

## Efficiency of plasmapheresis: a comparison of three Italian Centres

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**Background.** In order to support the economic and financial sustainability of the Italian health system, there is a need to define technically and economically efficient strategies that assure the self-sufficient apheretic production of plasma.

**Material and methods.** Process and product costs at the *Casa del Donatore* (CD) in Bologna were determined on the basis of costing models used at Verona's Inter-hospital Department of Transfusional Medicine (IDTM) by academics from the University of Turin and those used at the Marche Regional IDTM by academics from Marche Polytechnic University. During the first phase, data was collected concerning donors, biological screening tests, the number of units produced/discarded, the materials used (individual pharmacy codes and related final expenditure), human resources (number, professional status, time involved, the number of activities per day, percentage productivity), equipment, and general costs. During the second phase, direct costs were verified and the costs common to the units produced were attributed using the functional principle.

**Results:** The overall cost of a litre of plasma collected by means of apheresis (about € 280) was similar at the three centres, but there were differences in their cost structures that could be attributed to organisational choices, economic factors and/or structural variables. Plasmapheresis accounts for 24% of the plasma collected in Marche and the CD, but 17% of that collected in Verona, whereas the donation index is lower in the CD (1.8) than in the other two centres (2.2). The annual donor screening tests are substantially similar, but there are some differences in their timing (at the time of screening candidate donors or at the time of first donation). There are also some differences in the use of tests that are not required by law but are carried out in order to protect donors and recipients. The working times in three centres are similar, but personnel costs vary because of their different retribution policies.

**Discussion.** Comparing the cost determinants at each centre made it possible to highlight changes that each can make in order to improve efficiency, and may lay the basis for doing the same in other organisational contexts.

**Keywords:** plasma collection, plasma-apheresis, efficiency.

### Introduction

In order to support the economic and financial sustainability of the Italian health system, there is a need to define technically and economically efficient strategies that assure the self-sufficient apheretic production of plasma. Furthermore, the use of such collection and production standards could be extended throughout the transfusion system.

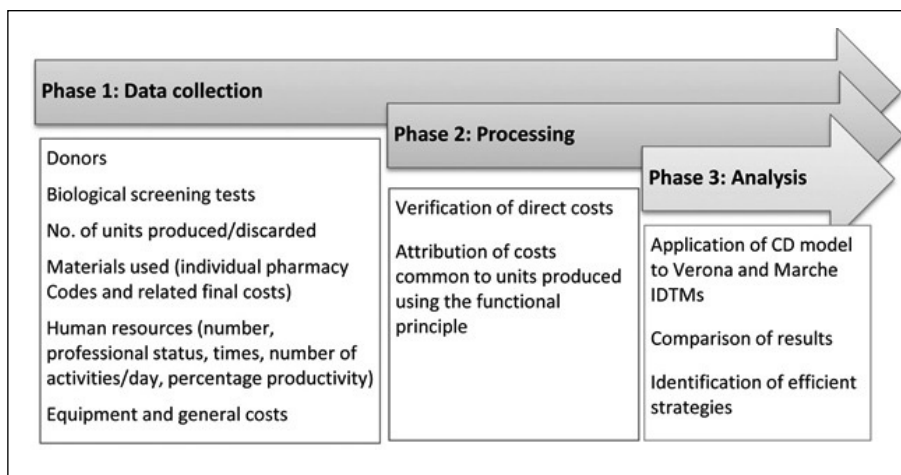
The aim of this analysis was to compare the strategies used at three Italian plasma collection centres of excellence and the related production costs in an attempt to find a common front of efficiency.

### Material and methods

Two research teams from the University of Turin and Marche Polytechnic University independently developed two models for analysing the cost of collecting plasma by means of apheresis:

- a cost accounting model based on an empirical analysis of the 12 operating units belonging to the Marche Regional IDTM<sup>1</sup>;
- a cost analysis based on a simulation model that integrates observational data provided by the IDTM in Verona<sup>2</sup>.

The synergistic convergence of these two experiences



**Figure 1** - Study design.

led to the creation of a combined model for determining process and product costs that was first applied to the CD in Bologna<sup>3</sup>, and subsequently used to re-analyse the other two centres in order to update the data and compare specific aspects. Figure 1 shows the study design.

## Results

Table I and Figure 2 show the flow of donors and the distribution of the donations. Plasmapheresis accounts for 24% of the plasma collected in the Marche region and at the CD, and 17% of that collected in Verona ( $p < 0.001$ ); the donation index at the CD (1.8) is lower than in the other two centres (both 2.2;  $p < 0.001$ ).

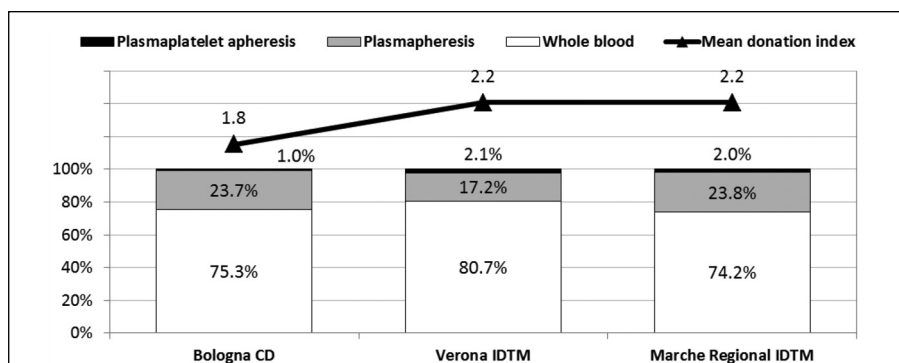
There are also differences in donor testing at the three centres (Table II):

- they use the same tests but there are differences in whether they are used at the time of screen or at the time of the first donation;
- there are also some differences in the use of tests that are not required by law but are carried out in order to protect donors and recipients.

**Table I** - Donor/donation flow in the three centres in 2013.

	Bologna CD	Verona IDTM	Marche Regional IDTM
<b>Total donations</b>	31,728	66,532	103,083
WB	23,899	53,560	74,954
PA	7,520	11,397	24,078
PPA	309	1,381	2,041
<b>Plasma per donation (mL)</b>			
WB (plasma yield)	270	268	266
PA (mean volume)	598	600	525
PPA (plasma yield)	398	400	398
<b>Total active donors</b>	17,474	30,246	45,922
Subject to annual controls	15,217	26,000	NA
Making first donation	1,282	3,606	4,924
<b>Candidate donors</b>	2,097	5,797	9,169
<b>Donors recalled for control</b>	NA	3,100	NA

WB: whole blood; PA: plasmapheresis; PPA: plasma platelet apheresis; NA: not available.



**Figure 2** - Collection and donation index mix in the three centres.

**Table II** - Tests in 2013 (significant differences highlighted in grey).

	Bologna CD	Verona IDTM	Marche Regional IDTM
<b>Immunohematology</b>			
ABO (direct and indirect) and Rh D	CD/FD	CD/FD	CD/FD
ABO group control (direct test) and Rh D	ALL	RD/FD/CD	RD/FD
Kell antigens	CD/FD	CD/FD	CD/FD
Direct Coombs test			
Determination of complete Rh phenotype	CD/FD	CD/FD	CD/FD
<b>Serovirology and molecular biology</b>			
HBs Ag	ALL	ALL	ALL
HCV Ab	ALL	ALL	ALL
HCV RNA	ALL	ALL	ALL
HBV DNA	ALL	ALL	ALL
HIV-1 RNA	ALL	ALL	ALL
Syphilis serodiagnosis	ALL	ALL	ALL
HIV 1-2 Ab	ALL	ALL	ALL
ALT determination	ALL	ALL	ALL
<b>Routine tests per donation</b>			
Complete hemochromocytometry	ALL	ALL	ALL
PT and aPTT - PLASMA	AC	NO	AC
PT and aPTT - PLT	RD/AC	ANNUAL <sup>1</sup>	AC
Search for anomalous anti-erythrocytic antibodies	CD/AC	CD/FD <sup>2</sup>	CD/AC <sup>3</sup>
Creatininemia	CD/AC	FD/AC	CD/AC
Glycemia	CD/AC	FD/AC	CD/AC
Proteinemia and serum protein electrophoresis	FD/AC	FD/AC	CD/AC
Cholesterolemia	FD/AC	FD/AC	CD/AC
Triglyceridemia	FD/AC	FD/AC	CD/AC
Ferritinemia	FD/AC	FD/AC	CD/AC/ID
Anti-HBc			ALL
Anti-HBs			Upon request
AST (when ALT altered)	FD	DD	DD
Azotemia	CD/AC	FD/AC	CD/AC
Total and fractionated bilirubin	FD		CD/CA
HDL cholesterol			DD
Gamma GT (when ALT altered)	FD		DD
Sideremia	FD/AC	FD/AC	DD
Hemoglobin electrophoresis			DD
Ericemia	FD/AC		DD
ESR		FD/AC	CD/AC
Urine test	FD/AC		CD/AC
ECG (at time of first donation and then every two years)	FD	CD/RD <sup>4</sup>	RD <sup>5</sup>
Sodium potassium chlorine	FD		DD
Alkaline phosphatase	FD		DD
Calcium	FD		CD/AC
Fibrinogen	AC		DD

RD: regular donor; CD: candidate donor; FD: first donation; AC: annual control; DD: diagnostic detail.<sup>1</sup>platelet donors; <sup>2</sup>also in the case of an immunising event; <sup>3</sup>if Coombs' test positive; <sup>4</sup>only when indicated; <sup>5</sup><45 years: once every two years; <sup>6</sup>>45 years: every year.

The three centres are absolutely similar in terms of the composition of their personnel ( $p=0.65$ , Figure 3) and working times, but there are differences in personnel costs due to differences in retribution policies (data not shown).

The composition of the cost of a litre of plasma obtained by means of apheresis is not the same in the three centres ( $p<0.001$ , Figure 4): the weight of material costs is least at the CD (38%), whereas that of personnel costs is least at the IDTM in Verona (24%).

**Discussion**

The differences in the individual cost items are attributable to organisational choices, economic factors and/or structural variables: for example, the cost of a bag for collecting whole blood varies from € 8.70 to € 13.80

(a difference due to differences in the characteristics of the device used, and therefore in their purchase price), and the cost of a plasmapheresis kit ranges from € 21.17 to € 35.60 (due to differences in the number of cell separators included in the centralised call for tenders). However, the estimated final cost is similar (Table III): € 278 at the Marche Regional IDTM; € 280 at the CD in Bologna, both of which are in line with results of the model developed for the IDTM in Verona (€ 284, 95% CI 251-329).

**Conclusions**

Given the differences in their cost determinants, the comparison made it possible to draw attention to the modifications that could be made at each centre in order to establish a common threshold of efficiency,

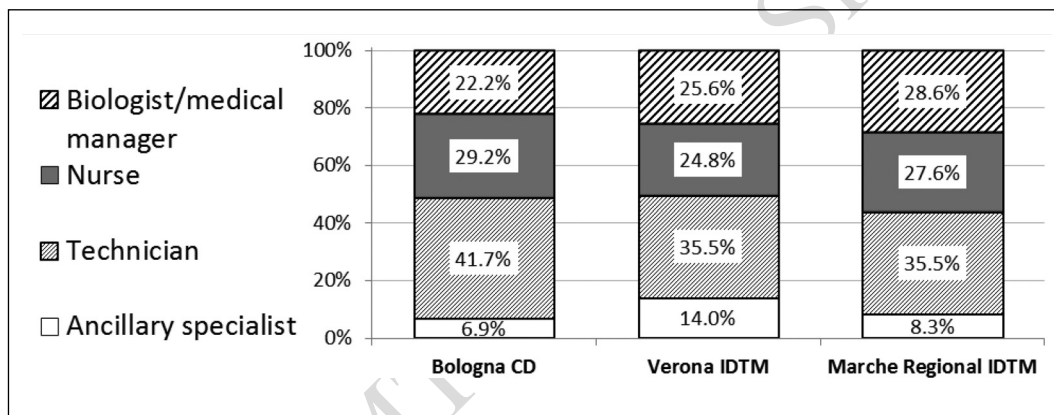


Figure 3 - Personnel involved in annual plasma collection in the three centres.

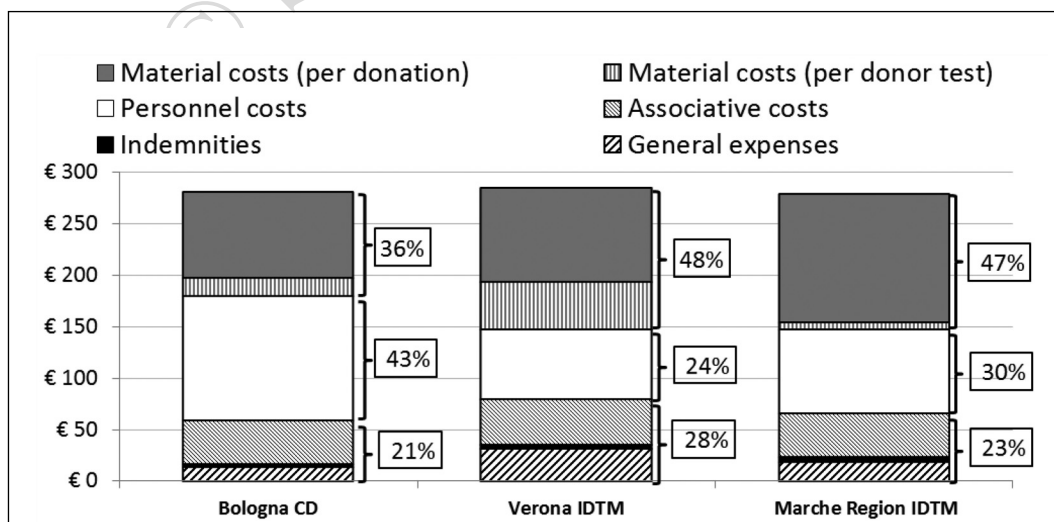


Figure 4 - Cost of a litre of plasma collected by means of apheresis in the three centres.

**Table III** - Annual activities in the three centres (€).

	Bologna CD	Verona IDTM*	Marche Regional IDTM**
<b>Material costs</b>	60.21	82.47	75.36
Per donation	49.31	54.47	71.56
Per donor test	10.90	28.01	3.81
<b>Personnel costs</b>	71.73	40.57	47.25
Collection	66.56	35.07	39.46
Production	4.60	1.55	7.07
Laboratory tests	0.47	1.74	0.21
Assigned to industry	0.09	1.72	0.51
<b>Associative reimbursement</b>	25.03	26.29	24.04
<b>Indemnities</b>	1.85	2.52	3.11
<b>General expenses</b>	8.10	18.46	10.25
AD of structural resources	0.05		1.93
Medical Manager	2.08		0.75
Other	5.96		7.56
<b>Total per donation</b>	166.91	170.32	160.02
<b>Plasma yield per bag (mL)</b>	<u>596</u>	<u>600</u>	<u>575</u>
<b>Total cost per litre of plasma</b>	280	284 (95% CI: 251-329)	278

\*Figures from Eandi M, Gandini G, Povero M, Zaniolo O, Pradelli L, Aprili G. Industrial plasma: cost analysis from the third payer perspective. *Blood Transfus* 2015; 13: 37-45 DOI 10.2450/2014.0066-14. \*\*Calculated using a pooled model but in phase of consolidation (awaiting balance sheet closure) AD: annual depreciation.

but the model could also be easily applied in other organisational contexts.

The analysis revealed the following key points:

- The flow of donors/donations was comparable in three centres albeit with main differences in the percentage of plasmapheresis (24% in Marche and the CD vs 17% in Verona) and the index of donation (2.2 in Marche and Verona vs 1.8 in the CD).
- Test profiles:
  - similarity in annual controls, and serovirology and molecular biology tests;
  - similarity in the testing of "new" donors, albeit with differences in the timing of the various tests (at the time of screening candidate donors or at the time of the first donation);
  - differences in the use of tests of donations that are not required by law but are carried out in order to protect donors and recipients.
- The working times recorded/estimated at the three centres were similar, whereas personnel costs were different because of differences in retribution policies.
- The differences in the individual cost items seem to be attributable to organisational choices, economic factors and/or structural variables.
- The final cost of a unit of plasma is similar: € 280 at the CD with slight differences at the other centres.

### Disclosure of conflicts of interest

Massimiliano Povero is an employee of AdRes, which has received project funding from Kedrion Biopharma. Giorgio Gandini is an employee of Azienda Ospedaliera Universitaria Integrata di Verona (AOUI VR), which has received project funding from Kedrion Biopharma. Alessia D'Andrea is an employee of L.I.V.E. srl, which has received project funding from Kedrion Biopharma. Mario Eandi, Stefano Marasca, Andrea Tieghi, Vanda Randi, Francesco Picardi, Giuseppe Aprili, Mario Piani and Claudio Velati have no competing interests to declare.

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