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Unveiling transfusions: Analyzing blood product utilization patterns in a leading tertiary care center in Madhya Pradesh, India

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ABSTRACT

Background: Blood transfusions play a pivotal role in medical care, saving millions of lives annually. The timely provision of safe blood is critical in various clinical scenarios, necessitating a careful balance between supply and demand. Despite advanced blood banking facilities globally, challenges persist in ensuring appropriate blood component utilization, prompting a need for clinical audits and optimization strategies. **Aims and Objectives:** This study aims to analyze the patterns of blood product utilization in a tertiary care hospital in Madhya Pradesh over 1 year, focusing on transfusion requests, cross-match-to-transfusion (C/T) ratios, transfusion indices (TIs), and indications for transfusions. **Materials and Methods:** A retrospective study was conducted at Shyam Shah Medical College from January 01, 2023, to December 31, 2023. Data from transfusion and cross-match requests in various departments were collected. C/T ratios, TI, and non-usage probability were computed to assess blood utilization efficiency. **Results:** Out of 16,682 cross-matched units, 71.93% were transfused. The overall C/T ratio was 1.39. The department of medicine demonstrated the most efficient blood usage with a C/T ratio of 1.16. Obstetrics and gynecology had the highest TI (1.06), while surgery had the lowest (0.71). Indications for transfusion included anemia (29.9%), pre-operative (17.2%), intraoperative (21.8%), and post-operative (31.1%). **Conclusion:** This study provides valuable insights into blood utilization patterns, offering a foundation for refining transfusion practices and enhancing the efficiency of blood management in the studied tertiary care hospital.

Key words: Blood transfusion indices; C/T ratio; Transfusion indices

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INTRODUCTION

Transfusions of blood and blood components are a vital component of medical care that save millions of lives annually. Every second, someone needs blood worldwide for procedures, injuries, severe anemia, or problems during pregnancy. In many of these clinical situations, timely access to safe blood transfusion is a life-saving intervention that can also shield these patients from catastrophic sickness.[1] The primary goal of contemporary transfusion services is to keep a sufficient, secure, and effective supply of blood components available for medical applications.[2] It is commonly known that a steady supply of safe blood units is essential to the efficient provision of healthcare globally and can save lives in a range of clinical situations. Prompt treatment is crucial for patients suffering from acute hemorrhage in the emergency department, antepartum/postpartum hemorrhage in obstetric patients, or anemia in children under 5 years old. It is also evident that there is a growing global need for blood as health systems grow and as alternatives for diagnosis and treatment proliferate.[3]

Attention has been drawn to making sure that available blood components are used appropriately in clinical settings due to mounting pressure on the blood supply and demand. The World Health Organization recommended using blood

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and blood products judiciously to minimize transfusion hazards and cut down on needless transfusions. National guidelines on the proper clinical use of blood have been produced by several nations.[4,5] Similar to medications, blood and its constituent parts can have negative effects on patients receiving them, making them an essential element of patient management therapy regimens. The possible danger of blood component therapy should be understood by doctors and intravenous therapists to optimize its efficacy, safety, and utility.[6]

To determine the pattern of blood utilization and establish optimal policies across all blood-using specialties, frequent audits of blood and its component consumption are crucial. The promiscuous use of blood components with either no indication or an improper indication persists despite the advanced blood banking facilities available worldwide. Clinical audit is a crucial component of the quality assurance program that can offer the data required to enhance the practice of transfusion medicine. It is a management tool for evaluating and justifying the suitability and effectiveness of transfusion therapy.[7]

Overestimating the amount of blood used stresses transfusion services using reagent, time, and labor resources needlessly, particularly in environments where resources are limited. Overordering blood increases the demand for blood overall, increases hospital stay costs, and results in financial loss for the patient. To prevent abuse or overuse, the ordering of blood and blood components must be properly justified. The effectiveness of blood ordering procedures is gauged by the cross-match to transfusion (C/T) ratio. Generally speaking, a ratio of 2.5 or below indicates substantial blood use.[8] Less than 40% of cross-matched blood is transfused when the C/T ratio is more than 2.5, indicating an excessive amount of cross-matching of blood for a particular treatment. Significant blood utilization is often indicated by a transfusion index (TI) value of 0.5 or above.[8]

The prevalence of complex surgical procedures, aging populations, efforts to improve health care standards, advancements in blood banking techniques, and strict screening criteria have all led to significant changes in the patterns of blood transfusion in recent years.[9,10] While there have been several national and regional surveys on the use of blood components published from Western countries, there are not many from emerging countries like India.[9-16]

Therefore, the purpose of this study was to assess the transfusion procedures at our hospital over a 1-year period by figuring out the trends in blood usage, transfusion requests, C/T ratios, and TI.

Aims and objectives

Aims

The aims of the study are as follows:

1. To Assess Blood Transfusion Patterns: The primary aim of this study is to assess the transfusion procedures at Shyam Shah Medical College, Rewa, Madhya Pradesh, India, over a 1-year period, focusing on trends in blood usage, transfusion requests, C/T ratios, and TIs across various clinical departments.
2. To Evaluate Departmental Variances: The study aims to investigate department-wise variations in blood transfusion practices, understanding which departments demonstrate efficient blood utilization and which may benefit from optimization strategies.
3. To Identify Indications for Transfusion: Another aim is to identify and analyze the indications for blood transfusion, categorizing them based on clinical scenarios such as anemia, pre-operative, intraoperative, and post-operative situations.
4. To Propose Optimization Strategies: The study seeks to propose potential strategies for optimizing blood transfusion practices, with a focus on reducing unnecessary cross-matching, improving the C/T ratios, and enhancing overall blood inventory management.

Objectives

The objectives of the study are as follows:

1. To Quantify Transfusion Requests: Calculate the total number of transfusion requests processed during the study period for each clinical department.
2. To Compute C/T Ratios: Determine the C/T ratios for each department to evaluate the efficiency of blood utilization, with a target ratio of 2.5 or below as an indicator of substantial blood use.
3. To Calculate TIs: Compute TIs for each department, with a focus on identifying values of 0.5 or above as indicative of effective blood use.
4. To Analyze Departmental Variations: Compare and analyze department-wise differences in C/T ratios and TIs to identify areas for improvement and optimization in blood transfusion practices.
5. To Identify Indications for Transfusion: Determine the indications for blood transfusion across different clinical scenarios and calculate the percentage distribution of transfusions based on these indications.
6. To Propose Optimization Strategies: Based on the findings, propose optimization strategies for blood transfusion practices, including the implementation of measures such as the Maximum Surgical Blood Ordering Schedule (MSBOS) or other transfusion protocols.

MATERIALS AND METHODS

This retrospective study was conducted at the Shyam Shah Medical College, Rewa, Madhya Pradesh, India over 1 year from January 1st, 2023, to December 31, 2023. During the study period, forms for transfusion requests and cross-match requests were obtained from clinical units, including departments of Radiation Oncology, Surgery, Pediatrics, Gynecology/Obstetrics, Internal Medicine, Super Specialty block (SSB), and Orthopedics; these forms were obtained through the hospital blood bank database. The TI (number of units transfused/number of patients cross-matched), non-usage probability (total units not transfused/total units cross-matched), and C/T ratio (total units crossed-matched/total units transfused) were computed for each department based on transfusion requests, units cross-matched, and completed transfusions.[17,18] In accordance with hospital protocol, all distributed blood products are returned to the blood bank for appropriate storage and, if feasible, cross-matched for a subsequent transfusion request. Every unit that was distributed and wasn't brought back to the blood bank was regarded as used (transfused).

RESULTS

During the 12-month research period, 12,835 transfusion requests were processed to cross-match a total of 16,682 units. The department of surgery (n=2883) and the department of medicine (n=2012) had the most transfusion requests, respectively. The department of obstetrics and gynecology had the greatest amount of blood units cross-matched (n=3241) (Table 1).

12,001 units (71.93%) of the 16,682 cross-matched units were transfused. As a result, the hospital's overall C/T ratio was 1.39 on average. The department of surgery had the second-highest C/T ratio (1.58), behind the orthopedics department (1.69). With a C/T ratio of 1.16, the department of medicine had the best blood usage efficiency in the institution (Table 1 and Figure 1).

The departments of obstetrics and gynecology and SSB and surgery had the highest and lowest TI, respectively, with 1.06 and 1.04 within the former departments, and 0.71 in the latter (Table 1 and Figure 2).

Out of the total 12,001 units transfused, maximum were transfused in the department of SSB (2253), followed by obstetrics and gynecology (2132) (Table 1 and Figure 3).

Out of the total number of units transfused, maximum were done in post-operative period for blood loss (n=3732; %=31.1), followed by anemia (n=3558; %=29.9) (Table 2 and Figure 4).

DISCUSSION

Transfusions of blood components are extremely important for patient treatment. Because it is a human product, there are significant dangers of infections and reactions, as well as expenses. The supply is also restricted. The process of conserving blood results in excessive orders for blood components, which ages blood units and lowers the amount of main stock. There is a residual risk of transfusion-transmitted illness if donations were made during the window period; thus, it is important to take into account the hazards related to transfusion-transmissible diseases, such as hepatitis B and C and HIV. Consequently, it is imperative to justify the use of blood components.[19]

The present study was carried out to learn more about the blood ordering processes used by different departments, to stop needless blood transfusions in the future, and to develop a blood transfusion optimization strategy that governs blood inventory.

Study findings indicate that while most cross-matched blood units were used for transfusion, a significant percentage (4681 units, or 28%) of cross-matched blood units were not transfused, which resulted in exhaustion of laboratory personnel, funds, and blood components and

Table 1: Department wise list of transfusion requests, units cross-matched, and transfusion indices

Departments	No of transfusion requests	No of units cross-matched	No of units transfused	No of units not transfused	CT ratio	TI
Surgery	2883	3217	2036	1181	1.58	0.71
Medicine	2012	2343	2020	323	1.16	1.00
Obstetrics and Gynecology	2003	3241	2132	1109	1.52	1.06
Pediatrics	1999	2543	2018	525	1.26	1.01
Orthopedics	1065	1570	929	641	1.69	0.87
Oncology/Radiotherapy	432	475	349	126	1.36	0.81
Super specialty blocks	2176	2974	2253	721	1.32	1.04
Other departments	55	55	50	5	1.1	0.91
Private hospitals	210	265	214	51	1.24	1.02
Total	12835	16682	12001	4681	1.39	0.94

C/T: Cross-match-to-transfusion, TI: Transfusion indices

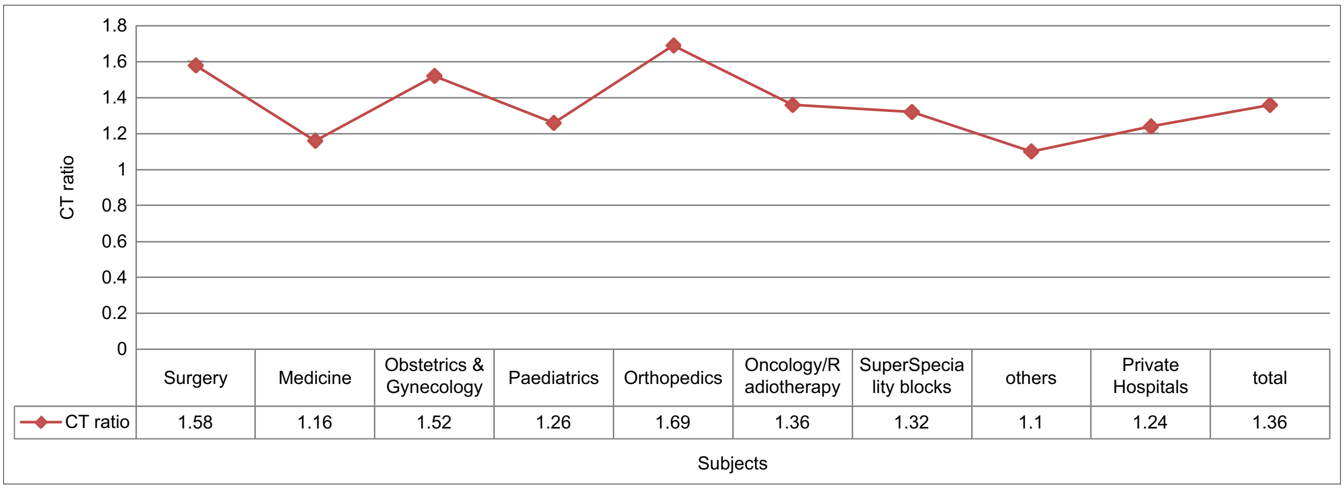

Figure 1: Line diagram showing CT ratios of various departments in Shyam Shah Medical College, Rewa

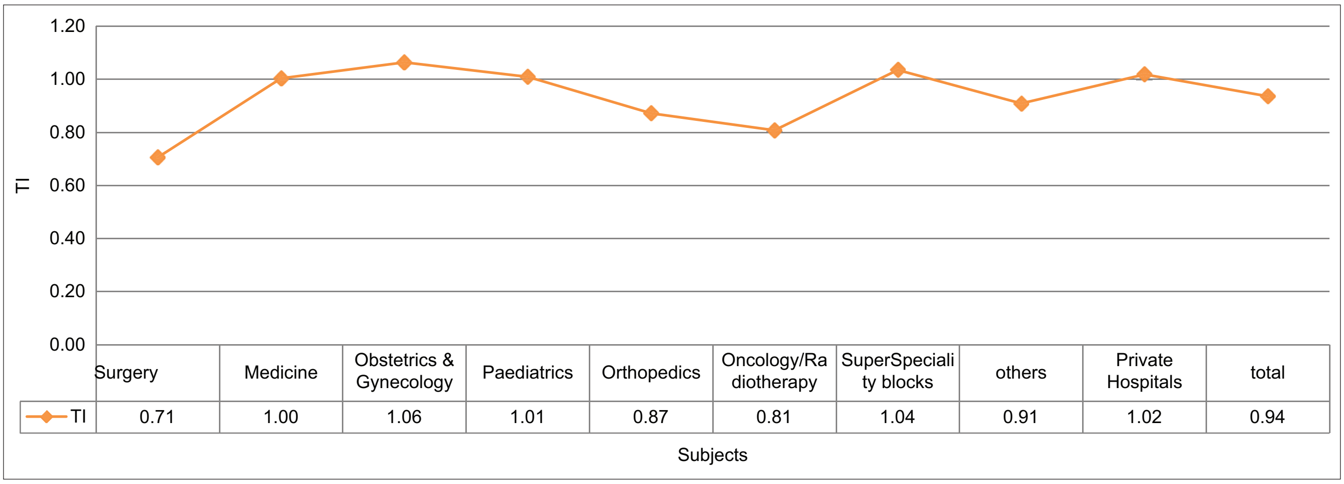

Figure 2: Line diagram showing TI of various Departments in Shyam Shah Medical College, Rewa

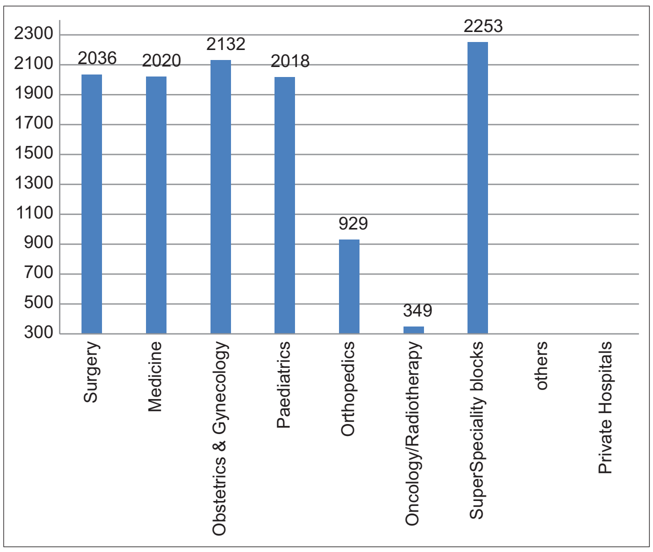

Figure 3: Bar graph showing number of units transfused by various Departments in Shyam Shah Medical College, Rewa

delayed the distribution of blood components to patients who deserved them.

Table 2: Indication of transfusion

Indication	Total number of units transfused	Percentage
Anemia	3588	29.9
Pre-operative	2064	17.2
Intraoperative	2616	21.8
Post-operative	3732	31.1
Total	12001	100

According to the present study, 28.06% of the cross-matched blood was not transfused. This finding was consistent with the study conducted by Shrestha et al.,[20] where this percentage was found to be 27.23% whereas in a study conducted by Thakur and Solanki[21] this was 47%. This percentage was found to be 55% in a study conducted by Chandrasekar et al.,[5] this percentage was even higher in studies conducted by Umesh and Subash (83.2%),[22] Vibhute et al., (76.8%)[23] Basnet et al., (86.4%)[24], and Ibrahim et al. (74.8%).[25]

The C/T Ratio = number of units cross-matched/number of units transfused. Ideally, this ratio should be 1.0.

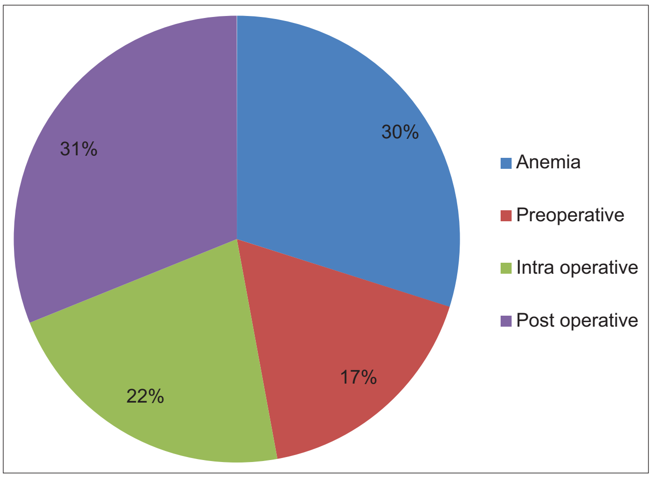

Figure 4: Pie chart showing the various indications for which blood transfusions were requested

Significant blood utilization is indicated by a ratio of 2.5 or less. The use of C/T ratio was first recommended by Boral and Henry in 1975.[26] The TI shows how many blood units are cross-matched appropriately. An effective use of blood is indicated by a value of 0.5 or above.[27]

The primary conclusions of this study are that the hospital's mean TI is 0.94 and the average C/T ratio for all departments is 1.39. The department of medicine had the lowest C/T ratio (1.16) and the lowest non-usage value (13.79%), while the orthopedics department had the greatest C/T ratio (1.69) and the highest non-usage value (40.83%). Although the overall blood TIs found in this study indicate productive blood consumption, the blood TIs for the departments of surgery, orthopedics, obstetrics, and gynecology were less productive than the hospital's overall indices.

The CT ratio and TI found in our study were comparable to a study conducted by Shrestha et al.,[20] (CTR = 1.37; TI = 1.09), and significantly better to other studies in South-east Asia Region like Thakur and Solanki,[21] Chaudhary et al.,[28] (CTR=6.7), Kumari[29] (CTR=1.6), Umesh and Subash[22] (CTR=5.95; TI=0.84), and Subramanian et al.,[30] (CTR=2.5). The mean C/T ratio is also lower than that reported from other studies from Benin (CTR=2.2),[32] Nigeria[31,33] (CTR=2.9), and Saudi Arabia[34] (CTR=2.96).

A lower C/T ratio denotes better blood use. Even while blood that is issued but not used can be returned to the blood bank and perhaps utilized again, not using the blood might still put more strain on resources and raise the risk of wastage. Various transfusion policies at various institutions may be the cause of the observed variations in use. Blood type (ABO and Rh) is determined at our hospital before blood is stored in the blood bank, and cross-matching is only performed when a transfusion is necessary. Furthermore, the clinical condition of patients and the treating physicians influence the reasons for blood transfusions. Lack of clinical audits, unclear blood ordering procedures in hospitals, and poor communication between doctors and blood bank staff are all potential reasons of elevated C/T ratios.

Our findings, which are in line with previous research, indicate that the surgery department's C/T ratio is greater than the hospital's general C/T ratio.[5,20-29] This may be explained by the necessity of having extra blood on hand for usage in the event of a major blood loss during certain surgical operations.[34] The high C/T ratio is partly explained by the fact that a significant fraction of these treatments do not require blood transfusions. Furthermore, pre-operative blood orders are frequently dictated more by habit than by the particular clinical requirements of the patient.[26]

It has been demonstrated that utilizing a type and screen strategy for transfusion procedures works well without sacrificing patient safety, as opposed to cross-matching.[35,36] The MSBOS and type, screen, save, and abbreviated cross-match (TSSAC) are further strategies that have been shown to improve the C/T ratio and TI.

The hospital transfusion committee, training programs, data-based formulas, audits, national transfusion guidelines, clinician meetings, and training programs can all be used to structure the MSBOS. This will save money, preserve inventory, free up technical staff, and lessen the amount of unnecessary cross-matched blood units. On the other hand, blood needs for oncology or hematological diseases, as well as blood loss after surgery, cannot be predicted or estimated. Consequently, it is technically challenging to strictly adopt MSBOS in any hospital; but, with the help of the blood bank staff and clinicians, it is possible to comply in order to preserve blood supplies and avoid waste.[27] MSBOS can be calculated using Mead's criterion (MSBOS=1.5×TI).[37]

The patient's ABO and Rh groups are determined in TSSAC, and their blood is screened for abnormal antibodies. Only if anomalous antibodies are discovered is full cross-matching carried out. If not, a quick spin cross-match is performed solely in the case that a transfusion is later required.[38]

According to studies, MSBOS is a workable solution for cutting down on pointless cross-matching and saving the blood bank a substantial amount of funds.[23,39-41] Murphy et al., discovered, however, that "the clinical use of blood for transfusion does not seem to be influenced by the use of an MSBOS."[42] Palmer et al., discovered that the patient-specific blood ordering system, which takes into account the patient's and the surgeon's characteristics when predicting the need for transfusions, is more accurate than the MSBOS, which alone estimates the amount of blood needed during surgery.[43] A surgical blood ordering algorithm was developed by Nuttall et al., that took patient characteristics into account when ordering blood for surgical patients.[44]

The C/T ratio may be decreased if any of these methods were included in hospital transfusion protocols. Blood arrangements for elective procedures should only be taken into consideration after the pre-anesthetic examination is completed and the final surgery is scheduled. The hospital's blood usage procedures must be improved through frequent audits and feedback. Regular audits and progress monitoring might be facilitated by a more rigorous approach to record-keeping in hospitals. For patients in underdeveloped nations, their expense is a major factor. It has been demonstrated that creating and following a blood ordering process helps patients feel less financially burdened, particularly when it comes to elective surgical treatments.[45] Therefore, to minimize the non-usage of cross-matched blood units and improve blood transfusion procedures, a protocol for ordering and transfusion of blood that is specific to the needs of the hospital should be developed with input from all relevant departments.

Limitations of the study

The retrospective nature of the current study and the use of secondary data, which includes mistakes such as typos and missing records, are its limitations. Because we had an insufficiently precise record, we were unable to calculate several additional indicators of blood use. Furthermore, there is a significant fluctuation in the principal index (C/T ratio) between hospitals, most likely as a result of the various indications for blood ordering that change according to hospital type. This makes it challenging to compare directly with other hospitals.

CONCLUSION

Even though the present study's blood TIs – such as the CT ratio, and TI – were ideal, a sizable amount of blood was not transfused. Thus, improved blood inventory, effective blood utilization, and cost savings can be achieved by the hospital transfusion committee by creating a structured blood transfusion policy with the assistance of frequent audits of blood usage, standard transfusion guidelines, and clinical programs with periodic feedback.

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