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Original article

Cost of red blood cell transfusion; evaluation in a French academic hospital

Évaluation du coût de la transfusion de concentrés de globule rouges dans un établissement de soins français

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ABSTRACT

Objectives. – The economic impact of Patient blood management (PBM) must be assessed beyond the acquisition cost of blood products alone. The estimate of indirect costs may vary depending on the organization and the elements taken into account. The transposition of data from the literature into a specific local context is therefore delicate. The objective of this work was to evaluate the overall cost of red blood cell concentrate (RBC) transfusion from a French healthcare establishment point of view.
Methods. – We carried out an activity based costing analysis in our hospital for the year 2018. The steps of the transfusion process and additional costs were detailed and cumulated (resource consumption, labor time, frequency) to populate the ABC model. Several scenarios were developed focusing either on RBC, all blood products or the surgical activity, and a univariate sensitivity analysis was conducted.
Results. – The average total cost of transfusion, including acquisition cost, was 339,64 euros per RBC transfused. The cost of administration was 138.41 euros/RBC. Focusing only on surgical activities increased this cost (152.43 euros) while taking all blood products into account reduced it (92.49 euros).
Conclusion. – The difference in our results with the literature confirms the local variability in the cost of transfusion, which may affect the economic impact of PBM. Our study related to the specific context of a single French institution has limitations that a multicenter study would clarify in order to carry out economic modelling of transfusion optimization and alternatives and to guide the choice of PBM strategies at the national level.

Mots clés :
Transfusion sanguine
Évaluation medico-économique
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RÉSUMÉ

Objectifs. – L'impact économique du patient blood management (PBM) doit être évalué au-delà du seul coût d'acquisition des produits sanguins. L'estimation des coûts indirects peut varier selon les organisations et les éléments pris en compte. La transposition des données de la littérature dans un contexte local spécifique s'avère ainsi délicate. L'objectif de ce travail était d'évaluer le coût de la transfusion de Concentrés de globules rouges (CGR) du point de vue d'un établissement de soins français.

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Méthodes. – Nous avons réalisé une analyse de coût basée sur l'activité de notre hôpital pour l'année 2018. Plusieurs scénarios ont été élaborés portant sur les CGR seuls, l'ensemble des produits sanguins ou centré sur l'activité chirurgicale et une analyse de sensibilité univariée a été menée.
Résultats. – Le coût total moyen de la transfusion de CGR, était de 339 64 euros par unité transfusée en incluant son coût d'acquisition. Le coût d'administration représentait 138,41 euros/CGR. Le focus sur l'activité chirurgicale augmentait ce coût (152 43 euros) alors que la prise en compte de l'ensemble des PSL tendait à le réduire (92,49 euros).
Conclusions. – La comparaison de nos résultats avec la littérature confirme la variabilité locale du coût de la transfusion. Cela est susceptible de modifier l'impact économique du PBM. Notre étude liée au contexte spécifique d'un seul établissement français comporte des limites qu'une étude multicentrique permettrait de préciser afin de réaliser une modélisation économique de la transfusion et orienter les choix de stratégies PBM à l'échelle nationale.

1. Introduction/objective

Blood transfusion has enabled major therapeutic advances for a century, allowing the development of medical or surgical management strategies that would have remained impossible without it. Labile blood products (LBPs) constitute a scarce and precious resource, for which the supply is made difficult by the aging of the population. Despite its undeniable benefits and the steady improvement in its safety, transfusion remains associated with undesirable effects which justify limiting its use to what is strictly necessary [1–4]. Patient blood management (PBM) aims to optimize the transfusion of LBPs (restrictive strategy), develop alternatives and improve the quality of patient care, achieving a primary prevention of transfusion risks [5,6]. PBM actions may concern the training, organisation, use of treatments, therapeutic or diagnostic devices, which are the subject of recommendations and consensus conferences [7–9]. A recent meta-analysis on the effective cost of PBM in surgery shows a reduction in complications and postoperative mortality allowing, despite an additional cost linked to PBM, an overall reduction in the costs of care [10,11].

Evaluating the cost of transfusion is complex, both from the point of view of the community and of a hospital [12]. This is linked to the variety of LBP production processes and the elements considered: blood collection, securing, delivery, administration, management of side effects, etc. [13]. There is little work to assess the cost of transfusion. The scope of their results is so wide, linked to specific contexts (country, type of activity. . .), that this limits the accuracy of the economic evaluation of the alternatives supported by the PBM [14–16].

The main objective of this work was to assess the cost of the transfusion process for the administration of red blood cell concentrates (RBCs) in a French public teaching hospital. This evaluation should make it possible to estimate the economic impact of the blood saving actions that could be implemented there.

2. Methods

To assess the cost of transfusion, we used the Activity-based costing (ABC) method described by Shander et al for transfusion [14]. After identifying the stages of the transfusion process, the time and resources required for each were evaluated, either by expert advice or by a practice survey carried out among caregivers. The frequency of each item, rates and salaries were determined (unless otherwise stated) from the activity of our hospital for the year 2018. The monetary valuation was carried out in euros.

The direct cost of the transfusion process (variable costs) is the sum of its unit steps multiplied by their frequencies (imputed by LBP, per patient or per transfusion episode) compared to the total of LBP transfused. The direct and indirect overhead costs (fixed costs) linked to transfusion were divided by the total of the LBPs transfused, then added to the cost of the process, thus giving a cost of transfusion per unit of LBP transfused. The calculation formulas are presented in Fig. 1.

Counting patients, LBPs and transfusion episodes was done from a transfusion database dedicated to traceability (HemoService®-Haemonetics®). A transfusion episode was defined either from the computer code for LBP issuing, a number generated by the French Blood Establishment (EFS), or as the administration of LBP for the same patient on the same date. Successive episodes were considered distinct if their issuing codes were different, determining a maximum estimate, or, for the same patient, if the LBPs were transfused on different dates, giving a minimum estimate.

The transfusion process has been split in 12 successive steps established on the basis of French regulatory recommendations [17]. The resources considered are detailed in Table 1. The time required to complete each step was evaluated by a practice survey; a specific questionnaire (appendix 1) was developed and submitted to the personnel concerned (general care nurses or anaesthetists nurses). The data, collected in a spreadsheet (Excel®-Microsoft®), were subjected to a descriptive statistical analysis (response rate, mean, standard deviation, 95% confidence interval).

The MD time was estimated by expert advice at 20 min per transfusion episode. It included patient information, writing transfusion orders and post transfusion checks. However, the information time on the possibility of a transfusion, issued during a preoperative consultation, was not considered, as it is included in the usual patient information process. A medico-administrative assistant (MAA) time, estimated at 15 min per patient (expert advice), allowed the management of the patient's file (classification and digitisation of transfusion documents). The salary costs of the staff involved were calculated based on 1607 hours of work per year. The average salary cost was 61,178 euros/year (0.63 euros/min) for a nurse, 103,225 euros/year (1.07 euros/min) for a MD and 44,353 euros/year (0.46 euros/min) for a MAA.

In addition to these steps, there was a haemovigilance team, regardless of the level of transfusion activity, responsible for training on transfusion, monitoring the traceability of LBPs, carrying out surveys on recipient adverse reactions (RAR) and adverse events (AE) in the transfusion chain, as well as the management of the blood bank.

For the baseline analysis, scenario 1, the cost calculation based on the activity of the transfusion process was carried out for procedures involving only RBCs. The presented results did not include the cost of purchasing the LBPs, unless explicitly stated otherwise.

Several alternative scenarios have been tested; a scenario 1.1 without integrating the monitoring time in the nursing care, a

Total cost per RBC unit transfused

$$Tc_{ut} = Pc_{ut} + \frac{C_d + C_i}{x}$$

Tc_{ut}= mean total cost per RBC unit transfused
Pc_{ut}= mean process cost per RBC unit transfused
C_d = transfusion-related direct overhead cost
C_i = transfusion-related indirect overhead cost
x = total number of RBC units transfused

Mean process cost per RBC unit transfused

$$Pc_{ut} = \frac{u_1 pc_1 + u_2 pc_2 \ldots\ldots + u_n pc_n}{x}$$

Pc_{ut} = mean process cost per RBC unit transfused
pc_n = process cost of main process n
u_n = usage factor of process n
x = total number of RBC units transfused

Fig. 1. Formula for calculating the cost of transfusion and transfusion process using the Activity-based costing method [14].

scenario 1.2 where the missing data from the practice survey were defined as 0. A scenario 2 including all the LBPs was carried out according to the same method as scenario 1, in integrating that the bedside ultimate ABO compatibility check was only applied to RBCs and the plasma thawing was carried out by the EFS before its issuing. A cost analysis of the RBC transfusion linked to a surgical act was also performed (scenario 3). Counting these transfusions was carried out by crossing the databases of transfusion and coding of hospital stays. Only stays for which the diagnosis related group (DRG) code corresponded to the performance of a surgical act were considered.

In order to assess the robustness of the obtained results and compare the different considered scenarios, a univariate deterministic sensitivity analysis was carried out and the result presented as a Tornado graph, making it possible to describe the uncertainty specifically linked to a parameter, the others being set at their value retained in the benchmark analysis [18].

3. Results

In 2018, a total of 36,914 blood group determinations and 26,887 irregular antibody testing (IATs) were performed for 22,147 patients. The creation of the transfusion record, the recording of the results of immunohaematological (IH) tests and LBP deliveries were automated via the computerised transmission of data from the EFS to the digital patient record of the hospital. In case of failure, the haemovigilance team proceeded with data follow up and correction.

The activity of our hospital was spread over 2 separate sites, one located near the EFS issuing site, open 24 hours a day. In this site, LBP transport was done by automated transport systems, also dedicated to transport of biological samples and drugs. As these systems are not specifically related to transfusion and as they have been purchased since more than 15 years, their costs have not been considered.

On the second site, there was an EFS issuing unit open 12 hours a day on working days. Outside these periods, the LBPs and tubes for IH tests were transported by a contracted service provider and billed 21 euros at each transport. The number of these transports (999 transports of LBPs and 1064 of IH tests) was estimated from a specific survey carried out in 2016, assuming that this activity was stable. An emergency blood bank was organised at this site to secure the supply of LBPs. The costs of purchasing the equipment (room, refrigerator, freezer) equalled 41,000 euros, but because they were more than 10 years old, they were considered as depreciated. So, only maintenance costs were considered (2,079 euros/year). The cost of human resources devoted to supply, follow up and maintenance of the emergency blood bank equalled 13,000 euros/year.

The haemovigilance team consisted of 1.8 MD full-time equivalent (FTE) and one MAA FTE. The salary costs of this organisation were a fixed cost equalling 230,637 euros/year. The costs of managing RARs and AEs were not taken into account: their low frequency (2.8/1000 transfusions in 2018) and their varied kinds, as well as the means necessary for their management, coordinated by the haemovigilance team, led us not to include them in this study.

Only post-transfusion IH tests performed in the hospital were counted among the step 1 tests (Table 1), those performed outside the hospital were not considered.

The practice survey on the time needed for transfusion, conducted from April to September 2018, analysed 109 responses, including 34 (31%) from nurses in a surgical department. Depending on the item, the response rate ranged from 61 to 100% and 33 questionnaires were fully completed. Missing data from the questionnaires were imputed to the average for the baseline analysis, and imputed to 0 for the sensitivity analysis. The nursing time dedicated to one transfusion was on average 86 ± 45 min. In the surgical departments, it was evaluated at 103 ± 65 min, compared to 79 ± 31 min in medicine. The results of the nursing time evaluation are summarized in Table 2.

The performed transfusions were noted in the patient's care record, both on paper (issuing documents and patient record) and computer (digital patient record and transfusion specific software). Only the cost of maintaining the transfusion software (27,716 euros/year) was considered. As it was purchased more than 10 years ago, it was considered as depreciated.

3.1. Labile blood products

In 2018, a total of 43,282 LBPs was issued, of which 42,436 were transfused to 5299 patients. Of the 25,676 RBCs delivered (59.1% of LBPs), 25,194 were transfused to 4905 patients. In total, 842 LBPs, of which 491 RBCs were destroyed.

The deliveries could concern several LBPs at the same time, in this case, the check at receipt was only carried out once, while the ultimate bedside pre-transfusion checks were carried out for each bag. The number of RBC transfusion episodes was estimated to be between 13,786 (differing dates and patients) and 16,579 (differing issuing computer codes). The number of RBCs administered was estimated to average 1.7 RBCs per transfusion episode.

The amount of all the equipment needed for each transfusion episode has been estimated at 6.98 euros (gloves, drapes, compresses, specific transfusion tubing sets, stopcock, peripheral venous catheter, needle, dressing, syringe, injectable NaCl 0, 9%, skin antiseptic). An ABO bedside check kit was used for each RBC, its unit price was 1.50 euros. A summary of the estimate of healthcare consumption and associated valuations is presented in Table 3.

3.2. Transfusion cost

The production cost, based on the activity of the RBC transfusion according to the elements described above, was on average 229.68 euros per transfusion episode, i.e. 138.41 euros per transfused RBC. In adding the cost of purchasing the LBPs, the transfusion cost equalled 563.61 euros per episode or 339.64 euros per transfused RBC. The results of the sensitivity analysis are presented in Fig. 2.

Table 1
Details of the transfusion process.

Step	Details and peculiarities	Actions	Source
1	Immuno-haematological tests for a transfusion	Creation of a transfusion record	Not valued
		Blood grouping and irregular antibody testing	2018 activity Number of tests performed
2	Informing the patient	Written and oral information to the patient	Expert advice/ Not valued for preoperative consultation[a]
3	Prescription and ordering	Drafting the prescription	Expert advice
		Transmission of the order	Not valued
4	Transport EFS-main hospital site and EFS-remote hospital site (day)	Internal transport of LBPs to the care unit	Not valued
	EFS- remote hospital site (night) And emergency blood bank	Transport and hand delivery of LBPs in the unit	2016 internal survey
5	Control of LBPs at receipt in the care unit	Checking the integrity of the packaging and the transit time	Practice survey 2018 activity
		Checking the NIF conformity	
		Checking the matches between patient identity, transfusion record, prescription, NIF and LBP	
		Checking the LBP integrity and expiry date	
		Acknowledgment of receipt on the NIF	
	Preparation of the transfusion procedure	Gathering the required documents	
		Informing the patient about transfusion modalities	
		Recording the patient's initial clinical state (pulse, blood pressure, temperature)	
		Setting up vascular access if necessary	
6	Ultimate pre-transfusion ABO control at the patient's bedside	Ultimate check of matches between patient, product, IH and NIF documents	Practice survey
		Ultimate control of patient and product match; small disposables	RBC ABO check kit; literature and expert advice; 2018 activity
7	Transfusion of LBP	Implementation of transfusion; Connecting the LBP	Practice survey
		Removal of the transfusion set and storage for 24 hours	
8	Clinical monitoring of the patient	Careful monitoring for the first 15 min	Practice survey
		Regular monitoring thereafter	
9	LBP traceability	LBP recording-traceability: paper and/or computer	Practice survey
		Update of the transfusion record	
		Archiving transfusion documents (prescriptions, NIF) MAA	
		Recalling traceability not done (haemovigilance)	
10	Management of recipient transfusion adverse reactions	Stopping the transfusion, specific patient care,	Not valued
		Declaration, blood tests in recipient ± donor according to type of RAR	
11	Return for destruction of unused LBPs	Identification of unused LBPs on the NIF	Practice survey
		Specific labeling of the LBP for destruction + specific form	
		Typing the traceability of the return in the transfusion record	
		Return of unused LBPs for destruction in the EFS	Not valued
12	Post-transfusion follow-up of the recipient	Drafting and delivery of IAT prescription to the patient	Expert advice
		Post transfusion IATs	2018 activity
		Completion of the patient file	Expert advice

MAA: medico-administrative assistant; EFS: French blood establishment; RAR: recipient adverse reaction; NIF: nominative issuing form; LBP: labile blood products; IAT: irregular antibody testing.

[a] The pre-transfusion information during a preoperative consultation was not considered because it is part of the usual consultation process for acts at risk of transfusion, a medical time was nevertheless estimated for the effected transfusion care.

Table 2
Results of the practice survey on the nurse time required to perform the transfusion procedure, expressed in minutes for the means, standard deviations and 95% confidence interval (IC 95).

Group	Number of responses	Time (min) Missing values imputed to the mean			Time (min) Missing values imputed to 0		
		Mean	Standard deviation	IC 95	Mean	Standard deviation	IC 95
All responses	109	86.2[a]	45.5	[81.0–91.4]	71.7	48.4	[67.1–76.4]
Complete questionnaires	33	89.5	67.3	[77.8–101.2]	NA	NA	NA
Medicine	75	78.7	30.9	[75.0–82.5]	64,4	35.2	[60.3–68.4]
Surgery	34	102.7[b]	65.0	[96.2–109.2]	87.9	67.0	[76.4–99.4]

NA: not applicable.
[a] Value considered in the main analysis.
[b] Value considered in the scenario specific to surgical acts.

Table 3
Estimates of care consumption and associated valuations, expressed as means, [Min–Max] according to the number of transfusion episodes taken into account.

	Quantity (frequency)	Unit price (euros)	Valuation (euros)
BG-IAT	26,887	65.02 euros ([c])	1,748,338 euros
Transports (LBP or IH tests)	2,063	21.00 euros	43,323 euros
Transfused RBC[a,c]	25,194 RBC[a]	201.23	5,069,789 euros[a]
Destroyed RBCt	482 RBC	euros	96,993 euros
ABO match kit for RBC	25,194 (1 per RBC)	1.50 euros	37,791 euros
Number of RBC recipients	4905 patients	NA	NA
Number of transfusion episodes	15,183 [13,786–16,579]	NA	NA
Materials and disposables	1 per episode	6.98 euros	105,974 euros [96,226–115,721]
Nurse time[b]	86 min/episode	0.63 euros/min	822,587 euros [746,925–898,250]
MAA time	15 min/recipient	0.48 euros/min	34,844 euros
MD time	20 min/episode	1.07 euros/min	324,906 euros
Emergency blood bank	1	15,079 euros	15,079 euros
Software	1	27,716 euros	27,716 euros
Haemovigilance	1.8 FTE MD	103,225 euros	230,637 euros
	1 FTE MAA	44,832 euros	
Recipient adverse reactions	Not considered		

MAA: medico-administrative assistant; RBC: red blood cell concentrate; FTE: full time equivalent; BG: blood group; IH: immunohematologic; LBP: labile blood products; IAT: irregular antibody testing.
[a] The cost of purchasing LBPs has not been considered in the base case.
[b] Missing data from questionnaires were imputed to the mean.
[c] Average cost of IH tests actually billed to the hospital in relation to the number of tests performed.

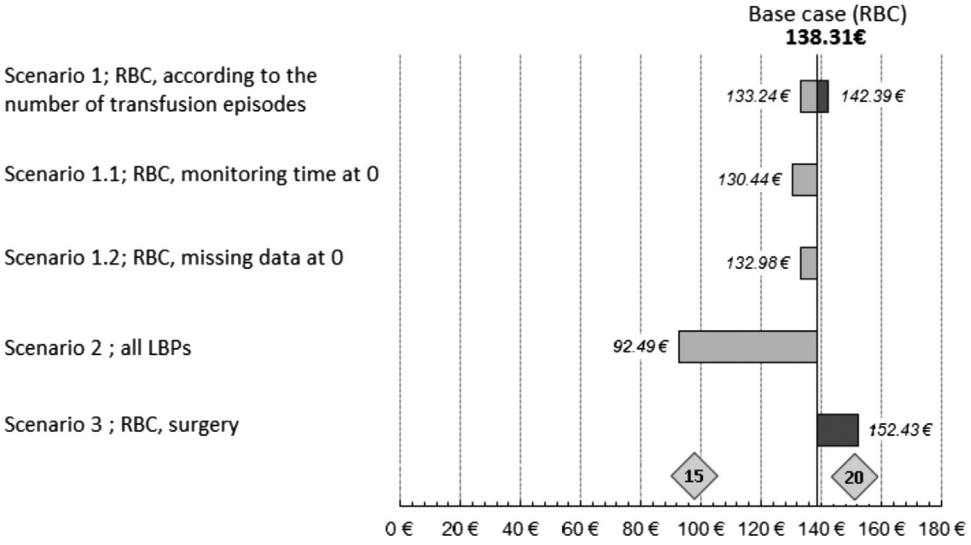

Fig. 2. Variations in the production cost for the administration of one RBC compared to the base case (RBC, average number of transfusion episodes, post-transfusion monitoring time cosnidered, missing data for nurse time, imputed to the average). Tornado graph, representation of the uncertainty related to the specific parameter of each scenario, the others being set at their value determined in the baseline analysis. Scenario 1; variations according to the estimated number of transfusion episodes. Scenario 1.1; variation, not considering the post transfusion monitoring time. Scenario 1.2; variation when missing data for nurse time are imputed to zero. Scenario 2; variations linked to the inclusion of all LBPs. Scenario 3; variation for transfusion of RBCs linked to a surgical act. Values of bibliographic references [15,20]. RBC, red blood cell concentrate; LBP, labile blood product.

For scenario 2 covering all LBPs, the number of episodes was evaluated between 19,119 and 28,201. The ultimate bedside ABO check was only applied to the RBCs, with an average completion time of 3.89 ± 2.35 min. The cost of the transfusion was then estimated at 165.89 euros per episode, or 92.49 euros per LBP transfused. For scenario 3, specific to the surgical activity, a total of 6698 RBCs were transfused in 1546 patients, the number of episodes was estimated between 2816 and 3652 for a nurse time of 103 ± 65 min. The cost of RBC transfusion was then estimated at 315.71 euros per episode, or 152.43 euros per RBC transfused.

4. Discussion

In our hospital, the average production cost of transfusion was estimated at 138.41 euros per RBC (229.68 euros per transfusion episode), representing 40% of the total cost of 339.67 euros per RBC (563.61 euros per episode), which includes the cost of purchasing the RBCs.

Our work on the cost of transfusion was carried out as part of a medico-economic evaluation funded by the general direction of care provision (PRME IMOTEC NCT02972684). It will be possible to use these results to compare the costs of care and quantify the economic impact of a blood saving measure: the use of viscoelastic diagnostic tests (ROTEM® or TEG®) in the management of perioperative haemorrhages in cardiac surgery [19]. The data available on this topic in the literature are sometimes diverging and difficult to transpose into the French context.

The result of our main estimate was 40% higher than the $ 70.5 per CGR (98 euros in 2018 euros) reported by the UK team of Stokes et al. in 2012, while our average of 1.7 CGR per episode was similar. Nevertheless, in this micro-costing based study, the nurse times described are lower, probably due to the lack of detailed consideration of some steps: product control at receipt, obtaining patient's consent, preparation of the procedure and ultimate pre-transfusion ABO check at bedside [12].

Our result was 6% lower than the 147 euros described in 2016 by Kleineruschkamp et al, but their patients were only surgical patients (20). In this same context, our estimate of 152.43 euros (scenario 3) turned out to be higher.

Whatever the considered scenario, all our evaluations were lower than the results of Shander et al. In 2010, they described a total cost (including the purchasing cost of the RBCs) between $ 522 USD for European centers, and $ 1183 USD for North Americans (from 389 to 880 euros after conversion for the year 2007 $, 1 USD = 0.7443 euros), while the reported purchasing costs of the RBCs were lower than the current ones in France (14).

The reduction in the cost observed in considering all LBPs (scenario 2) was linked for a minor part to the absence of ultimate ABO compatibility check for the plasma and the platelet concentrates, but above all, to the division of the same fixed costs over a greater number of LBPs and episodes.

Our mono-centric work, adopting only the perspective of one hospital, has limitations. The organizational context of our hospital, with LBP issuing fully provided by the EFS, could underestimate the fixed costs compared to an LBP issuing organisation at the expense of the hospital. Pre- or post-transfusion IH tests performed outside the hospital were omitted. This might underestimate the cost of the transfusion from a Health Insurance point of view. Likewise, it is only a financial analysis and this work only included short-term expenses, neglecting the consequences of the transfusion in the medium and long term for the patients.

Our estimate of nurse time proved to be higher compared to the data in the literature, whereas the time for collecting blood samples was not considered because it was not specifically linked to the transfusion. Our assessment of the monitoring time following the administration of LBPs was higher than those described in the literature [10,11,15,20]. However, our practice survey was carried out with nurses who regularly perform transfusions. The estimated treatment time, close to 1.5 hour, seemed clinically realistic. The longer time associated with surgical patients could be linked to the lack of distinction between intraoperative and postoperative transfusions. An observational audit would allow to specify the consumption of care and the variations in the duration of procedures associated with an intraoperative transfusion. On the other hand, any changes in the duration of the operation or the length of stay associated with the transfusion, or complications, were not considered. This work was not planned as part of a practice investigation on the transfusion act.

The assessment of the number of transfusion episodes was a source of imprecision in this study. There is no validated process to determine whether LBPs are transfused during separate episodes or not. During a massive transfusion linked to the management of an haemorrhage, the successive cares could overlap and lead to overestimating the care time linked to the episodes identified from an issuing code. Conversely, the count of episodes based on the date could lead to underestimate the caring time when several LBPs are transfused on the same day. Not knowing the precise times and context of administration of each LBP, we used the average of these estimates for our main scenario, in providing the extreme values according to the number of episodes, to underline their degree of uncertainty.

The large number of destroyed RBCs (482 bags), valued around 97,000 euros, constituted a variable cost which was accounted as a fixed cost, since it was considered independent of the number of transfusion acts or patients. This expense, which should be partly avoidable, has multiple causes. One related to the organization of our hospital on 2 remote sites could be the cause of an "over-anticipation" of LBP orders for surgeries at risk of bleeding performed in the absence of available on-site issuing. This situation, which justifies the existence of an emergency blood bank, could be improved by a 24-hour issuing organisation on both sites and thus reduce the burden of LBP destruction. However, such an organisational change would mean new fixed costs to be balanced against the low cost of the emergency blood bank.

Our study to estimate the overall cost of transfusion enriches the existing literature, it sheds light on the issues of investment in a PBM strategy [10,11] from the point of view of an hospital in the French context. The economic impact of transfusion exceeds the cost of purchasing LBPs, and the challenge is to quantify a combination of human resources, logistical means, organisation, and procedural know-how. If the transfusion involves fixed costs, distributed among all patients regardless of the activity, the variable costs can be influenced by PBM actions, depending on whether they modify the number of LBPs, transfusion procedures or recipients. For each blood saving action, an accounting balance sheet can be drawn up comparing the means of its implementation with the avoided transfusions. These PBM actions, beyond the clinical benefit for patients, could be of medico-economic interest from a societal point of view. Reducing the frequency of transfusion and associated costs would allow to optimise the allocation of blood resources and improve the populational benefits [5].

This study, based on activity and cost accounting actual data from an hospital, allowed a realistic estimate of the economic impact of transfusion. Extending this evaluation to several hospitals of different profiles and sizes would allow to specify the cost assessment and better characterise the uncertainties of our analysis.

Disclosure of interest

J.C.R. received during the past 5 years, lecture and consulting fees from Vifor pharma, congress registration fees from Fresenius, travel fees from Werfen and Edwards, research grant from direction générale de l'offre de soins (DGOS).

B.R. received, during the past 5 years, lecture fees from Fisher&Paykel, Baxter, LFB, Aspen, consulting fees from LFB, Astra Zeneca, Ethypharm, research grants from Baxter and direction générale de l'offre de soin.

V.P.R., M.T.S., C.F.R., J.F.H., J.C.A., R.B.O. and M.V.O. declare that they have no competing interest.

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