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Blood transfusion service in Poland in 2021

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Summary

Background: *The aim of this study was to present the basic aspects of the activity of Polish transfusion blood service (hereinafter referred to as Centers) in 2021, taking into account the conditions related to the ongoing COVID-19 pandemic.*

Material and methods: *Analysis of data forwarded to the Institute by the Polish Blood Transfusion Centers (Centers).*

Results: *In 2021, there were 23 Centers and 136 local collection sites opeerating in Poland. Blood and blood components were also collected during 11 150 mobile collections. The overall numer of blood donors was estimated at 615 784, the majority of which were non-remunerated donors (615 425, including 40 059 responders to donation appeals) as well as 45 remunerated donors and 313 autologous donors. Most frequent were whole blood collections (1 248 585 donations), and the least frequent — granulocyte concentrate collections (104 donations) and RBC collections by apheresis (26 donations). Whole blood was collected mostly in local collection sites (49.01%), less frequently in Centers (31%) and during mobile collections (19.99%). The most frequently prepared blood components were RBCs (1 231 538 units) and FFP (1 425 640 units). COVID-19 convalescent plasma was also collected (87 071 units altogether).*

In 2021, a total of 85 677 units of PCs pooled from whole blood and 52 346 units of PCs from apheresis were prepared.

Additional processing methods (leukocyte depletion, irradiation) were more frequently applied to PCs (49.57% leukodepleted, 50.43% both leuko-depleted and irradiated), than to RBCs (20.61% leukodepleted , 10.05% both leukodepleted and irradiated, 0.04% irradiated). Pathogen reaction technologies were applied to 15.64% of FFP units issued for clinical use and 12.53% of PCs.

For various reasons the following amounts of blood components were wasted in 2021: 12 403 units of whole blood, 32 866 units of RBCs, 55 058 units of FFP, 1598 units of apheresis PCs, 5317 units of pooled PCs and 1506 units of cryoprecipitate.

As compared to the previous year, in 2021 almost all the indicators of the activity of the blood transfusion service in Poland have increased.

Conclusions: *The study data point to a smaller impact of the COVID-19 pandemic on blood donation in Poland in the year 2021 as compared to 2020. The data may serve as a starting point for the analysis of issues related to the activity of organizational units of the Polish blood*

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transfusion service. The outcome may contribute to practical benchmarking, comparing experiences and seeking new solutions.

Key words: blood donors, blood donation, blood components, COVID-19

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Introduction

The activity of Polish blood transfusion service (BTS) is regulated by the Public Blood Transfusion Service Act of August 22, 1997 [1]. Pursuant to this Act, the following units of the public blood transfusion service are entitled to collect blood and prepare blood components: 21 Regional Blood Transfusion Centers, Military Blood Transfusion Center (WCKiK, supervised by the Ministry of Defense) and the Blood Transfusion Center of the Ministry of Internal Affairs and Administration (CKiK MSWiA, supervised by the Ministry of Internal Affairs and Administration). The Institute of Hematology and Transfusion Medicine (IHTM) has substantive supervision over the activity of all the above-mentioned entities of the public blood transfusion service.

In this presentation of selected issues related to the annual activities of the public blood transfusion service in Poland in 2021 we take into account the specific conditions caused by the COVID-19 pandemic. The following topics were discussed: the number of donors, the number of donations, the collection sites for whole blood and blood components, including red blood cell concentrate (RBC), fresh frozen plasma (FFP), platelet cell concentrate (PC) and granulocyte concentrate (KG) in 2021. We also discuss issues related to the use of some additional preparation methods as well as the inactivation of biological pathogens in labile blood components. The most common causes of the waste of blood components were explored as well as the degree of wastage.

Material and methods

This work relies on the data provided by: 21 Regional Blood Transfusion Centers (RCKiK), WCKiK, CKiK MSWiA in the form of annual activity reports for 2021. Together with the National Blood Center (NCK), IHTM created a template of definitions for the purpose of standardization of the forwarded data.

First-time donor — donates blood during the reporting period but has never before donated blood for medical purposes.

Multiple (regular) donor — systematically donates blood (at least twice during the last 24 months).

Multiple repeat donor — donates blood again more than 2 years after the last donation.

Non remunerated donor — receives no financial compensation for donated blood/blood component at least once during the reporting period.

Remunerated donor — receives financial compensation for every donation during the reporting period.

Responder to donation appeal — donates blood/blood component following emergency appeal for donation at least once during the reporting period (the term also applies to former „family donors").

Directed donor — donates blood for a specific patient at least once during the reporting period.

Autologous donor — donates blood/blood component for himself at least once during the reporting period.

Donation — whole blood or blood component collected by apheresis, including blood for clinical and scientific purposes collected from immunized and family donors etc.

Unit (u.) — volume of anticoagulated whole blood obtained from 450 ml of blood collected from the donor or volume of blood component obtained from one unit of anticoagulated whole blood.

Unit of plasma — volume of plasma obtained from whole blood or by automated plasmapheresis. One automated plasmapheresis procedure usually provides 3 units of plasma (600 ml).

Unit of PC from apheresis — platelets obtained from a single donor with cell separator (1 donation regardless of platelet count).

Therapeutic dose of PC — PCs (either pooled or from apheresis) dedicated for an adult; according to current guidelines it contains $\geq 3 \times 10^{11}$ platelets.

Results

Blood Transfusion Centers (Centers)

In 2021, there were 23 Centers and 136 local collection sites operating in Poland. Moreover, 11 150 mobile collections were organized which is about 7% more than in the previous year. In 2021 mobile collections were organized by all RCKiK and WCKiK. As in the previous year, the largest number of mobile collections was organized by RCKiK in Katowice (1273). Over 1000 mobile collections were organized also by RCKiK in Łódź (1267) and Warsaw (1048). As compared to the previous year, the number of mobile collections increased in 15 RCKiK and decreased in 5 RCKiK and WCKiK (Table 1).

Donors

In 2021, a total of 703 958 persons came to donate blood (in 2020 — 653 467), but only some of them (615 784) were found eligible for donation (in 2020 — 569 914).

As in the previous years, blood or blood components for clinical use were donated by 87% of the people who were willing to donate blood. The difference was mainly due to donor deferral. In 2021, a total of 9637 permanent deferrals were applied. There were also 223 836 temporary deferrals of 186 206 people, and the most common cause for deferral (69 758 cases) was low hemoglobin level (like in the previous years).

Temporary deferral was applied to 2080 people for various reasons related to the ongoing COVID-19 pandemic (disease itself, quarantine, contact with infected person/persons). Additionally,

Table 1. Mobile collections organized in Polish Blood Transfusion Centers in 2020 and 2021

Center	Mobile collections		
	2020	2021	Tendency (increase/decrease compared to 2020)
Białystok	760	581	↓
Bydgoszcz	718	770	↑
Gdańsk	201	201	bz
Kalisz	349	413	↑
Katowice	1366	1273	↓
Kielce	162	206	↑
Kraków	508	712	↑
Lublin	399	403	↑
Łódź	851	1267	↑
Olsztyn	421	511	↑
Opole	131	154	↑
Poznań	636	717	↑
Racibórz	126	113	↓
Radom	377	399	↑
Rzeszów	229	304	↑
Słupsk	108	131	↑
Szczecin	342	359	↑
Wałbrzych	1100	965	↓
Warszawa	1010	1048	↑
Wrocław	237	227	↓
Zielona Góra	186	201	↑
WCKiK	215	195	↓
CKiK MSWiA	0	0	bz
Total	**10 432**	**11 150**	↑

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration; ↓ — decrease as compared to 2020; ↑ — increase as compared to 2020; bz — no change as compared to 2020

Table 2. Blood donors in Polish Blood Transfusion Centers in 2021

Centers	Donors				Tendency (increase/ /decrease compared to 2020)
	First-time	Multiple--regular	Multiple--repeat	Total	
Białystok	4341	20 605	4271	29 217	↑
Bydgoszcz	7710	22 632	5695	36 037	↑
Gdańsk	6421	18 149	4433	29 003	↑
Kalisz	4679	14 592	3409	22 680	↑
Katowice	12 004	32 867	7810	52 681	↑
Kielce	4098	9724	3003	16 825	↑
Kraków	11 725	28 949	7649	48 323	↑
Lublin	6589	18 339	4525	29 453	↑
Łódź	9323	19 811	7970	37 104	↑
Olsztyn	6147	10 248	2968	19 363	↑
Opole	3461	8760	2215	14 436	↑
Poznań	8458	29 228	7190	44 876	↓
Racibórz	2097	9115	1939	13 151	↓
Radom	2824	7232	2062	12 118	↑
Rzeszów	5807	20 509	4237	30 553	↑
Słupsk	2385	5589	1560	9534	↑
Szczecin	5657	14 003	3582	23 242	↑
Wałbrzych	3205	7883	1609	12 697	↑
Warszawa	13 795	35 704	10 055	59 554	↑
Wrocław	9164	22 377	6482	38 023	↑
Zielona Góra	3017	9 258	3901	16 176	↑
WCKiK	6927	7774	2376	17 077	↑
CKiK MSWiA	1678	1824	159	3661	↑
Total	**141 512**	**375 172**	**99 100**	**615 784**	↑

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration; ↓ — decrease as compared to 2020; ↑— increase as compared to 2020

1802 deferrals were applied due to vaccinations against COVID-19.

Donors were mostly voluntary unremunerated (615 425). In 2021, blood and blood components were also donated by 45 remunerated donors and 313 autologous donors. Amongst voluntary donors, 40 059 were responders to appeal and 68 were directed donors.

In 17 Centers blood was donated only by voluntary unremunerated donors. The highest numbers of remunerated donors were reported by RCKiK in Gdańsk (32) and Katowice (6).

Among the donors of blood and blood components there were 141 512 first-time donors (22.98%), 375 172 multiple regular donors (60.93%) and 99 100 multiple repeat donors (16.09%).

21 Centers reported an increase in the number of donors, only in 2 (Poznań and Racibórz) — a slight decrease was observed (by 2.66 and 2.03% respectively). Table 2 presents the number of donors in each Center in 2021.

As in the previous years, the most numerous group of blood donors were people aged 18 to 44 (a total of 510 281, including 132 047 women and 378 234 men).

Donations

In 2021, whole blood was the most frequently collected blood component (1 248 585 donations), while the least frequent were collections of: granulocyte concentrate (104 donations in 6 RCKiK) and apheresis RBC as the only component (26 donations in 3 RCKiK). As in previous years, the largest

Table 3. Whole blood and apherisis donations in 2021*

Center	Whole blood	Apheresis						Total
		Plasma	RBCs	PC	GC	PC+plasma	PC+RBCs	
Białystok	58 985	12 327	0	136	11	1973	0	73 432
Bydgoszcz	72 774	8749	14	974	9	0	0	82 520
Gdańsk	63 033	2409	0	372	0	59	0	65 873
Kalisz	44 587	14 752	0	0	0	418	0	59 757
Katowice	119 300	1042	0	812	0	4895	0	126 049
Kielce	32 136	1431	0	670	0	0	0	34 237
Kraków	102 521	1003	0	2132	58	0	0	105 714
Lublin	60 191	5447	0	0	0	1691	0	67 329
Łódź	71 490	1391	0	1413	0	0	0	74 294
Olsztyn	39 122	3060	0	404	0	111	0	42 697
Opole	31 885	530	0	579	0	0	0	32 994
Poznań	94 145	5416	0	0	0	1807	0	101 368
Racibórz	26 907	4807	0	0	0	331	0	32 045
Radom	23 274	3221	0	12	0	847	0	27 354
Rzeszów	65 528	5725	0	1674	0	197	0	73 124
Słupsk	18 666	1334	8	22	0	351	8	20 389
Szczecin	47 081	1941	0	19	10	1374	0	50 425
Wałbrzych	27 500	536	0	58	0	71	0	28 165
Warszawa	113 806	2118	0	3425	13	7403	0	126 765
Wrocław	69 967	6699	4	1654	3	4933	102	83 362
Zielona Góra	29 903	741	0	0	0	57	0	30 701
WCKiK	29 502	78	0	25	0	0	0	29 605
CKiK MSWiA	6282	61	0	30	0	0	0	6373
Total	**1 248 585**	**84 818**	**26**	**14 411**	**104**	**26 518**	**110**	**1 374 572**

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration; *Complete donations only

numbers of whole blood donations were reported by RCKiK in Warsaw (113 806) and Katowice (119 300). Apheresis was mainly used for preparation of PCs (14 411 donations) and plasma (84 818 donations). The largest numbers of apheresis plasma donations were reported by RCKiK in Kalisz (14 752), and apheresis PC donations by RCKiK in Warsaw (3425).

Automated donations of a combination of blood components, mostly of PC and plasma (26 518 donations) were also collected mostly in RCKiK in Warsaw (7403 donations), less frequently of PC and RBCs (110 donations) — almost exclusively at RCKiK in Wrocław (102 donations).

Table 3 presents the number of complete donations of blood and blood components in 2021.

Blood was collected primarily in the local collection sites (49.01% of whole blood donations), less frequently at the Center premises (31%), and during mobile collections (19.99%). As in previous

Table 4. Sites of whole blood collection in 2021

Center	Whole blood collecterd (units)*						
	Center site		Local collection site		Mobile collection site		Total
	Units	%	Units	%	Units	%	Units
Białystok	26 662	44.91	18 980	31.97	13 722	23.12	59 364
Bydgoszcz	18 928	25.85	29 407	40.16	24 892	33.99	73 227
Gdańsk	21 580	34.03	36 461	57.50	5367	8.46	63 408
Kalisz	9546	21.33	20 062	44.84	15 138	33.83	44 746
Katowice	21 200	17.49	75 397	62.20	24 615	20.31	121 212
Kielce	14 662	45.38	10 764	33.32	6883	21.30	32 309
Kraków	25 223	24.43	58 950	57.09	19 084	18.48	103 257
Lublin	19 578	32.18	30 607	50.31	10 652	17.51	60 837
Łódź	27 843	38.41	30 030	41.43	14 611	20.16	72 484
Olsztyn	12 262	31.01	17 167	43.41	10 116	25.58	39 545
Opole	8183	25.58	20 469	64.00	3332	10.42	31 984
Poznań	27 758	29.02	51 566	53.90	16 339	17.08	95 663
Racibórz	4016	14.81	20 572	75.88	2524	9.31	27 112
Radom	12 965	55.48	2043	8.74	8359	35.77	23 367
Rzeszów	13 681	20.72	45 153	68.39	7188	10.89	66 022
Słupsk	11 112	58.66	4556	24.05	3275	17.29	18 943
Szczecin	20 582	43.51	17 889	37.82	8829	18.67	47 300
Wałbrzych	13 520	48.30	0	0.00	14 469	51.70	27 989
Warszawa	29 202	25.38	59 531	51.74	26 320	22.88	115 053
Wrocław	34 599	48.82	29 253	41.28	7018	9.90	70 870
Zielona Góra	9201	30.46	16 358	54.16	4646	15.38	30 205
WCKiK	2275	7.64	22 759	76.41	4753	15.96	29 787
CKiK MSWiA	6319	100,00	0	0.00	0	0.00	6319
Total	**390 897**	**31.00**	**617 974**	**49.01**	**252 132**	**19.99**	**1 261 003**

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration; *incomplete donations included

years, the largest number of whole blood donations — 51.70% — took place during mobile collections organized by the RCKiK in Wałbrzych. Table 4 provides a list of whole blood collection sites in 2021.

Blood components

Red blood cell concentrate

Donated blood was processed into blood components, mostly RBC (a total of 1 231 538 units), which was a marked country-wide increase as compared to the previous year (1 089 978 units). As in previous years, the largest amount of RBCs was obtained in RCKiK in Katowice and Warsaw (118 613 and 113 624 units, respectively) (Table 5). Most Centers reported an increase in the number of collected RBC units. A slight decrease (by 1.48%) was reported only in RCKiK in Raciborz.

Some part of RBC units was subjected to additional preparation the most common of which was leukocyte reduction and irradiation.

Table 5. Units of RBCs prepared in Polish Blood Transfusionn Centers in 2021

Center	RBCs (units)	Increase/decrease as compared to 2020
Białystok	58 841	↑
Bydgoszcz	72 807	↑
Gdańsk	62 885	↑
Kalisz	40 783	↑
Katowice	118 613	↑
Kielce	32 065	↑
Kraków	102 378	↑
Lublin	60 111	↑
Łódź	71 024	↑
Olsztyn	39 034	↑
Opole	31 821	↑
Poznań	89 271	↑
Racibórz	26 792	↓
Radom	22 934	↑
Rzeszów	63 576	↑
Słupsk	18 663	↑
Szczecin	47 061	↑
Wałbrzych	27 500	↑
Warszawa	113 624	↑
Wrocław	60 481	↑
Zielona Góra	29 883	↑
WCKiK	35 114	↑
CKiK MSWiA	6277	↑
Total	**1 231 538**	↑

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration; ↓ — decrease as compared to 2020; ↑— increase as compared to 2020

In 2021, a total of 253 876 units of leucocyte--depleted RBCs were obtained (20,61% of all RBC units) and 123 777 units of leucocyte-depleted irradiated RBC (10.05%). RBC irradiation was used sporadically, yielding 531 units of irradiated RBCs — 0.04% of all RBC units.

Country-wide, 30.67% of all RBCs were leukocyte-depleted and 10.09% of RBCs were irradiated. Table 6 presents the number of leukocyte-depleted and irradiated units of RBC prepared in Centers in 2021.

Platelet concentrate

Platelet concentrate was the second most frequently prepared blood component, just like in the years before. Two basic methods were used for PC preparation:

Tabela 6. Units of leukocyte-depleted and irradiated RBCs as well as of both leukocyte-depleted and irradiated RBCs prepared in Polish Blood Transfusion Centers (2021)

Center	Units of leukocyte--depleted RBCs	Units of irradiated RBCs	Units of both leukocyte-depleted and irradiated RBCs
Białystok	2185	0	6687
Bydgoszcz	3381	1	12 053
Gdańsk	651	4	18 231
Kalisz	36 930	0	0
Katowice	33 979	0	6137
Kielce	5845	0	3407
Kraków	6931	352	8149
Lublin	5363	0	10 298
Łódź	12 028	15	13 495
Olsztyn	4178	0	4096
Opole	4098	0	556
Poznań	16 156	0	8157
Racibórz	2187	0	28
Radom	1767	0	51
Rzeszów	176	54	7403
Słupsk	1247	0	1735
Szczecin	880	102	2186
Wałbrzych	927	0	0
Warszawa	98 559	0	10 389
Wrocław	4653	3	8318
Zielona Góra	3464	0	2402
WCKiK	3000	0	0
CKiK MSWiA	5292	0	0
Total	**253 876**	**531**	**123 777**

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration

— centrifugation of whole blood from traditional donations, and — if necessary — pooling several units of PC to obtain pooled PC. Some Centers used automated methods for obtaining PCs;
— apheresis with cell separators (some of the PCs obtained with this method were divided into smaller therapeutic doses). Apheresis PCs from modern separators are leucocyte--depleted require and no additional elimination of leukocytes.

In 2021, a total of 85 677 units of pooled PC were prepared (in 2020 — 77 485), including 61 636 from buffy coat with manual method and 24 013 with automated methods. Additionally, WCKiK prepared 28 units of PC from platelet rich plasma.

Table 7. PCs from whole blood and apheresis (2021)

Center	Therapeutic (doses)			
	Pooled, from whole blood	Apheresis	Total	% of apheresis PCs
Białystok	752	4116	4868	84.55
Bydgoszcz	9101	1253	10 354	12.10
Gdańsk	5939	639	6578	9.71
Kalisz	1754	735	2489	29.53
Katowice	9497	7010	16 507	42.47
Kielce	3015	754	3769	20.01
Kraków	8380	3013	11 393	26.45
Lublin	5133	1874	7007	26.74
Łódź	4595	1624	6219	26.11
Olsztyn	3583	623	4206	14.81
Opole	722	581	1303	44.59
Poznań	10 007	3299	13 306	24.79
Racibórz	454	446	900	49.56
Radom	646	865	1511	57.25
Rzeszów	5786	1924	7710	24.95
Słupsk	1386	403	1789	22.53
Szczecin	3061	1502	4563	32.92
Wałbrzych	1844	129	1973	6.54
Warszawa	4163	13 049	17 212	75.81
Wrocław	2765	8435	11 200	75.31
Zielona Góra	2762	59	2821	2.09
WCKiK	181	25	206	12.14
CKiK MSWiA	151	30	181	16.57
Total	**85 677**	**52 346**	**138 023**	**37.93**

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration

In 2021, a total of 52 346 units of PCs were obtained by apheresis (37.93% of all units issued for clinical use (in 2020 — 40.17%).

The highest number of PCs from whole blood was obtained in Katowice (9497 pooled PC units) and Poznań 10 007 pooled PC units), while from apheresis — in Warsaw (13 049).

The percentage of apheresis PCs differed significantly between Centers — from 2.09% in Zielona Góra to 75.81% in Warsaw and 84.55% in Białystok (Table 7).

Since 2021, only leukocyte-depleted PCs are issued for clinical use in Poland; some part of PC units are also irradiated. In 2021, a total of 68 412 therapeutic doses of leukocyte-depleted

Table 8. Leukocyte-depleted and irradiated leukocyte-depleted PCs prepared in Polish Centers in 2021

Centers	PC (therapeutic doses)	Leukocyte-depleted PCs	Irradiated leukocyte--depleted PCs
Białystok	4868	31	4837
Bydgoszcz	10 354	69	10 285
Gdańsk	6578	363	6215
Kalisz	2489	2489	0
Katowice	16 507	11 148	5359
Kielce	3769	2078	1691
Kraków	11 393	5346	6047
Lublin	7007	480	6527
Łódź	6219	4975	1244
Olsztyn	4206	359	3847
Opole	1303	1211	92
Poznań	13 264	7492	5772
Racibórz	900	895	5
Radom	1511	1507	4
Rzeszów	7710	3836	3874
Słupsk	1789	722	1067
Szczecin	4563	1712	2851
Wałbrzych	1973	1973	0
Warszawa	17 212	17 178	34
Wrocław	11 200	2590	8610
Zielona Góra	2821	1598	1223
WCKiK	206	179	27
CKiK MSWiA	181	181	0
Total	**138 023**	**68 412**	**69 611**

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration

PCs were obtained which accounted for 49.57% of all obtained PCs, as well as 69 611 therapeutic doses of irradiated leukocyte-depleted PCs (50.43%).

Table 8 presents the numbers of leukocyte--depleted and irradiated PCs obtained in Polish Centers in 2021.

In 2021, a total of 130 865 therapeutic doses of PCs were issued for clinical use (in 2015 — 114 163, in 2016 — 118 391, in 2017 — 123 668, in 2018 — 127 049, in 2019 — 129 652, in 2020 — 120 858). So a marked increase was recorded.

Some part of the obtained PCs were then stored frozen (frozen platelet concentrate).

In 2021 1.82% of pooled PCs and 4.74% of apheresis PCs were subjected to freezing.

With the exception of 2019 when a slight increase in the percentage of frozen components was recorded (by 0.04%), for the last several years, the percentage of frozen PCs has been observed

to decrease; by 0.48% between 2021 and 2020. A decrease was noted in the percentage of frozen apheresis PCs (by 0.44%) as well as of pooled PCs (by 0.42%). In 2021 there are however significant differences in this respect between individual Centers ranging from 0% in Kalisz, Poznań and WCKiK to 12.11% in Słupsk (decrease by 2.7% as compared to 2020), 13.84% in Wałbrzych (decrease by 4.97%), 23.29% in Opole (decrease by 6.91%), 18.80% in Radom (decrease by 10.46%) and 50.89% in Racibórz (increase by 13.75%). In the Centers of Radom, Słupsk and Wałbrzych, the percentage of frozen PCs systematically decreases. As in the previous years, Racibórz reported the highest percentage of frozen pooled PCs (69.38%, an increase by 18.68%) and an increase is recorded every year. On the other hand, Zielona Góra, CKiK, MSWiA, Słupsk, Wałbrzych, Radom and Raciborz reported the highest percentage of frozen apheresis PCs (61.54%; 56.67%, 42.52, 34.11%, 32.95%r and 31.90% respectively). At the same time, it should be noted that in Zielona Góra only 26 apheresis PCs were collected, 16 of which were frozen, while CKiK and MSWiA collected 30 PCs and subjected 17 to freezing hence such a high percentage of frozen PCs from apheresis.

In 2021, thawed frozen PCs accounted for 2.84% of all PC therapeutic doses issued for clinical use, i.e. 0.29% less than in 2020. The largest number of thawed PC units was reported by Racibórz (50.84% of all PC units issued for clinical use), Opole (27.69%), Radom (26.25%), Słupsk (15.17%) as well as Wałbrzych (11.26%). Only the Centers in Kalisz, and Poznań reported no thawed PCs issued for clinical use.

Fresh frozen plasma

In 2021, a total of 1 425 640 FFP units were prepared (in 2019 — 1 373 514 units and in 2020 — 1 264 654 units). As in the previous years, FFP was mainly obtained by manual method, i.e. plasma obtained from anticoagulated whole blood. With this method, 1 193 639 FFP units were obtained in 2021. On the other hand, with the less frequent method of apheresis 232 001 units were obtained, i.e. 16.27% of the total (in 2020 – 188 892 units, i.e. 14.94% of the total). This is the proof of the upward trend observed for the last several years.

The percentage of FFP obtained by apheresis differed between Centers (the highest was reported by Kalisz — 51.86% and Białystok — 44.46%).

Table 9 presents the number of FFP units obtained by the manual method and by apheresis in individual Centers in 2021.

A total of 246 013 FFP units were issued for clinical use which is more than in 2020 (229 059 FFP units) though still less than in 2019 — 273 519) As compared to the previous year, the number of FFP units issued for clinical use increased in most (17) Centers (Table 10).

COVID-19 convalescent plasma

The ongoing COVID-19 pandemic has burdened the Polish blood transfusion service with the additional task of collecting convalescent plasma. In 2021, a total of 87 071 units of convalescent plasma were collected, 58 670 units of which (67.38%) were issued for clinical purposes (in 2020 — 57 708 units, 44.83% of which were issued for clinical use).

Convalescent plasma was collected by all Centers; the highest volumes (11 349 units) were reported by the Center in Bydgoszczy. Table 11 presents the numbers of convalescent plasma units obtained from COVD-19 convalescents and issued for clinical purposes by individual Centers in 2021.

Granulocyte concentrate

As in previous years, in 2021, granulocyte concentrate (GC) was only sporadically obtained (104 donations in 6 Centers), i.e. more frequently than in 2020 (82 donations). Most GC donations took place in Kraków (58) and Warsaw (13).

Quarantine and inactivation of biological pathgens in labile blood components

In Poland only quarantine[1] or pathogen inactivated FFP and cryoprecipitate are issued for clinical use to ensure the safety of transfused blood components. Currently there are three (3) pathogen inactivation systems implemented in the Polish Blood Transfusion Centers: Theraflex MB Plasma (with methylene blue) for pathogen inactivation in plasma, Mirasol PRT (with riboflavin) and Intercept (with amotosalen hydrochloride) for pathogen inactivation in FFP and PC. Some methods of inactivation (Mirasol PRT and Intercept) are also effective for inactivation of immunocompetent T lymphocytes which is an alternative to irradiation of cellular blood components for prevention of transfusion-associated Graft Versus Host Disease (TA-GvHD) [2–4].

[1] Quarantine of FFP and cryoprecipitate consists in storage for at least 16 weeks of donation date followed by testing the donor for infectious disease markers (to eliminate the diagnostic window period)

Table 9. Fresh frozen plasma (from whole blood and apheresis) prepared in Polish Blood Transfusion Centers in 2021 (units)

Center	Whole blood (manual method)	Aheresis	Total	% apheresis FFP
Białystok	58 597	46 911	105 508	44.46
Bydgoszcz	69 694	17 599	87 293	20.16
Gdańsk	61 721	4507	66 228	6.81
Kalisz	39 464	42 506	81 970	51.86
Katowice	116 677	5118	121 795	4.20
Kielce	31 671	3323	34 994	9.50
Kraków	99 393	647	100 040	0.65
Lublin	57 496	15 331	72 827	21.05
Łódź	70 939	1534	72 473	2.12
Olsztyn	37 973	5575	43 548	12.80
Opole	31 368	1318	32 686	4.03
Poznań	87 998	13 842	101 840	13.59
Racibórz	26 788	13 150	39 938	32.93
Radom	22 692	7294	29 986	24.32
Rzeszów	62 425	12 180	74 605	16.33
Słupsk	18 538	2898	21 436	13.52
Szczecin	47 063	3735	50 798	7.35
Wałbrzych	26 380	670	27 050	2.48
Warszawa	111 235	9751	120 986	8.06
Wrocław	58 012	23 696	81 708	29.00
Zielona Góra	29 620	390	30 010	1.30
WCKiK	22 024	27	22 051	0.12
CKiK MSWiA	5871	0	5871	0.00
Total	**1 193 639**	**232 001**	**1 425 640**	**16.27**

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration

In 2021 pathogen inactivation technology (PRT) was present in 23 Centers which used:

— Mirasol — 16 Centers (in 14 regional Centers, WCKiK and CKiK MSWiA);
— Theraflex MB Plasma (in 12 regional Centers);
— Intercept (in 4 regional Centers).

Individual Centers subjected different amounts of plasma to inactivation, ranging from 0.02% in Szczecin to 15.91% in Warsaw. In the Centers of Warsaw and Poznań, the volume of inactivated plasma exceeded 10% (15.91% and 13.23% respectively) and in 4 other Centers the percentage ranged from 3.17 to 7.24%. Countrywide, 3.71% of all plasma was subjected to inactivation. COVID-19 convalescent plasma was also subjected to inactivation and the values ranged from 24.64% in Szczecin to 100% in WCKiK, CKiK MSWiA and Wałbrzych (66.90% countrywide).

Table 10. FFP issued for clinical use by Polish Blood Transfusion Centers in 2021 (convalescent plasma not included)

Centers	FFP issued for clinical use (units)	Tendency (increase/decrease compared to 2020)
Białystok	11 557	↑
Bydgoszcz	13 163	↓
Gdańsk	8694	↑
Kalisz	3279	↓
Katowice	20 072	↓
Kielce	6106	↑
Kraków	21 423	↑
Lublin	16 159	↑
Łódź	14 220	↑
Olsztyn	6875	↑
Opole	5206	↑
Poznań	16 456	↑
Racibórz	2154	↓
Radom	2248	↑
Rzeszów	11 003	↑
Słupsk	2352	↓
Szczecin	14 435	↑
Wałbrzych	6287	↑
Warszawa	36 385	↑
Wrocław	9299	↑
Zielona Góra	5279	↓
WCKiK	10 836	↑
CKiK MSWiA	2526	↑
Total	**246 013**	↑

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration; ↓ — decrease as compared to 2020; ↑— increase as compared to 2020

In 2021, 84.35% of quarantine FFP and 89.53% of quarantine cryoprecipitate were issued for clinical use.

In 2021, 15.64% units of FFP and 10.47% units of cryoprecipitate subjected to pathogen inactivation were issued to hospitals (cryoprecipitate — only in in Poznań).

Inactivation of pooled PCs was performed in 8 Centers, (6 used the Mirasol system, 2 used Intercept). The percentage of pooled PCs subjected to inactivation ranged from 0.1% (Center in Rzeszów) to 99.21% (Center in Warsaw). Countrywide, this accounted for 5.38% of all pooled PC units.

12 Centers inactivated apheresis PCs (11 used Mirasol, 2 used Intercept). The percentage of inactivated apheresis PCs ranged from 0.61% (in Kraków) to 98.53% (in Warsaw). Countrywide, this accounted for 27.27% of all apheresis PC units.

Table 11. Convalescent plasma issued for clinical use by Polish Blood Transfusion Centers in 2021

Centers	COVID-19 convalescent plasma (units)	Issued for clinical use (units)	% of plasma used for clinical purposes
Białystok	4212	3656	86.81
Bydgoszcz	11 349	6594	58.10
Gdańsk	4127	3466	83.97
Kalisz	2763	2537	91.83
Katowice	3935	3742	95.08
Kielce	1306	1615	123.66
Kraków	5263	3187	60.55
Lublin	4901	4253	86.78
Łódź	2709	2566	94.72
Olsztyn	4042	2514	62.20
Opole	808	675	83.54
Poznań	7186	2986	41.55
Racibórz	1851	1197	64.67
Radom	2802	2704	96.50
Rzeszów	6252	3622	57.93
Słupsk	1522	1227	80.61
Szczecin	4106	1672	40.71
Wałbrzych	1065	1088	102.16
Warszawa	6187	4360	70.46
Wrocław	8476	3082	36.36
Zielona Góra	1817	1579	86.90
WCKiK	228	189	82.89
CKiK MSWiA	164	161	98.17
Total	**87 071**	**58 670**	**67.38**

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration

In 2021, 12.53% of all PC therapeutical units issued for clinical use were subjected to inactivation.

Table 12 presents the percentage of FFP, pooled PCs and PC units from apheresis subjected to pathogen inactivation in Centers (2021).

Table 13 presents the percentage of COVID-19 convalescent plasma subjected to pathogen inactivation in 2021.

Table 14 presents the percentage of FFP, cryopercipitate and PC therapeutic units issued for clinical use following pathogen inactivation (2021).

Wastage of blood and blood components

In 2021, a total of 108 748 units of blood and most common blood components were wasted, including 12 403 units of anticoagulated whole blood, 32 866 units of RBCs, 55 058 units of FFP, 1598 therapeutic units of apheresis PCs, 5317 units of pooled PCs from whole blood, as well as 1506 units of cryoprecipitate.

As in the previous years, the most common reasons for wastage of blood components were:

— expiry date;
— seropositivity for transfusion transmitted diseases, syphilis tests, implementation of look-back procedure;
— other causes, including:
  • inadequate visual control,
  • low quantity/volume,
  • seropositive serological results,
  • other, including incorrect procedures, medical deferral, mechanical damage, donor self-deferral etc.

Components from autologous donations that were not put to clinical use were also subjected to wastage.

Table 12. Percentage of pathogen inactivated units of FFP, pooled PCs and apheresis PCs prepared in Polish Blood Transfusion Centers (2021)

Centers	FFP (%)	Pooled PCs (%)	Apheresis PCs (%)	Systems
Białystok	0.95	0.00	1.09	Theraflex, Mirasol
Bydgoszcz	0.80	0.00	0.00	Theraflex, Mirasol
Gdańsk	0.30	0.00	0.00	Theraflex, Mirasol
Kalisz	0.04	0.00	0.00	Theraflex
Katowice	1.60	1.51	1.65	Mirasol
Kielce	0.10	0.00	22.32	Mirasol
Kraków	7.24	1.01	0.61	Mirasol
Lublin	1.10	0.23	2.01	Theraflex, Mirasol
Łódź	3.61	1.52	0.86	Mirasol, Intercept
Olsztyn	0.56	0.00	0.00	Theraflex
Opole	0.04	0.00	0.00	Theraflex
Poznań	13.23	0.00	0.00	Theraflex
Racibórz	1.27	0.00	0.00	Theraflex
Radom	0.05	0.00	42.61	Mirasol, Intercept
Rzeszów	0.75	0.10	4.32	Theraflex, Mirasol
Słupsk	0.00	0.00	0.00	Mirasol (tylko do CP)
Szczecin	0.02	0.00	0.00	Mirasol, Intercept
Wałbrzych	4.20	0.00	0.00	Mirasol
Warszawa	15.91	99.21	98.53	Intercept
Wrocław	3.17	0.00	0.97	Theraflex, Mirasol
Zielona Góra	0.32	0.00	0.00	Theraflex
WCKiK	0.24	26.52	46.15	Mirasol
CKiK MSWiA	6.25	75.50	40.00	Mirasol
Total	**3.71**	**5.38**	**27.27**	

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration

Table 15 presents the number of blood components wasted in individual Centers in 2021; causes of waste are presented in Table 16.

Discussion

The year 2021 was the second year of COVID-19 pandemic and still very specific. Some pandemic-related conditions and their impact on transfusion medicine are presented in the section — *Current problems of blood transfusion medicine.*

Irrespective of the context, the basic factor that determines the availability of blood supply is still the good will, and thus — a sufficient number of volunteer, non-remunerated blood donors [5–9].

In line with the observations presented above, in 2021 the number of donors in the Centers in Poland (615 784) was the highest in several last years (569 914 in 2020, 614 579 in 2019, 614 570 in 2018).

The increase in the number of blood donors was observed despite the several-year decrease in the population in the 18–65 age group — the potential "recruitment source" of blood donors. According to the data provided by the Demographic Yearbook reports (Central Statistical Office of Poland) for 31 December 2011 this number was estimated at 26 460 477, while for 31 December 2020 — 24 689 690 and for 30 June 2021 — 24 574 460 [10–12]. So, during this period (2011–2021), the population in the above-mentioned age group decreased by almost two million, which may have a negative impact on the number of active blood donors.

Table 13. COVID-19 convalescent plasma — percentage of the plasma subjected to pathogen inactivation in the Polish Blood Transfusion Centers (2021)

Centers	Convalescent plasma (units)	Convalescent plasma subjected to pathogen inactivation (units)	Percentage of plasma subjected to pathogen inactivation
Białystok	4211,6	3553	84.36
Bydgoszcz	11 349	6195	54.59
Gdańsk	4127	2859,5	69.29
Kalisz	2763	2622,3	94.91
Katowice	3935	3177	80.74
Kielce	1306	387	29.63
Kraków	5263	3610	68.59
Lublin	4901	2040	41.62
Łódź	2709	2440	90.07
Olsztyn	4042	2478	61.31
Opole	808	624	77.23
Poznań	7186	7161	99.65
Racibórz	1851	998	53.92
Radom	2802	1122	40.04
Rzeszów	6252	4954	79.24
Słupsk	1522,1	1276	83.83
Szczecin	4105,9	1011,5	24.64
Wałbrzych	1065	1065	100.00
Warszawa	6187	4385	70.87
Wrocław	8476	4282	50.52
Zielona Góra	1817	1620	89.16
WCKiK	228	228	100.00
CKiK MSWiA	164	164	100.00
Total	**87070,6**	**58252,3**	**66.90**

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration

In the member states of the Council of Europe, the average number of blood donors per 1000 inhabitants decreased in the period 2008–2011 from 29.0 to 25.0 [13]. In Poland, in 2021 the average number of blood donors per 1000 inhabitants was estimated at 16.14 (in 2020 — 14.42 (in 2019 — 15.39, 2018 — 15.37, and in 2017 — 15.30). This was the highest value in the last several years.

Both in Poland and in other countries, there is a downward trend in the number of people declaring their willingness to donate blood; this is especially true for certain age groups. In Poland, such a tendency can be observed mostly in the 18–24 age group i.e. a group of potential donors of blood and blood components in the future [14].

Apart from the above-mentioned demographic changes, the number of blood donors is adversely affected by factors such as:

— periodic disease outbreaks — e.g. COVID-19 pandemic;
— travel-associated risk of infection e.g. malaria or West Nile virus [15–17];
— emerging infectious diseases (other than COVID-19) e.g. the epidemic of Zika virus infections [18, 19];
— health condition of the population, including reduced hemoglobin levels (the most common cause of deferrals in the last years) [20–22];
— no opportunity to donate blood or economic reasons.

Table 14. Percentage of pathogen inactivated FFP, cryoprecipitate units and PC therapeutic units issued for clinical use following pathogen inactivation (2021)

Centers	% FFP (units)	% Cryoprecipitate (units)	% PC (therapeutic units)
Białystok	8.51	0	0.46
Bydgoszcz	8.39	0	0.00
Gdańsk	0.74	0	0.00
Kalisz	20.03	0	0.00
Katowice	6.65	0	0.81
Kielce	0.43	0	5.21
Kraków	39.00	0	0.88
Lublin	6.21	0	0.36
Łódź	12.85	0	0.00
Olsztyn	3.43	0	0.00
Opole	0.00	0	0.00
Poznań	56.62	100	0.00
Racibórz	21.91	0	0.00
Radom	1.56	0	27.86
Rzeszów	17.06	0	1.13
Słupsk	0.00	0	0.00
Szczecin	0.01	0	0.00
Wałbrzych	0.00	0	0.00
Warszawa	23.44	0	99.63
Wrocław	26.06	0	0.63
Zielona Góra	0.00	0	0.00
WCKiK	0.91	0	55.21
CKiK MSWiA	5.46	0	72.00
Total	**15.64**	**10.47**	**12.53**

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration

The number of autologous donors has been low in the recent years. In 2021, it was estimated at 313, i.e. the lowest number in the last several years (in 2020 — 323, in 2019 — 630, in 2018 — 598, in 2017 — 692). The smaller number of preoperative autologous donations is a phenomenon observed in many countries [23]. In line with current recommendations, autologous donations are mostly relied on when they have significant advantage over allogenic transfusions, and when indications for transfusion are strong. Autologous donations are useful primarily in cases when compatible allogenic blood is unavailable, eg. when the patient has antibodies against antigens with high prevalence in population [24].

In 2021, the total number of blood and blood component donations amounted to 1 374 572, including 1 248 585 whole blood donations which is an increase as compared to the previous year (in 2020 — 1 201 272 donations and 1 105 434 whole blood donations).

One of the methods used for more effective collection of blood components is automated apheresis. In 2021, the number of apheresis PCs and plasma donations combined decreased as compared to 2020 (from 27 040 to 26 518) while the number of only PC donations increased (from 12 997 to 14 411). On the other hand, there was a reported increase in the number of only plasma donations (from 55 421 to 84 818). Collection by apheresis of other blood components, ie RBCs and granulocyte concentrate (GC) was only sporadic.

It is worth noting that automated methods (apheresis) are still used in Poland to a relatively small extent, in 2021 — only 9.16% of all donations were collected by apheresis.

Table 15. Wastage of blood components in Polish Blood Transfusion Centers in 2021

Center	Whole blood	RBCs	PC (therapeutic units)		FFP	Cryoprecipitate
			Pooled from whole blood	Apheresis		
Białystok	176	804	13	16	0	87
Bydgoszcz	428	564	0	0	2220	157
Gdańsk	259	1485	422	13	1995	121
Kalisz	295	2377	191	10	1290	27
Katowice	862	2552	465	166	3558	88
Kielce	73	1007	510	40	1353	80
Kraków	789	1785	133	61	6766	81
Lublin	80	1745	185	131	2271	16
Łódź	1450	2378	392	108	3691	89
Olsztyn	92	546	126	37	554	8
Opole	162	933	29	31	893	0
Poznań	1576	3171	911	103	2650	26
Racibórz	114	781	25	24	868	1
Radom	431	1953	268	105	1166	62
Rzeszów	1952	1511	503	71	1988	101
Słupsk	260	428	121	18	567	0
Szczecin	147	1456	208	60	1956	4
Wałbrzych	412	1177	134	18	312	1
Warszawa	1405	2430	68	468	6452	320
Wrocław	876	1778	123	115	2087	56
Zielona Góra	306	704	420	0	583	3
WCKiK	221	1284	23	0	9261	178
CKiK MSWiA	37	16	47	3	2578	0
Total	**12 403**	**32 866**	**5317**	**1598**	**55 058**	**1506**

WCKiK — Military Blood Transfusion Center; CKiK MSWiA — Blood Transfusion Center of Internal Affairs and Administration

In order to make blood donation easier for donors mobile collections are organized. In 2021, the Centers organized 11 150 mobile teams which is more than in the previous year (10 432) but less than in the year 2019 (13 511). The percentage of whole blood donations collected by mobile teams was also relatively small — 19.99%. In 2021, blood was mostly collected at local collection sites — 49.01% of all whole blood donations. This may be explained by the fact that donors are more willing to donate in familiar places. However, the contemporary high standards for collection of blood dedicated for clinical use do not favor small collection sites; centralization of blood transfusion service is recommended.

The demand for blood components is affected by a number of factors, including current guidelines issued by scientific societies, profile of the clinical ward and recommendations of the physician. No doubt, the COVID-19 pandemic also had strong impact on the activity of hospitals, and on the use of blood components.

In 2021, approximately 30.92 units of RBCs per 1000 inhabitants were issued for clinical purposes (in 2020 — 27.87, 2019 — 30.7 units, in 2018 — 30.38 units, in 2017 — 30.22 units, 2016 — 29.99, 2015 — 29.87) [11, 25–29]. Following the downward trend in RBC consumption observed in 2020, the RBC consumption in 2021 increased. For years now the RBC consumption in Poland has

Table 16. Reasons for blood component wastage in Polish Blood Transfusion Centers in 2021

Reason	Whole blood	RBCs	PC pooled from whole blood (therapeutic units)	PC from apheresis (therapeutic units)	FFP	Cryoprecipitate
Expiry date	0	12 919	3424	524	11 867	29
Seropositive for transfusion transmitted diseases, syphilis tests, implementation of *look-back* procedure	45	2531	214	58	3294	2
Other causes including: • inadequate visual control • low quantity/volume • seropositive serological results • other, including incorrect procedures, medical deferral, mechanical damage, donor self-deferral etc.	12 358	17 794	1679	1016	39 719	1476
Unused blood components from autologous donations	0	74			178	
Total	**12 403**	**33 318**	**5317**	**1598**	**55 058**	**1507**

been lower than in some other European countries — eg. in 2011 the RBC consumption in 32 member states of the Council of Europe was on average 37 units/1000 inhabitants [13].

In 2021 the number of FFP units issued for clinical purposes amounted to 246 013 and was higher than in the previous year (229 059 units) though still lower than in 2019 (273 519). On the other hand, the ratio of RBC issued for clinical use to FFP was approximately 4.80 (in 2020 — 4.57, in 2019 — 4.31, in 2018 — 4.09, in 2017 — 3.77, in 2016 — 3.56, in 2015 — 3.45), so the upward trend continues [30–35]. These observations indicate that the consumption of FFP gradually declines as compared to RBC consumption. However, the RBC/FFP ratio is still higher than in many European countries [13]. This may be explained by the lower consumption of RBCs in Poland — as mentioned above, but in many cases also by the fact that FFP is used with no sufficient rationale and sometimes against currently rather restrictive indications for use [36, 37].

The last several years have witnessed the increase in the consumption of PC. In the period 2015–2019, the number of PC therapeutic units issued for clinical use increased from 114 163 to 129 652 (more than 13%). A similar phenomenon was observed in other countries [38]. In 2020 however, only 120 858 therapeutic units of PC were issued for clinical purposes, so the decline is obvious. In 2021 however, the number of PC therapeutic units issued for clinical use was 130 865, so again an increase was recorded.

Additional preparation methods (leukocyte depletion, irradiation) for prevention of transfusion associated adverse reactions were applied mainly to PCs (49.57% leukocyte depleted PCs and 50.43% irradiated leukocyte depleted PCs), less often to RBCs (20.61% of leukocyte depleted RBCs, 10.05% irradiated leukocyte depleted RBCs and 0.04% irradiated RBCs). As mentioned above, since 2020, only leucocyte-depleted PCs are issued for clinical use in Poland. Moreover, leucocyte-depleted RBCs require additional preparation, while in the case of apheresis PCs leukodepletion usually occurs at collection.

Some automated methods of PC preparation from the buffy coat also allow for the simultaneous elimination of leukocytes, but the cost of such procedure is still relatively high as compared to manual methods. Automated methods do however guarantee higher quality parameters as result of standardization.

Regular/common leuko-depletion is now implemented in many countries, although its effectiveness for prevention of transfusion related adverse reactions is sometimes questioned [39].

As in the previous years, the numbers of frozen PCs in some Centers are too high. In 2021 — as in the years that preceded the COVID 19 pandemic — there was a slight decrease in the percentage of frozen PCs. The reported country-wide percentage is acceptable. However, routine freezing of large volumes of PCs, as is the case in some Centers, is to be limited.

Current indications for the use of thawed PCs are quite limited. The components should be used only in exceptional cases, therefore it is not recommended to freeze more than 10% of all PCs prepared. This does not refer to freezing of apheresis PCs collected from patients with anti-HLA or anti-HPA antibodies.

It is worth stressing that freezing and thawing increase the cost of preparation of components for clinical use and have a negative impact on the quality parameters of platelets and therefore their therapeutic efficacy. Cause of anxiety are those Centers which subject to freezing more than 50% of all PC units prepared; above 60% and 70% for apheresis PCs and pooled PCs respectively.

In this context it seems necessary to upgrade and strengthen the training activity which would be focused on the indications and limitations of using frozen PCs and targeted at the staff of Centers as well as that of hospital personnel involved in transfusion of blood components.

The Centers are obliged to safeguard the supply of blood/blood components but to fulfill this task they need to cooperate with hospitals and such cooperation requires implementation of appropriate management of blood and blood components in every hospital, taking into account the individual needs of patients. Furthermore, it is of utmost importance to establish constant and regular cooperation between physicians responsible for blood management, hospital transfusion committees and the Centers.

Depletion of blood and blood component supplies is associated with wastage which — though sometimes inevitable — occurs for a number of reasons. In order to limit the extent of waste of blood and blood components some countries have implemented special procedures [40].

The most common causes of wastage in 2021 (just like in previous years) are included in the category of "other reasons", in particular:

— inadequate visual control;
— incorrect/low volume;
— seropositive test results;
— incorrect performance (procedures), medical deferral, mechanical damage, donor self-deferral etc.

The less frequent causes of waste were expiry date or positive results of viral tests. Subjected to waste were also unused blood components from autologous donations.

Analysis of data related to quarantine and pathogen inactivated FFP and cryoprecipitate reveal that quarantine FFP is still the most commonly used component in clinical practice. Although currently all Centers are equiped with PRT systems (some have two different systems) most do not make adequate use of the illuminators installed on their premises. With the exception of two Centers (in which the percentage of pathogen inactivated blood components exceeds 10%) in most Centers „trace amounts" of plasma and PC are subjected to pathogen inactivation. As compared to 2020, in 2021 there was a decrease in the percentage of inactivated FFP units in 7 Centers and in 2 Centers the use of the inactivation procedure remained on the same („trace") level (0.02% Szczecin and 0.05% Radom) although both these Centers have two pathogen inactivation systems installed. In 2021 the Center in Łódź implemented Intercept as the second system for routine pathogen inactivation (the first one was Mirasol). Despite the implementation of these two systems however, the percentage of inactivated FFP as well as that of pooled PCs and PCs from apheresis was markedly lower. In 2021, the Center in Słupsk applied no pathogen inactivation of „conventional" FFP, or pooled PCs or PCs from apheresis; only COVID-19 convalescent plasma was subjected to inactivation. Eight (8) Centers reported slight increase in the amounts of inactivated FFP. The only Center which implemented pathogen inactivation on a larger scale was again Warsaw. In 2021, subject to inactivation were — 15.91% of FFP(in 2020 — 6.83%) and 99.21% of pooled PCs (in 2020 — 100%) as well as 98.53% of PCs from apheresis (in 2020 — 98.13%). Among the 8 Centers which subjected pooled PCs to inactivation, 5 Centers reported increase in the percentage of inactivated PCs as compared to 2020. Among 12 Centers which subjected PCs from apheresis to the procedure of inactivation, 8 Centers reported increase in the percentage of inactivated PCs from apheresis as compared to 2020.

As in the previous years, most Centers did not make adequate use of pathogen inactivation systems implemented on their premises. The most likely reason is that physicians rarely make orders for pathogen inactivated FFP, cryoprecipitate and PCs. One reason for limited use of pathogen inactivated plasma is the easy access to quarantine FFP. Moreover, physicians who order components for clinical use are not always fully aware that pathogen inactivated plasma is much safer than quarantine plasma as it is the safeguard against a wide spectrum of pathogens other than HIV, HBV, HCV and syphilis and offers protection against the consequences of the „diagnostic window" (as is the case for quarantine plasma). It is also likely that not all physicians have adequate knowledge and awareness regarding TA-GVHD prophylaxis which may be due to insufficient information on transfusion-related adverse reactions that are found in guidelines/regulations dedicated to some medical disciplines.

Conclusions

The study is a brief presentation of selected issues related to the activities of the Polish Blood Transfusion Centers (Centers) in 2021, as well as of some recently recorded trends observed over a extended period of time. As compared to the previous year, almost all values related to the activity of the Polish blood transfusion service (including the number of donors, donations, blood components prepared and issued for clinical use) have increased which is most probably due to the weaker effect of the COVID-19 pandemic as compared to 2020.

The above observations may serve as starting point for the analysis of issues related to the activities of healthcare units in the Polish blood transfusion service, for comparison of experience and development of optimal solutions for the future. Similar data reviews related to blood and blood components are systematically performed also in other countries.

Current problems of blood transfusion service

The COVID-19 pandemic has revealed the significance of proper preparation and readiness of the blood transfusion service for the challenges that may appear.

In 2020, it was necessary to introduce a number of important motions related to blood transfusion service including:

— implementation of additional precautions and safety measures in blood establishments;
— implementation of additional criteria for blood donor deferral;
— implementation of solutions for coping with new challenges related to predicted deficiencies in the supply of blood and blood components, emergency situations and development of principles for priority supply of blood for patients [41].

The solutions which are now introduced may contribute to efficient management of the blood transfusion service in a variety of situations that may take place. There is high likelihood of other pandemics occurring in the future. In addition, the climate changes and related disasters may also become a challenge to efficient functioning of the blood transfusion service.

It is therefore so extremely important to properly manage blood donors, to ensure the safety of personnel in blood establishments as well as to implement and apply the principles of Patient Blood Management (PBM) in order to efficiently cope with crisis situations [42–45].

The COVID-19 pandemic came as s a serious challenge to the blood transfusion service, on the other hand however, it provided opportunities for the development and research of new solutions in this field. The analysis of the results may contribute to improving blood and blood component availability for patients.

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