

Blood Use in a Large North Eastern Italian Academic Hospital During the Period 2009-2013: What Reasons for a Decrease?

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Introduction

Blood is a precious and scarce resource and its management needs continuous efforts in order to maintain a balance between supply and demand. Considering that blood components supply depends substantially on voluntary donors, population is getting older and new measures to reduce an unnecessary donor exposure to patients are expensive, the cost to maintain a sufficient provision is notably increased [1].

In the last decade programmes and guidelines for a better use of blood have been introduced in several hospital policies [2-4]. Patient Blood Management guidelines (PBM), for example, concern about a correct preoperative transfusion management based on right preoperative identification of anaemic patient, on control of blood loss and coagulopathy during and after operation and on optimisation of anaemia tolerance during the postoperative period [5].

Recently, several countries all over the world seem to present a decrease of blood products use.

American national data showed a diminution of blood components use of about 3% between 2009 and 2010 [6,7]. Australian data showed an abatement of 7% of consumed blood units after the revision of national blood use guidelines [8].

A recent report of the European Committee on Blood Transfusion revealed that in the last decade red blood cells (RBCs) use has been greatly decremented in all the Member States with an average of 37 total RBCs products per 1.000 inhabitants in 2011 [9]. A remarkable reduction has been registered in England, with a transfusions decrease in surgery due to the new techniques and to the review of the blood use national guidelines. In fact the transfusions rate was diminished from 45,5 RBCs units in "2.000". To 36 units per 100.000 inhabitants in 2009 [10].

Finally, also Italy showed an abatement of blood components use. The first decrement of the RBCs transfusions had been registered in 2013, with a reduction of 2% (about 50.000 units). The decrease was more evident in North regions such as the autonomous province of Bolzano [11] with a diminution of about 8% and in Friuli Venezia Giulia (FVG) with a transfusions abatement of 5.5% (from 60.453 to 57.103 units) [12].

This study consisted in comparing the trends of red cell concentrates (RCCs) consumptions in a large North Eastern Italian Academic Hospital (AH), located in FVG region, during the period 2009-2013 and in analysing some variables to reach hypothesis on reasons of decrement in RCCs use.

Materials and Methods

The study consisted in extracting, choosing and analyzing several data regards RCCs consumptions in an AH during the period 2009-2013 from different available database.

These variables were extracted by the following database:

- Consumptions of RCCs units and the Maximum Surgical Blood Order Schedule (MSBOS) by the Immunotransfusion Medicine Department Clinical System (EmoNets)
- Hospital outcomes [length of stay, case-mix index (CMI), 30-day readmission rates, mortality rate), Diagnosis Related Groups (DRGs) and patients' age by the regional business intelligence software (Business Object).
- Hospital activity volumes [hospitalisations. and surgeries – hospital-wide, stratified by departments and single operative units (UOs), urgent admissions (UAs) rate, UAs rate in medical OUs] and typologies of surgical interventions by the hospital informative directional system (SisInfo).
- Hospital guidelines, procedures and protocols by the hospital website (Intranet).

Data collected were analysed using the statistical software SPSS, version 20. Chi-square test and Mann-Whitney test were used. Statistical significance was defined as $p \leq 0,05$.

A multi-professional Committee for "good blood use" was present in the hospital according to the current national regulations in order to direct hospital blood utilisation coherently with hospital and regional plans.

Results

Table 1 shows RCCs units consumptions, hospital activity profile (hospitalizations. UAs rate, UAs rate in medical OUs) and outcomes (length of stay, CMI, MSBOS, 30-day readmission rates, mortality rate) during the period 2009-2013.

In detail, transfusions of RCCs were reduced of 1.067 units (5,9%) between 2012 and 2013, of 1.105 units (5,8%) between 2012 and 2011, of 484 (2,5%) units between 2011 and 2010. There was an increase of 0,1% (25 units) between 2009 and 2010. A preliminary analysis on blood consumptions in 2014 found out a use of 16.200 RCCs units with a decrease of 2,3% (396 units) compared to 2013 (Table 2 and Figures 1-3).

Report RCCs units consumptions and volumes of hospitalisations

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	2009	2010	2011	2012	2013	Δ 2013-2009/10	%
Hospitalisations (n.)	44651	42956	42044	41131	40113	-4538	-10,2%
Urgent admissions rate	45,4%	45,4%	46,1%	46,4%	48,6%	-784	-3,9%†
UA* rate in medical units	34,3%	33,4%	32,7%	32,7%	32,6%	-585	-8,4%†
Surgeries (n.)	29894	30543	30433	29945	27896	-1998	-6,7%
Length of stay (mean) - days	-	8,9	9,0	8,6	8,7	- 0,2	-2,2%
Case-mix index	-	-	-	1,17	1,18	-	-
MSBOS ≥4‡	661	688	675	643	731	70	10,6%
30-day readmission rate	5,0%	4,0%	4,1%	4,1%	4,2%	-526	-1,2%†
Mortality rate	-	4,0%	4,1%	4,3%	4,3%	-68	+3,8%

* urgent admissions; † p<0,05 ‡ Maximum Surgical Blood Order Schedule

Table 1: Hospital activity profile and consumed red cell concentrates (RCCs) units during 2009-2013 period.

	2009	2013	Δ 2013-2009	%
Anesthesia Department				
RCCs units	2248	1667	-581	-25,8
Hospitalisations (n.)	501	507	6	1,2
Cardiothoracic Surgery Department				
RCCs units	3396	2409	-987	-29,1
Hospitalisations (n.)	3800	3546	-254	-6,7
Surgeries (n.)	1041	995	-46	-4,4
General Surgery Department				
RCCs units	4228	3689	-539	-12,7
Hospitalisations (n.)	10137	9309	-828	-8,2
Surgeries (n.)	12010	11032	-978	-8,1
Surgical Specialities Department				
RCCs units	124	189	65	52,4
Hospitalisations (n.)	6315	5005	-1310	-20,7
Surgeries (n.)	2019	2079	60	3,0
Maternity Department				
RCCs units	323	407	84	26,0
Hospitalisations (n.)	6801	6506	-295	-4,3
Surgeries (n.)	213	98	-115	-54,0%
Medicine Specialities Department				
RCCs units	2571	2353	-218	-8,5%
Hospitalisations (n.)	3054	2699	-355	-11,6%
Neuroscience Department				
RCCs units	201	296	95	47,3
Hospitalisations (n.)	3309	3318	9	0,3
Surgeries (n.)	1383	1345	-38	-2,7
General Medicine Department				
RCCs units	3822	2936	-886	-23,2
Hospitalisations (n.)	11378	10283	-1095	-9,6
Oncology Department				
RCCs units	180	126	-54	-30,0
Hospitalisations (n.)	1569	1559	-10	-0,6
Day Hospital				
RCCs units	1160	1125	-35	-3,0
Discharges (n.)	*	11175	-1812	-13,9

*omitted data because not reliable

Table 2: Red cell concentrates (RCCs) units, hospitalisations and surgeries per year stratified by hospital departments between 2009 and 2013.

per year stratified by hospital departments during 2009-2013 period.

Table 3 shows the percentages of medical DRGs on total hospitalisations stratified by surgical OUs.

Table 4 reports age averages of transfused patients, means of RCCs units per patients and cases treated with a single RCCs unit stratified

by the major hospital blood consumers (heart surgery, orthopaedics, haematology, first aid, transfusion medicine) during 2009-2013 period.

An analysis of more frequent surgeries in the hospital showed a diminution of heart surgery interventions from 774 in 2010 to 647 in 2013 (-16%). Regards to the typologies of the more frequent ones, aortocoronary bypasses (CABs) and CABs with surgical aortic valve

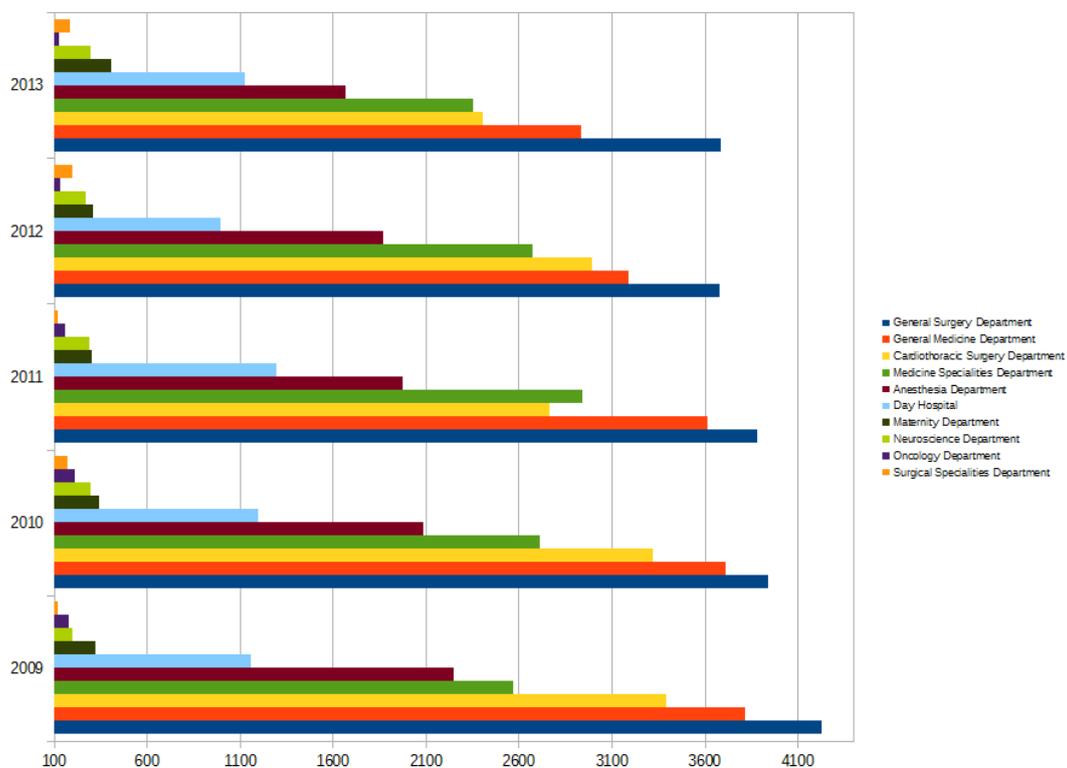


Figure 1: Red cell concentrates (RCCs) stratified by hospital departments during 2009-2013 period.

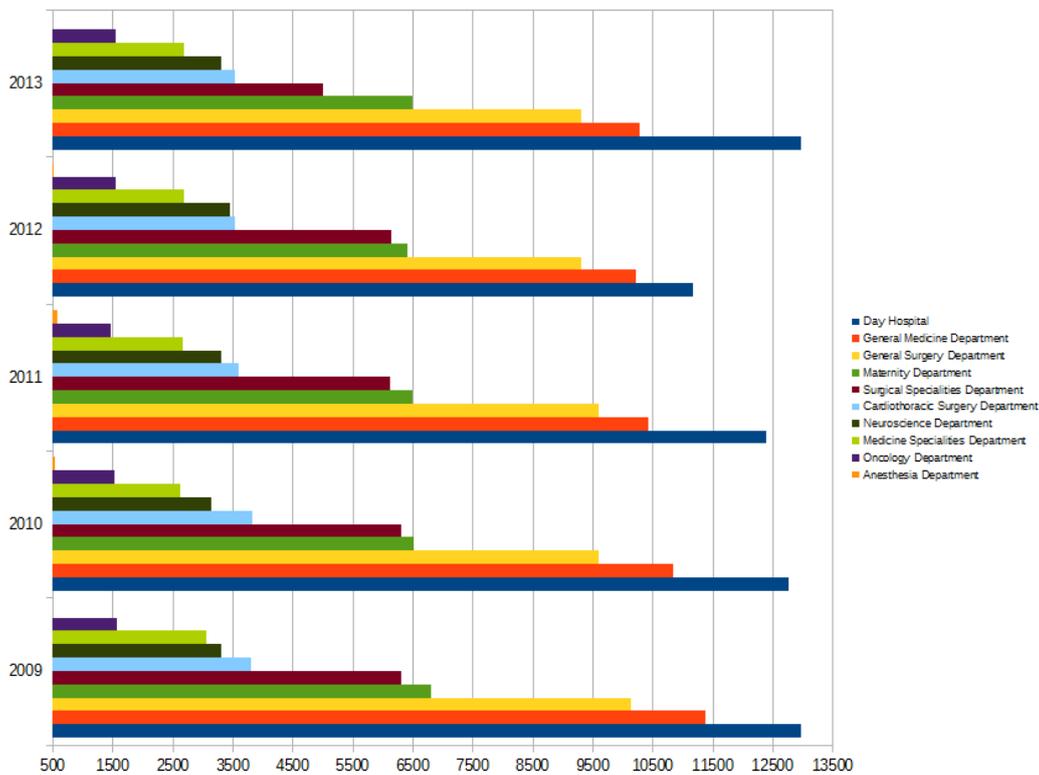
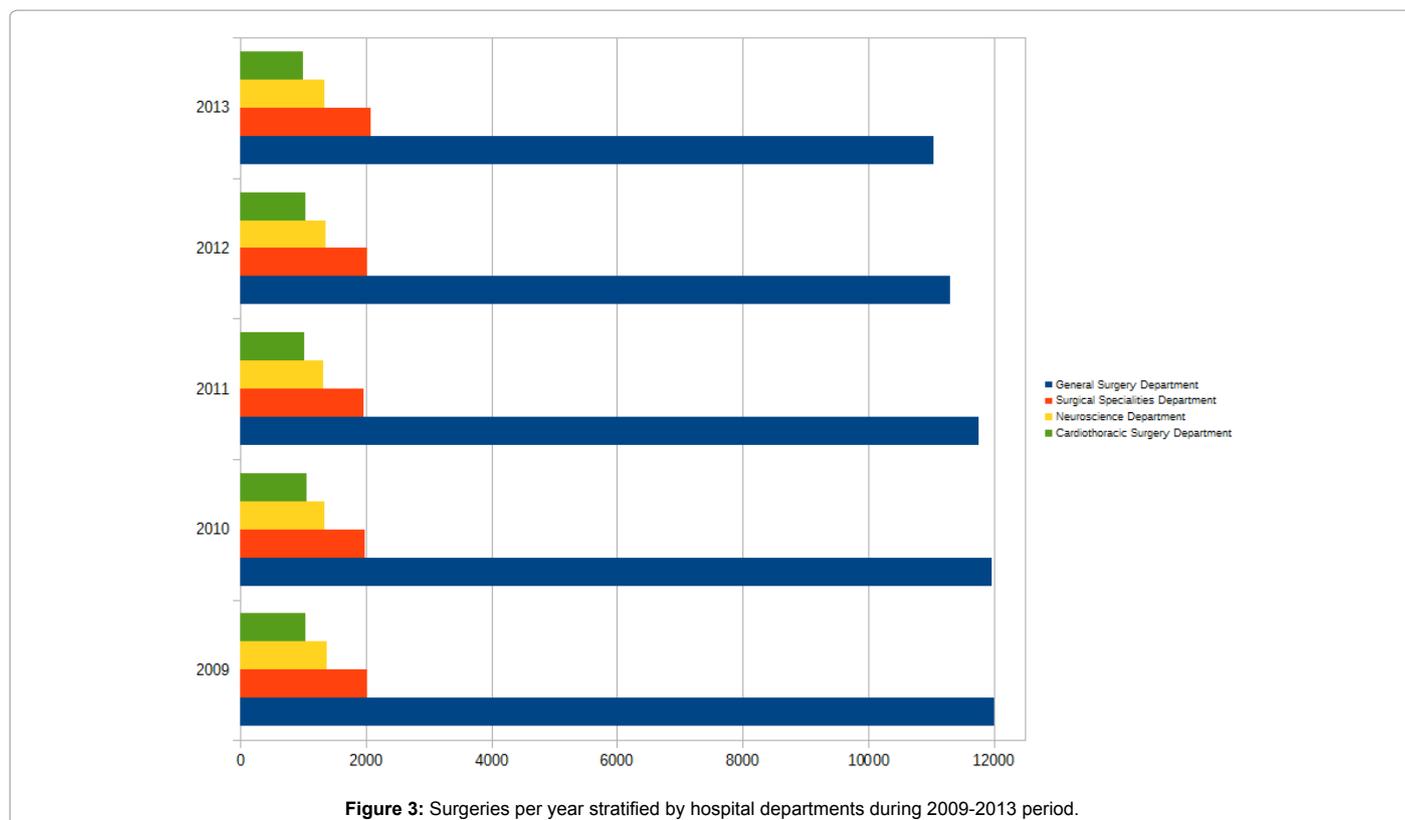


Figure 2: Hospitalisations per year stratified by hospital departments during 2009-2013 period.



YEAR	2009		2010		2011		2012		2013	
	Medical DRGs of total hospitalisations		Medical DRGs of total hospitalisations		Medical DRGs of total hospitalisations		Medical DRGs of total hospitalisations		Medical DRGs of total hospitalisations	
SURGICAL UNIT	%	N.								
Cardiac	15,3	381/2483	15,5	387/2492	12,1	239/1966	12,9	249/1923	12,9	244/1884
Maxillofacial	30,5	204/668	39,5	245/621	44,0	262/595	41,1	248/604	45,4	246/542
General surgery	32,9	1249/3791	32,1	1175/3659	33,4	1190/3560	29,6	989/3340	28,6	968/3384
Plastic surgery	27,4	240/877	27,5	238/864	32,2	269/835	26,0	244/939	15,4	129/836
Thoracic	/	/	/	/	31,0	96/310	14,1	54/382	22,0	80/363
Vascular	16,4	124/755	15,5	104/670	30,0	205/684	22,6	178/787	13,9	110/791
Vertebrobasilar-medullary	18,7	114/609	18,5	105/567	19,4	99/510	20,2	100/495	20,6	99/481
Neurological	31,0	397/1282	30,7	356/1160	29,2	342/1172	29,2	357/1222	25,5	337/1319
Orthopaedics -traumatology	16,1	317/1968	13,9	270/1949	12,4	234/1894	12,8	235/1831	13,4	244/1820
Obstetrics -gynaecology	58,6	1647/2810	62,4	1635/2621	62,1	1505/2423	64,3	1576/2451	64,2	1601/2492
Otorhino-laryngology	50,0	654/1308	49,5	586/1183	46,1	518/1124	40,9	481/1177	37,9	448/1181
Urology	32,5	403/1239	35,4	369/1042	38,4	406/1057	35,7	374/1047	34,1	362/1062
Total	32,2	5730/17790	32,5	5470/16828	33,3	5365/16130	31,4	5085/16198	30,1	4868/16155

Table 3: Medical DRGs percentages of total hospitalisations in surgical operativeunits during 2009-2013 period.

replacements (AVRs) was abated respectively from 201 to 177 and from 64 to 44, AVRs and heart transplants incremented respectively from 41 to 83 and from 0 to 23. Also global orthopaedics interventions decremented from 3.261 in 2010 to 2.397 in 2013: neurolyses of the median were reduced from 463 to 370 while plate and screw osteosyntheses and intramedullary osteosyntheses increased respectively from 0 to 313 and from 94 to 172.

During the period 2008 to 2013, the transfusion department,

coordinated by “good blood use” Committee wrote and implemented eleven guidelines about PBM.

Discussion

This study represents the first Italian attempt to analyse reasons of recent reduction in blood use in a hospital setting. Results showed a decrease of consumed RCCs units in accordance with regional and national data and also with international ones [1,6,13,14]. Between 2014 and 2009 the diminution of consumed RCCs units was of 17%,

YEAR	2009	2010	2011	2012	2013
Heath Surgery					
RCCs units per patient mean (SD)	5,0 (5,6)	4,6 (4,5)	4,4 (4,4)	4,1 (4,6)	3,6 [†] (3,1)
Cases transfused with a single unit of RCCs [% (n)]	9,8 (47/477)	11,2 (56/498)	9,1 (40/438)	15,2 (66/435)	14,3 (50/350)
Patients' age mean (SD)	72,6 (9,2)	70,1 (10,7)	70,3 (11,2)	71,7 (10,4)	67,0 (11,6) [†]
Orthopaedics					
RCCs units per patient mean (SD)	2,9 (1,5)	2,9 (1,7)	2,9 (2,2)	3,1 (1,9)	3,0 [†] (2,0)
Cases transfused with a single unit of RCCs [% (n)]	3,0 (11/380)	4,4 (16/361)	4,4 (14/316)	2,9 (10/347)	4,5 (16/358)
Patients' age mean (SD)	80,8 (13,4)	79,3 (14,1)	77,7 (15,7)	79,5 (14,5)	76,3 [†] (13,5)
Haematology					
RCCs units per patient mean (SD)	11,6 (12,2)	10,2 (9,4)	11,8 (13,2)	9,4 (10,6)	8,8 [†] (9,7)
Cases transfused with a single unit of RCCs [% (n)]	6,9 (11/160)	13,7 (25/182)	9,0 (17/168)	17,1 (36/210)	14,8 [§] (29/196)
Patients' age mean (SD)	56,9 (12,8)	54,3 (15,0)	56,7 (14,7)	56,3 (14,9)	53,4 [†] (14,2)
First Aid					
RCCs units per patient mean (SD)	3,9 (7,3)	4,6 (9,7)	4,1 (7,8)	4,1 (7,3)	4,2 [†] (7,7)
Cases transfused with a single unit of RCCs [% (n)]	9,1 (32/353)	5,1 (16/353)	9,4 (31/328)	10,6 (31/292)	14,1 [§] (39/276)
Patients' age mean (SD)	75 (13,7)	72,3 (16,8)	71,8 (17,7)	69,5 (17,8)	70,2 [†] (15,3)
Transfusional Medicine					
RCCs units per patient mean (SD)	9,9 (14,1)	8,4 (13,2)	10,6 (14,6)	9,7 (12,8)	10,5 [§] (16,4)
Cases transfused with a single unit of RCCs [% (n)]	4,8 (5/103)	10,7 (11/103)	6,7 (7/104)	4,4 (5/114)	4,0 (4/100)
Patients' age mean (SD)	78,8 (11,6)	76,6 (12,6)	76,9 (11,4)	76,4 (12,8)	74,8 [†] (12,2)

* standard deviation; † p<0,01; § p < 0,05

Table 4: Red cell concentrates (RCCs) units per patient, cases transfused with a single unit of RCCs and average patients' age in the five major blood consumers during 2009-2013 period.

while between 2012 and 2013 was of (5,9%), higher than global regional value of (5,5%) [13]. Also in 2014 blood consumptions were abated but with a percentage of (2,3%), half of the previous year.

Over the years general surgery department kept the first place regards to RCCs consumptions followed by internal medicine UOs. A special mention should be addressed to cardiothoracic department. In fact, in 2009 and 2010 it was 17% of the global hospital one and then it decremented to 15%. Cardiothoracic surgery areas contributed significantly to global hospital reduction in the RCCs use. This trend was in part due to a decrease of surgeries (-16%), but on the other hand it was in agreement with the Transfusion Requirements After Cardiac Surgery (TRACS) that had recently demonstrated the safety of a restrictive strategy of transfusion compared with a liberal strategy in patients undergoing elective cardiac surgery [15]. The appropriate use of blood was also confirmed by the statistically significant diminution in the consumptions of RCCs units per patient over the years (from 5 to 3.6) while typology of cardiac interventions became more complex. In fact heart transplants and AVRs increased at the detriment of CABs. Also in orthopaedics surgery the more complexity interventions such as plate and screw osteosyntheses and intramedullary osteosyntheses incremented.

In the anaesthetic area the abatement in blood use could be due to the application of the international guidelines for transfusions in trauma patients [16]. The hypothesis can be confirmed by the fact that the volume of admissions in the anaesthesia department was maintained during the years and, at the same time, the hospital represented the hub for traumatic pathology in FVG region.

In the medicine department an important aspect was the possible correlation between RCCs consumptions and the volumes of UAs from the first aid. The trend during the considered period was fluctuating. In fact between 2009 and 2010 there was a decrement in UAs of 4%, in the following years the absolute number of them remained constant, while the fraction of UAs on the global hospital admissions incremented from 45% in 2009 to 48% in 2013. One third of the UAs resulted in a

hospitalisation. In an internal medicine OUs. A consideration about this trend is that the hospital represented a point of regional reference for acute internistic illnesses instead of planned interventions or of high speciality performances. The hypothesis was confirmed by the percentage of patients with a medical DRGs discharged by surgical OUs. The overall hospital value was of 30% with a range from 13% in cardiac surgery OU to 64% in maxillofacial surgery OU.

This study also showed that the global reduction in blood utilisation occurred with a concurrent statistical significant decrease of the wide hospital activity. A detailed analysis showed an important diminution of discharges (10,2%) and a lower abatement of surgeries (6,7%). The decrement of hospitalisations and surgical interventions, stratified by hospital departments, kept pace with the reduction in blood consumptions of each one. The decrease in hospitalisations during the years could be correlated with regional and national policies that aimed to diminish hospital patients' admissions by using other health settings (i.e. Day Hospital, long-term health facilities, outpatient services). The abatement of surgeries could be explain by the introduction of alternative therapies to surgery, the spread of cancer screening, the rationalisation of resources use and the hospital turnover of surgeons with different expertise in blood use during interventions.

Incremented consumptions in blood use were observed for the department of surgical specialities, neuroscience and oncology, but consumed RCCs units were few. Therefore the increase could be due to the management of single cases required a large amount of blood.

The mean of RCCs transfusions units per patients was evaluated for the major RCCs consumers. The higher decrement in the average number of RCCs units per patient were recorded in cardiac surgery and in haematology. The percentages of patients transfused with a single unit of RCCs incremented in the years even if the absolute numbers were stable. The World Health Organization strongly discourages single unit transfusions in adults and many countries regarded them as a bad practice [17,18].

A result of this study in contrast with literature, reported that elderly patients are transfused at higher rates than younger patients, was the significant statistically reduction of average age of transfused patients especially in heart surgery (from 73 to 67 years) and in first aid (from 75 to 70 years) [19-21]. Furthermore transfusion guidelines from several national societies emphasized the need to consider the clinical setting and patient symptoms, but none mentioned age as a primary factor to consider [22-24].

The analysis of clinical patient outcomes demonstrated that length of stay, mortality and 30-day readmission rates were stable during the years despite the decrease of RCCs utilisation, while CMI and number of complex interventions with a MSBOS ≥ 4 incremented. This finding was in accordance with clinical recent clinical trials demonstrating that more restrictive transfusion practices were associated with equivalent or improved patient outcomes, when compared to more liberal transfusion practices [15,25-29].

Finally, over the years the transfusion department with the contribution of "good blood use" Committee wrote guidelines and procedures to implement patients' safety, to limit the exposure to RCCs transfusions (with their inherent risks) and to contain the costs [6,30]. Literature confirmed that mandatory hospital-wide programs to improve transfusion practices should be an effective method leading to success in reducing blood use [31].

In conclusion this study represents a starting point to investigate the reduction of blood use in a hospital setting during a period of five years. The analysis of the data explained the phenomenon by the decrease of hospital activities, in terms of admissions and surgeries, associated to a "good blood use" through implementation of specific guidelines and to application of specific correct procedures especially in cardiothoracic surgery and anesthetic departments.

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