

SYSTEMATIC REVIEW

A Systematic Review of the Clinical Appropriateness of Blood Transfusion in India¹Dr. Rajbir Kaur Cheema, ²Dr. Parmatma Prasad Tripathi, ³Dr. Abhitesh Badhan, ⁴Dr. Purnima Jindal¹Assistant Professor, Department of Transfusion Medicine, Maharishi Markandeshwar College of Medical Sciences & Research (MMCMSR), Sadopur, Ambala, Haryana, India²Assistant Professor, Department of Transfusion Medicine and Hematology, National Institute of Mental Health and Neurosciences (NIMHANS) Bangalore, Karnataka, India³Senior Resident, Department of Transfusion Medicine, Maharishi Markandeshwar Institute of Medical Sciences & Research (MMIMSR), Mullana, Ambala, Haryana, India⁴Associate Professor, Department of Biochemistry, Maharishi Markandeshwar College of Medical Sciences & Research, Sadopur, Ambala, Haryana, India**Corresponding author**

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ABSTRACT**Background:** Human blood is a scarce and precious resource with no substitute. Blood and its components hold significant value as a crucial and valuable health resource. Blood transfusion is a vital therapeutic method that can be lifesaving in specific situations and is an irreplaceable means of clinical treatment.**Aim:** In light of the lack of a comprehensive systematic analysis on the rational utilization of blood in India, this systematic analysis was undertaken to address this significant issue of evaluation of clinical appropriateness of blood transfusion in India.**Methods:** The database search was carried out using PubMed, Medline, Embase, Scopus and Cochrane Library for the studies existing from the initial records till December 2022, that reported the incidence of inappropriateness of blood transfusion in India. After going through the databases, 1464 relevant articles were identified as per the search strategy. Among those 1308 duplicate records were taken away. Among the remaining one 166 records, 138 records were excluded majorly going through their titles and abstracts. Next matching our inclusion criteria and going through the full texts, 13 studies were excluded. Lastly, after excluding the reviews we included relevant 15 studies that reported clinical appropriateness of blood and blood products transfusion in India. All the included studies were published between years 2009-2022.**Results:** The rates of inappropriate use varied between 3.3% to 53%, depending on the specific type of blood component utilized. The highest rates of inappropriateness were found in cases involving Fresh frozen plasma (FFP), followed by Packed Red Blood Cells (PRBC).**Conclusion:** India faces challenges in ensuring the clinical appropriateness of blood transfusion, particularly regarding the use of plasma and red blood cells (RBCs). Inadequate dosing, lack of awareness regarding guidelines for blood component transfusion, and concerns about patient safety are the major contributing factors. Moving forward, it is crucial to implement comprehensive measures to enhance the clinical appropriateness of blood transfusions.**Keywords:** Transfusion, Blood Components, FFP, PRBC**INTRODUCTION**

Human blood is a scarce and precious resource with no substitute. Blood and its components hold significant value as a crucial and valuable health resource. Blood transfusion is a vital therapeutic method that can be lifesaving in specific situations and is an irreplaceable means of clinical treatment.¹ Therefore blood transfusion should be prescribed only to treat conditions associated with significant morbidity or mortality that cannot be prevented or managed sufficiently by other mean.^{2,3}

In the 15th and 16th centuries, the idea of blood transfusion emerged, driven by the belief that transferring blood from a young and healthy person to an older or weaker individual could restore their youthfulness and enhance their well-being. However, Karl Landsteiner's groundbreaking discovery of blood group antigens in 1901 transformed transfusion therapy from a risky attempt into a relatively safe procedure.⁴ Over the past decade,

there has been a significant transformation in the field of transfusion medicine. The introduction of anticoagulant preservative solutions has revolutionized the storage of blood, allowing for the separation of blood donation from the subsequent transfusion to recipients⁵. This innovation has paved the way for the establishment of "blood banks." As per the latest Indian guidelines, the term "Blood bank" has been replaced with "Blood Centre" now.

The primary goal of the World Health Organization Blood Transfusion Services (WHO BTS) programme is to reduce the use of unnecessary transfusions by encouraging the appropriate clinical utilization of blood and blood products². Furthermore, the program emphasizes the adoption of simpler alternatives to transfusion whenever possible. With the advent of technology and increasing pressure on both the supply and the demand for blood, there is an increased focus on the utilization of specific blood components as well. Blood components, which are frequently essential for saving lives, possess unique properties that cannot be replicated by any substitute⁶.

Nevertheless, the decision to administer blood components must be carefully considered due to the significant risks associated with transfusion. Hence, considering the points mentioned, ensuring the suitability of transfusion practices entails a systematic approach, wherein blood components are administered solely when there is substantiated evidence of potential advantages, absence of viable alternatives, availability of safe and high-quality products, and a thorough evaluation of risks and benefits before proceeding with the transfusion⁷.

A scarcity of blood and blood components is prevalent in many developing countries including India. The available resources are insufficient to meet the constantly increasing demand for blood and its components. It is crucial to utilize blood components appropriately to ensure their availability for patients in need and to minimize the avoidable risk of transfusion-transmitted diseases.

The issue of appropriate blood utilization has raised significant concerns within the Indian population, with frequent reports of irrational blood usage in recent years. Therefore, it is crucial to examine the appropriateness of clinical blood transfusion and its management. Clinical transfusion audits and hemovigilance serve as valuable tools for comprehending and analyzing the rationality of blood transfusions.

Hence, In light of the lack of a comprehensive systematic analysis on the rational utilization of blood in India, this systematic analysis was undertaken to address this significant issue of evaluation of clinical appropriateness of blood transfusion in India.

MATERIAL AND METHODS

Ethics Statement

All analyses in this study were based on previous published papers so ethical approval and patient consent is not required.

Search strategy for identification of literature

The present systematic review was accomplished in agreement with the guidelines framed by Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). The database search was carried out using PubMed, Medline, Embase, Scopus and Cochrane Library for the studies existing from the initial records till December 2022, that reported the incidence of inappropriateness of blood transfusion in India. This intended search was conducted by two independent reviewers, keeping in observation the structured format of this systematic analysis.

Intervention

Our search strategy incorporated the terms "blood transfusion", "clinical," "appropriateness," "India," "blood products," "blood component," "audit," "plasma," "red blood cell," "white blood cell," "cryoprecipitate," "granulocyte," and related terms.

Study design

This systematic review enrolled all observational studies that reported the incidence of inappropriateness of blood transfusion in India

Inclusion criteria

- In this review we included all published studies from last 14 years i.e ranging from year 2009 to year 2022.
- Studies in English language and academic peer-reviewed journals were included.
- Studies that used the Specifications and Guidelines of Clinical Blood Transfusion Technology as the standard to determine blood transfusion appropriateness.
- Studies carried out in India.
- Studies involved in clinical blood transfusion cases.
- Studies that reported the total number of cases of blood use and the cases of blood inappropriate use.

Exclusion criteria

- Studies those were published in language other than English.
- The records not related to this study.
- Studies with incorrect or inconsistent data.

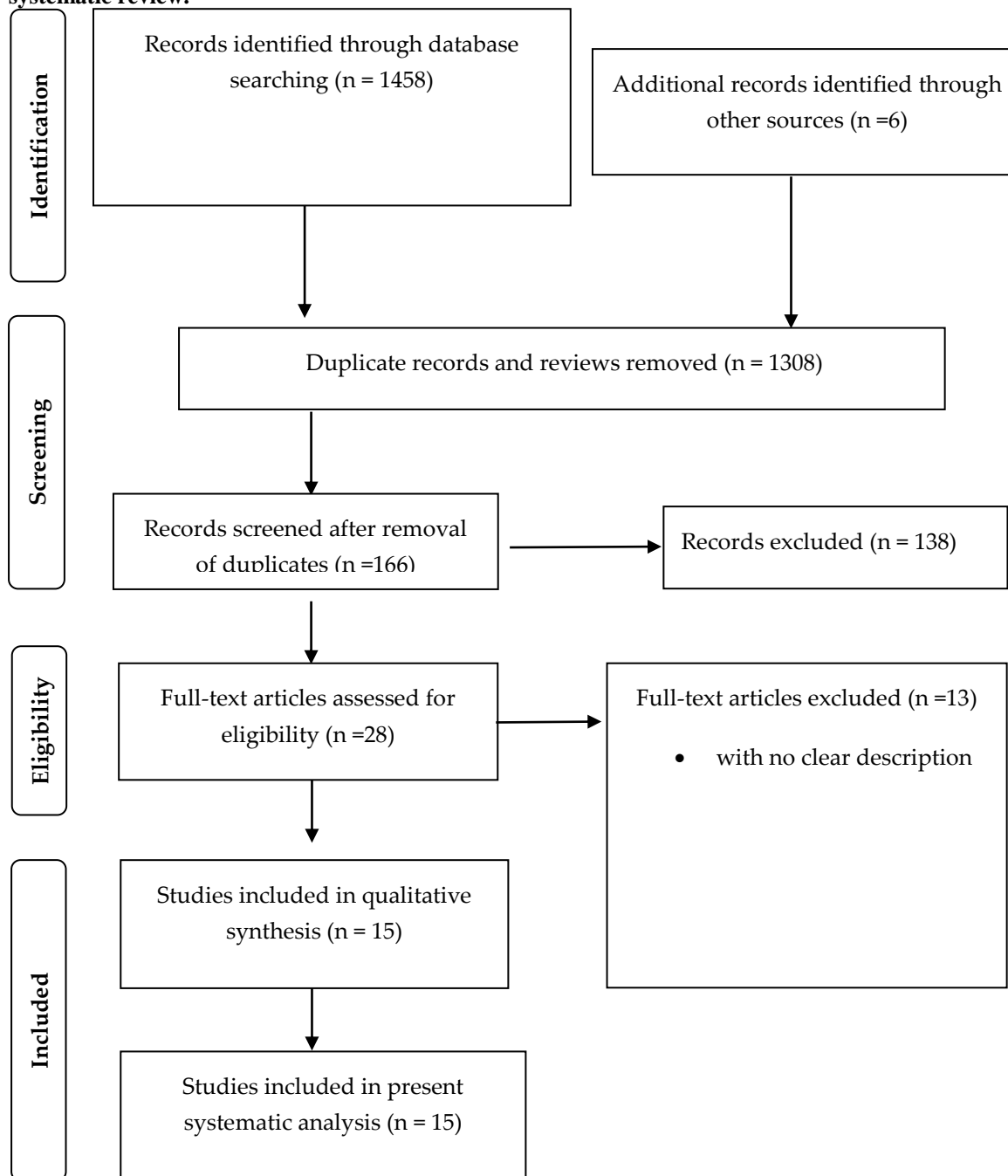
Process of screening and selection of articles

All the published research articles that met our inclusion and exclusion criteria were assessed. The selected entire articles were reviewed and screened by the two independent researchers. Additionally, all the selected articles, bibliographies were also reviewed thoroughly in an attempt to obtain some more relevant researches which were not detected during the initial research. Thereafter any obtained discrepancy between the two researchers was resolved by discussion and a mutual consent was obtained from both.

Ethical clearance from the institutional ethical committee was not required as all the obtained data was extracted from studies which had already been published earlier. We did not receive any outside funding for the execution of this study.

A “PRISMA flow chart” has been presented in figure 1 which evidently represents the screening process in the present review.

Figure 1: PRISMA Flow chart reporting the preferred studies identified, included and excluded in the systematic review.



Data Extraction and Assessment

The data was cautiously read and manually extracted from the included studies using a standardized data extraction method. The following information was gathered: authors and year of study, sample size, total number of transfusions, and department of patient admitted to, blood and the blood components used for transfusion, percentage of appropriateness and inappropriateness of transfusions and possible reasons for inappropriateness mentioned in the study.

RESULTS

After going through the databases, 1464 relevant articles were identified as per the search strategy. Among those 1308 duplicate records were taken away. Among the remaining one 166 records, 138 records were excluded majorly going through their titles and abstracts. Next matching our inclusion criteria and going through the full texts, 13 studies were excluded. Lastly, after excluding the reviews we included relevant 15 studies that reported clinical appropriateness of blood and blood products transfusion in India. All the included studies were published between Years 2009-2022. Table 1 summarizes the included studies and its general characteristics.

Table 1: General characteristics of the included studies

S.No.	Author	Year	Region	Sample Size (No. Of Patients)	Age Of Patients	Total Number Of Transfusions
1.	Wade M et al ⁹	2009	Mumbai	85	Below 12 years of age	184
2.	Ranganathan P et al ¹⁰	2012	Mumbai	1175	18 yrs above	-
3.	Gomathi G et al ¹¹	2012	Pondicherry	148	18 yrs above	422
4.	Katara AA et al ¹²	2014	Gujrat	1050	18 yrs above	1078
5.	Jindal G et al ¹³	2015	PGI Chandigarh	39	3 months-12 years old	51
6.	Sharma R et al ¹⁴	2015	Rajasthan	545	18 yrs above	902
7.	Ravishankar J et al ¹⁵	2016	Chennai	122	16 years above	308
8.	Ahmed M et al ¹⁶	2016	Mumbai	122	29 days to 12 years	161
9.	Tiwari AK et al ¹⁷	2017	Haryana	764	18 yrs above	1024
10.	V. Puri et al ¹⁸	2019	Uttarpradesh	250	18 yrs above	901
11.	Sharif M et al ¹⁹	2020	Mumbai	315	Less than 12 years	336
12.	Lingegowda JB et al ²⁰	2020	Tamil Nadu	207	13-68years	785
13.	Sharma A et al ²¹	2020	New delhi	5507	18 yrs above	11829
14.	Chandrasekar M et al ²²	2021	Tamil Nadu	450	40 -60 years	1500
15.	Mathew S C et al ²³	2022	Tamil Nadu	200	18 yrs above	332

The cases and the department they presented to along with type of the blood components used in the included studies are summarised in Table 2. Most of the research encompassed patients from a broad age spectrum, comprising both children and adults, who were admitted to different departments within the hospital. In contrast, a small number of studies specifically concentrated on pediatric patients admitted to the general pediatric ward, PICU (Pediatric Intensive Care Unit), NICU (Neonatal Intensive Care Unit) ^{9, 13, 16, 19} and only one study centered exclusively on burn patients ¹⁵.

The majority of the studies included in the analysis showed a preference for whole blood, packed red blood cells, platelet concentrate, and fresh frozen plasma as the primary source. Specifically, two studies exclusively employed fresh frozen plasma ^{18,20} two studies relied solely on packed red blood cells for transfusion ^{17,22} and cryoprecipitate use was observed in one of the studies ¹⁴.

Table 2: Blood components utilised in the studies

	Type Of Patient/ Department	Blood Components Utilised (N= No. Of Patients)
Wade M et al ⁹	Pediatric ward: (Pediatric intensive care unit, Pediatric hematology section, Neonatal intensive care unit and Pediatric surgery ward)	<ul style="list-style-type: none"> • Packed RBCs : 59.78% • Platelet concentrate: 15.2% • Fresh frozen plasma (FFP):22.28% • Cryoprecipitate: 5%
Ranganathan P et al ¹⁰	Cancer patients undergoing surgery	<ul style="list-style-type: none"> • Red cell transfusions: 99% • Fresh frozen plasma (FFP) :<1% • Platelet concentrate: <1%
Gomathi G et al ¹¹	General Medicine Cardiology Gastroenterology General Surgery Obstetrics and Gynaecology, Neurology Nephrology & Urology.	<ul style="list-style-type: none"> • Whole blood: 178 patients • Packed RBCs : 84 patients • Platelet concentrate: 14 patients • Fresh frozen plasma (FFP)
Katara AA et al ¹²	Obstetrics and Gynaecology General surgery, Medicine	<ul style="list-style-type: none"> • Red cell concentrates • Whole blood • Platelet concentrate • Fresh frozen plasma
Jindal G et al ¹³	Pediatric department	<ul style="list-style-type: none"> • Fresh frozen plasma (FFP) :51 • Platelet concentrate: 31 • Packed RBC infusion: 138
Sharma R et al ¹⁴	Obstetrics and Gynaecology General surgery, Medicine, Paediatrics Orthopedics Skin T.B.Chest	<ul style="list-style-type: none"> • Packed cells :81.3% • Whole blood: 6.20% • Platelet concentrate 10.2% • Fresh frozen plasma: 2% • Cryoprecipitate: 1 patient
Ravishankar J et al ¹⁵	Burn patients	<ul style="list-style-type: none"> • Whole blood: 223 • Red cell units: 85 • Fresh frozen plasma units: 441 • Platelet concentrate:1
Ahmed M et al ¹⁶	Pediatric intensive care unit [PICU]	<ul style="list-style-type: none"> • Packed cells :74.53% • Platelet concentrate 14.28% • Fresh frozen plasma: 11.18%
Tiwari AK et al ¹⁷	Cardiac surgery Liver transplant GI surgery Critical care Gynecology	<ul style="list-style-type: none"> • Red cell transfusions
V. Puri et al ¹⁸	Obstetrics and Gynaecology (Bleeding related to surgery with deranged coagulation profile)	<ul style="list-style-type: none"> • Fresh frozen plasma
Sharif M et al ¹⁹	Pediatric ward PICU NICU	<ul style="list-style-type: none"> • Packed RBCs : 46.35% • Fresh frozen plasma units: 17.44% • Platelet concentrate:36.21%
Lingegowda JB et al ²⁰	Surgery Medicine Obstetrics Paediatrics Cardiovascular Surgery, Oncology Burn & Plastic, Intensive care.	<ul style="list-style-type: none"> • Fresh frozen plasma (FFP)

Sharma A et al ²¹	Surgery Medicine Obstetrics Paediatrics Cardiovascular Surgery, Oncology Burn & Plastic, Intensive care Neurosurgery Urology Respiratory medicine Haematology.	<ul style="list-style-type: none"> • Packed RBCs : 59.78% • Platelet concentrate: 15.2% • Fresh frozen plasma (FFP):22.28%
Chandrasekar M et al ²²	Elective and emergency procedure patients.	<ul style="list-style-type: none"> • Packed red blood cell.
Mathew S C et al ²³	ICU patients: Emergency surgery , trauma	<ul style="list-style-type: none"> • Packed RBCs: 99.4% • Whole blood transfusions: 0.6%

Appropriateness of transfusions and possible reasons for inappropriateness are described in Table 3. The rates of inappropriate use varied between 3.3% and 53%, depending on the specific type of blood component utilized. The highest rates of inappropriateness were found in cases involving FFPs, primarily due to inadequate understanding and knowledge regarding its proper and improper applications. In general, lack of awareness regarding guidelines for blood component transfusion, fear of endangering life of the patients by withholding transfusions and a casual approach regarding decision to transfuse and a false sense of security provided by transfusions among clinicians were some commonly observed reasons for appropriateness of transfusions.

Table 3: Appropriateness and inappropriateness of transfusions and the possible reasons for inappropriateness

Author	Appropriate Transfusion	Inappropriate Transfusion	Reasons For Inappropriateness
Wade M et al ⁹	<ul style="list-style-type: none"> • Total: 83.1% • Packed Cell volume : 90% • Platelet concentrate: 92.86% • Fresh frozen plasma (FFP): 56.10% • Cryoprecipitate: 100% 	<ul style="list-style-type: none"> • Total :16.9% • Among them: <ul style="list-style-type: none"> • FFP: 58% • RBC: 35.5% • Platelet concentrate: 6.45% 	<ul style="list-style-type: none"> • A misconception regarding fresh frozen plasma, that it is a good volume expander and a source of albumin, probably is the cause of its increased inappropriate use. • In the present study, FFP was given inappropriately for coffee brown gastric aspirates without derangement of coagulation tests. • Apprehension of immediate risk to the patient and misperception of role of PRCs in the treatment • Emergency situations in intensive care settings may lead to inappropriate use of platelets and fresh frozen plasma
Ranganathan P et al ¹⁰	<ul style="list-style-type: none"> • Red cell transfusions: 96.6% 	<ul style="list-style-type: none"> • Red cell transfusions: 3.3% cases 	<ul style="list-style-type: none"> • -
Gomathi G et al ¹¹	<ul style="list-style-type: none"> • Whole blood: 91% • Packed RBCs: 92% <ul style="list-style-type: none"> • Platelet concentrate:93% • Fresh frozen plasma (FFP): 73% 	<ul style="list-style-type: none"> • Whole blood: 9% • Packed RBCs: 8% • Platelet concentrate: 7% • Fresh frozen plasma (FFP): 27% 	<ul style="list-style-type: none"> • Inadequate doses • Unnecessary transfusion of FFP
Katara AA et al ¹²	<ul style="list-style-type: none"> • Total: 81% 	<ul style="list-style-type: none"> • Total :19% 	<ul style="list-style-type: none"> • -
Jindal G et al ¹³	<ul style="list-style-type: none"> • Fresh frozen plasma (FFP) : 24% • Platelet concentrate: 74% 	<ul style="list-style-type: none"> • Fresh frozen plasma (FFP) : 76% • Platelet concentrate: 26% 	<ul style="list-style-type: none"> • Lack of awareness regarding guidelines for blood component transfusion. • Fear of endangering life of the

	<ul style="list-style-type: none"> • Packed RBC infusion: 74% 	<ul style="list-style-type: none"> • Packed RBC infusion: 26% 	<p>patients by withholding transfusions</p> <ul style="list-style-type: none"> • A casual approach regarding decision to transfuse and a false sense of security provided by transfusions among clinicians.
Sharma R et al ¹⁴	<ul style="list-style-type: none"> • Total: 62.63% • Packed cells :60.21% • Whole blood: 80.35% • Platelet concentrate 72.34% • Fresh frozen plasma: 55.55% 	<ul style="list-style-type: none"> • Total: 37.37% • Packed cells :39.79% • Whole blood: 19.65% • Platelet concentrate 27.65% • Fresh frozen plasma: 44.45% 	<ul style="list-style-type: none"> • RBC transfusion dictated by Hb concentration alone, but not based upon on assessment of the patient clinical status. • FFP used as plasma expander and as a source of albumin in hypoproteinemic. Risk of FFP transfusion overweighs its potential benefits.
Ravishankar J et al ¹⁵	<ul style="list-style-type: none"> • RBC Transfusion: 64% • FFP transfusion: 47% 	<ul style="list-style-type: none"> • RBC transfusion: 36% • FFP transfusion: 53% 	<ul style="list-style-type: none"> • Inadequate doses • Non-availability of 5% albumin for treating hypoproteinemia and to promote wound healing.
Ahmed M et al ¹⁶	<ul style="list-style-type: none"> • Total: 75.15% • Packed cells: 74.16% • Platelet transfusion: 73.91% • FFP transfusion: 83.33% 	<ul style="list-style-type: none"> • Total : 25.84% • Mianly red blood cells 	<ul style="list-style-type: none"> • Red blood cell transfusion were given considering the oxygen requirement whether on CPAP or mechanical ventilation. The recommendations of IAP do not consider the oxygen requirement of the children above four months of age. • Inappropriate transfusions of FFP without supportive evidence
Tiwari AK et al ¹⁷	<ul style="list-style-type: none"> • Red cell transfusions: 90.23% 	<ul style="list-style-type: none"> • Red blood cell transfusions: 9.77% 	<ul style="list-style-type: none"> • -
V. Puri et al ¹⁸	<ul style="list-style-type: none"> • FFP: 67% 	<ul style="list-style-type: none"> • FFP:33% 	<ul style="list-style-type: none"> • Improper understanding and knowledge about the appropriate and inappropriate usages of FFPs.
Sharif M et al ¹⁹	<ul style="list-style-type: none"> • Overall : 72.6% • RBC Transfusion: 78.7% • Platelet transfusion: 63.2% • FFP transfusion: 71.1% 	<ul style="list-style-type: none"> • Overall: 27.4% • RBC Transfusion:21.2% • Platelet transfusion: 36.8% • FFP transfusion: 28.9% 	<ul style="list-style-type: none"> • Critical patients • Clinicians tend to be more aggressive to transfuse considering the variability of underlying diagnosis and physiologic stability.
Lingegowda JB et al ²⁰	<ul style="list-style-type: none"> • FFP :59.36% 	<ul style="list-style-type: none"> • FFP : 40.64% 	<ul style="list-style-type: none"> • Widespread uncertainty about the appropriate indications of FFP among the clinicians is the cause of this high rate of inappropriate FFP transfusions. • Due to litigation atmosphere, precaution transfusions are also known to happen. • Lack of awareness about blood component usage, especially FFP usage is the most common reason for this inappropriate use of FFP.
Sharma A et al ²¹	<ul style="list-style-type: none"> • Packed RBCs : 65.63% • Fresh frozen plasma 	<ul style="list-style-type: none"> • Packed RBCs : 34.37% • Fresh frozen plasma 	<ul style="list-style-type: none"> • Most common cause of inappropriate use of PRBC was multiple units requested at same

	<ul style="list-style-type: none"> units: 98.13% • Platelet concentrate: 86.71% 	<ul style="list-style-type: none"> units: 1.47% • Platelet concentrate: 13.29% 	<ul style="list-style-type: none"> time without indication. • Demand for FFP and platelets was inappropriate primarily due to unindicated transfusion demands and incompletely filled forms
Chandrasekar M et al ²²	<ul style="list-style-type: none"> • Red cell transfusions: 65.9% 	<ul style="list-style-type: none"> • Red cell transfusions: 34% 	<ul style="list-style-type: none"> • Blood products which are cross matched for the purpose of transfusion are not transfused, and impacts the transfusion services by underutilization or over-ordering of blood products. • Low incidence of prophylactic patient blood management
Mathew S C et al ²³	<ul style="list-style-type: none"> • 89.2% 	<ul style="list-style-type: none"> • 10.8% 	<ul style="list-style-type: none"> • Blood loss • Co-morbid conditions

DISCUSSION

The utilization of blood and blood components has been characterized by indiscriminate practices, mainly due to their easy accessibility and insufficient clinical understanding of the recommended guidelines for component usage. In recent years, the issue of the appropriateness of blood use has become a focus worldwide.

In 2015 a systematic review focused on the clinical appropriateness of blood transfusion in China²⁴. According to the analysis results, the overall incidence of clinical inappropriateness of transfusion in China was estimated to be 37.3%. The authors were of the view that China has suffered from inappropriate clinical use of blood transfusions, especially plasma and RBC use. In future, they suggested some comprehensive measures should be implemented to improve the clinical appropriateness of blood transfusion. In a similar analysis from Ethiopia in 2021, an overall 82.1% of transfusions were observed to be appropriate; while only 27.8% of patients received appropriate components as 96.5% of individuals received a whole blood transfusion²⁵.

The blood transfusion service in India is decentralized and consists of a network of 2,760 blood centres operated by public, private, and not-for-profit sectors, collectively collecting approximately 12 million units of blood per year. The majority (77%) of these blood centres are affiliated with hospitals, while 22% operate independently. About 51% of these blood centres have the capability to separate blood components, accounting for 53% of the total annual blood collection in the country²⁶. Despite the significant rise in the availability and utilization of blood components, there is still a significant demand for and utilization of whole blood and its components in clinical settings across India²⁶.

The practice of clinical transfusion is increasingly relying on evidence-based approaches. Giuliano G. in 2008 in their review mentioned about the appropriateness of transfusion practices, stating that “blood components are transfused only when there is evidence for potential benefit, there are no valid alternatives, safe and quality products are available, and risks and benefits are carefully assessed before the decision to transfuse are made”⁷. Hence, Transfusion audits and hemovigilance have gained prominence in determining the optimal transfusion requirements for patients. Even in India, a national program on recipient hemovigilance was initiated in December 2012 through a collaborative effort between the National Institute of Biologicals and the Indian Pharmacopoeia Commission, under the Ministry of Health and Family Welfare, Government of India^{27,28}.

In the present systematic analysis we observed that the rates of inappropriateness of usage of blood components ranged from 3.3% to 53%, depending on the specific type of blood component utilized. Further, the highest rates of inappropriateness were found in cases involving Fresh frozen plasma (FFP), followed by inappropriate Packed RBC transfusion.

Fresh frozen plasma (FFP) is a commonly prescribed blood product, and its usage continues to increase, even though the supply of plasma obtained from allogeneic blood donation is limited. Unfortunately, this product is frequently subjected to overuse or improper utilization. Similar findings have been reported both nationally and internationally, highlighting this concern.^{20,29-32} The possible reasons include widespread uncertainty about the appropriate indications of FFP among the clinicians is the cause of this high rate of inappropriate FFP transfusions. Lack of awareness about blood component usage, especially FFP usage is the most common reason for this inappropriate use of FFP.

British Committee for Standards in Haematology (2012) have published the guidelines for appropriate use of FFP, and to minimize the misuse of FFP. It reviews that the practice of plasma transfusion as prophylaxis in non-bleeding patients before invasive procedures seems unlikely to have clinical benefit; there is currently insufficient evidence to allow an evidence based recommendation on the optimal dose for FFP is 15 to 20 mL/Kg. However, despite these guidelines, many studies from around the world still report a high frequency of inappropriate FFP usage^{12, 20, 33}.

The second most common cause of inappropriate transfusion was with the use Packed RBCs. because of multiple units requested at same time without indication. Transfusion of a single unit of PRBC should not be considered inappropriate itself; The inappropriate utilization of packed red blood cells (PRBC) can be prevented by adopting a "patient-centered" approach that combines laboratory criteria with the patient's symptoms. Regular training for clinicians and residents is essential to enhance the information provided on requisition forms and improve overall decision-making regarding PRBC transfusions. According to Australian Red Cross Blood Service "where indicated, transfusion of a single unit of RBC, followed by clinical reassessment to determine the need for further transfusion, it's appropriate"¹⁴. According to the guidelines established by the BCSH (British Committee for Standards in Haematology) as well, red blood cell (RBC) transfusion should not solely rely on hemoglobin concentration but should also consider an evaluation of the patient's clinical condition³⁵.

Further, in our findings related to the inappropriateness due to the platelet transfusions, the most common reasons identified were unindicted/inappropriate transfusion and incomplete forms without platelet count value. Sharma R et al¹⁴ and study by Wade et al⁹ on paediatric populations also showed high inappropriate use of platelets 27.65% and 43.90% respectively. This can be prevented by sensitizing the clinicians with the recent transfusion guidelines and train them to fill the requisition forms properly.

It is evident that the understanding of clinicians regarding blood products, including their preparation, storage, requirements, dosages, and administration, can significantly influence patient care and transfusion outcomes. Considering the leaps and bounds by which the speciality had grown in the last 2-3 decades, the need for trained personnel became essential. To address such shortcomings in this regard, the Medical Council of India granted approval to start specialised training programmes i.e. MD Immunohaematology and Blood transfusion/Transfusion Medicine and National board in Immunohaematology and Transfusion Medicine²⁸.

Since the establishment of these programs in India, the number of Transfusion Medicine specialists is rising to a satisfactory level. The role of Transfusion Medicine physicians in modern medical practice in India is crucial, especially when it comes to prescribing blood and blood components. Seeking advice from a transfusion medicine specialist regarding the appropriate dosage of blood components at the right time is essential for optimal patient care.

Limitations of study were as follows

1. None of the included study had thrown light on data for granulocyte transfusion and therefore we did not assess the appropriateness of granulocyte transfusion.
2. There was large variability in sample size and the incidence of inappropriate use of blood components in different studies, which had added heterogeneity to results of this systematic review.

So, more powerful evidence based research is needed in future to clarify the rational use of blood and its components.

CONCLUSION

To conclude, India faces challenges in ensuring the clinical appropriateness of blood transfusion, particularly regarding the use of plasma and red blood cells (RBCs). Inadequate dosing, lack of awareness regarding guidelines for blood component transfusion, and concerns about patient safety are the major contributing factors. Moving forward, it is crucial to implement comprehensive measures to enhance the clinical appropriateness of blood transfusions. This includes conducting regular audits, providing proper education and training of rational usage of blood components to healthcare professionals and establishing more effective blood transfusion management systems. We hold the belief that the implementation of these comprehensive measures will significantly enhance the rational utilization of blood in India.

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