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Quick Response Code:

Website: www.ajts.org
DOI: 10.4103/ajts.AJTS_72_18

# Platelets transfusion in Greece: Where, when, why? A national survey

Serena Valsami, Abraham Pouliakis<sup>1</sup>, Maria Gavalaki<sup>2</sup>, Aspasia Argyrou<sup>3</sup>, Evagelia Triantafillou<sup>4</sup>, Evagelia Arvanitopoulou<sup>4</sup>, Fotios Girtovitis<sup>5</sup>, Virginia Voulgaridou<sup>5</sup>, Aggeliki Megalou<sup>6</sup>, Paraskevi Chronopoulou<sup>6</sup>, Andreas Papachronis<sup>2</sup>, George Sakellarakis<sup>2</sup>, Eleftheria Zervou<sup>7</sup>, Christina Batsi<sup>7</sup>, Kalliopi Fountouli<sup>8</sup>, Aggelos Athanasopoulos<sup>9</sup>, Elias Kyriakou<sup>10</sup>, Afrodite Cheropoulou<sup>11</sup>, Anastasia Livada<sup>12</sup>, Konstantinos Lebessopoulos<sup>13</sup>, Maria Papakonstantinou<sup>14</sup>, Anthi Gafou<sup>3</sup>, Despina Katopi<sup>15</sup>, George Martinis<sup>16</sup>, Ioanna Dendrinou<sup>17</sup>, Hrysanthi Katharopoulou<sup>18</sup>, Marianna Politou, Margarita Papadopoulou<sup>19</sup>, Paraskevi Papadopoulou<sup>20</sup>, Ekaterini Manaka<sup>21</sup>, Konstantina Paneta<sup>22</sup>, Chrissoula Alepi<sup>23</sup>, Christos Damaskos<sup>24</sup>, Nikolaos Garpis<sup>24</sup>, Konstantinos Stamoulis<sup>25</sup>, Elisavet Grouzi<sup>12</sup>

Hematology, Laboratory-Blood Bank Department, Aretaieion Hospital, National and Kapodistrian University of Athens, Medical School, <sup>1</sup>Second Department of Pathology, National and Kapodistrian University of Athens, "Attikon" University Hospital, <sup>2</sup>Department of Blood Transfusion, Laiko General Hospital, <sup>3</sup>Department of Blood Transfusion, "Saints Anargyroi" Hospital, <sup>4</sup>Department of Blood Transfusion, Evangelismos Hospital, <sup>5</sup>Department of Blood Transfusion, Metaxa Oncology Hospital, <sup>6</sup>Laboratory of Hematology and Blood Bank Unit, "Attikon" University Hospital, National and Kapodistrian Athens, <sup>7</sup>Department of Blood Transfusion, General Hospital Sismanogleio, <sup>8</sup>Department of Transfusion Service and Clinical Hemostasis, "Saint Savvas" Oncology Hospital of Athens, <sup>9</sup>Department of Blood Transfusion, "Amalia Fleming" Hospital, <sup>10</sup>Blood Transfusion Centre, General Hospital of Nikea, <sup>11</sup>Department of Blood Transfusion, General Hospital Alexandra, <sup>12</sup>Department of Blood Transfusion, General Hospital Nea Ionia "Agia Olga", <sup>13</sup>Department of Blood Transfusion, General Hospital "Tzaneio" of Piraeus, <sup>14</sup>Second Department of Propedeutic Surgery, "Medical School,

## Abstract:

**BACKGROUND:** Platelet transfusion is among the most useful therapeutic tools in modern clinical settings which mean that ensuring an adequate supply is of paramount importance.

**AIM:** The aim of our study was to record the use and wastage of platelet concentrates (PCs) in Greece, so as to come up with evidence-based interventions.

**METHODS:** The study was conducted during May and June 2015. We evaluated the use of random-donor platelets (RDPs) and single-donor apheresis platelets (SDPs). We analyzed such parameters as hospital department and diagnosis, indication for transfusion, PCs' age at the time of transfusion, and wastage rate.

**RESULTS:** We used data from 21 hospitals across the country. A total of 12,061 RDPs and 1189 SDPs were transfused, with an average of 4.84 ( $\pm 2.72$ ) and 1.12 ( $\pm 2.73$ ) units per episode, respectively. Most patients had been admitted to the internal medicine and hematology departments. The transfusions were mostly given prophylactically, usually in cases of acute leukemia, and mostly on the day before expiration. Wastage rate was 16.75% for RDPs and 2.70% for SDPs, primarily because of the expiration of the use-by date.

**CONCLUSIONS:** This is the first national survey regarding platelet transfusion in Greece. Since most patients were admitted in internal medicine and hematology departments, we recommend that the staff of the abovementioned departments should undergo training on contemporary transfusion guidelines. Platelet discard rate could further be lowered through the centralization of inventory management along with the extension of the lifetime of PCs by means of emerging technologies.

## Keywords:

National, platelet, platelet products, platelets transfusion, survey

## Introduction

Nowadays, platelet transfusion is a useful therapeutic and preventive

method in modern clinical settings. The most common indications for platelet transfusion are thrombocytopenia resulting from chemotherapy and bone marrow failure syndromes, with increased risk of bleeding and as a way of preventing

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**How to cite this article:** Valsami S, Pouliakis A, Gavalaki M, Argyrou A, Triantafillou E, Arvanitopoulou E, et al. Platelets transfusion in Greece: Where, when, why? A national survey. Asian J Transfus Sci 2020;14:158-66.

Laiko" General Hospital, National and Kapodistrian University of Athens, <sup>25</sup>Hellenic National Blood Transfusion Center, <sup>4</sup>Blood Transfusion Center, University Hospital, Patras, <sup>5</sup>Department of Blood Transfusion, AHEPA, University Hospital of Thessaloniki, Thessaloniki, <sup>7</sup>Department of Blood Transfusion, University Hospital of Ioannina, <sup>18</sup>Department of Blood Transfusion, "Hatzikosta" General Hospital of Ioannina, Ioannina, <sup>8</sup>Department of Blood Transfusion, University Hospital of Heraklion, Heraklion, <sup>16</sup>Department of Blood Transfusion, University Hospital of Alexandroupolis, Alexandroupolis, <sup>19</sup>Department of Blood Transfusion, General Hospital of Katerini, Katerini, <sup>20</sup>Department of Blood Transfusion, General Hospital of Kavala, Kavala, <sup>21</sup>Department of Blood Transfusion, General Hospital of Messologgi, Messologgi, <sup>22</sup>Department of Blood Transfusion, General Hospital of Pirgos, Pirgos, Greece  
On Behalf of the Working Committee of Transfusion Medicine and Apheresis of the Hellenic Society of Hematology

**Address for correspondence:**

Dr. Serena Valsami,  
Hematology, Laboratory-Blood Bank Department, Aretaieion Hospital, National and Kapodistrian University of Athens Medical School, Athens, Greece.  
E-mail: serenavalsami@yahoo.com

Submission: 14-06-2018

Accepted: 02-06-2019

Published: 19-12-2020

bleeding prior to surgical procedures.<sup>[1,2]</sup> However, the cost of transfusing platelets (PLTs) is among the highest in transfusion medicine and their specific characteristics, such as special storage requirements and relatively short shelf life, mean that they are not always freely available.<sup>[2,3]</sup>

Inappropriate use of PLTs is another important reason for the scarcity of platelet concentrates (PCs) which results in transfusion centers often being unable to cover the patients' needs. Setting proper guidelines for platelet transfusion should have solved the problem of inappropriate use. A plethora of guidelines has been introduced in many countries, including Greece.<sup>[4-8]</sup> However, despite existing national and institutional guidelines, in the majority of clinical settings, doctors' compliance to these guidelines varies significantly from 43% to 89% for both therapeutic and prophylactic platelet transfusion.<sup>[3,9,10]</sup>

Furthermore, data from previous years showed that platelet usage is constantly rising. Reasons for this increase, at both regional and national level, include the fact that an aging population implies an increase in the prevalence of malignancies, along with the fact that there is an increased use of antiplatelet agents in cardiac disease. Thus, it seems clear that the proportion of the population requiring platelet products for transfusion is likely to rise over the coming decades, while the proportion eligible for donations of blood and platelet products is likely to fall.<sup>[6,11]</sup>

Hence, we conducted this study to assess and evaluate the production, distribution, use, and wastage rate of platelet products in Greece to identify the parameters that contribute to their proper use and sufficiency. Special national characteristics, such as the decentralization of transfusion services and geographical particularities, have been taken into consideration. Given that Greece very often cannot cover its high national transfusion needs, results, and conclusions of this survey will be used

to inform educational initiatives on appropriate platelet use, thus improving platelet availability and decreasing platelet wastage rate.

## Methods

This study was conducted by the Working Committee of Transfusion Medicine and Apheresis of the Hellenic Society of Hematology. An electronic data collection form (Excel 2016, Microsoft/Corp, WA, USA) was used, and all transfusion services in Greece were invited to participate in the study. Data collection was conducted from May to June 2015 using the aforementioned data forms that were filled by the participating centers. The collected data consisted of the number of platelet units produced, transfused, and discarded. Platelet units were separately recorded for those originating from random donor platelets (RDPs) and those retrieved during apheresis from single-donor platelets (SDPs). A RDP unit is a platelet component derived from a single whole blood donation prepared from platelet-rich plasma (PRP method). Both RDPs and SDPs met the requirements of the European Directorate for the Quality of Medicines and HealthCare of the Council of Europe (EDQM).<sup>[12]</sup> Maximum storage time for PCs in Greece is 5 days. The data recorded included the patients' departments, diagnosis, indication for transfusion (bleeding vs. prophylaxis), the transfusion episodes, and the age of the platelet unit at the time of transfusion. The transfusion of several PLTs units at the same time was recorded as the transfusion dose given in a single episode. Numbers of platelet units produced in and imported to each transfusion center and discharge rates were separately recorded as well. Data regarding national platelet units' supplies were provided by the Hellenic National Blood Transfusion Center, which is responsible for the national inventory blood management along with the implementation of the blood products' molecular testing.

Electronic spreadsheet data forms (Excel 2016, Microsoft/Corp, WA, USA) were also used to perform

part of the analysis. Additional Statistical analysis was performed using the SAS software version 9.3 for Windows (SAS Institute Inc., USA).

### Results

From 97 transfusion services located within equal number of hospitals that have been invited to join this study, 21 (21.6%) have responded positively. Twelve out of 21 hospitals are located in Athens, and the remaining nine are general hospitals located in cities outside Athens (Thessaloniki, Katerini, Kavala, Alexandroupolis, Ioannina, Agrinio, Patras, and Heraklion) covering most of the country as they were geographically equally distributed. After being invited to participate in this study, all 21 hospitals voluntarily contributed with data covering the entire 2-month period. The total number of platelet units evaluated was 13,250; 12,061 RDPs and 1189 SDPs. Numbers of RDPs and SDPs for every contributing hospital are listed in Table 1.

The overall number of PLTs units reported by the hospitals in Athens was 7505 (6646 RDPs and 859 SDPs), while the units reported by the hospitals outside Athens were 5745 (5415 RDPs and 330 SDPs). Imported PLTs

units from other blood services constituted the 15.0% and 1.9% of RDPs and SDPs, respectively [Table 1].

Seven hundred and four patients received RDPs. The majority of those patients was admitted to the internal medicine and hematology departments (30.26% and 26.28%, respectively). These patients received 12,061 RDPs in 2494 episodes, leading to an average of 4.84 ( $\pm 2.73$ ) RDPs/episode. Patients in cardiac surgery and emergency departments received the most RDPs/episode ( $6.69 \pm 3.02$  and  $6.5 \pm 2.83$ , respectively), and patients in neonatology units received the least RDPs/episode ( $2.06 \pm 1.11$ ). In most cases, 83.68% (2087/2494) one transfusion episode was recorded per day, in 16% (407/2494) two episodes, while there was no recorded case of more than two transfusion episodes per day. The majority of episodes occurred in the internal medicine and hematology departments in 36.09% and 33.48%, respectively. Other departments and their respective results can be seen in detail in Table 2. It is worth noticing that the number of transfused RDPs per episode varied widely between hospitals from 3.51 in HA1 to 7.31 in HOA1,  $P < 0.0001$  was depicted in Table 3.

Three hundred and twenty-eight patients received SDPs; most of those were treated in hematology and

**Table 1: Hospital contributing to this study and their respective platelet units**

	RDPs				SDPs			
	Produced RDPs	Imported RDPs	Total RDPs	RDPs (%)	Produced SDPs	Imported SDPs	Total SDPs	SDPs (%)
HA1	1348		1348	11.18	147		147	12.36
HA2	1272		1272	10.55	242		242	20.35
HA3	81	731	812	6.73	105	15	120	10.09
HA4	655	82	737	6.11	84	1	85	7.15
HA5	651	60	711	5.90	47		47	3.95
HA6	338	70	408	3.38	95	3	98	8.24
HA7	341		341	2.83	47		47	3.95
HA8	307	10	317	2.63				0.00
HA9	115	160	275	2.28				0.00
HA10	179	41	220	1.82	73		73	6.14
HA11	111	13	124	1.03				0.00
HA12	17	64	81	0.67				0.00
HOA1	1494	33	1527	12.66	44	3	47	3.95
HOA2	66		66	0.55				0.00
HOA3	14		14	0.12				0.00
HOA4	259		259	2.15	45		45	3.78
HOA5	992	49	1041	8.63	28		28	2.35
HOA6	85		85	0.70				0.00
HOA7		10	10	0.08				0.00
HOA8	1028	483	1511	12.53	124		124	10.43
HOA9	902		902	7.48	86		86	7.23
Totals	10,255	1806	12,061	100.00	1167	22	1189	100.00

HA=Hospital in Athens, HOA=Hospital outside Athens, AH=Athens Hospital, AH1=Laikon Hospital, AH2=Evangelismos Hospital, AH3=Metaxa Anticancer Hospital, AH4=General Hospital "ATTIKON," AH5=General Hospital Sismanogleio, AH6=St. Savvas Oncology Hospital, AH7= "Amalia Fleming" Hospital, AH8=General Hospital "Saint Panteleimon," AH9= "Saints Anargyroi" Hospital, AH10=General Hospital Alexandra, AH11=General Hospital Nea Ionia "Agia Olga," AH12=Aretaio University Hospital, HOA1=University Hospital of Thessaloniki AHEPA, HOA2=General Hospital of Katerini, HOA3=General Hospital of Kavala, HOA4=University Hospital of Alexandroupolis, HOA5=University Hospital of Ioannina, HOA6="Hatzikosta" General Hospital of Ioannina, HOA7=General Hospital of Agrinio, HOA8=University Hospital of Patras, HOA9=University Hospital of Heraklion, RDPs=Random donors platelets, SDPs=Single-donor platelets

**Table 2: Distribution of patients receiving random donors platelets and single-donor platelets grouped by hospital department**

Department	RDPs						SDPs						
	Patients (%)	Number of consumed RDPs	Consumed RDPs (%)	Number of episodes	Episodes (%)	RDPs per episode (average)	Patients (%)	Number of consumed SDPs	Consumed SDPs (%)	Number of episodes	Episodes (%)	SDPs per episode (average)	
Bone marrow/solid organ transplantation unit	14	382	3.17	67	2.69	4.39	3	0.91	61	5.13	41	3.85	1.49
Cardiac surgery	110	950	7.88	142	5.69	6.69	31	9.45	45	3.78	35	3.28	1.29
Coronary unit	2	12	0.10	4	0.16	3.00							
Emergency room	3	26	0.22	4	0.16	6.50							
Gastroenterology	6	40	0.33	10	0.40	4.00							
Hematology	185	3857	31.98	835	33.48	4.62	157	47.87	646	54.33	591	55.44	1.09
Intensive care units (adult)	69	787	6.53	156	6.26	5.04							
Intensive care units (pediatric)	1	10	0.08	3	0.12	3.33	1	0.30	10	0.84	10	0.94	1.00
Internal medicine	214	4205	34.86	900	36.09	4.67	93	28.35	293	24.64	268	25.14	1.09
Neonatology	26	130	1.08	63	2.53	2.06	3	0.91	3	0.25	3	0.28	1.00
Neurosurgery	4	19	0.16	4	0.16	4.75	1	0.30	1	0.08	1	0.09	1.00
Obstetrics - gynecology	1	5	0.04	1	0.04	5.00	-	-	-	-	-	-	-
Oncology	47	481	3.99	101	4.05	4.88	11	3.35	28	2.35	24	2.25	1.17
Orthopedics	7	43	0.36	9	0.36	4.78	-	-	-	-	-	-	-
Pediatrics	15	150	1.24	35	1.40	4.64	16	2.44	49	2.06	47	2.20	1.04
Pneumatology	4	30	0.25	8	0.32	3.75	1	0.30	1	0.08	1	0.09	1.00
Private hospitals	18	123	1.02	28	1.12	4.39	3	0.91	4	0.34	4	0.38	1.00
Special care units	2	33	0.27	8	0.32	4.13	18	5.49	27	2.27	23	2.16	1.17
Special infections	2	25	0.21	6	0.24	4.17	1	0.30	1	0.08	1	0.09	1.00
Surgery	50	697	5.78	117	4.69	5.96	11	1.68	20	0.84	18	0.84	1.28
Urology	3	56	0.46	14	0.56	4.00							
Total	704*	12,061	100.00	2494	100**	4.84	328*	100**	1189	100.00	1066	100**	1.12

\*This is the exact number of patients in this column, a patient admitted to two different clinics is counted one time for every clinic, \*\*Percentages in this column are calculated considering that a patient is different if admitted in two or more clinics. RDPs=Random donors platelets, SDPs=Single-donor platelets

**Table 3: Transfused random donors platelets per episode and transfusion indication for both random donors platelets and single-donor platelets grouped by hospital**

Hospital	RDPs					SDPs from apheresis			
	RDPs per episode	Bleeding	Prophylactic	NR	Total	Bleeding	Prophylactic	NR	Total
HA1	3.51	208	1140		1348	145	2		147
HA2	4.28	713	552	7	1272		242		242
HA3	4.98	98	714		812	16	104		120
HA4	4.07	99	638		737	9	76		85
HA5	5.01	170	541		711	6	41		47
HA6	5.44	74	334		408	8	90		98
HA7	5.17	148	129	64	341	9	37	1	47
HA8	4.34	9	308		317				
HA9	5.09	89	186		275				
HA10	5.00	76	144		220	9	64		73
HA11	5.17	5	119		124				
HA12	3.86	38	43		81				
HOA1	7.31	629	898		1527	7	40		47
HOA2	5.08	41	25		66				
HOA3	4.67		14		14				
HOA4	5.40	48	211		259	1	44		45
HOA5	5.00	343	698		1041	6	22		28
HOA6	4.47	39	46		85				
HOA7	5.00		10		10				
HOA8	5.30	966	544	1	1511	83	41		124
HOA9	4.93	31	871		902		86		86
Totals		3824	8165	72	12,061	299	889	1	1189

RDPs=Random donors platelets, SDPs=Single-donor platelets, HA=Hospital in Athens, HOA=Hospital outside Athens, NR=Nonreported

internal medicine departments; 47.87% and 28.35%, respectively [Table 2]. The total number of SDPs transfused was 1189 in 1066 episodes, leading to an average of 1.12 ( $\pm 2.73$ ) SDPs/episode. Patients in transplantation and cardiac surgery departments received most SDPs/episode ( $1.49 \pm 0.29$  and  $1.29 \pm 0.47$ ) [Table 2].

The most common diagnosis for RDPs transfusion was acute leukemia, myelodysplastic syndrome, solid tumors, lymphoma, and cardiovascular procedures in  $32.12\% \pm 1.82\%$ ,  $10.87\% \pm 1.21\%$ ,  $9.86\% \pm 1.16\%$ ,  $8.06\% \pm 1.06\%$ , and  $6.01\% \pm 0.93\%$ , of the episodes, respectively. SDPs were transfused mostly in patients with acute leukemia (51.41%), lymphoma (11.91%), transplantation patients (6.00%), Multiple myeloma (6.94%), solid tumors (5.53%), myelodysplastic syndromes (4.78%), and cardiovascular procedures (3.47%). Patients with aneurysms were found to receive the highest number of RDPs/episode reaching  $11.08 \pm 6.00$  and premature infants received the least with  $2.11 \pm 1.27$  RDPs/episode [Table 4].

Both RDPs and SDPs were transfused mostly prophylactically to prevent bleeding (8165/12,061 RDPs – 68.11% and 889/1189 SDPs – 74.83%). The rest of the PLTs units in each group was administered as therapy to already established bleeding, that concerned bleeding cases during cardiovascular surgery (61.89%) or other surgery interventions (15.17%), aneurysm rupture

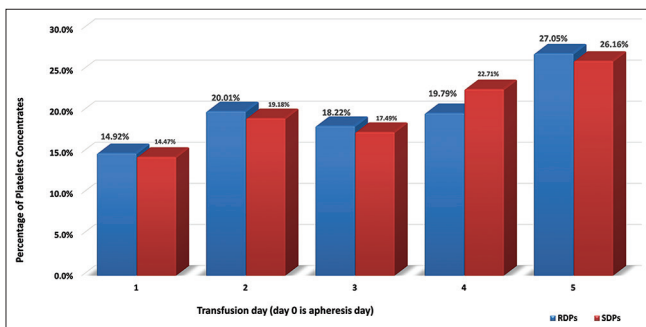
(9.62%), gastrointestinal bleeding (6.48%), trauma (5%), and obstetric hemorrhage (1.85%). A very small portion of RDPs and SDPs (0.6% and 0.3%, respectively) was transfused for reason that has not been reported [Table 3].

The age of PLT units at the time of transfusion varied from 1 to 5 days. RDPs were more frequently transfused at the 5<sup>th</sup> and 2<sup>nd</sup> day in 27.05% and 20.01%, respectively. SDPs were more frequently transfused at the age of 5 and 4 days in 26.16% and 22.71% of units, respectively, as shown in Figure 1. Both RDPs and SDPs at the time of transfusion have a similar distribution among age groups. Except for day 4, there was no statistically significant difference in the percentages of RDP and SDPs when compared for every individual transfusion day (test for proportions:  $P = 0.7089, 0.5187, 0.5595, 0.0182, \text{ and } 0.5316$  from day 1 to day 5). Hospitals demonstrate very different results regarding age at the time of transfusion, and this is common to both RDPs as well as to SDPs (data not shown). It was not found a relation of the hospital size and the transfusion day. On the contrary, it was found that hospitals located in Athens transfused the majority of RDPs in day 5 (transfusion percentages per day 1–5: 9.15%, 20.12%, 20.55%, 20.28%, and 29.90%), while hospitals outside Athens had a more balanced approach (transfusion percentages per day 1–5: 21.99%, 19.89%, 15.36%, 19.19%, and 23.56%;  $P < 0.05$ ). Similar picture was observed for SDPs, whereas in Athens hospitals, the percentages transfused per day

**Table 4: Random donors platelets and single-donor platelets per episode grouped by diagnosis**

Diagnosis	RDPs				SDPs			
	RDPs	Episodes	RDPs per episode (average)	Episodes (%)	SDPs	Episodes	SDPs per episode (average)	Episodes (%)
Acute leukemia	3777	801	4.72	32.12	594	548	1.08	51.41
Anemia - thrombocytopenia	261	64	4.08	2.57	7	7	1.00	0.66
Aneurysm	133	12	11.08	0.48	1	1	1.00	0.09
Aplastic anemia	149	33	4.52	1.32	4	4	1.00	0.38
Autoimmune disease	71	15	4.73	0.60	1	1	1.00	0.09
Cardiovascular procedure	787	131	6.01	5.25	48	37	1.30	3.47
Gastrointestinal bleeding	76	18	4.22	0.72	1	1	1.00	0.09
Idiopathic Thrombocytopenia	95	20	4.75	0.80				
Infant hemolytic disease	32	12	2.67	0.48				
Liver cirrhosis	34	7	4.86	0.28	1	1	1.00	0.09
Lymphoma	913	201	4.54	8.06	143	127	1.13	11.91
Multiple myeloma	496	113	4.39	4.53	80	74	1.08	6.94
Myelodysplastic syndrome	1348	271	4.97	10.87	57	51	1.12	4.78
Myelohyperproliferative disease	49	8	6.13	0.32	1	1	1.00	0.09
Noncardiovascular surgical procedure	267	66	4.05	2.65	10	9	1.11	0.84
Obstetric bleeding	20	3	6.67	0.12				
Preterm infant	80	38	2.11	1.52	2	2	1.00	0.19
Sepsis	553	110	5.51	4.41	23	18	1.62	1.68
Solid tumor	1245	246	5.06	9.86	63	59	1.07	5.53
Thrombocytopenia (other)	671	167	4.02	6.70	20	20	1.00	1.88
Transplantation BM/solid organ	513	84	6.11	3.37	90	64	1.41	6.00
Trauma	94	18	5.22	0.72	1	1	1.00	0.09
Other causes	327	82	3.99	3.29	38	37	1.03	3.47
Not reported	70	16	4.38	0.64	4	4	1.00	0.38
Totals	12,061	2494*	4.78	100	1189	1066*	1.11	100

\*Exact number of patients, if a patient is treated for more than one reasons in different clinics, then he/she is counted separately for each reason. BM=Bone marrow



**Figure 1:** Percentages of RDPs and SDPs transfused according to transfusion day. RDPs = Random-donors platelets, SDPs = Single-donor platelets

were: 8.73%, 18.16%, 17.58%, 24.80%, and 30.73%, and in hospitals outside Athens were 29.39%, 21.82%, 17.27%, 17.27%, and 14.24% (day 1–5, respectively,  $P < 0.05$ ).

In total, 2427 RDPs were discarded out of the total number of RDPs evaluated in our study representing a wastage rate of 16.75%. The wastage rate for SDPs was 2.70% (1189 transfused plus 33 discarded). Data regarding the reason for discarding PLTs were available

for 1703 out of 2427 RDPs and for 30 out of 33 SDPs. The most prevalent reason was the expiration of the lifetime for both RDPs and SDPs (1073/1703=63.01% and 21/30=70.00%, respectively). The rest of the reasons of discarding RDPs were distributed as follows: component contaminated with red cells 278/1703 (16.32%), component out of specification 119/1703 (6.99%), positivity for infectious disease 74/1703 (4.35%), broken bag 43/1703 (2.52%), high suspicion for infection 31/1703 (1.82%), component used for quality control 22/1703 (1.29%), indirect Coombs positivity 2/1703 (0.12%), and other causes 61/1703 (3.58%). The reasons for SDP discard apart from expiration of lifetime included component out of specification (4/30, 13.33%) and other causes (5/30 16.67%).

## Discussion

Twenty-one hospitals participated in our study, out of the 70 that report transfusing PLTs, according to data provided by the Hellenic National Blood Transfusion Center. The sample size consisted of 13,250 platelet units; 12,061 RDPs and 1189 SDPs transfused over a

period of 2 months, May and June 2015. At a national level, PLT units transfused over a 2-month period in 2015 averaged 28,093 RDPs and 3142 SDPs. The PLT units evaluated to account for 42.93% of RDPs, and for 37.85% of SDPs transfused in Greece over the corresponding time period. Thus, the total sample size was considered representative, and hence, the analysis is assumed to have led to safe conclusions (with a 95% confidence interval, margin of error 0.65% for all samples, and 0.67% for RDPs and 2.24% for SDPs).

Blood transfusion services in Greece are still decentralized and are located in almost every hospital. At present, the National Blood Transfusion Centre is moving to restructure the system and centralize the blood products' production and supply. However, until this happens, every hospital's blood transfusion service is responsible for the whole blood transfusion chain (recruitment of donors, collection, and serological testing of donated blood, preparation, storage and issue of various blood products).<sup>[13]</sup> Thus, both RDPs and SDPs are generally produced in the same hospital, where they are transfused at rates that reach 85.01% and 98.14%, respectively. Therefore, production and transfusion of PLTs units are high in major hospitals and mainly in Athens, where population density is higher, and in some regional university Hospitals. This is to be expected as these same hospitals attract the majority of patients, for example, HA2 (18.87%), HA1 (8.65%) located in Athens, and HOA8 (8.79%) located in Patras as well as HOA1 (8.51%) located in Thessaloniki (data not shown). This concentration of patients and platelet transfusion needs in specific hospitals could be the result of the fact that these hospitals have very large hematology departments, where patients from other geographical areas are also treated.<sup>[14]</sup> The majority of patients receiving PLTs transfusions were admitted to either internal medicine or hematology departments (28% and 24%, respectively), as in many Greek hospitals, especially outside larger towns, hematology wards are subunits of internal medicine departments.<sup>[14]</sup>

According to our data, the vast majority of PCs are produced from whole blood donations (PRP method), while a small portion comes from apheresis. Regarding the type of RDPs products, there is a major difference between Greece and other European countries and Canada, where pooled buffy coat (BC) PCs in additive solution are widely used. By contrast, PCs resuspended in plasma (including both apheresis and PRP derived) are the norm in the United States and China. However, in these countries, most of the PCs transfused involve apheresis PLTs (97.23% SDPs, 2.77% RDPs), while the opposite is true in Greece (91.2% RDPs, 9.8% SDPs), as only 13 out of the 21 hospitals in the study have the necessary equipment and the expertise to produce PCs by apheresis.<sup>[15-17]</sup>

We found that the majority of PLTs (both RDPs and SDPs) were used in patients with hematological disease (64.19% and 76.11%), malignancies (10.32% and 5.30%), and those undergoing cardiovascular procedures (6.53% and 4.04%). The most common diagnosis within hematology was acute leukemia, (outside the setting of stem cell transplantation) followed by myelodysplastic syndromes and lymphomas. Our results can be compared to those of similar reports in the UK, which provide relevant information on the clinical diagnosis of platelet recipients and which give largely similar results.<sup>[16,18]</sup> According to Charlton *et al.* and Pendry and Davies, the largest number of PLTs (54% and 57%) was also given to patients with hematological disease including acute leukemia followed by transplantation allogeneic and autologous.<sup>[16,18]</sup> In our study, patients undergoing transplantation were preferably transfused with SDPs. This finding could probably be explained as this practice is consistent with the current guidelines, to minimize the risk of human leukocyte antigens and human platelet antigens alloimmunization, to prevent RhD alloimmunization, and to manage platelet transfusion refractoriness.<sup>[19]</sup>

According to our study, the average number of RDPs and SDPs transfused per episode was 4.84 ( $\pm 2.73$ ) and 1.12 ( $\pm 2.73$ ), respectively. The mean adult standard platelet dose is  $2.2 \times 10^{11}$  platelets/m<sup>2</sup>.<sup>[4,20]</sup> Although parameters regarding the mean platelet yield in RDPs and SDPs were not included in our study, all participating transfusion services produce PCs according to the "Guide to the preparation, use and quality assurance of Blood Components" by EDQM and accordingly perform regular quality controls.<sup>[12]</sup> Thus, the mean platelet dose transfused in Greece (corresponding to five RDPs and one SDP) seems to be equivalent to the standard adult dose defined above. As expected, preterm neonates in neonatology departments received the lowest number of RDPs/episode, while patients with aneurysms the highest.

Platelet transfusion has both therapeutic and prophylactic purposes depending on whether bleeding is already established, or there is a significant risk of it occurring. Approximately two-thirds of RDPs (66%) and three quarters (75%) of SDPs were transfused prophylactically, to prevent bleeding. This phenomenon was evident in almost all participating hospitals in our study as depicted in Table 4 and was more prominent in hospitals with large hemato-oncology units treating patients with hypoproliferative thrombocytopenia. These data are in accordance with the results reported in the North of England, where 72% of platelet doses were given for prophylactic purposes, with the majority of the above given without any planned procedure.<sup>[16]</sup> However, the platelet count threshold for prophylactic platelet transfusion was not assessed in our study. It

would be interesting to see the laboratory threshold for prophylactic platelet transfusion in Greece in a future audit, as different guidelines define the need for platelet transfusion for patients with therapy-induced hypoproliferative thrombocytopenia, in the absence of active bleeding at different platelet counts, ranging from 10 or less to  $50 \times 10^9/L$ .<sup>[19,21-24]</sup>

It is well known that platelet products are frequently wasted due to the expiration of their use-by date, which is attributed to a combination of an uncertain daily demand and a short shelf life. The majority of both RDPs and SDPs in Greece were transfused on day 5, just a day before expiration. Accordingly, the discard rate of 16.75% for RDPs and 2.70% for SDPs was mainly attributed to their expiration. In ten European countries, the mean discard rate for PLTs (regardless of their method of production) was estimated at 13.7%.<sup>[24]</sup> Regarding RDPs, recently published data indicate that the RDPs wastage rate in Iran varied between 18.5% and 10.5% before and after specific intervention.<sup>[25]</sup> In another study conducted in the Central India, 37% of PLT units were discarded,<sup>[26]</sup> while in Malaysia PLT wastage, excluding units discarded due to the expiry date and transfusion-transmitted diseases, was estimated at 6%.<sup>[27]</sup> Regarding SDPs in the US, the wastage rate calculated only for shelf life expiration was 10.3%, while in the UK, it was 3.8%.<sup>[16,28]</sup> It is worth mentioning that our results include wastage due to seropositivity for transfusion-transmitted diseases, and to perform regular quality controls, that are not included in the majority of the studies evaluating blood wastage. Considering the heterogeneity of the above-mentioned studies and the diversity of factors evaluated, our results could be considered to be at a very similar level. Nevertheless, the wastage rate could further be reduced by means of a central inventory management system in our country, which the Hellenic National Blood Transfusion Center is planning to implement in the near future.

Efforts to prolong platelet lifetime to decrease wastage are continuing. Recently, published data revealed that BC-derived PLT in AS stored for 7 days at 22°C are safe regarding the risk of a positive blood culture.<sup>[29]</sup> Additional pathogen inactivation systems in platelet products reduce bacterial contamination and provide a safeguard against the risk of emerging and reemerging pathogens.<sup>[30]</sup> Furthermore, cold storage and cryopreservation of PLTs may facilitate the extension of the products' shelf life to weeks and even years, and they may also provide the benefit of the PLTs being more hemostatically effective than conventionally stored PLTs.<sup>[31]</sup> In support of these, it has already been shown that PLTs stored at 4°C for 10–14 days have a better hemostatic and biochemical profile than those stored for 5 days in 22°C.<sup>[32]</sup>

## Conclusions

The present study is the first national survey regarding platelet transfusion in Greece. The majority of patients receiving PLTs transfusions are admitted to either internal medicine or hematology departments, and they are treated for hematological diseases or other malignancies. Thus, it would seem sensible that members of the hematology and internal medicine clinical teams should be the target for educational and training initiatives on contemporary transfusion guidelines, implemented locally or at a national level. Platelet discard rate could further be lowered by the centralization of the inventory management in combination with the expansion of lifetime of PCs through the use of emerging technologies.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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