



A Comparative Analysis of the Blood Products used in the Emergency Room and other Clinics with the Pre-pandemic Period

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Abstract

Aim: In this study, we evaluated the blood transfusion statistics by determining the frequency of blood component transfusions by year and the total number of transfusions administered in emergency departments (EDs) and all inpatient clinics across Turkey, to provide a foresight of the future and to guide planning.

Methods: The study was conducted retrospectively, covering the period between January 1, 2016, and January 1, 2022. The numerical data of the blood transfusions applied in the 2nd and 3rd level public hospitals in Turkey were collected as the number of units, and the data were used by obtaining the necessary permissions from the Ministry of Health. The most frequently used blood components in EDs and inpatient clinics in our country were examined. The total number of transfusions in EDs and all inpatient clinics was calculated, and the frequency changes over time were investigated. In the study, the 4-year period of 2016-2019 was specified as the prepandemic period. The 2-year data for 2020 and 2021 are also stated as the pandemic period. The mean values of the data belonging to both periods were taken, and their significance was evaluated with Fisher's exact test. Blood transfusion statistics for each year were recorded on the tabulation software, and the frequency changes were calculated using the statistical formulas of the tabulation software. Patient consent was waived because of the study.

Results: The most common types of blood components transfused in Turkey were packed red blood cell (PRBC), fresh frozen plasma (FFP), platelet concentrate, whole blood, and cryoprecipitate. When the blood component transfusion rates in the EDs were evaluated, the most frequently transfused blood component was found to be PRBC, followed by FFP (64.4% and 29.8%, respectively). Platelet concentrate, cryoprecipitate, and whole blood transfusion rates were found to be 5.5%, 0.17%, and 0.13%, respectively. 6.6% of all blood transfusions were administered in EDs. The use of all blood and blood products, except PRBC, has decreased in the ED. In all departments, there was a decrease in the use of platelets and whole blood and an increase in the use of cryoprecipitate.

Conclusion: Since the current study shows blood and blood product replacement and includes a broad comparison with the pandemic and pre-pandemic periods, it can guide the blood replacement strategies of the ED and all departments.

Keywords: Blood components, emergency department, transfusion

Introduction

Circulating blood consists of shaped elements such as erythrocytes, leukocytes, and platelets, suspended in a liquid medium called plasma. Blood transfusions can be defined as a special type of tissue transplantation. With the discovery of blood group antigens, blood typing

methods, and crossmatching at the beginning of the 20th century, blood transfusions became available (1).

While "blood products" are all therapeutic substances derived from blood, including both blood components and plasma products, the term "blood components" includes packed red blood cell (PRBC), leukocytes,

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platelet concentrates, plasma, and cryoprecipitate. Major transfusion indications include replacement of blood volume and missing blood components, exchange transfusion, correction of bleeding and coagulation disorders, and correction of immunological deficiencies. When deciding whether to transfuse a patient, it is important to consider whether the patient truly requires transfusion, if so, which blood component is needed, how many units should be transfused to the patient, and what the potential benefit-to-harm ratio of the transfusion is (2,3).

A unit of whole blood collected from a healthy donor is usually separated into PRBC, platelet concentrate, white blood cell concentrate, fresh frozen plasma (FFP), and cryoprecipitate, as this facilitates the preparation, storage, and use of blood components. Immunoglobulin and coagulation factors are obtained with more advanced technology in manufacturing conditions with large plasma pools (4). Emergency departments (EDs) are places that are not only a step in the diagnosis of diseases but also the primary clinics where many treatment plans are applied. Most patients who need blood transfusions but do not need hospitalization are treated in the ED and safely discharged. Some patients with additional comorbidities who required both hospitalization and blood transfusions received the primary treatment in the EDs, and their treatment continued in the inpatient clinics. In previous studies, anemia was found to be the most common indication for transfusion in EDs, and gastrointestinal system bleeding, hemorrhages in oncology and hemato-oncology patients, chronic anemia, and trauma were found to be other important causes (5).

In this study, we evaluated the blood transfusion statistics by determining the frequency of blood component transfusions by year and the total number of transfusions administered in EDs and all inpatient clinics across 2nd and 3rd public hospitals in Turkey, to provide foresight for the future and to guide planning.

Materials and Methods

Compliance with Ethical Standards

The study was conducted retrospectively, covering the period between January 1, 2016, and January 1, 2022, after obtaining the approval of the Clinical Research Ethics Committee No 2 of Ankara City Hospital (date: 30.03.2022; approval number: E2-22-1619).

Study Design

The data were obtained from the information data system of the Ministry of Health, Department of Blood and Blood Products. These data were used by obtaining the necessary permissions from the Ministry of Health. The numerical data of blood transfusions used in Turkey's second and third level public hospitals were collected as many units. The study was conducted on the total data of 758 hospitals, of which 552 were second-level and 206 were third-level public hospitals.

The most frequently used blood components in EDs and inpatient clinics in our country were examined. The total number of transfusions in EDs and in all inpatient clinics were determined, and the frequency changes according to year were examined. In our study, data on the coronavirus disease-2019 (COVID-19) pandemic process, before and after, were also shared. The effect of the COVID-19 pandemic on the transfusion of blood and blood products was also evaluated.

Statistical Analysis

In the study, the 4-year period of 2016-2019 was specified as the pre-pandemic period. The 2-year data for 2020 and 2021 are also stated as the pandemic period. The mean values of the data belonging to both periods were taken, and their significance was evaluated with Fisher's exact test. Blood transfusion statistics for each year were recorded on the tabulation software, and the frequency changes were calculated using the statistical formulas of the tabulation software. Patient consent was waived because of the study.

Results

The total number of blood transfusions administered in all clinics has increased continuously except for 2020. There was no regular increase or decrease in the blood transfusion numbers of EDs (Table 1). When all of the blood component transfusions were evaluated, the most frequently transfused blood component was found to be PRBC, followed by FFP (60.8% and 30.7%, respectively). While the platelet concentrate transfusion rate was 8.3%, the whole blood and cryoprecipitate transfusion rates were 0.11% and 0.09%, respectively (Figure 1). When the blood component transfusion rates in the EDs were evaluated, the most frequently transfused blood component was found to be PRBC with a rate of 64.4%. It was followed by FFP (29.8%). Platelet concentrate, cryoprecipitate, and

Table 1. Number of blood transfusions by years and annual change rates

Blood product	2016	2017	2018	2019	2020	2021	Mean
All clinics-total (number/unit)	2.038.400	2.347.838	2.461.927	2.739.322	2.274.517	2.471.499	2.388.917
Emergency department (number/unit)	145.339	166.922	161.307	162.639	148.182	153.377	156.294

whole blood transfusion rates were found to be 5.5%, 0.17%, and 0.13%, respectively (Figure 2).

The average number of blood and blood product transfusions in all clinics during the 4-year pre-pandemic period, including 2016-2019, and the 2-year pandemic period, including 2020-2021, were evaluated. Comparisons of both periods were made (Table 2). Likewise, comparisons and results for emergency services are shown in Table 3. The rates of blood transfusions administered in EDs compared to blood transfusions administered in all clinics are shown in Table 4. Additionally, the comparison of these data for the pre-pandemic and pandemic periods is shown in Figure 3. Platelet transfusions were determined separately as random, pooled, and apheresis platelet concentrates. Statistics for all clinics are shown in Figure 4, and transfusions administered in the ED are shown in Figure 5.

Discussion

In our study, the total number of blood transfusions administered in all clinics of 758 2nd and 3rd level public hospitals in Turkey and the number of blood transfusions administered in EDs were examined. It was found that 6.6% of total transfusions in the last 6 years were administered in the EDs. The total number of blood transfusions administered in all clinics has increased continuously except for 2020. There was no regular increase or decrease in the blood transfusion numbers of EDs (Table 1).

PRBC was the most commonly administered blood product, with a rate of 60.8% and a rate of 64.4% in ED transfusions. Similarly, in a study conducted in Korea, PRBC transfusion was found to be the most common of all transfusions, just as it is in our country (6). Previous

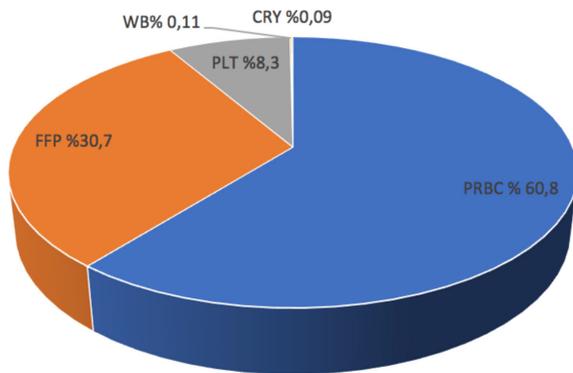


Figure 1. Average PRBC, platelet, FFP, whole blood, cryoprecipitate transfusions in emergency departments

FFP: Fresh frozen plasma, PRBC: Packed red blood cells, PLT: Platelet, CRY: Cryoprecipitate, WB: Whole blood

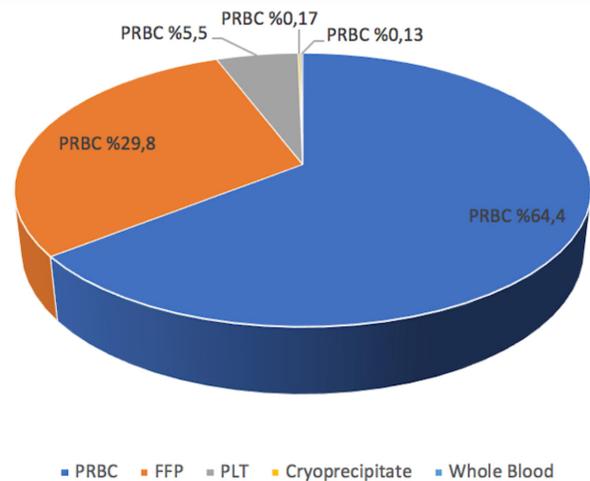


Figure 2. Average PRBC, platelet, FFP, whole blood, cryoprecipitate transfusions across all departments

FFP: Fresh frozen plasma, PRBC: Packed red blood cells, PLT: Platelet, CRY: Cryoprecipitate, WB: Whole blood

Blood product	All departments	Prepandemic	Pandemic	p-value
PRBC	Count	1.427.481	1.441.739	
	% within group	49.8%	50.2%	>0.05
FFP	Count	720,907	731,896	
	% within group	49.6%	50.4%	>0.05
PLT	Count	209,083	169,127	
	% within group	55.3%	44.7%	<0.001
CRY	Count	12,663	24,969	
	% within group	33.6%	66.4%	<0.001
WB	Count	26,738	5,279	
	% within group	83.5%	16.5%	<0.001

The mean values of the data belonging to both periods were taken and their significance was evaluated with Fisher's exact test
 FFP: Fresh frozen plasma, PRBC: Packed red blood cells, PLT: Platelet, CRY: Cryoprecipitate, WB: Whole blood

Table 3. Average of PRBC, PLT, FFP, WB, CRY transfusions in emergency departments in pre-pandemic and pandemic periods

Blood product	Emergency departments	Prepandemic	Pandemic	p-value
PRBC	Count	95,941	109,768	
	% within group	46.6%	53.4%	<0.001
FFP	Count	52,366	34,993	
	% within group	59.9%	40.1%	<0.001
PLT	Count	9,982	5,618	
	% within group	64.0%	36.0%	<0.001
CRY	Count	445	230	
	% within group	65.9%	34.1%	<0.001
WB	Count	318	171	
	% within group	65.0%	35.0%	<0.001

The mean values of the data belonging to both periods were taken and their significance was evaluated with Fisher's exact test
 FFP: Fresh frozen plasma, PRBC: Packed red blood cells, PLT: Platelet, CRY: Cryoprecipitate, WB: Whole blood

Table 4. Emergency departments/all clinics blood transfusion rates

Blood product	2016	2017	2018	2019	2020	2021	Mean
PRBC (single unit)	6.8	7.1	6.5	6.4	7.5	7.6	6.98
FFP (single unit)	8.8	8.2	7.1	5.5	5.2	4.3	6.51
Platelet (single unit, apheresis, random, and pooled in total)	5.2	4.7	4.6	4	3.7	2.9	4.22
Cryoprecipitate (single unit)	4.3	6	4	1.2	1.4	0.5	2.9
Whole blood (single unit)	1.3	1.1	0.8	1.7	2.8	3.7	1.9

The values expressed as "%".
 FFP: Fresh frozen plasma, PRBC: Packed red blood cells

studies found that the rates of PRBC transfusions for all blood transfusions were 70%, 59%, 63%, and 84%, respectively (7-10). The changes in PRBC transfusions in all clinics before and during the pandemic were not statistically significant. However, a significant increase was observed in the use of emergency services during the pandemic period ($p < 0.001$).

EDs are the first point of contact for patients with anemia and symptoms, patients with gastrointestinal bleeding, and patients with major traumas. Therefore, it is natural to expect an increase in prpc transfusions. Another study examining the departments administering blood and blood products revealed that 50.6% of the transfusions were administered by the internal medicine department, followed by the ED at a rate of 44.9% (10,11). Similar to our study, in a study conducted in the USA and covering all departments, PRBC transfusions were evaluated between 2017 and 2019, and no significant change was found in transfusion levels during this 3-year period (12).

FFP was found to be the second most frequently administered blood component following PRBC, both in the EDs and in total. When the total number of FFP transfusions was examined, a continuous increase was observed from 2016 to 2020, and the increase rate was approximately 45% in this 4-year period. In 2020,

a decrease of approximately 20% was observed in FFP transfusions. The fact that FFP has a wide area of use is the main reason for its high frequency of use (13-15). Although there was an increase in the use of FFP during the pandemic period in all clinics compared to the pre-pandemic period, it was found to be statistically insignificant. When the usage levels in the emergency services were compared, a significant decrease was found during the pandemic period ($p < 0.001$). While total FFP usage is increasing in all areas, the usage rate in emergency services is decreasing. The earlier transfer of patients diagnosed and treated in the emergency room to services, operating rooms, and intensive care units may explain this decrease in their use in emergency services. Although the use of FFP in emergency services is decreasing, its share (6.51%) in total transfusions in all units is still close to the share of erythrocyte suspension (6.98%) (Table 4).

Among the total transfusions in all units, platelet transfusion was the most frequently used blood component with a rate of 8.3%, after erythrocyte and FFP. It has a rate of 5.5% among transfusions in emergency services and 4.2% among all transfusions. The total number of random platelet transfusions given in all units decreased year after year, eventually falling by 93% to 14,705 units at the end of six years. The use of pooled

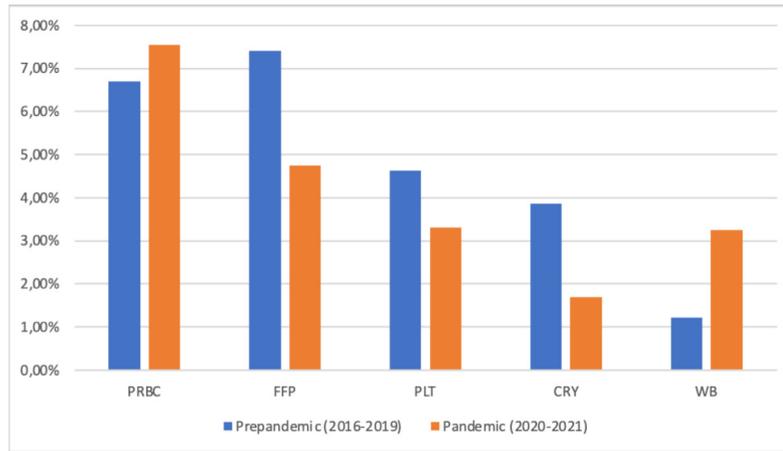


Figure 3. Emergency departments blood transfusions/all departments blood transfusions
 FFP: Fresh frozen plasma, PRBC: Packed red blood cells, PLT: Platelet, CRY: Cryoprecipitate, WB: Whole blood

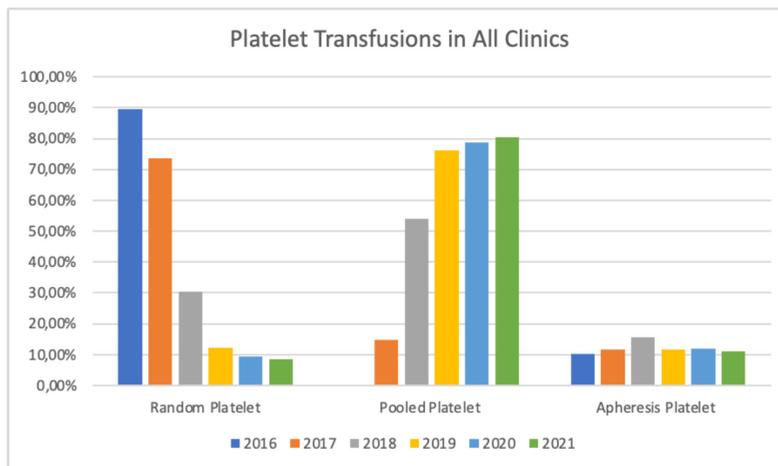


Figure 4. Change of platelet transfusions by years in all clinics

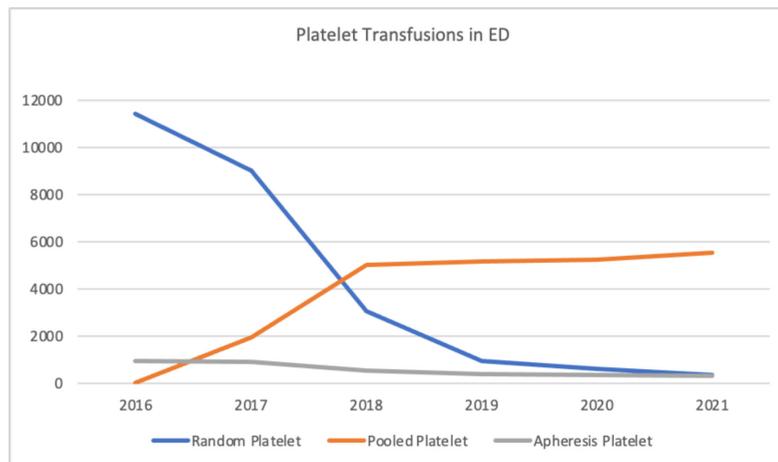


Figure 5. Change of platelet transfusions by years in emergency department (unit/year)
 ED: Emergency department

platelets significantly increased every year, except for a partial decrease in 2020, and increased from 329 units to 141,598 units in six years. Apheresis platelet transfusion, on the other hand, increased between 2016 and 2017, then decreased to 19,678 units with an annual average decrease of about 7% each year (Figure 4). Random platelets, which were used 11,424 units in emergency services in 2016, decreased to only 363 units in 2021. Similarly, the use of apheresis platelets also decreased continuously, from 932 units to 323 units within 6 years. When platelet transfusions are examined according to the pre-pandemic period in the pandemic period, a statistically significant decrease was found both in all clinics and in the ED ($p < 0.001$).

These data show that the priority of platelet transfusion in hospitals has shifted from random platelets to pooled platelets over the years. Although the use of apheresis platelets still maintains its importance, it is seen that transfusion levels have decreased over the years, although not as much as random platelets.

The use of whole blood remained very limited compared with other blood components. The ratio of whole blood in all blood transfusions was found to be 0.11% on average. Platelets contained in the whole blood product lose their effectiveness within 2 days at +1-6 °C. FV and FVIII, in particular, lose their effects quickly. While factor V is 80% active on the fifth day and 50% active on the 14th day, factor VIII levels decrease to 50% of normal within 1-2 days and to 30% of normal after 5 days. The factor XI level was only 20% of normal after 7 days. For these reasons, the use of whole blood has decreased by approximately 92% in the last 6 years (1,2).

Considering the decrease in the use of whole blood during the pandemic process, during the pandemic period, a statistically significant decrease was detected both in the emergency services and in all other clinics compared to the pre-pandemic period ($p < 0.001$).

The use of cryoprecipitate has been increasing continuously over the years in all units of the hospital. Its use in 2021 has quadrupled from its 2016 level. The use of cryoprecipitate in all clinics increased statistically during the pandemic period compared to the pre-pandemic period ($p < 0.001$). The opposite situation was observed in emergency services, where cryo use decreased significantly during the pandemic period ($p < 0.001$). The reason for this is thought to be able to meet the transfusion needs of patients in need of cryo use in areas such as the service, intensive care, and operating rooms without waiting in the emergency services. In a study by Morrow et al. (16) it was shown that cryotransfusion restores essential fibrinolytic regulators and limits plasmin formation to form stronger clots. Clot structure and stability, as well as additional

factors in cryoprecipitate, enable a stronger and more stable clot formation. The use of cryoprecipitate increases survival in patients with bleeding (16).

Although cryoprecipitate transfusions in the ED peaked in 2017, they decreased drastically in 2021. While the rate of total cryoprecipitate transfusion in all units was 6% in 2017, when it was used the most in the ED, this rate decreased to 0.5% in 2021. Generally, the decrease in cryoprecipitate transfusions in EDs is similar to the decrease in other transfusions. The reason for this can be shown as the effect of the understanding that, recently, the hospitalization of individuals in need of specialty transfusions such as fibrinogen, factor 8, factor 13, and vWF should be made earlier and these treatments should be administered in inpatient services, not in EDs.

Study Limitations

The most important limitation of this study was the lack of data from universities and private hospitals. Another limitation is that the transfusion indications could not be reached. Although there are limitations, the most crucial aspect of the study is that the data containing blood transfusions belonging to the emergency services and other departments of our country are shared for the first time with such a large amount of data.

Conclusion

Since the current study shows blood and blood product replacement and includes a broad comparison with the pandemic and pre-pandemic periods, it can guide the blood replacement strategies of the ED and all departments.

Ethics

Ethics Committee Approval: Ethics committee approval was received for this study from the Clinical Research Ethics Committee No 2 of Ankara City Hospital (date: 30.03.2022; approval number: E2-22-1619).

Informed Consent: Patient consent was waived because of the study.

Peer-review: Internally peer-reviewed.

Authorship Contributions

Concept: A.B., Design: A.B., Data Collection or Processing: A.B., A.T., Analysis or Interpretation: A.B., A.T., Literature Search: A.B., A.T.,

Writing: A.B.

Conflict of Interest: No conflict of interest was declared by the authors.

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