

# Overview of blood transfusion appropriateness with one-day point prevalence: Right decision? Right product? Right amount?

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## ABSTRACT

**OBJECTIVE:** Blood and blood products are a scarce resource and thus, they should be used efficiently. Inappropriate use of blood leads not only to waste of valuable medical resource, but also increases the risks of blood transfusion and economic burden.

**METHODS:** This study is a prospective, observational one-day single-center point prevalence study in which transfusion activities performed in our hospital. It was aimed to determine the prevalence of patients receiving blood products in hospitals, types of blood products, characteristics of recipients, distributions of blood group, appropriateness of blood transfusion and the cost of these products, using the one-day standardized prevalence method for the first time in our country.

**RESULTS:** One hundred seventy blood transfusions were performed in 102 patients. It was found that 64 (37.6%) of 170 blood products used according to the guidelines were non-evidence-based and inappropriate blood transfusions. It was established that the frequency of inappropriate use of blood products was significantly higher in surgical divisions (n=31 48.4%) compared to internal medicine divisions (n=20, 31.3%) (p<0.0001). The amount corresponding to 64 (37.6%) units transfused inappropriately according to the guidelines was found for one day. When we estimated the results of this study at the level of yearly use of blood products, we found that transfusion of approximately 28 000 units of blood products was being performed yearly in our hospital and a total of 8.435.006 TL/281.166 USD was being spent yearly considering 10 523 units were being transfused inappropriately.

**CONCLUSION:** This study shows that the condition in our country is only the tip of the iceberg. Examination of the indications for use of blood products by transfusion committees in hospitals and generalizing use of national guidelines could be the primary applications to prevent inappropriate use of blood products.

*Keywords: Blood cost; point prevalence; transfusion indications.*

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Blood transfusion is one of the important, irreplaceable and most commonly used clinical treatment methods worldwide. Recently, blood transfusion has reached considerably high levels of safety due to advancements in science and legal regulations [1, 2].

Advancements in the quality of blood transfusions have been achieved with establishment of Hospital Transfusion Committees, development of education programs and guidelines, and application of cost saving strategies [3].



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However, there are still important potential risks related to blood transfusion despite such advancements. Many transfusion-related adverse events, including immunological reaction and infections, have been reported [4–7].

The basic objective of modern transfusion services is to provide a supply of blood components for therapeutic use in an adequate, safe and efficient manner. Increased pressure on both supply and blood request has drawn attention to appropriate clinical use of present blood components. Transfusion safety is based not only on appropriate selection, preparation and application of blood products, but also on the ability to properly interpret the appropriate time of such an intervention. Considering the risks, scarcity and high cost, indications for use of blood products should be appropriate in order to prevent wastage and minimize the risks [8]. In this context, it is estimated that 5–58% of blood transfusions are “unnecessary or inappropriate” [9–12]. An indication for blood transfusion is generally based on clinical application guidelines or the recommendations of expert panels, but rarely supported by clinical researches [13, 14]. Therefore, blood transfusion is a complex treatment method that should be based on clinical evidence and adjusted according to cardiovascular risk factors and laboratory test results.

Use of risk reduction methods, development and application of new technologies for donation and transfusion have caused an important increase in the cost of blood transfusion [15]. Currently, 1% of the total hospital costs is attributed to blood transfusion, but this may change by disease and procedure. For treatments such as liver and bone marrow transplantation, for example, blood transfusion plays an important financial role that represents 5–9% of total hospital costs [16].

Hospital blood transfusion surveillance, which is defined as systematic collection, analysis, and interpretation of data for the objective of controlling use of blood products in hospitals, enables knowledge about the magnitude of the problem related to blood use in hospitals, monitoring tendencies and changes in time, comparison between hospitals and continuous education of health-care personnel. For surveillance studies to achieve success, opportunities should be reviewed and evaluated in detail, and a clear model with a specific objective should be presented. Blood use in a hospital may be examined with prevalence surveillance. Prevalence studies are cross-sectional studies and involve individuals who are receiving blood products at the time of the study; these studies are also named one-day (point) prevalence surveys. These surveys are useful for rapidly determining

### Highlight key points

- According to national guidelines, 37.6% of blood products were used inappropriately in a non-evidence-based manner.
- The highest transfusion rate was observed in internal medicine divisions.
- The rate of inappropriate blood product use was significantly higher in surgical divisions than in internal medicine units.
- Inappropriate transfusions resulted in an unnecessary annual cost exceeding 281166 USD for 10523 units.

blood use in hospitals and for specifying its limits. In addition, it may be considered a good alternative method to be used in large hospitals with limited resources.

In this study, it was aimed to demonstrate use of blood products in hospitals, which has been defined as one of the important health problems in recent years and to which much effort has been devoted, in different dimensions. With this objective, it was aimed to determine the types of blood products used for transfusion in our hospital, characteristics of recipients, blood group distributions, appropriateness of blood transfusion and the cost of these products using one-day standardized prevalence method for the first time in our country.

## MATERIALS AND METHODS

Our hospital is a tertiary city hospital in Istanbul with 758 beds, 27 operation rooms, and 96 intensive care beds, in which education-training activities are being conducted. This study is a prospective, observational, one-day, single-center point prevalence study in which transfusion activities in our hospital were investigated in a one-day follow-up period. All transfusions performed in our hospital in a period of 24 hours on the date specified were included in the study. No transfusion was excluded from the analysis. This study was conducted in compliance with the ethical standards of the Helsinki Declaration of Human Rights. The study was approved by Istanbul Medeniyet University Goztepe Training and Research Hospital Ethics Committee (Decision number: 2020/0503) on 12.08.2020.

The patients' demographic data, diagnoses, clinics where they were followed up, type of the blood product transfused, blood groups, transfusion period, transfusion dose, if the product was processed additionally (radiation, cleaning, filtration), if any reaction developed against the blood products, the objective of use of blood product, if the blood product was given for the appro-

**TABLE 1.** Indications for transfusion of blood and blood components

Indication for transfusion of blood and blood components	
Erythrocyte concentrate (E)	Platelet concentrate (P)
<p><b>E1</b> Acute hemorrhage</p> <p><b>E2</b> Stable patient with Hb <math>\leq</math> 7 g/dL,</p> <p><b>E3</b> Cardiovascular disease or hematologic malignancy with Hb <math>\leq</math> 8 g/dL</p> <p><b>E4</b> Chronic anemia requiring transfusion</p> <p><b>E5</b> Exchange Transfusion</p> <p><b>E6</b> Preoperative preparation of patients</p> <p><b>E7</b> Risk for perioperative hemorrhage</p> <p><b>E8</b> Other (explain):.....</p>	<p><b>P1</b> Prophylaxis to prevent spontaneous hemorrhage</p> <p><b>P1A</b> Platelets <math>&lt;10 \times 10^9/L</math>; reversible bone marrow failure</p> <p><b>P1B</b> Platelet <math>10-20 \times 10^9/L</math>; sepsis/hemostatic anomaly</p> <p><b>P1C</b> Platelet <math>&lt;30 \times 10^9/L</math>; confirmed coagulopathy</p> <p><b>P2</b> Prophylaxis before invasive procedure or preoperative prophylaxis</p> <p><b>P2A</b> Platelet <math>&lt;20 \times 10^9/L</math>; central venous catheter</p> <p><b>P2B</b> Platelet <math>&lt;40 \times 10^9/L</math>; before lumbar puncture/spinal anesthesia</p> <p><b>P2C</b> Platelet <math>&lt;50 \times 10^9/L</math> before liver biopsy/major surgery</p> <p><b>P2D</b> Platelet <math>&lt;80 \times 10^9/L</math>; epidural anesthesia</p> <p><b>P2E</b> Platelet <math>&lt;100 \times 10^9/L</math>; before surgery on a critical region, for example: central nervous system, eye</p> <p><b>P3</b> Therapeutic use to treat hemorrhage (WHO bleeding grade 2 or above)</p> <p><b>P3A</b> Platelet <math>&lt;50 \times 10^9/L</math>; major hemorrhage</p> <p><b>P3B</b> Platelet <math>&lt;100 \times 10^9/L</math>; critical region hemorrhage, CNS/traumatic brain damage</p> <p><b>P3C</b> Platelet <math>&lt;30 \times 10^9/L</math>; clinically prominent hemorrhage</p> <p><b>P4</b> Specific clinical conditions</p> <p><b>P4A</b> Before procedure or if bleeding is present in disseminated intravascular coagulation.</p> <p><b>P4B</b> Primary immune thrombocytopenia (severe hemorrhage).</p> <p><b>P5</b> Platelet dysfunction</p> <p><b>P5A</b> Critical hemorrhage arising from use of anti-platelet drug</p> <p><b>P5B</b> Hemorrhage in hereditary platelet disorders</p> <p><b>P6</b> Other (explain):.....</p>
<p>Fresh frozen plasma (P)</p> <p><b>P1</b> Major Hemorrhage</p> <p><b>P2</b> INR <math>&gt;1.5</math> with hemorrhage</p> <p><b>P3</b> PT/INR <math>&gt;1.5</math> before procedure</p> <p><b>P4</b> Liver disease or preprocedural period with PT/INR <math>&gt;2</math></p> <p><b>P5</b> FFP/Plasma Exchange</p> <p><b>P6</b> Replacement of a Deficient Coagulation Factor</p> <p><b>P7</b> Preoperative preparation of patient</p> <p><b>P8</b> Risk of perioperative hemorrhage</p> <p><b>P9</b> Other (explain):.....</p>	
<p>Cryoprecipitate (C)</p> <p><b>C1</b> Clinically significant hemorrhage and Fibrinogen <math>&lt;1,5g/L</math> (for obstetric hemorrhage <math>&lt;2 g/L</math>)</p> <p><b>C2</b> Preprocedural Fibrinogen <math>&lt;1 g/L</math></p> <p><b>C3</b> Hemorrhage related to thrombolytic treatment</p> <p><b>C4</b> In conditions where fibrinogen concentrate can not be reached in hereditary hypofibrinogenemia</p>	

appropriate indication and the costs were recorded in the form prepared. These data were obtained by using patient files and nursing documentations and by interviewing with physicians. The patients' complete blood counts were reviewed primarily. Thereafter, the patients' diagnoses and other medical records were reviewed in the hospital information system. Additional evidence, including medical history, the patient's condition (symptoms and signs etc.) and blood loss, was searched in the medical records. Appropriate use of blood products (appropriate indication, appropriate dose, appropriate period) was evaluated by a hematologist considering the "Appropriate Clinical Use of Blood Products 2020 Guideline" and "National

Hemovigilance 2020 Guideline" which were put into effect by the Ministry of Health [17, 18]. The criteria that were used to evaluate the indications for transfusion decisions are explained in Table 1. Inappropriate use of blood was specified considering absence of an indication, inappropriate dose, inappropriate period of use, unnecessary or deficient additional procedure and lack of appropriate filling of follow-up forms. Presence of one or more criteria was considered inappropriate use.

For analysis of the direct costs of the blood products applied to the patients, a calculation was made according to the retail prices used by the Turkish red crescent and Social Security Institution (SSI) prices and Commu-

**TABLE 2.** Types of inappropriateness in use of blood products

Types of inappropriateness	%
Inappropriate indication	21.2
Inappropriate period	14.7
Inappropriate dose	7.1
Inappropriate filling of blood monitoring form	19.4
Presence of at least one inappropriateness	37.6

nique on Healthcare Practices (CHP) prices on the day of the study considering the costs directly related to processing of the blood products (selection of blood donor, collection, analysis, degradation, storage, additional procedure and compliance test) without considering annual inflation rate. Conversion from Turkish lira (TL) to USA dollar (USD) was performed according to the Exchange Rate Related to Pay off USA Dollar Debts in Türkiye published by the Turkish Central Bank on the day when the study was conducted.

### Statistical Analysis

SPSS 22 (*Statistical Package for Social Science Inc., Chicago, USA*) was used for statistical analysis of the data obtained at the end of the study. Compatibility of the measurement values obtained in the study to the normal distribution was examined using the “Shapiro-Wilk Test”. Descriptive statistics for continuous numerical variables were expressed as mean±standard deviation and median [Interquartile range (IQR) in 95% confidence interval] and categorical variables were expressed as numbers (n) and percentages (%). The “Student’s t-test” and “Mann-Whitney U Test” were used for comparison of continuous numerical variables between the groups, and “Chi-square Test” and “Fischer’s Exact test” were used for comparison of categorical variables. A p value of <0.05 was considered statistically significant for statistical decisions.

## RESULTS

On the day when the point prevalence study was performed in our hospital, 170 blood transfusions were performed in 102 patients and multiple blood products were used in 51 patients. It was found that 4 units of blood were used maximally for one patient. Among the patients who underwent transfusion, 52 (51%) were female, 50

**TABLE 3.** Rates of appropriate use by blood product type

Type of product	Appropriate use n=106	Inappropriate use n=64	Total number of products n=170
	%	%	n (%)
Erythrocyte suspension	82.1	59.4	125
Platelet suspension	8.5	6.3	13
Fresh frozen plasma	9.5	34.4	32

(49%) were male, and the median age of the patients was found to be 61.5 (28–73) years. When the diagnoses were examined in terms of the indications of transfusion, it was found that transfusion was performed because of malignancy in 35 (34.3%) patients, because of operation in 19 (18.6%) patients, because of anemia in 13 (12.7%) patients, because of thalassemia in 13 (12.7%) patients, because of coagulation disorder in 10 (9.8%) patients, because of renal failure in 8 (7.8%) patients and because of gastrointestinal bleeding in 4 (3.9%) patients.

The most commonly used blood product was erythrocyte suspension (ES, n: 125, 73.5%). The most commonly transfused blood type was A Rh positive. Mild allergic reaction was observed only in one patient. When the indications for transfusion of blood products were examined, it was found that the most common diagnosis code was chronic anemia for ES, thrombocytopenia (<30×10<sup>9</sup>/L) and confirmed coagulopathy (T1C) for platelets (PLT) and an INR value >1.5 associated with bleeding for fresh frozen plasma (FFP).

When the blood products transfused were examined, it was found that 125 of these blood products were ES (73.5%), 32 were FFP (18.8%) and 13 were PLT (7.6%). According to the “Appropriate Clinical Use of Blood Products 2020 Guideline” and “National Hemovigilance 2020 Guideline”, it was found that 64 units (37.6%) among 170 blood products were used inappropriately in a non-evidence-based manner and 106 units (62.4%) were used appropriately (Table 2). The rate of inappropriate transfusion was found to be 59.4% for ES transfusions, 43.4% for FFP transfusions and 6.3% for PLT transfusions. ESs had the highest rate of inappropriate transfusion (Table 3).

The frequencies of blood product transfusion were examined by the hospital wards. The highest transfusion

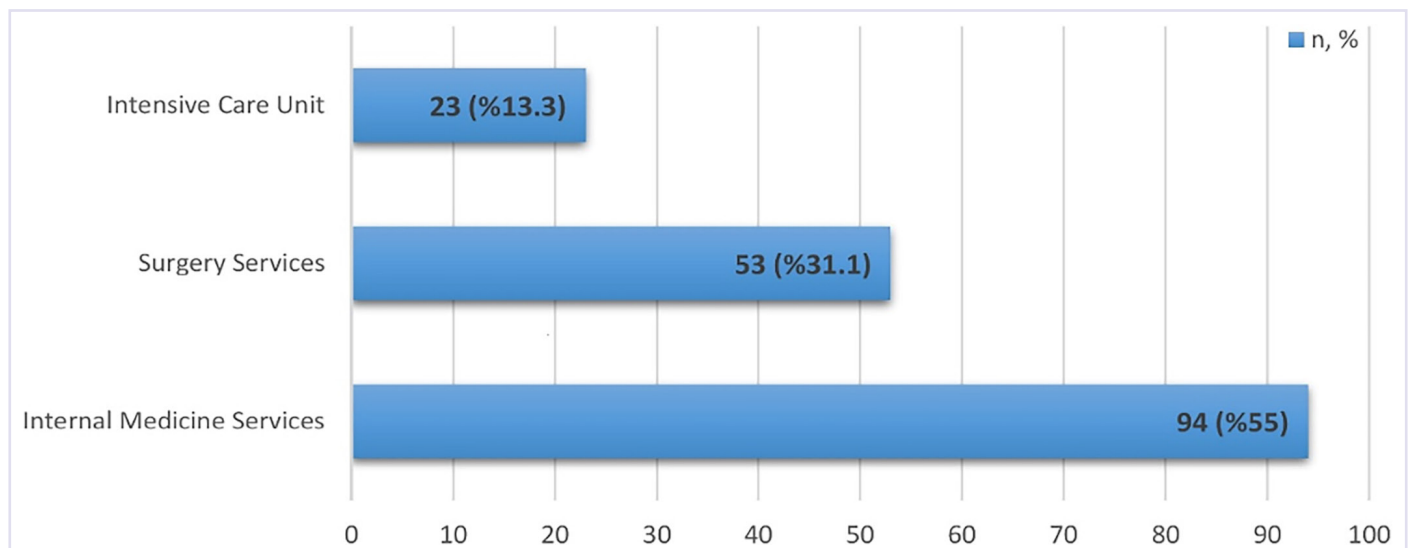


FIGURE 1. Blood transfusion numbers and percentages by services.

rate was found in internal medicine divisions (55%, 94 units), while this rate was found to be 31.1% (53 units) in surgical divisions and 13.5 % (23 units) in intensive care units (Fig. 1). Although the highest number of blood products was used in internal medicine divisions, the rate of inappropriate use of blood product was found to be significantly higher in surgical divisions (n=31, 48.4%) compared to internal medicine units (n=20, 31.3%) ( $p<0.0001$ ) (Table 4).

According to the results, the approximate daily cost of 170 units included in this study was 136.440 TL which corresponded to 4 553 USA dollars. The daily cost corresponding to 64 units (37.6%), which were transfused inappropriately according to the guidelines, was found to be about 51.301 TL, 1 710 dollars. When we estimated the results of this study at the level of yearly use of blood products, we found that transfusion of approximately 28 000 units of blood product was being performed in our hospital yearly and a total of 8.435.006 TL/281 166 USD was being spent yearly considering 10 523 units were transfused inappropriately.

## DISCUSSION

Since blood is a limited resource depending only on the devotion of individual donors, it is essential to rationalize and optimize transfusion applications. Transfusion has risks and costs as well as benefits. Appropriateness of use of blood products has become an issue that has been emphasized in recent years [19–22].

The rate of inappropriate blood transfusion found in our study (37.6%) was in the mid range (4–66%) of the results reported in other studies [23]. Different study periods, application guidelines, study designs and especially specific appropriateness criteria probably contribute to the variation in the results reported, and make it difficult to compare absolute inappropriate transfusion levels between studies [24].

In the literature, the rate of inadequate indications was reported to be 74% for erythrocyte suspension (ES), 96.2% for FFP and 13% for PLT [25, 26]. In a study conducted on appropriate blood transfusion indications in Spain, the rate of inappropriate use was observed to be 13%, 48% and 67%, respectively, for erythrocyte suspension, platelet concentrate and fresh frozen plasma [27].

TABLE 4. Distribution of inappropriate use of blood products

Use of blood product	Divisions where blood products were used			p
	Internal medicine services n=94 (%)	Surgical services n=53 (%)	Intensive care units n=23 (%)	
Inappropriate use	31.3 <sup>a,b</sup>	48.4	20.3	<0.001
Appropriate use	69.8	20.8	9.4	

<sup>a</sup>: Statistical difference by surgical wards  $p<0.001$ ; <sup>b</sup>: Statistical difference by intensive care units  $p=0.001$

In our study, the rate of inappropriate use was found to be 59.4% for ES, 43.4% for FFP and 6.3% for PLT.

In another study conducted in Brazil to evaluate the appropriateness of blood product requests, it was found that 85.57% of transfusions were appropriate and the rate of appropriate use was 81.4% for intensive care unit and 71.42% for surgical wards [28]. Studies have emphasized the importance of introducing blood bank awareness-raising campaigns related to rational use of blood products, applying strategies directed to more efficient use of blood products and establishing mandatory transfusion committees [29].

It is possible to at least partially explain the variation observed in the levels of inappropriate transfusion between different clinical specialties with the typical characteristics of the patients treated in these specialties. Therefore, the possibility of surgical patients to receive inappropriate erythrocyte transfusion is higher. Although the highest number of transfusions (94 units, 55%) was found in the internal medicine patients in our study, the rate of inappropriate use of blood products was found to be significantly higher in surgical divisions ( $n=31$  48.4%) compared to internal medicine divisions ( $n=20$ , 31.3%) and this was similar to previous studies [30].

Another objective of this study was to determine the effect of inappropriate blood transfusion on the cost. Continuously increasing financial pressure and limited resources necessitate critical review of transfusion applications. In a retrospective study conducted by Juarez-Rangel et al. in 2004 [26], it was reported that 63.3% of blood products were transfused inappropriately and the annual cost corresponded approximately to 95 775 USD. Our study, which was conducted to evaluate transfusion costs in our hospital, is the first study in which inappropriate use of transfusion and its cost were evaluated in our country. As a result of the assessment based on the guidelines in our country, it was found that more than one third of transfusions were used inappropriately and this caused an unnecessary total annual cost above 281 166 USD for 10 523 units. However, only the direct costs related to blood product processing were calculated when performing cost analysis, and indirect costs that could increase transaction costs in divisions (labour cost, equipment amortization, facility maintenance costs etc.) or annual fluctuation were not considered. These figures would be higher if indirect costs were considered. In addition, this cost arising from inappropriate use of blood products signifies a serious burden for the national economy. Considering this financial aspect of transfusion of

blood products, reducing inappropriate use of blood products is important in terms of decreasing this economic burden. Application of the guideline principles that will justify use of blood products and periodical inspections by transfusion committees will provide a reduction in the rate of inappropriate use of blood products.

## CONCLUSION

In this study, which was conducted to evaluate use of blood products, shows that the condition in our country is only “the tip of the iceberg”. A protocol related to appropriate clinical use of blood products should be prepared, such that surgical divisions are prioritized, in order to reduce the rates of inappropriate use of blood products. Education studies related to appropriate use of blood products and adjustments that would increase the efficiency of transfusion committees are needed. The primary interventions include examination of the indications for use of blood products by hospital transfusion committees and extension of use of national guidelines.

**Ethics Committee Approval:** The Medeniyet University Goztepe Training and Research Hospital Ethics Committee granted approval for this study (date: 12.08.2020, number: 2020/0503).

**Informed Consent:** Written informed consents were obtained from patients who participated in this study.

**Conflict of Interest:** The authors declared that they have no conflict of interest.

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