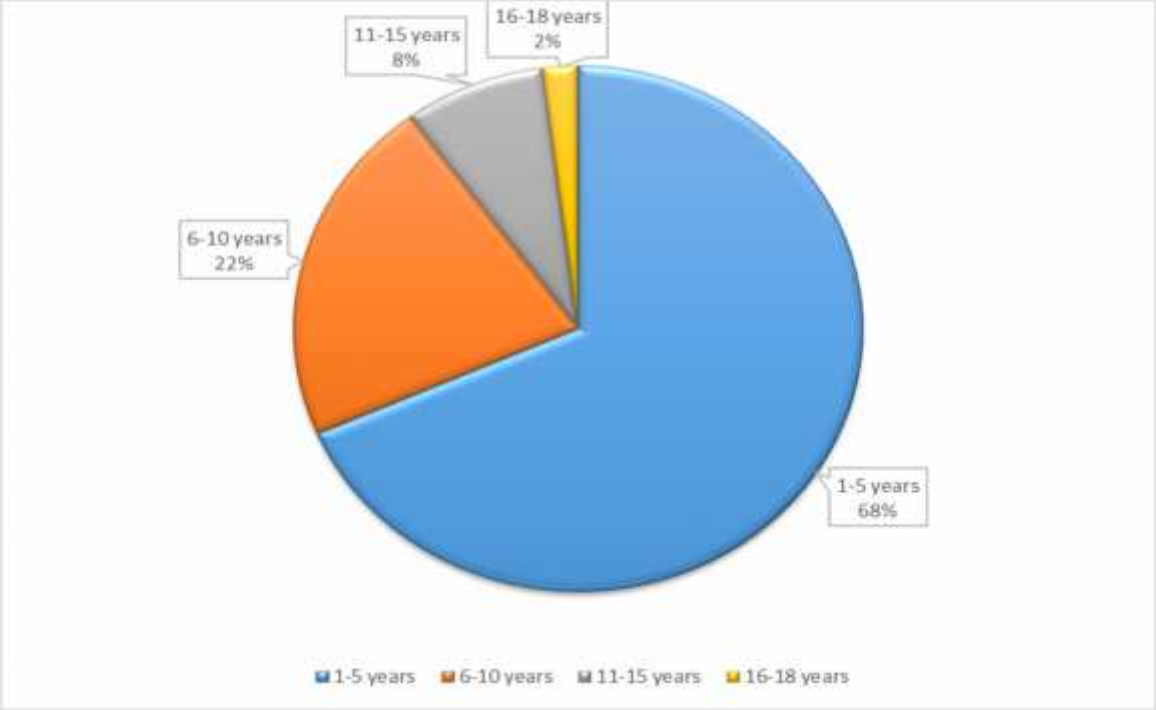


TABLE 6: AGE DESCRIPTIVE

MINIMUM AGE (YEARS)	MAXIMUM AGE (YEARS)	MEAN	STANDARD DEVIATION	MEAN ± SD
1	16	8.5	10.6	8.5 ± 10.6

USE OF BLOOD COMPONENT BY DISEASES

Blood and component transfusion were done for various diseases. Anemia was found to be the most common disease for which component transfusion was done, followed by sepsis and bleeding disorders. Odd's ratio for ALL is 0.29 and protein energy malnutrition with dehydration is 30.25 indicating that blood component was most appropriately transfused for ALL and most inappropriately transfused for PEM. The difference was statistically significant for sepsis and protein energy malnutrition with dehydration. ($p<0.05$)

TABLE 7: ODD'S OF INAPPROPRIATE USE OF BLOOD COMPONENTS BY DISEASES

DIAGNOSIS	NO. OF TRANSFUSION EPISODES	OR (95% CI)	P- VALUE
Anemia	88	1	
Bleeding disorder	25	1.59 (0.65-3.95)	0.31
Sepsis	47	2.75 (1.32-5.7)	**0.006**
Intra-operative	11	2.44 (0.69-8.7)	0.17
Dengue	16	0.47 (0.12-1.8)	0.27
PEM with dehydration	7	30.25 (1.67-548)	**0.02**
ALL	3	0.29 (0.01-5.8)	0.42
VWF deficiency	2	0.40 (0.02-8.7)	0.56
Liver disease	7	1.52 (0.32-7.3)	0.60
DIC	1	0.67 (0.03-17)	0.81
Malaria	7	0.81 (0.15-4.5)	0.81

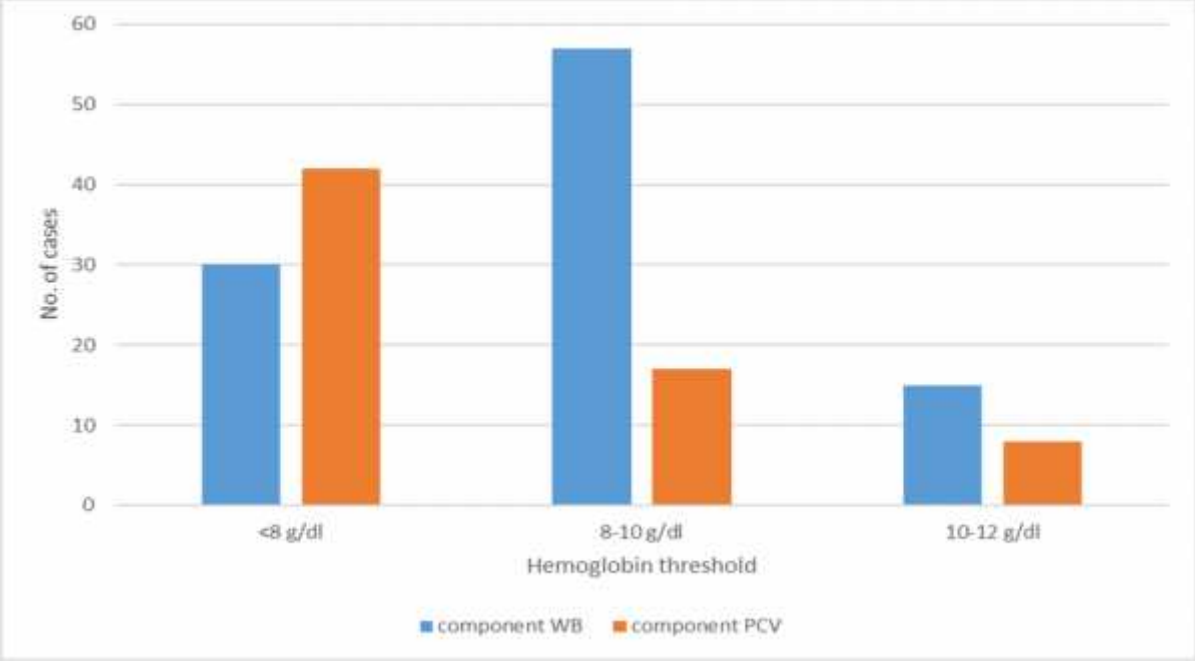
HEMOGLOBIN THRESHOLD FOR WB AND PRBC

57 units of total 102 whole blood transfusion were received to patients with hemoglobin of 8-10 gm/dl. 42 units of total 67 packed red cell transfusion were received to patients with hemoglobin of <8 gm/dl.

TABLE 8: NO. OF WB AND PRBC ACCORDING TO HB LEVEL

	HB LEVEL		
BLOOD PRODUCT	**<8 g/dl**	**8-10 g/dl**	**10-12 g/dl**
WB	30	57	15
PRBC	42	17	8

FIGURE 10: NO. OF WB AND PRBC ACCORDING TO HB LEVELS

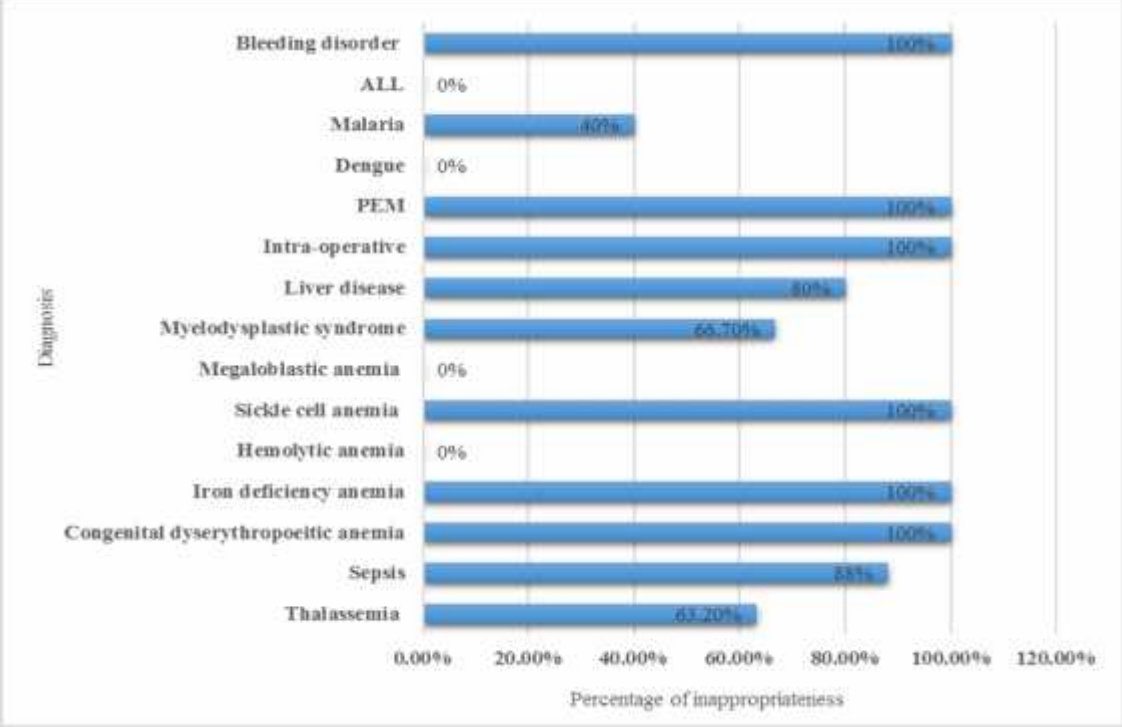


WHOLE BLOOD TRANSFUSION

TABLE 9: PERCENTAGE INAPPROPRIATENESS OF WHOLE BLOOD TRANSFUSION

DIAGNOSIS	NO. OF TRANSFUSION EPISODES	APPROPRIATE	INAPPROPRIATE
Thalassemia	19	7 (36.8%)	12 (63.2%)
Sepsis	25	3 (12%)	22 (88%)
Congenital dyserythropoeitic anemia	5	0 (0%)	5 (100%)
Iron deficiency anemia	6	0 (0%)	6 (100%)
Hemolytic anemia	4	4 (100%)	0 (0%)
Sickle cell anemia	1	0 (0%)	1 (100%)
Megaloblastic anemia	2	2 (100%)	0 (0%)
Myelodysplastic syndrome	3	1 (33.3%)	2 (66.7%)
Liver disease	5	1 (20%)	4 (80%)
Intra-operative	6	0 (0%)	6 (100%)
PEM	7	0 (0%)	7 (100%)
Dengue	2	2 (100%)	0 (0%)
Malaria	5	3 (60%)	2 (40%)
ALL	2	2 (100%)	0 (0%)
Bleeding disorder	10	0 (0%)	10 (100%)

FIGURE 11: PERCENTAGE INAPPROPRIATENESS OF WHOLE BLOOD TRANSFUSION



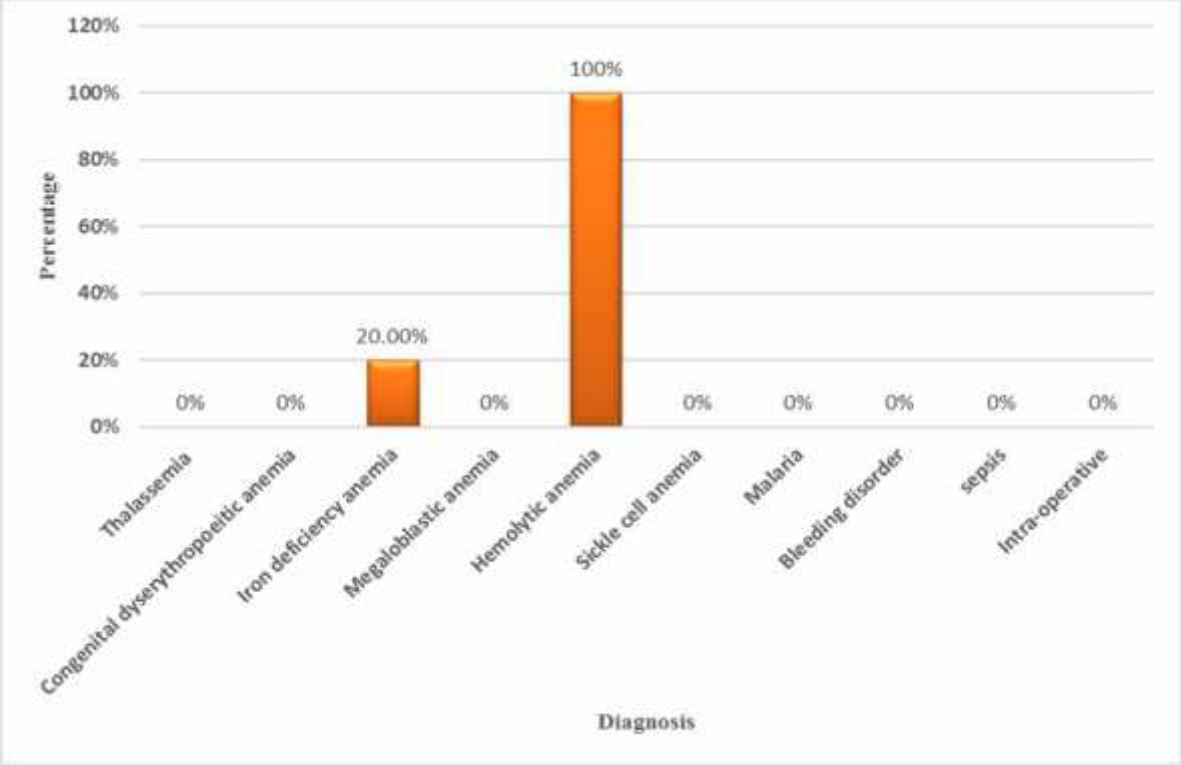
Sepsis, thalassemia and bleeding disorders were among the most common diseases for which whole blood transfusion was done. 100% inappropriateness was seen with Congenital dyserythropoeitic anemia, iron deficiency anemia, sickle cell anemia, intra-operative cases, PEM and bleeding disorder. Sepsis and liver disease had almost equal percentage of inappropriateness (88%). Thalassemia and myelodysplastic syndrome also had equal percentage of inappropriateness (66.7%). 40% of inappropriate transfusions were done for malaria.

RED BLOOD CELL TRANSFUSION

TABLE 10: PERCENTAGE INAPPROPRIATENESS OF PRBC TRANSFUSION

DIAGNOSIS	NO. OF TRANSFUSION EPISODES	APPROPRIATE	INAPPROPRIATE
Thalassemia	28	28 (100%)	0 (0%)
Congenital dyserythropoeitic anemia	1	1 (100%)	0 (0%)
Iron deficiency anemia	10	8 (80%)	2 (20%)
Megaloblastic anemia	1	1 (100%)	0 (0%)
Hemolytic anemia	1	0 (0%)	1 (100%)
Sickle cell anemia	1	1 (100%)	0 (0%)
Malaria	2	2 (100%)	0 (0%)
Bleeding disorder	3	3 (100%)	0 (0%)
Sepsis	15	15 (100%)	0 (0%)
Intra-operative	5	5 (100%)	0 (0%)

FIGURE 12: PERCENTAGE INAPPROPRIATENESS OF PRBC TRANSFUSION



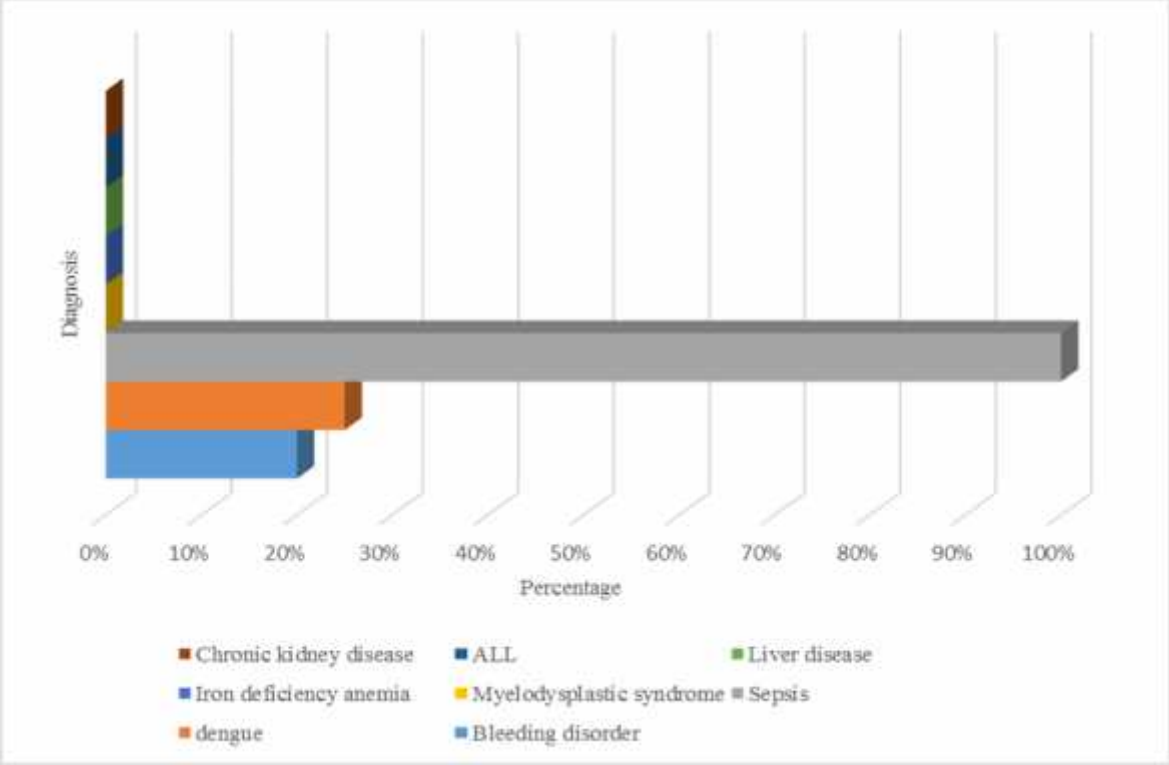
PRBC transfusion was done mainly for thalassemia, sepsis and iron deficiency anemia. 100% inappropriateness was seen for hemolytic anemia and 20% inappropriate usage was for iron deficiency anemia.

PLATELET TRANSFUSION

TABLE 11: PERCENTAGE INAPPROPRIATENESS OF PLATELET TRANSFUSION

DIAGNOSIS	NO. OF TRANSFUSION EPISODES	APPROPRIATE	INAPPROPRIATE
Bleeding disorder	5	4 (80%)	1 (20%)
Dengue	12	9 (7%)	3 (25%)
Sepsis	2	0 (0%)	2 (100%)
Myelodysplastic syndrome	3	3 (100%)	0 (0%)
Iron deficiency anemia	1	1 (100%)	0 (0%)
Liver disease	1	1 (100%)	0 (0%)
ALL	1	1 (100%)	0 (0%)
Chronic kidney disease	1	1 (100%)	0 (0%)

FIGURE 13: PERCENTAGE INAPPROPRIATENESS OF PLATELET TRANSFUSION



Dengue cases received the maximum episodes of platelet transfusion. This was followed by bleeding disorder, myelodysplastic syndrome and sepsis. 100% inappropriate usage was observed for sepsis. Dengue and bleeding disorder had almost equal percentage of inappropriateness (25%).

TABLE 12: PATIENTS RECEIVING PLATELET TRANSFUSION WITH THEIR RANGE OF PLATELET COUNT

PLATELET COUNT (CELLS/CUMM)	NO. OF TRANSFUSION EPISODES	BLEEDING	SEPSIS	INAPPROPRIATE
<10,000	7	5	2	0
11-20,000	5	4	1	0
21-40,000	10	4	3	3
41-1,00,000	4	0	1	3
Total	26	13	7	6

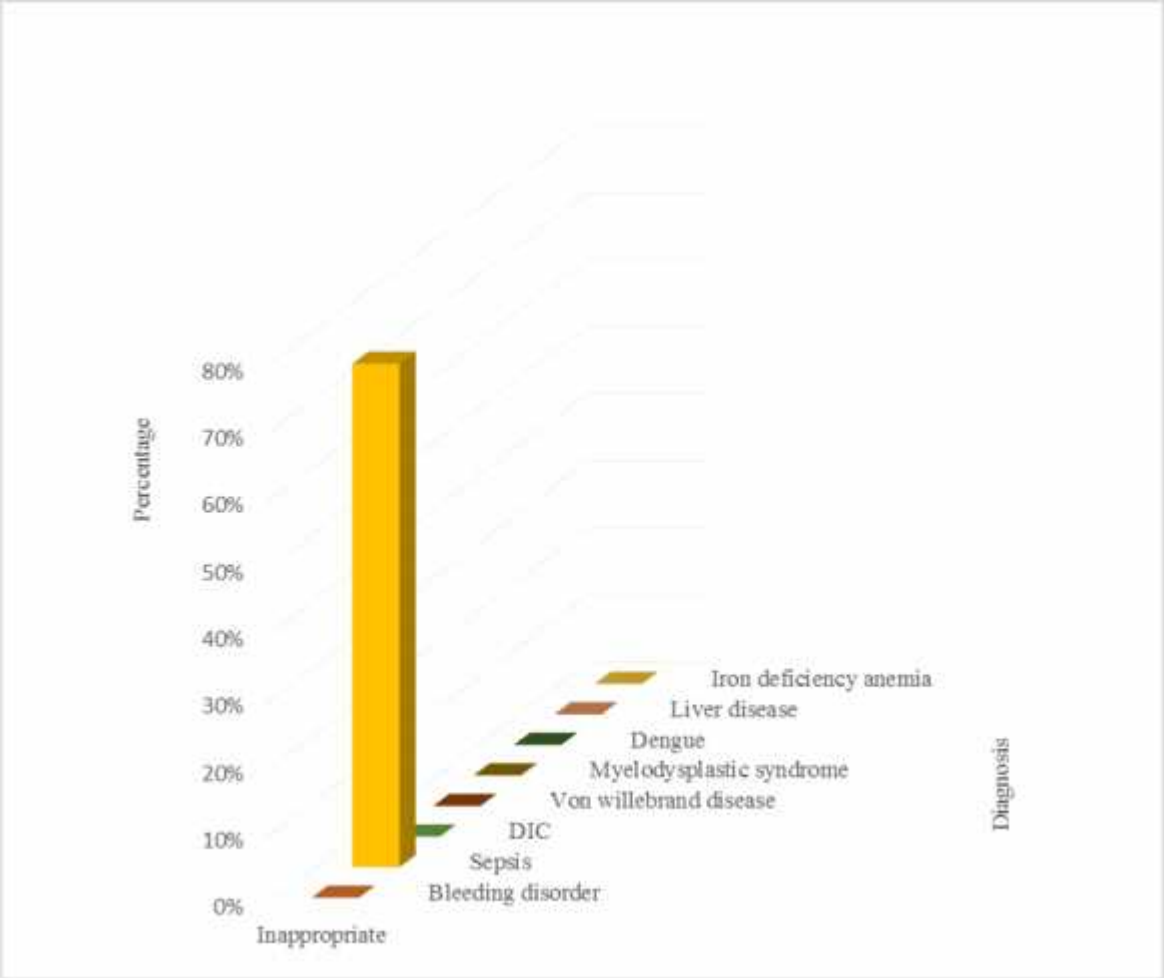
Out of 26 episodes of platelet transfusion, 7 episodes of transfusion were done for platelet count<10,000/cumm. 5 episodes of transfusion were done for count 11-20,000/cumm. 10 episodes of transfusion for count 21-40,000/cumm and 4 episodes of transfusion for count 41,000-1 lakh/cumm. Out of 12 episodes of transfusion for platelet count <20,000/cumm, 9 episodes of transfusion were done for bleeding manifestation and 3 episodes of transfusion were done for sepsis.

FRESH FROZEN PLASMA TRANSFUSION

TABLE 13: PERCENTAGE INAPPROPRIATENESS OF FFP TRANSFUSION

DIAGNOSIS	NO. OF TRANSFUSION EPISODES	APPROPRIATE	INAPPROPRIATE
Bleeding disorder	7	7 (100%)	0 (0%)
Sepsis	4	1 (25%)	3 (75%)
DIC	1	1 (100%)	0 (0%)
Von willebrand disease	2	2 (100%)	0 (0%)
Myelodysplastic syndrome	1	1 (100%)	0 (0%)
Dengue	2	2 (100%)	0 (0%)
Liver disease	1	1 (100%)	0 (0%)
Iron deficiency anemia	1	1 (100%)	0 (0%)

FIGURE 14: PERCENTAGE INAPPROPRIATENESS OF FFP TRANSFUSION



The most common indication for FFP transfusion was bleeding disorder accounting for 7 transfusion episodes. This was followed by sepsis, Von willebrand disease and dengue. 75% of inappropriate transfusions were done for sepsis.

INAPPROPRIATE USE OF INDIVIDUAL COMPONENT

Out of the total 214 episodes of blood and component transfusion, 88 (41.5%) episodes were judged inappropriate. Out of 102 episodes of whole blood transfusion, 76 (74.5%)episodes were found to be inappropriate. Out of 67 episodes of packed cell transfusion, 3 (4.5%) episodes were used inappropriately. Out of 26 episodes of platelet transfusion, 6 (23.1%) episodes were judged inappropriate and out of 19 episodes of FFP transfusion, 3 (15.8%) were judged inappropriate.

TABLE 14: DISTRIBUTION OF APPROPRIATE AND INAPPROPRIATE TRANSFUSIONS

COMPONENT	**APPROPRIATE**		**INAPPROPRIATE**		**TOTAL**
	EPISODE	**%**	**EPISODE**	**%**	
WB	26	25.5	76	74.5	102
PRBC	64	95.5	3	4.5	67
Platelet	20	76.9	6	23.1	26
FFP	16	84.2	3	15.8	19
Total	126	58.5	88	41.5	214

FIGURE 15: DISTRIBUTION OF APPROPRIATE AND INAPPROPRIATE TRANSFUSIONS

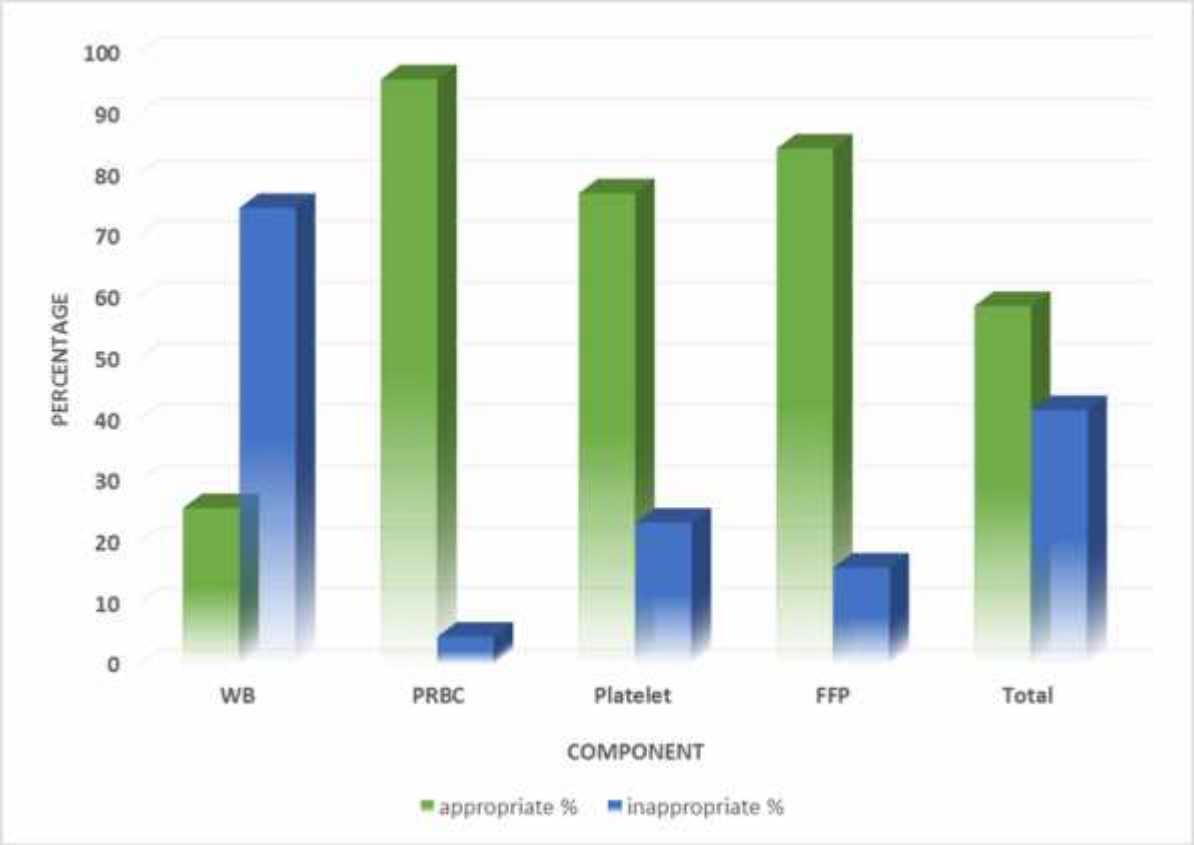


TABLE 15: ODD'S RATIO AND P-VALUE OF INAPPROPRIATE USE OF BLOOD COMPONENTS

COMPONENT	OR (95% CI)	P-VALUE
PRBC	1	
Platelet	6.4 (1.47-27.9)	**0.01**
FFP	4 (0.74-21.7)	0.11
WB	62.4 (18.03-215.6)	**<0.0001**

Odd's ratio for whole blood is 62.4 indicating that whole blood is most inappropriate component used. Platelet was the next used inappropriate component with odd's ratio 6.4. This was followed by inappropriate use of FFP with odd's ratio 4. Least inappropriately used component was PRBC with odd's ratio 1. The difference was found statistically significant. ($p<0.0001$)

DISCUSSION

Blood component therapy is a life-saving treatment to provide hemodynamic stability in critically ill children in intensive care setting.[29]

The purpose of blood transfusion is to replace lost blood, to increase the flow rate, to increase the blood elements, to replace the missing clotting factors and immune system elements.[30]

Appropriate use of blood is required to ensure the availability of blood for patients in whom it is really indicated, as well as to avoid unnecessary exposure of the patients to the risk of transfusion reactions and transmission of blood borne infections.[31]

According to WHO, appropriate use of blood products is defined as 'transfusion of safe blood products only to treat a condition leading to significant morbidity or mortality that cannot be prevented or managed effectively by other means'. The wide variation in the transfusion practice was due to absence of consensus on the most appropriate criteria for blood transfusion therapy; differences on blood component therapy guidelines; and the mixed effectiveness on the strategies in changing transfusion practice.[32]

Availability of allogeneic blood and its components have had important impact on surgical management of patients as well as other clinical healthcare issues such as resuscitation following trauma, radical surgeries, radical chemotherapy or radiotherapy including organ/tissue transplant are only possible when blood and blood products are available. When used appropriately blood and its components transfusion has continued to be invaluable in the management of patients.[33]

When the blood transfusion is correctly done, it is expected to raise the hemoglobin concentration, achieve hemodynamic stability, and cause the recipient no harm in terms of transfusion related infections or adverse events.[34]

Guidelines in children are different from those in adults, because of growth and development that must be taken into consideration.[35]

Despite the availability of guidelines, inappropriate use of blood and blood products is on the rise, both in developed and developing countries.[36]

Hence, regular audit of blood and its component usage is essential to access the blood utilization pattern and set ideal policies in all the blood using specialities.

The present study was conducted upon 149 pediatric patients receiving 214 episodes of component transfusion from December 2014 to June 2016. Of the total 214 transfusion episodes, 102 (47.7%) episodes were for whole blood, 67 (31.3%) episodes for packed red blood cells, 26 (12.1%) episodes for platelets concentrates and 19 (8.9%) episodes for fresh frozen plasma.

The demographic, clinical and laboratory parameters of all 149 patients were collected along with the indication for blood component transfusion. Of the total number of 214 episodes of transfusion, 88 episodes were for anemia which were the maximum episodes followed by 47 episodes for sepsis and 25 episodes for bleeding disorders. These were further categorized based on appropriateness of blood component therapy into appropriate and inappropriate groups depending on the indication for transfusion.

AUDIT OF THE USE OF BLOOD COMPONENT THERAPY

WHOLE BLOOD AND PACKED RED BLOOD CELL TRANSFUSION:

In practice, whole blood is rarely available and used infrequently for situations such as massive bleeding leading to hypovolemia, massive trauma and also during exchange transfusion. An urgent transfusion is recommended if the loss is more than 40% of the blood volume while in case of blood loss between 30% and 40% of the blood volume, presence of signs of inadequate perfusion mandates blood transfusion.[37]

Red cell units (RBCs, packed red cells) are prepared by removing plasma from whole blood, often replacing it with an additive solution for improved cell viability during extended storage. RBC volume ranges between 200ml and 350ml and the hematocrit from 55% to 80%. Transfusions of 8-10ml/kg of RBCs is expected to increase hemoglobin by 3 g/dl in children. The effect is also dependent on the patient's height and weight, the hemoglobin content of the unit and age of the red cells.[38]

RBC transfusions are used to improve oxygen delivery to tissues and to treat hemorrhage. Transfusion of RBCs should be based on the patient's clinical condition. Patients with symptomatic anemia should be transfused if they cannot function without the treatment of anemia. Symptoms of anemia include weakness, fatigue, dizziness, shortness of breath, reduced exercise tolerance, muscle cramps, changes in mental status, and angina or severe congestive heart failure.[38]

In our study, WB (47.7%) was utilized most frequently, followed by PRBCs (31.3%), platelet concentrate (12.1%) and fresh frozen plasma (8.9%). Utilization of WB as the most frequent component is in accordance with other studies.[30,34,39,40,41,42]

TABLE 16: COMPARISON OF PERCENTAGE OF USAGE OF WB

PUBLICATION	COMPONENT	PERCENTAGE OF USAGE
Efe S *et al*	WB	50%
Ughasoro MD *et al*	WB	56.4%
Agrawal VP *et al*	WB	46.5%
Gahine R *et al*	WB	57%
Gaur DS *et al*	WB	43.3%
Khan MM *et al*	WB	71.5%
Present study	WB	47.7%

In our study, maximum number of transfusions were received by children in the age group of 1-5 years accounting for 68.5%. This is in accordance with the study done by Khan et al.[42]

Overall prevalence of inappropriate use was 88 (41.5%) episodes. This percentage varies with the study done by various authors.[29,32,43,44,45,46]

TABLE 17: COMPARISON OF OVERALL PERCENTAGE OF INAPPROPRIATENESS IN VARIOUS STUDIES

PUBLICATION	OVERALL PERCENTAGE OF INAPPROPRIATENESS
Ahmed M *et al*	24.85%
Alcantara JC *et al*	35%
Katara AA *et al*	19%
Niraj G *et al*	59.3%
Richa S *et al*	37.3%
Sheikholeslami H *et al*	20.4%
Present study	41.5%

Out of the 102 episodes of whole blood transfusion, 76 (74.5%) episodes were judged inappropriate whereas out of the 67 episodes of packed red cell transfusion, 3 (4.5%) episodes were judged inappropriate. WB was the component used most inappropriately. This is in agreement with the results of similar studies done by other researchers.[2,32]

TABLE 18: COMPARISON OF PERCENTAGE OF INAPPROPRIATENESS OF WB

PUBLICATION	BLOOD COMPONENT	PERCENTAGE OF INAPPROPRIATENESS
Bhat AW *et al*	WB	71.4%
Alcantara JC *et al*	WB	61%
Present study	WB	74.5%

Most common indication for blood transfusion in our study was found to be anemia. WB was mostly received for sepsis and PRBCs were mostly received for thalassemia. Indications for receiving blood and component transfusion as mentioned by various other authors.[34,41,42,47,48,49,50]

TABLE 19: MOST COMMON INDICATION FOR WB AND PRBC TRANSFUSION IN VARIOUS STUDIES

PUBLICATION	COMPONENT TRANSFUSED	INDICATION	% OF USAGE
Ughasoro MD *et al*	Overall	Malignancy	31.7%
Gaur DS *et al*	Overall WB PRBC	Anemia Intraoperative Anemia	41.1% 53.56% 90.3%
Khan MM *et al*	Overall	Thalassemia	28.4%
Qureshi MZ *et al*	PRBC	Thalassemia	31.19%
Mosha D *et al*	Overall	Malaria	98%
Arewa OP *et al*	WB PRBC	Acute blood loss Anemia	53.8% 38%
Singh SP *et al*	Overall	Anemia	50.3%
Present study	Overall WB PRBC	Anemia Sepsis Thalassemia	41.1% 24.5% 41.7%

Other indications for WB transfusion in our study were thalassemia (18.6%), bleeding disorders (9.8%), protein energy malnutrition with dehydration (6.8%), iron deficiency anemia (5.8%) and intraoperative procedures (5.8%). PRBCs were transfused for sepsis (23.9%), iron deficiency anemia (13.4%) and intraoperative procedures (7.4%).

Ogunlesi TA *et al*[51] mentioned following indications for blood transfusion-jaundice in 62 (55.4%), severe anemia in 42 (37.5%), PDA with anemia in 3 (2.7%) and bleeding disorders in 5 (4.4%) patients. The authors concluded that whole blood was used in situations where red cell concentrate was most ideal.

Most common reason for inappropriate whole blood transfusion in our study was for achieving hemostasis in bleeding patients with normal platelet and coagulation profile. The reason for majority of the inappropriate usage of PRBCs were apprehension of immediate risks to the patient and misperception of the role of PRBCs. Hemoglobin threshold for both WB and PRBCs transfusion was found to be 10-12 g/dl.

Similar findings were observed in studies done by Efe S *et al*[30], Agrawal VP *et al*[39] and Qureshi MZ *et al*[47]. This is in contrast to the studies done by other authors.[29,34,48]

TABLE 20: COMPARISON OF HEMOGLOBIN THRESHOLD FOR WB AND PRBC TRANSFUSION

PUBLICATION	**HEMOGLOBIN THRESHOLD**
Ahmed M *et al*	<7-6 g/dl
Ughasoro MD *et al*	<5 g/dl
Mosha D *et al*	<6 g/dl
Present study	10-12 g/dl

Transfusion triggers stated by Alcantara JC *et al*[32] were low hemoglobin and active bleeding for WB and symptomatic anemia for PRBCs transfusion.

A multicenter, randomized, controlled clinical trial, in 1999 evaluated a restrictive transfusion trigger (hemoglobin level of 7 to 9 g/dl) versus liberal transfusion trigger (hemoglobin level of 10 to 12 g/dl) in critically ill patients. Restrictive transfusion practices resulted in decrease in the number of units transfused by 54% and a reduction in the 30-day mortality rate. Transfusion is recommended when the hemoglobin is less than 7 g/dl, and maintenance of hemoglobin level between 7 to 9 g/dl.[52,53]

In our study, packed red blood cells was used most appropriately accounting for 64 (95.5%) episodes. This is in contrast to the study done by Katara AA *et al*[43] on 267 pediatric patients receiving 312 episodes of transfusion. PRBC (278 episodes) was the component most frequently used with equal usage of Platelets and FFP (16 episodes). The component used in the least time was WB (02 episodes). Total inappropriate transfusions were 19%. PRBCs was the component most inappropriately used accounting for 23.7%, followed by FFP (12.1%), Platelet (12%) and WB (10%).

Dzik WH[54] in his study focused on transfusion support for the most severely anemic individuals and recommend 10 ml/kg of packed red blood cells (or 20 ml/kg of whole blood).

Bhave AA[55] in his study concluded that red blood cell transfusion should not be done for volume expansion, as a hematinic, to enhance wound healing or to improve general ‘well-being’.

In our study, P<0.0001 for whole blood states that the probability of occurrence of inappropriate transfusions with whole blood is highly significant. Inappropriate use of blood and blood components is significantly seen with different types of diseases (P value is 0.006).

The clinical and laboratory data collected indicate little need to transfuse patients with a Hb of 10 g/dl or higher. Between 8-10 g/dl, the risk of hypoxic damage is low for most patients. Patients with a Hb below 7 g/dl are usually at substantial risk. The decision to transfuse red cells should be made in conjunction with analysis of volume, pulmonary, cardiovascular and cerebrovascular status, duration of anemia and likelihood of unexpected acute blood loss.

From a general point of view, a decision to transfuse should always be based on the analysis of risk and benefit, and should consider two factors: (1) evaluation of the physiological needs of the patient and (2) transfusing only blood products that satisfy those physiological needs.[32]

PLATELET TRANSFUSION:

There is increasing demand for platelet transfusion, and it remains an ongoing challenge for most blood centers to maintain an adequate platelet inventory. There is no doubt that adequate platelet transfusions are beneficial and that they have permitted the use of more aggressive chemotherapy and bone marrow transplantation. However, there is still controversy regarding when platelets should be administered to maximize their benefit while minimizing the risk of bleeding.[56]

According to the data collected in the last 10 years, there is no real threshold for bleeding complications. Other factors affect bleeding risk, such as platelet function, rapid platelet consumption during febrile episodes, plasma coagulation factor deficiencies and local factors such as vascular lesions or organ infiltrations.[56]

It is believed that the use of prophylactic platelet transfusions to keep the platelet count above 10 x 10^9 /L reduces the risk of haemorrhage as effectively as keeping it above any higher level. On the other hand, in the presence of factors such as fever or infection, ongoing chemotherapy, concurrent coagulopathy, rapid fall in platelet count or in the presence of potential bleeding sites as a result of surgery, the use of platelet transfusion to keep the platelet count above 20 x 10^9 /L is clinically justified.[57]

In our study, out of 214 episodes of blood transfusion, 26 (12.1%) episodes of platelet transfusion were done. Out of these 7 episodes were for platelet count <10,000/mm^3, 5 episodes were for platelet count 11-20,000/mm^3, 10 episodes were for count 21-40,000/mm^3 and 4 episodes were for count 41- 1,00,000/mm^3. 6 (23.1%) episodes with platelet count >20,000/mm^3 in absence of bleeding or sepsis received inappropriate transfusion.

Similar findings were seen in the study conducted by Pallavi P *et al*[31] on 343 dengue positive patients, out of which 71 patients received platelet transfusion. Out of these, 15 patients had platelet count <10,000/mm^3, 19 patients with platelet count 11-20,000/mm^3, 28 patients with count 21-40,000/mm^3 and 9 patients with count 41-1,00,000/mm^3. 26 (36.62%) patients with platelet count >20,000/mm^3 in absence of bleeding or sepsis received inappropriate transfusion.

Jamal R *et al*[57] conducted a study on 119 patients out of which 22 (18.5%) cases were judged as inappropriate. Out of the 22 cases, 6 cases had platelet count < 20 x 10^9 /L and 16 cases had platelet count > 20 x 10^9 /L. Inappropriate usage was due to platelet transfusion been done in the absence of bleeding.

Efe S *et al*[30] evaluated 1010 patients receiving 80 units of platelet transfusion. 45 (8.4%) units were received to patients with platelet levels below 10 x 10^9 /L, 19 (23.8%) units were received to patients with platelet levels below 10 x 10^9 - 30 x 10^9 /L with bleeding, 13 (16.2%) units in surgical patients with average platelet count 30 x 10^9 - 50 x 10^9 /L and 3 (3.8%) were received to patients with platelet levels higher than 50 x 10^9 /L.

TABLE 21: COMPARISON OF NUMBER OF TRANSFUSION EPISODES DEPENDING ON PLATELET COUNT

Platelet count	Pallavi P *et al*	Jamal R *et al*	Efe S *et al*	Present study
<20 x 10^9 /L	34 episodes	6 episodes	64 episodes	12 episodes
>20 x 10^9 /L	37 episodes	16 episodes	16 episodes	14 episodes

In our study, the most common reason for inappropriate platelet transfusion was seen with sepsis (100%), dengue (25%) and bleeding disorder (20%). Similar findings were observed in study done by Ahmed et al[29] on 122 patients, out of which 23 (14.28%) patients received platelet transfusion. Maximum inappropriateness was seen with platelet transfusion accounting for 26.09% transfusions. The reason for inappropriate usage was transfusion been done in dengue and idiopathic thrombocytopenia without bleeding.

A study conducted by Alcantra JC *et al*[32] on 1075 transfusion events showed 91 episodes of platelet transfusion. Out of these 91 episodes, 16% were judged

inappropriate. Common transfusion triggers were active bleeding with thrombocytopenia, prophylactic administration with severe thrombocytopenia and thrombocytopenia in patients undergoing surgery on critical area or in patients undergoing invasive procedure.

Percentage of inappropriate usage of platelets in our study accounts to 23.1%. This percentage varies with the study done by various authors.[29,31,32,46,58]

TABLE 22: COMPARISON OF PERCENTAGE OF INAPPROPRIATENESS OF PLATELET

PUBLICATION	**PERCENTAGE OF INAPPROPRIATENESS**
Ahmed M *et al*	26.09%
Pallavi P *et al*	36.62%
Alcantara JC *et al*	16%
Sheikholeslami H *et al*	40.8%
Schofield WN *et al*	33%
Present study	23.1%

Bhave AA *et al*[55] in his study concluded that platelet transfusion is not indicated in ITP (unless bleeding), TTP/HUS, drug induced, cardiac bypass associated thrombocytopenia and asymptomatic thrombocytopenia.

Lye DC *et al* [59] analyzed 256 patients with dengue infection who developed thrombocytopenia (platelet count < 20 x 10^9 /L) without prior bleeding. Out of 256

patients, 188 were given platelet transfusion. It was concluded that prophylactic platelet transfusion was ineffective in preventing bleeding in patients with dengue infection.

The efficacy of prophylactic platelet transfusion and the threshold for transfusion is questionable. Circulating platelets are hematologically active and sufficient to prevent bleeding by thrombocytopenia per se, therefore, platelet transfusions are hardly ever required even with counts as low as 10,000/mm^3. In general, platelet transfusions are indicated only when there are serious hemorrhagic manifestations. Transfusion requirements correlate with the occurrence of bleeding from the gastrointestinal tract but not with the platelet count. Strict bed rest and protection from trauma to reduce the risk of bleeding is recommended in patients with profound thrombocytopenia.[31]

According to the guidelines by Ministry of Health, Srilanka there is no place for prophylactic platelet even with a count below 10,000/mm^3 if there is absence of bleeding. Considering the various guidelines and several studies done it is clear that platelet count alone does not predict the severity of bleeding. Hence, the hemodynamic status and signs of sepsis must be taken into consideration before giving prophylactic platelet transfusion to a high risk group patients with platelet count <20,000/mm^3. [31]

In our study, the clinical outcome in a cohort of children who received platelet transfusion therapy was assessed in terms of appropriateness of blood transfusion. Platelet transfusion in children with platelet <20,000/mm^3 with presence of bleeding were considered appropriate and were compared to children who received platelet transfusion for counts > 20,000/mm^3.

In the developing world a considerable heterogeneity exists for platelet transfusion practices between countries and even within countries in hospitals where this precious resource is available.[60]

Best platelet transfusion practices needs to be implemented as the platelet products are scarce and expensive. An effective way of increasing the likelihood of improving transfusion practices is by performing a regular medical audit or a blood utilization review. Constitution of a hospital transfusion committee, with constant communication, interaction and co-ordination amongst clinicians and transfusion medicine specialist, as well as continuing medical educational programmes for prescribing clinicians and blood transfusion personnel would also be helpful in promoting appropriate use of blood.

FRESH FROZEN PLASMA TRANSFUSION:

Plasma units are biological products containing the acellular portion of blood obtained from a whole-blood donation after centrifugation or by plasmapheresis. Most plasma units contain 200-250 ml, but plasmapheresis derived units may contain as much as 400-600 ml.[61]

The appropriate use of FFP requires an understanding of the properties of FFP and its adequacies, as well as an appreciation of the complications of FFP usage.[36] Contrary to the belief of many clinicians, FFP transfusions are not at risk. Bioactive substances (histamine, eosinophil cationic protein, eosinophil protein X, myeloperoxidase and interleukin-6) are present in FFP responsible for transfusion related acute lung injury

(TRALI), adult respiratory distress syndrome (ARDS), febrile non-hemolytic transfusion reactions (FNHTR), fatal shock in septicaemia and possibly immunosuppression.[62]

According to Bhave AA[55], FFP is not indicated in hypovolemia, immunodeficiency state, volume expansion and nutrient supplementation.

In our study, out of total 214 episodes of transfusion, 19 (8.87%) episodes of FFP transfusion were done. Of these 3 (15.8%) episodes of FFP were judged inappropriate.

In the present study, most common inappropriate usage was for patients with sepsis accounting to 75%. In 2 of these 3 patients coagulogram was not done whereas 1 patient showed PT and APTT < 1.5 times that of the normal range with INR 0.93. Similar findings were observed in studies done by Iqbal H *et al*[63] and Luk C *et al* [64].

This is in contrast to studies done by Kulkarni N *et al*[65], Pahuja S *et al*[66], Patel VR *et al*[67] and Emektar E *et al*[68].

TABLE 23: COMPARISON OF REASONS FOR INAPPROPRIATENESS OF FFP TRANSFUSION IN VARIOUS STUDIES

PUBLICATION	REASON FOR INAPPROPRIATENESS
Iqbal H *et al*	Bleeding with no coagulation test
Luk C *et al*	Active bleeding with INR<1.5 times the normal
Kulkarni N *et al*	Bleeding or surgical intervention
Pahuja S *et al*	Normal/mildly elevated coagulation profile irrespective of bleeding status
Patel VR *et al*	Raised INR without bleeding
Emektar E *et al*	No active bleeding or prophylaxis for surgery
Present study	Bleeding with no coagulation test/ INR <1.5 times the normal

Jayanthi N *et al*[69] studied 100 patients who received FFP transfusion, out of which 24% were found to be inappropriate. Most common inappropriate usage for patients undergoing surgery. Other reasons for which FFP was transfused were DIC and coagulation factor deficiency.

Chng WJ *et al*[36] conducted a study on 359 patients receiving 932 episodes of FFP transfusion. Out of 932 episodes, 653 (70.06%) episodes were judged inappropriate. 71% inappropriate episodes were in patients with DIC in the absence of bleeding. PT and/or APTT were not more than 1.5 times that of the normal in 66% and 72% patients,

respectively. For liver disease and warfarin reversal, 71% and 44% transfusions were done in the absence of bleeding or planned surgery, respectively.

In the present study, the percentage of inappropriate usage of FFP was found to be 15.8%. this varies with the studies done by various authors.[36,63,64,65,66,67,68,69,70]

TABLE 24: COMPARISON OF PERCENTAGE OF INAPPROPRIATENESS OF FFP

PUBLICATION	PERCENTAGE OF INAPPROPRIATENESS
Chng WJ *et al*	70.06%
Iqbal H *et al*	56%
Luk C *et al*	45%
Kulkarni N *et al*	52%
Pahuja S *et al*	78.2%
Patel VR *et al*	62%
Emektar E *et al*	59.6%
Jayanthi N *et al*	24%
Chaudhary R *et al*	70.43%
Present study	15.8%

In the present study, most common indications for FFP transfusion were bleeding disorder (36.8%), sepsis(21%), Von willebrand disease(2%) and dengue(2%). Other less common indications were DIC, liver disease, myelodysplastic syndrome and iron deficiency anemia.

Labarinas S *et al*[61] did a study on 121 critically ill patients who received plasma for moderately abnormal coagulation test (INR <1.85), only 1 was able to correct his INR

(<1.1) after the plasma transfusion. It was concluded that, whatever the volume, plasma transfusion do not correct moderate coagulopathy with INR <2.0-2.5.

Dzik WH[54] had suggested that inappropriate FFP orders occur because of 3 assumptions: (1) elevation of prothrombin time (PT/INR) will predict bleeding in the setting of a procedure. (2) preprocedure administration of FFP will correct the prolonged clotting time results. (3) prophylactic transfusion results in fewer bleeding events.

Ahmed M *et al*[29] in his study on 122 patients receiving 161 episodes of transfusion, 16.67% episodes of FFP transfusion were found to be inappropriate. The reason for inappropriateness was due to altered Ryle tube aspirate and replacement in view of ascitic tapping with pretransfusion INR <1.5.

Efe S *et al*[30] studied 1010 patients receiving 392 episodes of FFP transfusion. 106 (27%) episodes were indicated in patients with INR higher than normal levels, 39 (9.9%) episodes were in cases with active bleeding depending on factor deficiency. 87 (22.2%) episodes were in septicemia, DIC and 6 (1.5%) episodes were in patients with higher levels INR because of organophosphorus poisoning.

Non adherence to the guidelines and inadvertent use of FFP is a major problem. To make appropriate interventions to prevent misuse of this valuable commodity concurrent audit of FFP use needs to be done.[36] There are certain situations where FFP is clearly indicated, such as in patients with active bleeding or those with thrombotic thrombocytopenic purpura (TTP), in patients with coagulopathy who are undergoing invasive procedures and in patients with liver failure with active bleeding.[62]

However, there are many instances where FFP use is either controversial or not indicated, such as specific factor deficiency, patients needing volume expansion. Furthermore, FFP is capable of transmitting viruses like Human immunodeficiency virus, Hepatitis B and Hepatitis C virus.[21] Hence, FFP should be used only if clearly indicated, as its use is not without potential danger.

CONCLUSION AND SUMMARY

- The present study was conducted upon 149 paediatric patients from 1st December 2014 to 30th June 2016.
- The over view of appropriateness of transfusion of various blood components in our study revealed that of the total 214 transfusion episodes, 88(41.5%) were inappropriate.
- Maximum number of inappropriate transfusions were with whole blood followed by platelets, FFP and PRBCs.
- 76(74.5%) episodes of inappropriate whole blood transfusion was for achieving hemostasis in bleeding patients.
- 6 (23.1%) episodes of platelet transfusion were inappropriate with platelet count >20,000/mm^3 in absence of bleeding or sepsis received inappropriate transfusion.
- 3 (15.8%) of inappropriate usage FFP was for bleeding with no coagulation test/ INR <1.5 times the normal.
- It was observed that 3(4.5%) episodes of inappropriate usage of PRBCs were apprehension of immediate risks to the patient and misperception of the role of PRBCs.
- Restrictive transfusion strategy can be followed to optimize the use of blood and blood components.
- Inappropriate transfusions in anemia can be reduced by reducing the transfusion trigger to Hb<10 gm/dl.
- Educational programmes addressing appropriate use of blood products should be continued in order to decrease the risk of inappropriate transfusions.

- The requirements to meet established criteria is an effective mechanism to improve transfusion practices.

LIMITATIONS OF THE STUDY

1) Use of laboratory criteria alone cannot be used to determine the request for transfusion. Ideally clinical status and laboratory reports should be considered.
2) The present study did not include all the blood components like cryoprecipitate, intravenous immunoglobulin.

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ANNEXURE-I

B.L.D.E. UNIVERSITY'S
SHRI.B.M.PATIL MEDICAL COLLEGE, BIJAPUR-586 103
INSTITUTIONAL ETHICAL COMMITTEE

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 22-11-2014 *at* 3-30pm *to scrutinize the Synopsis of Postgraduate Students of this college from Ethical Clearance point of view. After scrutiny the following original/corrected & revised version synopsis of the Thesis has been accorded Ethical Clearance.*

Title "Utility of Blood Components in Paediatric Patients and Audit"

Name of P.G. student Dr. Shefali Goyal.
Dept of Pathology

Name of Guide/Co-investigator Dr R.M. Patekar Professor.
Dept of Pathology.

for
DR.TEJASWINI VALLABHA
CHAIRMAN
INSTITUTIONAL ETHICAL COMMITTEE
BLDEU'S, SHRI.B.M.PATIL
MEDICAL COLLEGE, BIJAPUR.

Following documents were placed before E.C. for Scrutinization
1) Copy of Synopsis/Research project.
2) Copy of informed consent form
3) Any other relevant documents.

ANNEXURE-II

B.L.D.E.UNIVERSITY, SHRI B.M.PATIL MEDICAL COLLEGE HOSPITAL AND RESEARCH CENTER, VIJAYAPUR-586103

INFORMED CONSENT FORM FOR DISSERTATION/RESEARCH

I, the undersigned_____, S/O D/O W/O , aged _____ years, ordinarily resident of do hereby state/declare that Dr. _____ of Hospital has examined me thoroughly on _____ at (place) and it has been explained to me in my own language.

Further Doctor SHEFALI GOYAL informed me that he/she is conducting dissertation/research Titled "UTILITY OF BLOOD COMPONENTS IN PEDIATRIC PATIENTS – AN AUDIT" under the guidance of Dr R.M. POTEKAR requesting my participation in the study.

Further doctor has informed me that my participation in this study help in evaluation of the results of the study which is useful reference to treatment of other similar cases in near future.

The Doctor has also informed me that information given by me, observations made/ photographs/ video graphs taken upon me by the investigator will be kept secret and not assessed by the person other than me or my legal hirer except for academic purposes.

The Doctor did inform me that though my participation is purely voluntary, based on information given by me, I can ask any clarification during the course of treatment / study related to diagnosis, procedure of treatment, result of treatment or prognosis. At the

same time I have been informed that I can withdraw from my participation in this study at any time if I want or the investigator can terminate me from the study at any time from the study but not the procedure of treatment and follow-up unless I request to be discharged.

After understanding the nature of dissertation or research, diagnosis made, mode of treatment,

I the undersigned Shri/ Smt _____ under my full conscious state of mind agree to participate in the said research/ dissertation.

Signature of patient:

Signature of doctor:

Witness: 1.

2.

Date:

Place:

ANNEXURE III

PROFORMA

NAME	:	OP/IP No.	:
AGE	:		
SEX	:	D.O.A	:
RELIGION	:	D.O.D	:
OCCUPATION	:		
RESIDENCE	:		
Presenting Complaints	:		
Past history	:		
Personal history	:		
Family history	:		
Treatment history	:		

General physical examination:

Pallor	present/absent
Icterus	present/absent
Clubbing	present/absent
Lymphadenopathy	present/absent
Edema	present/absent
Built	poor/average/well

VITALS: PR: RR:

BP: TEMPERATURE:

WEIGHT:

SYSTEMIC EXAMINATION:

Cardiovascular system

Respiratory system:

Per Abdomen:

Central nervous system:

Clinical Diagnosis:

INVESTIGATIONS

1. Hematological investigations:

Pretransfusion

Parameters	
WBC	
RBC	
HGB	
HCT	
MCV	
MCH	
MCHC	
PLATELETS	
LYMPHOCYTES(%)	
MIXED (%)	
NEUTROPHILS (%)	
RDW	
PDW	
MPV	
P-LCR	

Postransfusion

Parameters	
WBC	
RBC	
HGB	
HCT	
MCV	
MCH	
MCHC	
PLATELETS	
LYMPHOCYTES(%)	
MIXED (%)	
NEUTROPHILS (%)	
RDW	
PDW	
MPV	
P-LCR	

2. Coagulogram:

Bleeding Time:

Clotting Time:

Prothrombin Time:

Activated Partial Thromboplastin Time:

3. Peripheral Smear Examination:

RBC:

WBC:

PLATELETS:

IMPRESSION:

FOR BLOOD TRANSFUSION –

Blood group of the patient:

Name of blood and blood product transfused:

Quantity of blood transfused:

Number of transfusions (single/multiple):

Indication for transfusion:

Is the transfusion appropriate/inappropriate:

Post transfusion complications:

KEY TO MASTER CHART

F	Female
M	Male
WB	Whole blood
FFP	Fresh frozen plasma
PRBC	Packed red blood cell
ml	Milliliter
MDS	Myelodysplastic syndrome
PEM	Protein energy malnutrition
ALL	Acute lymphoblastic leukemia
DIC	Disseminated intravascular coagulation

Sl. No.	NAME	AGE (YEARS)	SEX	IP NO.	DIAGNOSIS	BLOOD GROUP	BLOOD PRODUCT TRANSFUSED	QUAN TITY	NO. OF TRANSFUSIONS	INDICATION	APPROPRIATE/ INAPPROPRIATE
1.	Satyakka	6	F	36021/2014	bleeding disorder	O+ve	WB FFP WB Platelet PRBC	250ml 150ml 100ml 1unit 220ml	multiple	anemia , thrombocytopenia	inappropriate, appropriate inappropriate, inappropriate, appropriate
2.	Sarvesh	1 ½	M	12920/2015	thallessemia major	B+ve	PRBC	120ml	single	anemia	appropriate
3.	Akash	8	M	37024/2014	thallessemia major	O+ve	PRBC	200ml	single	anemia	appropriate
4.	Sunil	6	M	12800/2015	thallessemia major	O+ve	PRBC	350ml	single	anemia	appropriate
5.	Haniyanum	3	F	34683/2014	congenital dyserythropoietic anemia	O+ve	PRBC	150ml	single	anemia	appropriate
6.	Adhik	5	M	10993/2015	thallessemia major	AB+ve	PRBC	200ml	single	anemia	appropriate
7.	Mamallesh	5	M	35466/2014	sepsis	AB+ve	Platelet	80ml	single	thrombocytopenia	inappropriate
8.	Vittal	6	M	33034/2014	thallessemia major	B+ve	PRBC	250ml	single	anemia	appropriate
9.	Sushmita	2	F	39113/2014	sepsis	O+ve	Platelet FFP WB	120ml 150ml 250ml	multiple	anemia , thrombocytopenia	inappropriate, inappropriate, inappropriate
10.	Sajan	3	F	36001/2014	thallessemia major	B+ve	PRBC	120ml	single	anemia	appropriate
11.	Mahanada	12	F	32642/2014	dengue	O+ve	Platelet Platelet	60ml 60ml	multiple	thrombocytopenia	appropriate, appropriate

12.	Samarth s	1	M	2498/2015	sepsis	B+ve	WB	150ml	single	anemia , leucopenia, thrombocytopenia	appropriate
13.	Manzit	2	M	2932/2015	bleeding disorder	O+ve	WB	130ml	single	anemia	inappropriate
14.	Siddu	3	M	1840/2015	iron deficiency anemia	B+ve	WB	200ml	single	anemia	inappropriate
15.	Adarsh	6	M	519/2015	sepsis	O+ve	WB	170ml	single	anemia	inappropriate
16.	Tejaswini	3	F	217/2015	sepsis	B+ve	PRBC	100ml	single	anemia	appropriate
17.	Rakesh	5	M	442/2015	thallessemia major	O+ve	WB	160ml	single	anemia	appropriate
18.	Umesh	1	M	1338/2015	iron deficiency anemia	O+ve	PRBC	160ml	single	anemia	inappropriate
19.	Tipanna	4	M	3815/2015	thallessemia major	B+ve	PRBC	250ml	single	anemia	appropriate
20.	Pratibha	7	F	3962/2015	thallessemia major	O+ve	PRBC	250ml	single	anemia	appropriate
21.	Mallikarjun	3	M	4017/2015	thallessemia major	B+ve	PRBC	100ml	single	anemia	appropriate
22.	Rakesh	5	M	8400/2015	thallessemia major	B+ve	WB	200ml	single	anemia	appropriate
23.	Bhagyashree	10	F	7814/2015	sepsis	B+ve	WB	350ml	single	anemia	inappropriate
24.	Prajwal	9	M	7181/2015	thallessemia major	O+ve	WB	250ml	single	anemia	appropriate
25.	Saajan	3	F	9995/2015	congenital dyserythropoietic anemia	B+ve	WB	150ml	single	anemia	inappropriate
26.	Pooja	4	F	8293/2015	sepsis	O+ve	FFP	150ml	single	anemia	inappropriate
27.	Shreya	3	F	9443/2015	sepsis	O+ve	WB	400ml	single	anemia	inappropriate
28.	Sujain	3	M	9235/2015	iron deficiency anemia	O+ve	PRBC	250ml	single	anemia	appropriate
29.	Sanika	1	F	9296/2015	sepsis	B+ve	PRBC	150ml	single	anemia	appropriate
30.	Deepika	6	F	7891/2015	iron deficiency anemia	B+ve	PRBC	250ml	single	anemia	inappropriate

31.	Samarth g	1 ½	M	5921/2015	congenital dyserythropoietic anemia	A+ve	WB	200ml	single	anemia	inappropriate
32.	Basavaraj	11	M	5058/2015	bleeding disorder	B+ve	WB Platelet PRBC	1unit 3units 1unit	multiple	anemia, thrombocytopenia	inappropriate, appropriate, appropriate
33.	Nagaraj	12	M	4217/2015	liver disease	O+ve	Platelet FFP	100ml 150ml	multiple	thrombocytopenia	appropriate, appropriate
34.	Samarth y	2	M	4240/2015	iron deficiency anemia	O+ve	WB	200ml	single	anemia	inappropriate
35.	Rehan	5	M	4358/2015	iron deficiency anemia	B+ve	WB	250ml	single	anemia	inappropriate
36.	Sanganagouda	3	F	3590/2015	MDS	A+ve	WB Platelet FFP WB Platelet Platelet	150ml 1unit 150ml 150ml 1unit 1unit	multiple	anemia	inappropriate, appropriate, appropriate, inappropriate, appropriate, appropriate
37.	Akshata s	13	F	16626/2015	iron deficiency anemia	AB+ve	PRBC	350ml	single	anemia	appropriate
38.	Saurabh a	1	M	10664/2015	thallessemia major	O+ve	PRBC	100ml	single	anemia	appropriate
39.	Mahesh l	5	M	10768/2015	thallessemia major	O+ve	PRBC	250ml	single	anemia	appropriate
40.	Asmita D	1	F	11321/2015	intra-operative	O+ve	WB WB	150ml 150ml	multiple	anemia	inappropriate inappropriate
41.	Samarth	2	M	11613/2015	congenital dyserythropoietic anemia	A+ve	WB WB	200ml 100ml	multiple	anemia	inappropriate inappropriate
42.	Ganesh p	4	M	6994/2015	sepsis	B+ve	WB	250ml	single	anemia	inappropriate
43.	Sateesh kumar	5	M	19013/2015	thallessemia major	O+ve	PRBC PRBC	100ml 100ml	multiple	anemia	appropriate, appropriate
44.	Gangadhar I	2	M	17409/2015	iron deficiency anemia	B+ve	PRBC PRBC	150ml 150ml	multiple	anemia	appropriate appropriate

45.	Sajan K	3	F	17408/2015	thallessemia major	B+ve	PRBC	200ml	single	anemia	appropriate
46.	Ajith M	3	M	6757/2015	liver disease	B+ve	WB	200ml	single	anemia, thrombocytopenia, abnormal coagulogram	appropriate
47.	Karthika A	1 ½	F	17447/2015	intra-operative	O+ve	PRBC	130ml	single	anemia	appropriate
48.	Sajan K	3	M	19220/2015	thallessemia major	B+ve	WB	200ml	single	anemia	appropriate
49.	Farhana M	8	F	18999/2015	thallessemia major	B+ve	PRBC WB	150ml 350ml	multiple	anemia	appropriate appropriate
50.	Arati s	1	F	18594/2015	Megaloblastic anemia	O+ve	PRBC	50ml	single	anemia	appropriate
51.	Sanganagouda	3	M	18357/2015	bleeding disorder	A+ve	WB WB Platelet WB	200ml 100ml 1unit 200ml	multiple	anemia, thrombocytopenia	inappropriate inappropriate appropriate inappropriate
52.	Sukanya N	1 ½	F	12406/2015	PEM	A+ve	WB	100ml	single	anemia	inappropriate
53.	Shreya J	1	F	13629/2015	PEM	B+ve	WB	120ml	single	anemia	inappropriate
54.	Shankreppa g	5	M	13622/2015	sepsis	A+ve	WB	200ml	single	pancytopenia	appropriate
55.	Danamma s	1	F	13609/2015	PEM	O+ve	WB	100ml	single	anemia	inappropriate
56.	Ayesha M	3	F	14192/2015	ALL	A+ve	WB Platelet WB	200ml 1 unit 100ml	multiple	pancytopenia abnormal coagulogram	appropriate appropriate appropriate
57.	Sanika y	4	F	15903/2015	Von willebrand disease	AB+ve	FFP FFP	1unit 1 unit	multiple	anemia abnormal coagulogram	appropriate appropriate
58.	Spoorti	3	F	17704/2015	sepsis	A-ve	WB	150ml	single	anemia	inappropriate
59.	Mohammadjair	1	M	17670/2015	liver disease	O+ve	WB	200ml	single	anemia	inappropriate
60.	Amit n	5	M	17794/2015	liver disease	B+ve	WB WB	200ml 150ml	multiple	anemia, thrombocytopenia	inappropriate inappropriate

61.	Sharath s	1	M	20850/2015	bleeding disorder	O+ve	FFP	150ml	single	abnormal coagulogram	appropriate
62.	Mohammadishaik	9	M	13662/2015	intra-operative	B-ve	WB	300ml	single	anemia, leucopenia	inappropriate
63.	Afsana D	4	F	20679/2015	thallessemia major	B+ve	WB	300ml	single	anemia	appropriate
64.	Mallappa M	5	M	18045/2015	bleeding disorder	A+ve	WB	350ml	single		inappropriate
65.	Mehak	2	F	16897/2015	thallessemia major	O+ve	WB	120ml	single	anemia	appropriate
66.	Santosh s	1	M	14306/2015	PEM	B+ve	WB	100ml	single	anemia	inappropriate
67.	Ravi s	7	M	15881/2015	intra-operative	O+ve	WB WB	150ml 150ml	multiple	anemia	inappropriate inappropriate
68.	Shridhar M	14	M	24323/2015	bleeding disorder	O+ve	WB	350ml	single	anemia, abnormal coagulogram	inappropriate
69.	Satishkumar	5	M	24950/2015	Thallessemia major	O+ve	WB	350ml	single	anemia	inappropriate
70.	Varsha R	1	F	22538/2015	sepsis	O+ve	WB	100 ml	single	anemia	inappropriate
71.	Sajan K	3	M	26278/2015	thallessemia major	B+ve	WB WB	200 ml 150 ml	multiple	anemia	inappropriate inappropriate
72.	Chinnu B	3	M	26266/2015	sepsis	A+ve	WB WB	160 ml 160 ml	multiple	anemia	inappropriate inappropriate
73.	Parashuram M.	2	M	26888/2015	Malaria fever	AB+ve	WB WB WB	30 ml 50 ml 50 ml	multiple	anemia, thrombocytopenia	appropriate appropriate appropriate
74.	Shankaraling P.	3	M	20906/2015	liver disease	B+ve	WB	220 ml	single	anemia, thrombocytopenia	appropriate
75.	Mehak D	2	M	27976/2015	thallessemia major	O+ve	WB	150 ml	single	anemia	inappropriate
76.	Apasan D	4	F	27974/2015	thallessemia major	B+ve	WB	350 ml	single	anemia	inappropriate

77.	Shankar N	2	M	27950/2015	Dengue fever	A+ve	FFP WB	150 ml 100ml	multiple	anemia, thrombocytopenia	appropriate appropriate
78.	Sanganagouda R	3	M	28450/2015	MDS	A+ve	WB	120 ml	single	anemia, thrombocytopenia	appropriate
79.	Gayatri A.	2	F	26096/2015	thallessemia major	O+ve	PRBC PRBC PRBC PRBC	50 ml 75 ml 110 ml 100 ml	multiple	anemia	appropriate appropriate appropriate appropriate
80.	Bhavani M	4	F	26887/2015	Malaria fever	B+ve	PRBC	100 ml	single	anemia, thrombocytopenia	appropriate
81.	Pratibha D.	6	F	26639/2015	sepsis	A+ve	PRBC PRBC	100 ml 100 ml	multiple	anemia	appropriate appropriate
82.	Bhuvaneshwari	2	F	27591/2015	thallessemia major	A+ve	PRBC PRBC	70 ml 100 ml	multiple	anemia	appropriate appropriate
83.	Sainath D.	3	M	27294/2015	iron deficiency anemia	O+ve	PRBC PRBC	100 ml 100 ml	multiple	anemia	appropriate appropriate
84.	Saurabh	13	M	25894/2015	Dengue fever	A+ve	Platelet Platelet	50 ml 50ml	multiple	thrombocytopenia	inappropriate inappropriate
85.	Sabamma N.	14	F	35417/2015	megaloblastic anemia	A+ve	WB WB	350 ml 350 ml	multiple	pancytopenia	appropriate appropriate
86.	Karan G	8	M	33937/2015	Sickle cell anemia	A+ve	WB PRBC	350 ml 150 ml	multiple	anemia	inappropriate appropriate
87.	Nidafsha M	2	F	31774/2015	sepsis	B+ve	WB FFP	200 ml 100 ml	multiple	anemia, thrombocytopenia	appropriate appropriate
88.	Vinod	2	M	32339/2015	Iron deficiency anemia	O+ve	WB	200 ml	single	anemia	inappropriate

89.	Sushmita S.	7	F	32012/2015	sepsis	A+ve	WB	350 ml	single	anemia	inappropriate
90.	Vijayakumar R.	14	M	32092/2015	thallessemia major	O+ve	WB WB	350 ml 350 ml	multiple	anemia	inappropriate inappropriate
91.	Nikita V.	2	F	34770/2015	thallessemia major	A+ve	WB WB	250 ml 150 ml	multiple	anemia	inappropriate inappropriate
92.	Sanvi M.	4	F	34025/2015	sepsis	B+ve	PRBC PRBC	160 ml 90 ml	multiple	anemia	appropriate appropriate
93.	Kushi D.	1	F	34931/2015	thallessemia major	B+ve	PRBC PRBC	100 ml 100 ml	multiple	anemia	appropriate appropriate
94.	Shravya R	1 ½	F	34762/2015	sepsis	B+ve	PRBC	150 ml	single	anemia	appropriate
95.	Vishal T.	7	M	34591/2015	sepsis	O+ve	PRBC	150 ml	single	anemia	appropriate
96.	Karthik K	1	M	40814/2015	sepsis	O+ve	WB WB	150 ml 200 ml	multiple	anemia	inappropriate inappropriate
97.	Danamma s	7	F	40125/2015	Dengue fever	B+ve	WB	200 ml	single	pancytopenia	appropriate
98.	Shravani R	1	F	40019/2015	PEM	A+ve	WB	350 ml	single	anemia	inappropriate
99.	Daneshwari S.	8	F	39325/2015	Complicated malaria	B+ve	WB PRBC WB	350 ml 250 ml 350 ml	multiple	anemia, thrombocytopenia	inappropriate appropriate inappropriate
100.	Haniyanum	4	F	38198/2015	thallessemia major	O+ve	PRBC	180 ml	single	anemia	appropriate
101.	Nagesh R	1 ½	M	38520/2015	intra-operative	O+ve	WB	350 ml	single	anemia	inappropriate
102.	deepa C	2	F	38982/2015	PEM	O+ve	WB	350 ml	single	anemia	inappropriate
103.	Manjunath M	5	M	38848/2015	bleeding disorder	O+ve	WB	250 ml	single	anemia	inappropriate
104.	Harish P	5	M	41767/2015	dengue	O+ve	FFP Platelet	300 ml 50 ml	multiple	anemia, thrombocytopenia	appropriate inappropriate
105.	Sujana M	1	F	39289/2015	Sepsis	B+ve	WB WB	150 ml 150 ml	multiple	anemia	inappropriate inappropriate
106.	Parashuram s	4	M	39433/2015	sepsis	A+ve	FFP	150 ml	single	anemia	inappropriate

107.	Bhuvaneshwari	1 ½	F	39457/2015	thallessemia major	A+ve	WB WB	90 ml 90 ml	multiple	anemia	inappropriate inappropriate
108.	Jaytunabi B	2	F	35937/2015	sepsis	A+ve	WB	350 ml	single	anemia, thrombocytopenia	inappropriate
109.	Shivakumar C	1	M	36779/2015	sepsis	AB+ve	PRBC PRBC	150 ml 80 ml	multiple	anemia	appropriate appropriate
110.	Nandini M	4	F	36883/2015	thallessemia major	B+ve	PRBC WB	180 ml 150 ml	multiple	anemia	appropriate inappropriate
111.	Neelamma S	2	F	35564/2015	sepsis	AB+ve	WB WB	100 ml 150 ml	multiple	anemia	inappropriate inappropriate
112.	Papahushen B	4	M	35830/2015	intra-operative	B+ve	PRBC PRBC	150 ml 100 ml	multiple	anemia	appropriate appropriate
113.	Sujan U	2	M	36009/2015	sepsis	B+ve	PRBC	150 ml	single	anemia	appropriate
114.	Shainaz M	13	F	36663/2015	hemolytic anemia	B+ve	WB WB WB WB	350 ml 350 ml 350 ml 350 ml	multiple	anemia, thrombocytopenia	appropriate appropriate appropriate appropriate
115.	Alankrita P	2	F	36095/2015	sepsis	AB+ve	WB WB	200 ml 100 ml	multiple	anemia	inappropriate inappropriate
116.	Ameenawwa R	1 ½	F	36029/2015	sepsis	B+ve	WB WB	100 ml 200 ml	multiple	anemia	inappropriate inappropriate
117.	Preetamsingh G	1	M	27451/2015	intra-operative	A+ve	PRBC PRBC	100 ml 100 ml	multiple	anemia	appropriate appropriate
118.	Sushrut G	7	M	12698/2016	Dengue fever	A+ve	Platelet	1 unit	single	thrombocytpenia	appropriate
119.	Sakshi	4	F	925/2016	iron deficiency anemia	A+ve	PRBC	100 ml	single	anemia	appropriate
120.	Bagappa	2	M	14386/2016	bleeding disorder	O+ve	Platelet	1 unit	single	thrombocytpenia	appropriate

121.	Abhishek C	6	M	3386/2016	bleeding disorder	A+ve	FFP	150 ml	single	thrombocytpenia	appropriate
122.	Preeti Iranna	4	F	11175/2015	iron deficiency anemia	A+ve	FFP Platelet	150 ml 1 unit	multiple	pancytopenia	appropriate appropriate
123.	Shivakumar L	3	M	15483/2016	dengue fever	O+ve	Platelet	I unit	single	thrombocytpenia	appropriate
124.	Zoya	11	F	3343/2016	sepsis	AB+ve	PRBC	200 ml	single	anemia	appropriate
125.	Tejaswini	7	F	8476/2016	sepsis	O+ve	PRBC	200 ml	single	anemia	appropriate
126.	Purnachandra I	5	M	3971/2016	bleeding disorder	A+ve	FFP	150 ml	single	abnormal coagulogram	appropriate
127.	Shravankumar	6	M	5895/2016	Dengue fever	A+ve	Platelet	1 unit	single	thrombocytopenia	appropriate
128.	Swayam S.	4	M	5455/2016	bleeding disorder	O+ve	PRBC	200 ml	single	anemia	appropriate
129.	Swapna Kakamani	8	F	18293/2016	bleeding disorder	O+ve	FFP Platelet	150 ml 1 unit	multiple	thrombocytpenia	appropriate appropriate
130.	Nivedita	12	F	6163/2016	iron deficiency anemia	B+ve	PRBC	200 ml	single	anemia	appropriate
131.	Archana	6	F	8053/2016	DIC	A+ve	FFP	150 ml	single	abnormal coagulogram	appropriate
132.	Prem S	3	M	40989/2016	PEM	B+ve	WB	350 ml	single	anemia	inappropriate
133.	Darshan	17	M	1744/2016	iron deficiency anemia	B+ve	WB	350 ml	single	anemia	inappropriate
134.	Abhishek M	8	M	6679/2015	sepsis	A+ve	PRBC	200 ml	single	anemia	appropriate
135.	Sathwik	8	M	11675/2016	Chronic kidney disease	O+ve	Platelet	1 unit	single	thrombocytopenia	appropriate
136.	Sairam J	5	M	7588/2016	thallessemia major	A+ve	PRBC	200 ml	single	anemia	appropriate
137.	Ravitej D	10	M	7349/2016	Dengue fever	A+ve	Platelet	1 unit	single	thrombocytopenia	appropriate

138.	Pramila	5	F	1829/2016	bleeding disorder	B+ve	FFP	150 ml	single	abnormal coagulogram	appropriate
139.	Sachin Y	16	M	3604/2016	iron deficiency anemia	B+ve	WB	350 ml	single	anemia	inappropriate
140.	Nikita B	3	F	8701/2016	Hemolytic anemia	A+ve	PRBC	200 ml	single	anemia	inappropriate
141.	Azan B	9	M	4158/2016	sepsis	B+ve	PRBC	200 ml	single	anemia	appropriate
142.	Deepika	7	F	5204/2016	sepsis	B+ve	WB	350 ml	single	anemia	inappropriate
143.	Nitin	10	M	18691/2016	Dengue fever	B+ve	Platelet	1 unit	single	thrombocytopenia	appropriate
144.	Suprita B	3	F	3348/2016	Thallessemia	B+ve	PRBC	200 ml	single	anemia	appropriate
145.	Salma J	12	F	5433/2016	congenital dyserythropoietic anemia	AB+ve	WB	200ml	single	anemia	inappropriate
146.	Chinamay	16	M	17455/2016	Dengue fever	O+ve	Platelet	1 unit	single	thrombocytopenia	appropriate
147.	Sanath L	2	M	5525/2016	bleeding disorder	A+ve	FFP	150 ml	single	abnormal coagulogram	appropriate
148.	Kushi S.	2	F	150/2016	Thallessemia	AB+ve	PRBC	200 ml	single	anemia	appropriate
149.	Sufiyana B	4	F	18379/2016	Dengue fever	A+ve	Platelet	1 unit	single	thrombocytopenia	appropriate