

A Study on Utilisation of Blood and Blood Components in a Tertiary Care Hospital in West Bengal, India

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ABSTRACT

Introduction: Blood transfusion is an indispensable service component of inpatient as well as emergency management of care seeking patients in a hospital. Establishment of criteria for blood transfusion and adherence to such criteria is necessary to reduce blood wastage. It is necessary therefore, to conduct such studies for monitoring and improving transfusion practices as well as to find strategies for such improvement.

Aim: To evaluate the pattern and appropriateness of blood and blood components utilisation, the status of transfusion practice in the hospital and assessing the wastage of blood.

Materials and Methods: The present study was a retrospective record-based cross-sectional study. The data was collected in January-February 2021, from issue registers of blood bank of Burdwan Medical College and Hospital and also from the blood transfusion registers of the wards of Medicine, Obstetrics and Gynaecology, Paediatrics, Surgery and Orthopaedics Departments of Burdwan Medical College and Hospital using a pretested, predesigned schedule. For the month, June 2020, representative of the year 2020, details of Whole Blood (WB) and components cross-matched and transfused were noted. Utilisation rate (Units transfused \times 100/Units cross-matched) and blood utilisation quality

indicators {Crossmatch/Transfusion Ratio (CTR=Number of units Cross-matched/Number of units transfused), Transfusion Probability (%T=Number of patients transfused/Number of patients cross-matched \times 100), Transfusion Index (TI=Number of units transfused/Number of patients cross-matched)² and Wastage Rate (WR=Number of blood units discarded/Number of blood units issued \times 100)} were computed.

Results: Total 1,544 units were cross-matched for 1,324 patients and 1,219 units were transfused to 882 patients. Overall utilisation rate was 78.95%. Department-wise utilisation rates in descending order were paediatrics 98.25% (112/114), Medicine 90% (478/531), Gynaecology and Obstetrics 73.84% (254/344) and Surgery and Orthopaedics 66.62% (375/555) departments respectively. The overall quality indicators of blood utilisation were CTR of 1.27, %T of 67.52%, TI of 0.92 and WR of 21.05%, respectively.

Conclusion: Blood transfusion quality indicators demonstrated efficient blood utilisation. One-fifth of the cross-matched blood was not transfused. Non transfused blood units were not returned, resulting in wastage of blood, known as transfusion wastage. The overall utilisation rate was not acceptable. Higher blood wastage could be reduced with evidence-based blood utilisation strategies.

Keywords: Blood transfusion, Crossmatch/Transfusion ratio, Transfusion index, Transfusion probability, Wastage rate

INTRODUCTION

After the first recorded blood transfusion on 22nd December 1918 by James Bundell who was a physician, physiologist and one of the prominent obstetricians of his time, attempts to come up with substitutes have not yielded any satisfactory results over the next 100 years, and hence judicious and appropriate use of blood and its component becomes imperative [1]. For surgical patients especially, blood transfusion plays a major role for resuscitation and management. There is over ordering of blood for elective and emergency surgical procedures and it is usually a common practice [2]. According to World Health Organisation (WHO) blood donation by 1% of the population is generally taken as the minimum need to meet a nation's basic requirements for blood. As per the above norm, India's demand for blood is around 13.9 million blood units (1% of 1.39 billion populations). However, there are huge variations in the estimated demand, supply as well as utilisation of blood and blood products [3]. A study done in 2021 to estimate the annual population need of India, has found that the estimated annual population need was 26.2 million units (95% CI; 17.9-38.0) of WB to address the need for red cells and other components after the separation process [4].

Taken together a declining donation and an increase in the consumption of blood components require novel approaches to meet the demand for blood supply. WHO dissuades single unit transfusions in adults. Most elective surgery does not result in sufficient blood loss to require blood transfusion. There is rarely justification for the use of preoperative blood transfusion simply to facilitate

elective surgery [5]. Establishment of criteria for blood transfusion and strict adherence to such criteria may be necessary to reduce blood wastage. It is absolutely necessary therefore, to conduct such studies for monitoring and improving transfusion practices. Results of this study may help to provide improvement opportunity and to find strategies for such improvements in future. Additionally, this study will hopefully pave way for future studies to comprehensively assess annual institutional pattern and appropriateness of utilisation of blood as well as its wastage. The present study was conducted with the objectives to evaluate the pattern and appropriateness of blood and blood components utilisation and the status of transfusion practice in Burdwan Medical College and Hospital and also to assess the wastage of blood components/ WB units, if any.

MATERIALS AND METHODS

The present study was a retrospective, record-based cross-sectional study which was conducted in the blood bank and inpatient wards {Medicine, Paediatrics, General Surgery, Orthopaedics and Gynaecology and Obstetrics (G&O)} of Burdwan Medical College and Hospital, Purba Burdwan, West Bengal, India. The above-mentioned research proposal was approved by Institutional Ethics Committee (IEC) at Burdwan Medical College, in the meeting held on 23-11-2020, Memo No.: BMC/IEC/149. Confidentiality of the patient-data as recorded in the registers and records was ensured. The study was conducted over a period of two months from 1st January-28th February 2021. The number of all WB units and

blood components supplied in the year 2020, from 1st January 2020-31st December 2020 was recorded and the average was calculated. The month, i.e., June 2020 having data closest to the average blood supply for this year, was chosen as a representative month, considering the seasonal variation in demand for blood [6].

Inclusion criteria: All blood units issued during June, 2020 from the blood bank of Burdwan Medical College and Hospital to the patients who were admitted in the wards of the Departments of Medicine, Paediatrics, Gynaecology and Obstetrics, General Surgery and Orthopaedics requiring blood transfusion were included in the study.

Exclusion criteria: Blood units, if any, issued from any blood bank, other than the blood bank of Burdwan Medical College and hospital were excluded from the study.

Data Collection

The date of withdrawal and the date of expiry of all blood units were noted from the blood bank's register. The records in wards were reviewed to find out whether received blood units were transfused or not. Total cross-matched and transfused units were counted. To evaluate the status of transfusion practice, all details of the blood and component recipients in this representative month i.e., June 2020 were recorded, including age, gender, address, department where admitted. Details of present usage of blood, including the number and type of components transfused and reactions, if any, were noted. To evaluate the pattern of blood and blood components utilisation, the usage of different types of components was recorded. It was also noted whether there was any reduction in single unit transfusion, due to restriction on elective surgical procedures during COVID-19 pandemic since late March, 2020. Utilisation rate of WB and all blood components were calculated. (Utilisation rate=Units transfused×100/Units cross-matched). The overall utilisation rate, if it is found to be above 96% for WB and components, then it is an acceptable rate of utilisation [3].

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

- Cross-match to transfusion ratio (C/T ratio)=Number of units cross-matched/number of units transfused. A ratio of 2.5 and below was considered indicative of significant blood usage [1].
- Transfusion probability (%T)=Number of patients transfused/number of patients cross-matched×100. Accordingly, a value of 30% and above has been suggested to be appropriate and signifies the appropriateness of number of blood unit cross-matched [2].
- Transfusion Index (TI)=Number of units transfused/Number of patients cross-matched. A value of 0.5 or more was considered indicative of significant blood utilisation [1].
- Wastage Rate (WR)=Number of blood units discarded/Number of blood units issued×100 [7]

STATISTICAL ANALYSIS

The collected data on background characteristics was checked for completeness and consistency and entered in the computer in the Excel data sheets. Data was organised and presented applying the principles of descriptive statistics in the form of tables and diagrams.

Departments	Blood units transfused	Blood units cross-matched	Blood utilisation rate (%)	Whole blood transfused	Whole blood cross-matched	Whole blood utilisation rate (%)
Medicine	478	531	90	15	19	78.95
Surgery and Orthopaedics	375	555	67.57	20	31	64.52
G&O	254	344	73.84	54	57	94.74
Paediatrics	112	114	98.25	8	8	100
Total	1219	1544	78.95	97	115	84.35

[Table/Fig-2]: Blood and blood component utilisation rate-according to the departments.

All collected data was entered in and analysed using Statistical Package for Social Sciences (IBM Corp. Released 2015. IBM SPSS Statistics for Windows, version 23.0 Armonk, NY: IBM Corp).

RESULTS

[Table/Fig-1] showed the distribution blood and its product issued from the blood bank covering the selected hospital departments. A total of 1,544 units were cross-matched and issued for the patients in the Departments of Surgery and Orthopaedics (555 (35.94%)), Medicine (531 (34.39%)), G&O (344 (22.28%)) and Paediatrics (114 (7.38%)) for 1,324 patients. The majority of the issued blood units were Packed Red Blood Cells (PRBC) (54.15%), followed by FFPs (30.95%), and platelets and WB (7.45% each). Medicine department was issued most of the PRBC (37.32%) and the Paediatrics department was issued the least (3.71%). For WB, the G&O department ordered the largest proportion (49.56%) and the least was by the Paediatrics department (6.96%). Of the FFPs, highest number was issued to surgery and orthopaedics departments (61.09%) and least number was issued to G&O department (4.6%). Medicine (67.83%) and paediatrics (28.69%) departments ordered maximum platelets.

Departments	WB units utilised (%)	FFP units utilised (%)	PRBC units utilised (%)	RDP units utilised (%)
Medicine	19 (16.52)	122 (25.52)	312 (37.32)	78 (67.83)
Surgery and Orthopaedics	31 (26.96)	292 (61.09)	232 (27.75)	0
G&O	57 (49.56)	22 (4.6)	261 (31.22)	4 (3.48)
Paediatrics	8 (6.96)	42 (8.79)	31 (3.71)	33 (28.69)
Total	115 (100)	478 (100)	836 (100)	115 (100)

[Table/Fig-1]: Distribution of utilisation of blood and its components according to the Departments.

*WB: Whole blood; FFP: Fresh frozen plasma; PRBC: Packed red blood cells; RDP: Random donor platelets; G&O: Gynaecology and obstetrics

[Table/Fig-2] showed that utilisation rate was highest in Paediatrics (112 (98.25%)), followed by Medicine (478 (90%)), G&O (254 (73.84%)) and Surgery and Orthopaedics (375 (67.57%)) departments respectively, with overall utilisation rate being 78.95% (1219/1544) for all types of blood products. The study also revealed that paediatrics (100%), followed by G&O (94.74%) were closer to the acceptable rate of utilisation (96%) for WB. But the utilisation rate of G&O department went down drastically from 94.74% for WB to 73.84% for all blood products. Addition of components improved the score of Surgery and Orthopaedics departments slightly (67.57%) as compared to only WB utilisation rate (64.52%).

[Table/Fig-3] showed all the quality indicators of blood usage including WR of blood. Overall CT ratio was 1.27, with Surgery having the highest CT ratio of 1.48 and Paediatrics having the best CT ratio of 1.02. TI for all kind of blood products was 0.92 and it indicated significant blood usage. Overall %T was 66.62% which was a measure of appropriateness of blood utilisation.

[Table/Fig-3] also revealed department-wise WR for Surgery and Orthopaedics department was highest (32.43%), followed by Obstetrics and Gynaecology department (26.16%). Along with that, from [Table/Fig-2] it was calculated that overall WR of WB was 15.65% (18/115) and WR for components was 21.48% (307/1429).

Departments	No. of patients cross-matched	No. of patients transfused	Total blood units Cross matched	Total blood units transfused	Units discarded	CTR	TI	%T	WR%
Medicine	455	425	531	478	53	1.11	1.05	93.41	10
Surgery and Orthopaedics	476	195	555	375	180	1.48	0.78	40.97	32.43
G&O	295	164	344	254	90	1.35	0.86	55.59	26.16
Paediatrics	98	98	114	112	2	1.02	1.14	100	1.75
Total	1324	882	1544	1219	325	1.27	0.92	66.62	21.05

[Table/Fig-3]: CT ratio, transfusion indices, transfusion probability (%T) and wastage rate according to the departments.

*CTR=Cross match-Transfusion ratio; Transfusion probability (%T) and TI=Transfusion index; WR=Wastage Rate

Overall, WR for all blood products as well as for all selected departments was 21.05% (325/1544).

Few other relevant findings from the study were that females were 55.18% and males were 44.82% of all the recipients of blood and its components. Among the blood products, males were allotted 59.41% of FFPs. WB (69.57%), PRBC (61.72%) and platelets (53.91%) were allotted more to female patients.

B positive blood group (37.7%) was utilised by most of the patients followed by A positive (29.4%) and O positive (23.8%) and least was AB positive (6.9%), AB negative (0%), A negative (0.5%), O negative (0.6%) and B negative (1.1%) blood groups were on the lower side of utilisation. Both sexes followed the same trend for transfusion of different blood group. Single unit transfusions were also more than multiple unit transfusions. Only 150 patients were issued multiple units of blood.

Utilisation pattern for elective and emergency use purpose showed emergency use of blood and blood products was predominant over elective use with only WB and PRBC having elective use (26.09% and 28.59%, respectively). A 73.91% of WB, 71.41% of PRBC and 100% each of FFP and RDP were used predominantly for emergency purpose.

Among the indications for all issued blood products taken together, hepatic disorder {276/1544 (17.88%)} was the most common indication which made the hospital blood bank to issue 218 FFPs (45.61%) along with other blood components. Hepatic disorder is followed by anaemia as the second most common indication for which 238 (15.41%) blood units were issued out of which 207 (24.76%) were PRBC, 16 (13.91%) were WB and 15 (13.04%) were FFPs. For bleeding 188 (12.18%) units of blood were issued comprising of 135 (16.15%) PRBC and 43 (37.39%) were WB. Blood-related disorders including thrombocytopenia accounted for 140 (9.1%) units of issued blood products with 87 (75.65%) Random Donor Platelets (RDP).

DISCUSSION

Blood and its components play a major role in patient care. The supply of this human product is limited with considerable risks of infections and reactions. Pattern of utilisation of blood and its components and status of transfusion practice in different centres in different countries, vary accordingly. In studies conducted by Joshi AR et al., Gaur D et al., and Giriyan SS et al., showed that the majority of the blood transfused was WB which was contrary to the present study [5,6,8]. In the present study, it was found that the majority of the blood component transfused was PRBC (54.15%) followed by FFP (30.95%). The least number of transfused blood components was platelets and WB.

In the present study, the total blood utilisation rate at Burdwan Medical College and Hospital was observed to be 78.95% (1219/1544) whereas for the Surgery and Orthopaedics departments it was 67.57%. The utilisation rate as studied by few other centres for surgical patients varies from 16%-43.6% [2,8,9]. Therefore, the present study revealed better utilisation rate by the Surgery and Orthopaedics departments, as compared to other studies, though still fell short of acceptable rate of utilisation. Based on the results of the study, a good portion of the blood units which were cross-matched

were not utilised for transfusion and this caused wastage of WB and blood components. CT ratio is acceptable for all departments as it is below 2.5 for all departments, however, many consider ideal CT ratio to be 1. In present study, the overall CT ratio was 1.27, with Surgery having the highest CT ratio of 1.48 and Paediatrics having the best CT ratio of 1.02. Vibhute M et al., and Collins RA et al., reported a higher CT ratio by surgical departments in which there was up to 90% of over-ordering for a number of surgeries [9,10]. The major issue that needs to be addressed here is how to minimise the over-ordering of blood units due to individual estimation of surgical blood loss without jeopardising the patient safety.

The %T for a given procedure was suggested by Mead JH et al., for the first time [11]. A value of 50% and higher was recommended as appropriate. However, Belayneh T et al., recommended a value of 30% and above as appropriate in 2013 [2]. The overall %T calculated in the present study was 67.52% which is dependent on the number of patients transfused as against the number of patients cross-matched. The %T reflects the appropriateness and significance of the transfusion ordered by the department. While surgery and orthopaedics had lowest %T (40.97%), all departments had %T above 30% mark for the study period. The %T of the present study was similar to the findings reported by various studies [12-16].

The TI indicates the appropriateness of numbers of blood units cross-matched. A value of 0.5 or more is suggestive of efficient blood usage [17]. In present study, it was seen that overall TI was 0.92 which was indicative of efficient blood usage. Ebose EM and Osalumese IC reported a TI of below 0.5 in their study [14].

The %T and TI of the surgical departments reflected the anticipated emergency transfusion needs of patients with obstetric emergencies, abdominal injuries and fractures due to accidents and trauma and gynaecological procedures which necessitate additional number of blood components to be cross-matched per patient than the number of blood components transfused per patient. This observation was similar to the findings reported by Bashawri LA; Murphy MF et al., and Pei Z and Szallasi A, [13,15,18].

The WR for WB, blood components and all types of blood products were 15.65%, 21.48% and 21.05% respectively in present study and these findings were comparatively higher than findings by other studies [19,20]. A total of 325 blood products were wasted due to "time expired" as a result of non transfusion. This is transfusion wastage which is when a blood component expires whilst it is issued to a patient.

Based on the present study, the higher CT ratio of surgical departments can be improved by implementing Maximum Surgical Blood Order Schedule (MSBOS). MSBOS using Mead's criterion ($MSBOS = 1.5 \times TI$) can be formulated to prevent wastage [12]. Type and screen or Group and save with abbreviated crossmatch have been implemented in certain centres and they have proven to reduce CTR and improve %T and TI. Workup is necessary to determine the target antigen and identifying antigen-negative units for transfusion [18].

Patient Blood Management (PBM) strategies like evaluation of appropriateness of transfusion orders and further discussion with clinical team, use of pharmaceutical products like intravenous iron, vitamin K etc., blood-sparing strategies during surgery such as

normovolemic or haemodilution measures or usage of cell salvage can be implemented along with evidence-supported transfusion guidelines, eliminating unnecessary transfusions as these are considered the main goals of PBM programs during a disaster like COVID-19 pandemic [21].

National Blood Policy of India suggests guidelines for management of blood supply during natural and manmade disasters shall be made available as a strategy [22]. There has been some effect on the blood supply chain as COVID-19 pandemic made it difficult to organise voluntary blood donation camps. Also, following vaccination for COVID-19, there is deferring of voluntary blood donation for a period of 14 days, resulting in further shortage in supply albeit temporarily. Hence, it becomes absolutely necessary to prevent wastage of blood during a major disaster like COVID-19 pandemic.

Being a retrospective study, this study had considered blood supply of one representative month to the selected departments. However, this does not deter future researchers to take up a larger study in the hospital. This study paves the way for future studies which can take into account blood supply of one whole year for comprehensive analysis of annual utilisation pattern, appropriateness of utilisation and wastage of blood. This study is one of the rare studies showing both utilisation and wastage in a single study.

Limitation(s)

The study was limited by the fact of it being a retrospective study. Another limitation of the present study was data of blood usage in critical care including Intensive Care Unit (ICU) and Intensive Coronary Care Unit (ICCU), dialysis and massive transfusions were not taken. The study looked into expiry due to non utilisation as the only reason for wastage known as transfusion wastage. Due to paucity of time and other resources, designed as a short study by a single researcher, this study had considered blood supply of only one representative month in the selected departments.

CONCLUSION(S)

The blood transfusion quality indicators including CT ratio, %T and TI of the present study demonstrated efficient blood utilisation. But more than one-fifth of the cross-matched blood was not transfused. There was no return policy for blood units which were not transfused, and hence, were wasted; mostly by surgical departments. Hence, the overall utilisation rate of blood was not acceptable. Developing a structured blood transfusion policy by the hospital administration with the help of regular audits of blood usage, standard transfusion guidelines and clinical programs with periodic feedbacks will pave way for better blood inventory, efficient blood utilisation and resource management.

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