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To Study the Quality Indicators of Blood Utilization in a Tertiary Care Hospital in A Northen Region

[1]Dr Raman Sharma, Department of Pediatrics, GMC Jammu

[2]Dr Sonia Gupta, Department of Transfusion Medicine, GMC Jammu

[3]Dr Kajal Khajuria, Department of Transfusion Medicine, GMC Jammu

Corresponding Author: Dr Raman Sharma, Department of pediatrics, GMC Jammu

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Introduction

Blood transfusion is considered appropriate when it is used to treat conditions leading to significant morbidity and mortality and which cannot be presented or managed by other means. Blood is an expensive and scarce resource. The blood need still exceeds its supply. Unnecessary transfusion may cause a shortage of blood products in real need. To overcome this, the performance of blood transfusion services (BTS) can be increased by increasing the level of resources used in the collection and production of blood components or by utilizing existing resources more efficiently. (Morish M et al, 2012)

The blood transfusion services can reach the optimum level of efficiency in terms of quantity and quality of blood and blood components through the implementation of a quality management system in all phases of the collection, processing and storage of the blood. The American Association of Blood Bank (AABB) defines quality indicators as the specific performance measurements designed to monitor one or more processes during a defined time and are useful for evaluating service demands, production, adequacy of personnel and process stability. (Roback JD et al, 2011)

Requests for large amount of blood arise from the fear of not having sufficient blood available during surgery (Couture DE et al, 2002) or from not having specific patterns and guidelines for blood requests. (Brown PJ et al, 1995) The consequence of requesting large amount of cross matched blood pre-operatively is that a lot of the blood is not used and after 2 or 3 days, these blood products can no longer be used for other patients. (Palmer T et al, 2003)

Furthermore, the cost of production, storage and separation of products, hospital transfer and screening tests for blood safety and the typing and cross matching add to the importance of appropriate application and use of blood products. It has been suggested that in surgeries usually requiring less than 0.5 units of blood, performing compatibility testing before surgery is not necessary and that it is sufficient to determine patient's ABO and Rh group and perform a type and screen. (Friedman BA et al, 1976)

To satisfy their obligations to the medical communities that they serve, including satisfying the obligation of meeting requirements for hospital accreditation, hospital blood bank managers routinely scrutinize the efficiency with which their medical communities utilize blood products. With increasing frequency, hospitals in various report and monitor indicator data in order to improve the quality of care. Quality indicators aim to detect sub-optimal care either in structure, process or outcome, and can be used as a tool to guide the process of quality improvement in health care. (Donabedian A et al, 1980) Monitoring the health care quality makes hospital care

more transparent for physicians, hospitals and patients. Furthermore, it provides information to target quality improvement initiatives. However, collection of indicator data also implies an administrative burden for physicians and hospitals; therefore, the use of this information should be optimized. The implementation of quality indicators as a tool to assist quality improvement requires effective communication strategies and the removal of hindrances. (Davis DA et al, 1997) Evidence suggests that audit and feedback based on indicator data can be effective in changing health care professional practices. (Foy R et al, 2005) (Jamtvedt G et al, 2006) Monitoring the indicator data may also help to target specific quality improvement initiatives such as educational programs and development of protocols. Performance monitoring is an important tool, which can be used for setting priorities for process improvement. (Motschman TL et al, AABB) It is defined as a method by which procedures, activities, or human resources can be assessed on certain parameters keeping the pre-established criteria and objectives as a benchmark. It is a well-established procedure in the human resource department worldwide. Performance monitoring is one type of internal audit, which helps us to improve our quality standards in transfusion practices. The present study was conducted to measure the impact of monitoring performance indicators and how they could be used as a tool for continuous quality improvement.

A better estimate of the need for transfusions may be obtained from parameters such as the cross-match to transfusion ratio (C/T ratio), transfusion probability (T %), transfusion index (TI) and MSBOS. (Nuttall GA et al, 1998)

The C/T ratio, the most important parameter for estimating the need for blood during surgery was introduced in 1975 by Henry and Boral. They suggested that a C/T ratio lower than 2.5 is a significant indicator of the need for blood transfusion during surgery. (Boral LI et al, 1977)

The T% was described for the first time by Mead et al in 1980 and a value greater than 30% indicates considerable requirement of blood. (Mead JH et al, 1980)

The average number of units used per patient is calculated by TI and according to Henry and Boral for operations that usually require less than 0.5 units of blood compatibility testing before surgery is not necessary and it is sufficient to determine the patient's ABO and Rh groups and perform an antibody screen. (Boral LI et al, 1977)

Given the considerable advantages of decreasing unnecessary blood requests and the absence of regional guidelines on blood orders for different types of surgery, we decided to study the amount of cross matched blood requested prior to surgery and the transfusion rates associated with surgery, determining the C/T ratio, T%, TI and MSBOS for elective urological surgeries. The Maximum surgical blood ordering schedule is also one of the approaches which add to the importance of appropriate application and use of blood products. (Khoshrang H et al, 2013)

Therefore, there is a need for continuous monitoring of blood utilization and auditing the transfusion practices which serves in identifying key areas of concern in the blood component usage as well as instances of inappropriate component use, wherein corrective actions can be planned. If unnecessary blood orders can be reasonably waived, it will reduce both workload and financial expenditure, we need to optimize the quantity of being cross matched by assigning each elective surgical procedure, a tariff of transfusion. (Subramanian A et al, 2012)

Unnecessary transfusion may cause a shortage of blood products for patients in real need. Various strategies have

been developed to reduce the inappropriate use of blood and blood products to needy patients and prevent over utilization of a scarce resource. As per WHO the working definition of an indicator is a variable with characteristics of quality, quantity and time used to measure changes in health and health related situations, directly or indirectly, the progress made in addressing it and the providing a basis for developing adequate plan for improvement. All indicators have a part to play in maintaining quality, monitoring performance and ensuring safety and integrity for the recipient, donor and staff. (WHO regional office , manila Philippines et al, 1996)

This study was designed to analyze the trend of utilization of different blood components by various medical and surgical specialties at our hospital by determining the quality indicators for the same.

Review of Literature

Boral LI et al, 1977 Reviewed prospective data in 1975 and examined 12,848 blood specimens using the type and screen as well as cross match and detected 283 antibodies in 247 patients. The incompatibility frequencies, type and screen can be shown to be 99.99% effective in preventing the transfusion of incompatible blood. Therefore, we before that the type and may be safely substituted for the routine two units cross match in there operative procedure usually not requiring transfusion. Adoption of this approach would reduce patient changes provide more efficient distribution of limited blood supplies and allow for more effective utilization of blood bank technologist time.

Mead JH et al, 1980 conducted a prospective study in 1980 on various regional medical centers which have shown the current practice of type and screen method for reserving blood units effectively increases the available pool and decreases costs of maintaining a blood bank. Approaches other than the cross match to transfusion ratio are proposed to provide objectivity for establishing procedures to be converted to type and screen the appropriate number of units for patients requiring a type and cross match.

Friedman BA et al, 1984 in this study the author proposes that the maximum surgical blood ordering schedule (MSBOS) can serve as a paradigm for test reduction system in other laboratories. He begins by reviewing briefly the development of cross match reduction system in hospital blood banks and he suggests later that the number of type and screen tests performed can also be reduced on part of effort to curb unnecessary testing.

Rund RLI et al, 1992 Evaluated unnecessarycross matching of blood is expensive and can result in unwarranted transfusion with needles exposure of patients to the risk of transfusion therapy. Blood usage in elective surgery was studied over a period of 3 months in 1990 to determine adherence to the MSBOS, C/T ratios and transfusion appropriateness. 29% of postoperative transfusions were considered to have been excessive.

Murphy WG et al, 1995 The author did a prospective study over a period of 1year to analyze the use of an effective schedule for ordering blood for transfusion for surgical patients. 27 hospitals participated in the study. Twenty three (85%) of these 27 operated a schedule. The implementation of schedules was compared in 3 hospitals each for caesarean section, TURP and primary hip replacements. Use of MSBOS does not appear to influence clinical use of blood for transfusion, indicating that the gains in efficient use of laboratory resources and in safe handling of blood units can be made without compromising patient care.

Bhutia SGI et al, 1997 prospectively evaluated the performance blood ordering and transfusion practices for common elective general surgical procedures at major

Indian hospital. 680 patients undergoing 21 different surgical procedures between April 1993 and March 1995 were studied. Blood ordering and transfusion details were noted and the data used to calculate C/T ratio, transfusion probability and transfusion index. The MSBOS was calculated using Mead's criterion. They found that 370 (40%) of the cross match performed were unnecessary, 60% of the patients studied had blood loss of less than 10% of the total blood volume and 90% of the cross matches performed for this group were unnecessary. Implementation of the recommended MSBOS and introduction of type and screen for eligible and economic solution to preoperative over ordering of blood.

Nuttak et al, 1998 A prospective double blind randomized study compared the Surgical blood order equation (SBOE), with maximal surgical blood ordering schedule (MSBOS) system for ordering allogeneic RBC units in 60 patients undergoing surgeries. There were no differences in patient demographic, surgical or laboratory variables at any time. The median number of allogeneic RBC units ordered was 2 for MSBOS and 0 for the SBOE. The SBOE had a lower C/T ratio than MSBOS (0.83 vs. 4.12) costs were lower with the SBOE.

Chawla TI et al, 2001 in this prospective randomized study, author audit transfusion data for elective surgical procedures in our hospital during the last 2 year. Data was analyzed for 32 elective surgical procedures in 2131 patients. Majority (2079) (97.56%) of the patients had C/T ratio higher than 2.5, only 12 in 450 patients had a transfusion index higher than 0.5. There were 13 procedures in which both C/T ratio was greater than 2.5 and Ti less than or equal to 0.5 so author propose a draft MSBOS. Implementation of MSBOS will result in about 60% reduction of cost to the patient.

Sakurai Y et al, 2001 A retrospective study conducted by author to promote efficient blood ordering practice for surgical patients. The author compared the SBOE with MSBOS. The SBOE was calculated as: SBOE(units)= mean blood loss / 200 –(preoperative Hb - postoperative Hb) divided by (40/body weight(kg)). The SBOE reduces C/T ratio from 1.2 to 1.6. Therefore the SBOE reduced the ordered units more effectively than the MSBOS.

Vibhute M et al, 2000 in this study, the author evaluated blood ordering and transfusion practices in 500 elective surgical procedures. Out of 1145 units of blood cross matched for the first 500 patients. Only 265 were transfused with non-utilization of 76.86% of ordered blood. With the help of the C/T ratio, transfusion index and transfusion probability; the wastage was reduced in next 150 patients i.e. from 76.86% to 25.26% and improve the utilization of blood i.e. from 23.14% to 74.74%.

Subramanian et al, 2012 conducted a prospective study to compile and review the blood bank records of the patient undergoing elective surgical and neurosurgical procedures carried out between April 2007 and March 2009. There were 252 surgery patients in this study. 1088 units of blood were cross matched, 432 were transfused (CT ratio 2.5). 44% patients did not require transfusion during entire stay. 3 (50%) elective procedures had CT ratio >2.5 and 4 (66%) elective procedures had TI < 0.5. In this study 40% and 22% of cross matched blood was being utilized for elective general surgery and neurosurgical procedures, respectively. The calculated required blood units were <0.5 units in four of the neurosurgical procedures, and hence only these units should be arranged. Regular auditing and proper feedbacks are also vital to improve the blood utilization practices.

Morish M et al, 2012 Reviewed data of the number of discarded whole blood units and its components. Reasons for discard and the number of blood components processed as well as the number of collected blood units

were obtained from Blood Bank Information System. Total number of blood and its components was 8968(23%). Platelets recorded the highest of discard at 6% followed by whole blood at 3.7%, FFP at 2.5%, cryoppt at 2%. The rate of discarded PRBCs, plasmapheresis and plateletpheresis was less than 1% at 0.6%, 0.6% and 0.29% respectively. Other causes include leakage, lipemia and underweight. Therefore, good donor selection training and evaluation of staff as well as implementation of automation will help to improve process and output of BTS.

Couture DE et al, 2012 A prospective study reviews the perioperative use of red blood cell transfusion in cerebrovascular neurosurgery. Records of 301 patients undergoing cerebrovascular neurosurgery at the University of Virginia were reviewed to evaluate RBC transfusion practices. In 126 patients undergoing carotid endarterectomy, there were no preoperative or intraoperative transfusion and 5 postoperative transfusions (4%). In 71 ruptured aneurysm, were 2 preoperative (2.8%), 4 intraoperative transfusion (5.6%) and 15 postoperative (21.1%) transfusions. The overall ratio of preoperative C/T ratio in this series is 41.4. In these institutes, blood has routinely been ordered excessively. We recommend ABO-RH type and antibody screen for aneurysm surgeries and no screen for carotid endarterectomy to efficiently utilize transfusion therapy in cerebrovascular surgeries.

Khoshrang H et al, 2013 In this descriptive prospective study all orthopedic surgeries in Poursina hospital, between April to June 2013 were reviewed all patient information was recorded, including demographic, type of surgery, hemoglobin level, cross match test, duration of surgery and blood loss and transfusion. Among 872 selected candidates, 318 of them were cross matched and among those, 114 patients received transfusion probability 36.47% TI 0.6 and MSBOS 0.9. So it is highly recommended to focus on the knowledge of evidence based on transfusion and standard guidelines for blood transfusion to avoid over ordering.

Alam MM et al, 2013 This study utilized a single institutional i.e (Aga Khan University) retrospective chart review of patients undergoing elective spinal fusion over 2 year period. 85% patients were included in the study of the 292 units of packed red blood cells ordered preoperatively; only 66 were transfused (C/T ratio 4.4:1). Those undergoing arthrodesis for degenerative diseases or cervical spine arthrodesis had highest C/T ratio at this institution. Based on the results of this study we recommend that 2 unit packed cells to be arranged for patients with preoperative Hb level <9 g/dl.

Yazdi AP et al, 2016 In this cross-sectional study, blood was requested for 398 patients. According to available blood unit deficiency, from 961 blood unit requisitions, only 456 units were cross matched and 123 units were transfused. The C/T ratio, transfusion probability, TI were 3.71%, 16.83% and 0.31 respectively. The most unfavorable indexes were observed in patients who had ear, nose and throat surgeries and obstetric and gynecologic surgery. The best indexes were related to thoracic surgery and neurosurgery. There were no significant correlations between hemoglobin, hematocrit, and platelet count and pro-thrombin time with the number of transfused blood units.

David A. Novis et al, 2002 In this study hospital blood bank personnel can achieve C:T ratios below 2.0, RBC unit expiration rates below 1.0%, and RBC unit wastage rates below 0.5%. Lower C:T ratios and/or RBC unit expiration rates were associated with blood bank personnel setting C:T threshold of 2.0 or less, monitoring requests for blood components by transfusion indication criteria, monitoring categories of health care workers

responsible for blood wastage, not accepting short dated units from blood distribution centers, and if short dated units were accepted, being allowed to return those units to the blood distribution center. These practices were not associated with lower blood wastage rates.

Maartje De Vos et al, 2009 A totals of 21 studies were included. In four studies, quality indicator implementation was found to be ineffective, in one partially effective and in one it was found to be effective. Twenty studies focused on care processes, and most reported significant improvement with respect to part of the measured process indicators. The implementation of quality indicators in hospitals is most effective if feedback reports are given in combination with an educational implementation strategy and/or the development of a quality improvement plan.

Aims And Objectives

To study quality indicators of blood for its utilization in transfusion services.

Material and Methods

Study period: The proposed study is conducted over a period of eleven months with effect from September 2016 to July 2017 in the postgraduate department of Immunohematology and Blood Transfusion Medicine of Government Medical College Jammu which is a tertiary care hospital.

Study design: This is a prospective and descriptive study.

Inclusions: All the patients requiring blood transfusion from various specialties of our hospital.

Modalities: Patient transfusion request forms, cross match and issue records.

Data inclusion: Age, gender, blood group, specialty where the patient is admitted, diagnosis of the patient, type and number of blood and its components requested.

The transfusion data information so obtained from the documents is entered into Microsoft excel sheet for future analysis. The data pertaining to the number if whole blood/packed red cells/fresh frozen plasma/platelet concentrates requested as well as cross match/issue data will be collected and analyzed. The records of all the patients, daily blood collection, cross matching, actual transfusion and blood stock were taken.

The various parameters for blood utilization so studied will be calculated as:

1. Cross match to transfusion ratio (C/T ratio) = Number of units cross matched / Number of units transfused

2. Transfusion probability (t %) = Number of patients transfused / Number of patients cross matched x 100

3. Transfusion index (TI) = Number of units transfused / Number of patients transfused

4. Maximum surgical blood ordering schedule (MSBOS) = 1.5xTI

Results

During our study period, a total issuance of blood was 17,570. The age of admitted patients varied from 3 days to 90 years. During our study period, total units cross matched were 19,500 and blood units transfused was 17,533.

Total no of patients 7745 out of which Males are 2000 and Females are 5745

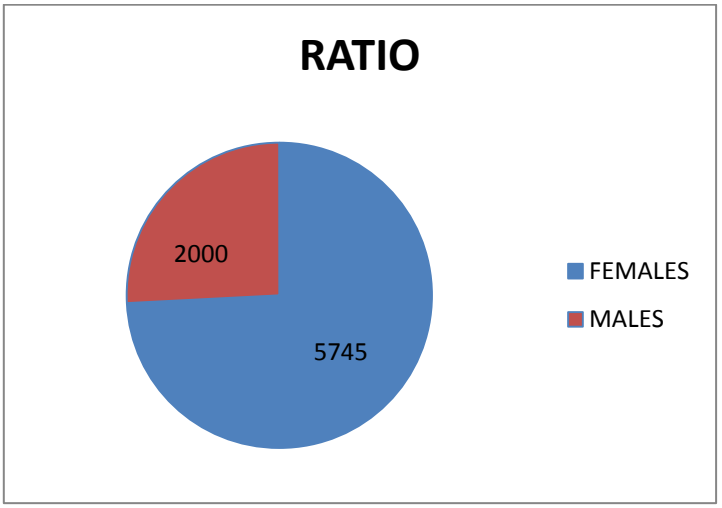
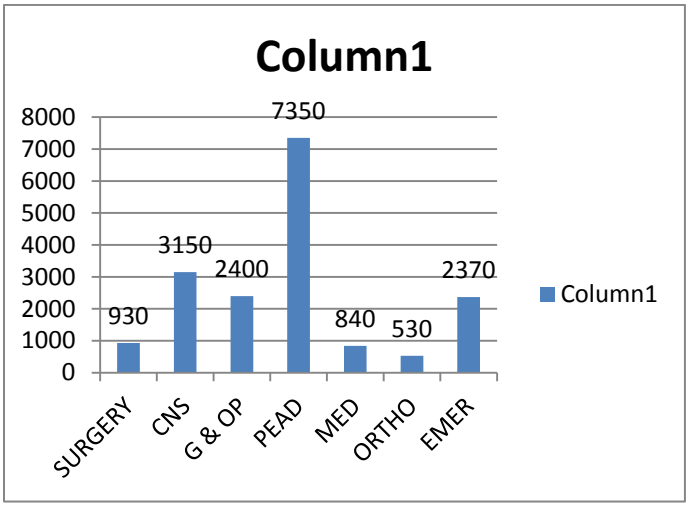


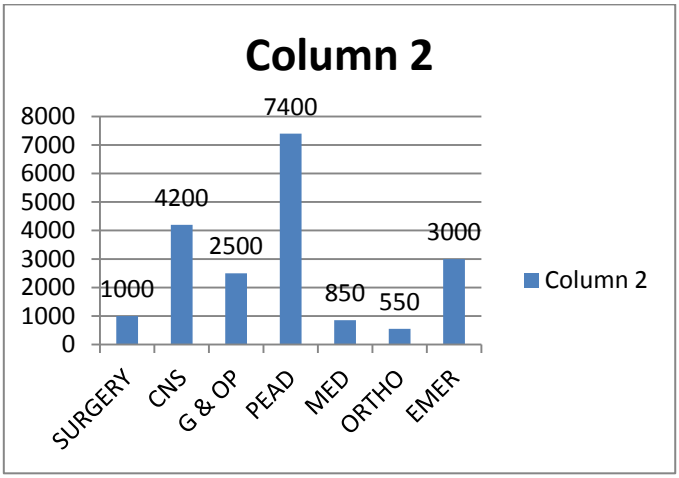
Table 1:

S. No.	Departments	Total units cross matched (%)	Total units Issued (%)	Total units transfused (%)	Total no. of patient transfused (%)
1.	Surgery	1000 (5.1)	930 (5.2)	925 (5.2)	500 (6.4)
2.	CTVS	4200 (21.5)	3150 (17.9)	3145 (17.9)	800 (10.3)
3.	Gynae & Obs.	2500 (12.8)	2400 (13.6)	2390 (13.6)	1400 (18.07)
4.	Pediatrics	7400 (37.9)	7350 (41.8)	7345 (41.8)	3000 (38.7)
5.	Medicine	850 (4.3)	840 (5.3)	839 (4.7)	400 (5.1)
6.	Ortho	550 (2.8)	530 (3.01)	525 (2.9)	400 (5.1)
7.	Emergency	3000 (15.3)	2370 (13.4)	2364 (13.4)	1245 (16.07)

Column 1: units issued according to department:



Column 2: Total no of units' cross matched according to department:



1. **CT ratio**

S. No	Department	CT ratio
1.	Surgery	1.08
2.	CTVS	1.33
3.	Gynae & Obs.	1.04
4.	Pediatrics	1.00
5.	Medicine	1.01
6.	Ortho	1.04
7.	Emergency	1.26

The CT ratio at our hospital was 1.07.

2**. Transfusion Probability (%)**

S. No.	Department	Transfusion Probability (%)
1.	Surgery	50
2.	CTVS	19.04
3.	Gynae & Obs.	56
4.	Pediatric	40.5
5.	Medicine	47.05
6.	Ortho.	72.72
7.	Emergency	41.5

The transfusion Probability at our hospital was 46.6%.

3. **Transfusion Index (TI):**

S.NO.	**Department**	**Transfusion Index (TI)**
1.	Surgery	1.8
2.	CTVS	3.9
3.	Gynae & Obs.	1.7
4.	Pediatrics	2.44
5.	Medicine	2.09
6.	Ortho	1.31
7.	Emergency	1.89

The transfusion index at our hospital was 2.1.

4. **Maximum blood order schedule (MSBOS):**

S. NO.	Department	MSBOS
1.	Surgery	2.7
2.	CTVS	5.85
3.	Gynae & Obs.	2.55
4.	Pediatrics	3.6
5.	Medicine	3.10
6.	Ortho	1.96
7.	Emergency	2.83

The MSBOS at our hospital was 3.2.

Discussion

The transfusion of blood or blood components is one of the most significant parts of the delivery of health care services in a hospital setting (Teresa J Nel et al, 2008). It is quite challenging to maintain a balance between the ongoing blood demand and supply. Unnecessary transfusions may cause a shortage of blood products for patients in real need. Various strategies have been developed to reduce the inappropriate use of blood and blood components. These include guidelines as well as monitoring of transfusion practice, education and self-audit by clinicians (Hui CH et al, 2005). Continuous monitoring will help to supply safe blood and blood products to needy patients and prevent over-utilization of a scarce resource. Various quality indicators have been identified. As per WHO – the working definition of an indicator is 'a variable with characteristics of quality, quantity and time, used to measure changes in health and health related situation, directly or indirectly, the progress made in addressing it and providing a basis for developing adequate plan for improvement'. All indicators have a part to play in maintaining quality, monitoring performance and ensuring safety and integrity for the recipient, the donor and staff (Safe blood and blood products: indicator and quality of care. WHO, Regional office for the Western Pacific, Manila Philippines. October 1996).

The C: T ratio is often used as a measure of the efficiency of blood ordering practice. The desirable C: T ratio varied from 2to 3 in different studies (Friedman BA et al, 1976) (Palmer et al,2003) (Mead JH et al, 1980). The value of 1.11 in our study is within desirable limits. Kozarzewska M et al have reported the values justifying blood ordering and utilization as C: T ratio <or= 3, %T >or= 30 and TI >or= 0.5 (Kozarzewska M et al, 2011). The TI is an average number of units used per patient cross matched and determine whether the number of units ordered is appropriate (Kozarzewska M et al, 2011). At our hospital, the maximum requisitions were received from Pediatrics dept. followed by cardiothoracic and vascular surgeries. The maximum number of patients transfused were of the age group 50 to 60 years followed by 10 to 20 years while a study from South India and Saudi Arabia observed an average age of 35.12+_ 20.4 years (Apuca Susan M et al, 2014) (Tayara BK et al, 2015). As the majority of the patients requiring blood transfusion in our study were pediatric thalassemia patients followed by cardiac patients for elective surgeries and hence the age corroborated with the same. The mean hemoglobin observed in our study for all the blood requests was 7.47g/dl which is similar to the observations made by Frank et al, 2012.

A CT ratio of 2.5 or below, Transfusion Probability of ≥ 30% and TI of more than 0.5 is considered indicative of efficient blood utilization as conceptualized by Boral LI et al, 1977 & Mead JH et al, 1980. The overall CT ratio at the hospital was 1.11 and the highest being for CTVS as 1.33 followed by emergency department as 1.27 suggests the significant blood utilization in contrast to several other studies worldwide and in India, where the CT ratio was very high ranging from 14.16 to 41.4 (Khoshrang H et al, 2012) (Couture DE et al, 2002). The key issue remains an over ordering of blood units due to individualistic estimation of anticipatory excessive surgical blood loss and in view of the patient safety. Another study by Davis et al. has reported even better utilization results than ours

as CT ratio of 1.02, TP of 97.2% and TI of 0.97 highlighting significant blood utilization and efficient blood transfusion practices at their center (Devi KM et al, 2014).

The highest MSBOS was observed with the CTVS (5.85) followed by Pediatrics (3.60), Medicine (3.10), Emergency (2.83), Surgery (2.7), Gynae & obs (2.55), and Ortho (1.96). There is a great need to discuss type and screen approach vs. cross match protocol at our center which can further lower the resource wastage due to holding of blood units as reported by Jayaranee S et al, 2002.

Therefore, there are numerous factors which can affect the transfusion practices at a hospital including the level of training of technicians, criteria's used for transfusion by surgeons and sharing of blood utilization information with other departments. Any issues related to the turnaround time, availability of units in emergency and holding the cross matched blood units are discussed and resolved if need there be.

Conclusion

This study conducted in our hospital helped in assessment of the transfusion practices at our center.

The CT ratio, transfusion probability and Transfusion index demonstrated that there is significant blood utilization at our hospital.

But excessive blood ordering for elective surgeries have been observed which leads to wastage of reagent resources, time of our technical staff and increasing workload on our staff.

Therefore, various measures should be taken to improve upon the safety and efficiency of blood supply and discuss to imply type and screen approach on cross match protocol at our center.

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