

# Cost of chronic red blood cell transfusion in the Brazilian private healthcare sector from a payer perspective

*Custo de transfusão crônica de concentrado de hemácias na perspectiva do sistema de saúde suplementar brasileiro*

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## Keywords

erythrocytes, blood transfusion

## ABSTRACT

**Objective:** In the private healthcare sector in Brazil, the dearth of information regarding transfusion cost may compromise the management of conditions requiring long-term transfusion. Therefore, the present study aimed to estimate the cost of chronic red blood cell (RBC) transfusion in this context. **Methods:** A payer perspective was chosen for the analysis. A survey performed by an expert advisory board gathered information on the amounts reimbursed by health plans to blood centers per outpatient transfusion of a single RBC bag in multitransfused patients. Survey results were contrasted to RBC transfusion cost calculated using Brazilian Hierarchical Classification of Medical Procedures (CBHPM) parameters from 2018 and 2010, the latter suggested by the advisory board as more accurately reflecting market prices. **Results:** Six blood centers in the South and Southeast of Brazil were surveyed. The median amount reimbursed per RBC unit was R\$ 1,066.44 (interquartile range: R\$ 665.00-1,252.00). The mean amount reimbursed was R\$ 959.54 ± R\$ 337.14 (minimum: R\$ 295.00 – maximum: R\$ 1,980.00). Using 2018 CBHPM parameters, the cost of transfusing one RBC unit was calculated as R\$ 1,905.18. Using 2010 CBHPM parameters, the cost was R\$ 1,119.69 per RBC unit. **Conclusions:** Analyses using 2018 CBHPM parameters may lead to overestimation of transfusion cost. The best estimate for outpatient transfusion of one RBC bag in the private health care sector in Brazil lies between the observed reimbursed values and 2010 CBHPM cost. The present results provide valuable information for future cost-effectiveness analyses focusing on disorders whose treatment involves routine RBC transfusion.

## Palavras-chave:

eritrócitos, transfusão de sangue

## RESUMO

**Objetivo:** A carência de informações sobre custo de transfusão sanguínea na saúde suplementar brasileira pode comprometer análises econômicas e eventuais decisões relacionadas a esse procedimento no longo prazo. O objetivo deste estudo foi estimar o custo de transfusão crônica de con-

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**Precis:** Chronic red blood cell transfusion cost was estimated in Brazil using reimbursement information from private health plans and Brazilian Hierarchical Classification of Medical Procedures parameters.

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centrado de hemácias (CH) nesse contexto. **Métodos:** Foi escolhida a perspectiva do pagador. Uma pesquisa foi realizada com especialistas para levantamento de valores reembolsados para transfusão de uma bolsa de CH em pacientes politransfundidos. Os resultados da pesquisa foram comparados ao custo de transfusão de CH calculado utilizando a Classificação Brasileira Hierarquizada de Procedimentos Médicos (CBHPM), edições de 2018 e 2010, sendo a edição mais antiga sugerida pelos especialistas como estando mais de acordo com a realidade de mercado. **Resultados:** Seis hemocentros localizados no Sul e Sudeste do Brasil foram incluídos. Os valores mediano e médio reembolsados aos hemocentros foram R\$ 1.066,44 (amplitude interquartil: R\$ 665,00-1.252,00) e R\$ 959,54 ± R\$ 337,14 (mínimo: R\$ 295,00 – máximo: R\$ 1.980,00), respectivamente. Com base nos parâmetros da CBHPM 2018 e 2010, os custos de transfusão calculados para uma bolsa de CH foram R\$ 1.905,18 e R\$ 1.119,69, respectivamente. **Conclusões:** Análises utilizando parâmetros da CBHPM 2018 podem superestimar os custos de transfusão de CH. Na perspectiva do sistema de saúde suplementar brasileiro, a melhor estimativa de custo de transfusão por bolsa de CH está entre o valor reembolsado e o valor calculado utilizando a CBHPM 2010. O presente estudo apresenta informações importantes para futuras análises de custo-efetividade de patologias que envolvem tratamentos à base de politransfusão de CH.

## Introduction

Around the world, information regarding blood transfusion cost is often limited or inaccurate, in part because the estimation of such cost is not simple; micro-costing studies performed at hospitals or other facilities involve detailed data collection that requires considerable time. In addition, the results of such efforts are not necessarily generalizable, due to possible regional or institutional specificities that affect cost items (Stokes *et al.*, 2018).

Red blood cells (RBC) are the most frequently transfused blood product in the world (Garcia-Roa *et al.*, 2017), with an estimated 85 million units transfused every year. In Brazil, a country with a population of over 200 million, the National Health Surveillance Agency (Anvisa) estimates that 1,229,947 outpatient and inpatient RBC procedures were performed in 2015 in the overall healthcare system (Brasil, 2017). In 2017, the overall number of RBC units transfused in Brazil was estimated at 1,116,363 (Brasil, 2018a). However, because a centralized electronic database is still not available in the country to monitor blood transfusion operations, this information is likely to be underestimated.

There are only a few studies in the literature regarding transfusion cost in Brazil. Ubiali *et al.* (2008) have used the activity-based costing (ABC) method to estimate the mean cost of collecting whole blood units in a regional blood center within the public Unified Health System (SUS). In SUS, the amounts reimbursed for blood transfusion are defined by the Ministry of Health. The authors concluded that the actual mean cost of collecting blood units was 68.75% higher than the value paid by the Brazilian government at the time of the study (2008).

In the private sector (covering about 25% of the Brazilian population), a national price list for blood products (for example, comparable to the NHS Blood and Transplant price lists in the United Kingdom (NHS, 2018)) is not available. One previous study focusing on the treatment of myelodysplastic syndrome (MDS) in Brazil has estimated the cost of RBC transfusion at US\$ 164.00 per unit based on the Brazilian

Hierarchical Classification of Medical Procedures (CBHPM) (Clark & Faleiros, 2011), a standard designed by the Brazilian Medical Association and endorsed by the Federal Council of Medicine. The CBHPM classifies treatment and diagnostic pathways according to their complexity, and provides an estimate of operating cost in Brazilian Reals (R\$) to ensure that physicians are adequately compensated for the procedures. The fact that this earlier study does not inform the exchange rate and the exact CBHPM parameters considered in the calculation of RBC cost limits the applicability of the proposed estimate beyond its original context. Also, despite being acknowledged as a possible cost reference, the CBHPM is not officially adopted by the National Regulatory Agency for Private Health Insurance and Plans (ANS), and reimbursement values are still negotiated directly between health insurance/health care providers. Nevertheless, inaccurate information regarding transfusion cost may compromise the adequate management of conditions requiring long-term blood transfusion, such as sickle cell disease (Detterich *et al.*, 2015), thalassemia or MDS, which often involve transfusion dependence (Lal *et al.*, 2018; Leitch *et al.*, 2017).

Therefore, given the dearth of information, the present study aimed to estimate the cost of chronic RBC transfusion in the private healthcare sector in Brazil.

## Methods

In the present study, a payer perspective was chosen for the analysis, combining reimbursement information obtained from private health insurance providers and costing based on CBHPM categories. To address this perspective, an expert advisory board was established. The board included four hematologists with expertise in blood banking, all of whom are currently and actively involved in blood banking activities, in addition to one oncologist and two specialists in health technology assessment (a clinical epidemiologist and a pharmacist). The unit of analysis was the outpatient transfusion of a single RBC bag.

Initially, the board performed a survey (March 2019) to gather information on the amounts reimbursed by health insurance plans to blood centers per RBC unit. Following the survey, the CBHPM was reviewed to define the parameters to be considered in the costing of an equivalent RBC unit.

In the CBHPM, "RBC transfusion" is considered as a treatment pathway involving several procedures. To determine the cost of each procedure, the CBHPM relies on three parameters: operating cost of the procedure (pre-established); a fixed operating cost unit (UCO), which reflects equipment depreciation, maintenance, payroll, and other added expenses; and the technical complexity of the treatment/diagnostic pathway (considering the amount of time and training required of a physician to perform the task), with 14 complexity categories. The fractions for each complexity category are also pre-established. The contribution of each procedure to the overall complexity category assigned to the treatment is given as a fraction (0.1 to 1.0) of the amount attributed to the specific complexity category. Therefore, to calculate the cost of each procedure, the following formula is used: (operating cost of the procedure \* UCO) + fraction of complexity level. The sum of the costs obtained for each procedure corresponded to the CBHPM cost of transfusing one RBC unit to multi-transfused patients in an outpatient setting. Two CBHPM editions were used for RBC transfusion costing: the current 2018 list and the 2010 list. The latter was suggested by the advisory board as being closer to the actual values currently practiced for health care transactions. Regarding the complexity level, the CBHPM considers two categories for blood transfusion, reflecting less (1A) or more intensive (5A) physician involvement. As defined by the advisory board, level 1A was used for the calculation.

## Results

Six blood centers were surveyed, of which two were located in the South and four in the Southeast of Brazil. The median amount reimbursed per RBC unit for multi-transfused patients was R\$ 1,066.44 (interquartile range: R\$ 665.00–R\$ 1,252.00). The mean amount reimbursed was R\$ 959.54 ± SD 337.14 (minimum: R\$ 295.00 – maximum: R\$ 1,980.00). When different types of health plans were considered (Table 1), similar reimbursement amounts were observed for self-managed, group health, and insurance plans.

Using the 2018 CBHPM list, the following parameters were considered: UCO = R\$ 20.47 and 1A = R\$ 19.84; based on that, the cost of transfusing one RBC unit was R\$ 1,905.18. In turn, using the more conservative 2010 parameters, with UCO = R\$ 13.57 and A1 = R\$ 11.78, the result was R\$ 1,119.69 per RBC unit, which is fairly close to survey results. Thus, these findings suggest that the best estimate of RBC transfusion cost in the Brazilian private health care setting lies between R\$ 959.54 (survey) and R\$ 1,119.69 (2010 CBHPM). If multiple

**Table 1.** Mean amounts reimbursed to blood centers for outpatient red blood cell transfusion in Brazil according to type of health plan, 2019

Type of health plan provider (no.)	Mean reimbursed amount (R\$)	SD (R\$)
Self-managed (24)	1,066.44	266.74
Group health (10)	1,042.56	248.43
Insurance (6)	967.34	520.42
Other <sup>a</sup> (11)	646.60	267.61
Total (51)	959.54	337.14

<sup>a</sup>Includes cooperatives.

SD: standard deviation.

RBC units are transfused, the cost is obtained by multiplying the number of units by the estimate.

Table 2 shows the comparative cost of each CBHPM procedure in RBC transfusion using 2018 and 2010 parameters. Subtotal 1 shows the estimated cost of one-time RBC transfusion (e.g., surgical patients); and Total shows the estimated cost of chronic RBC transfusion, given by the sum of Subtotal 1 plus the cost of additional procedures required by multi-transfused patients (Subtotal 2).

## Discussion

In Brazil, the cost of blood transfusion is virtually unknown. Because, as pointed out by Stokes *et al.*, 2018, a large number of particular steps is involved in the transfusion process, international parameters cannot be extrapolated to estimate transfusion cost in different settings. Therefore, in the present study, we combined a survey of actual amounts reimbursed for RBC transfusion by different types of health plans with cost estimated according to an accepted standard, the CBHPM. The results showed a broad variation in reimbursed amounts – R\$ 295.00 to 1,980.00. Also, the mean amount reimbursed (R\$ 959.54) was lower than that obtained using 2018 CBHPM parameters (R\$ 1,905.18), but close to the R\$ 1,119.69 obtained using 2010 CBHPM parameters. Therefore, the best estimate for transfusion of one RBC unit in the private health care sector in Brazil is possibly between R\$ 959.54 and R\$ 1,119.69.

As previously reported in the literature (Stokes *et al.*, 2018; Cataife & Pagano, 2018), a variation in transfusion cost might be expected given the contextual differences among blood centers. Interestingly, the fact that several types of health plans were surveyed did not seem to be a factor influencing reimbursement in our study, since similar mean values were observed for the different types. Therefore, a likely explanation might be the differences in demand and supply for blood. This underscores the need to develop a basis for cost-effectiveness analyses that involve blood transfusion in the country. The CBHPM provided a comprehensive

**Table 2.** Cost of red blood cell transfusion in Brazil according to 2018 and 2010 CBHPM parameters

CBHPM code	Procedure	2018			2010		
		Fraction of 1A	Operating cost (R\$)	Total cost <sup>a</sup> (R\$)	Fraction of 1A	Operating cost (R\$)	Total cost <sup>b</sup> (R\$)
4.04.02.04-5	RBC concentrate	1.0	6.300	148.80	1.0	5.280	83.43
4.04.03.10-6	Hemoglobin electrophoresis per blood component	0.1	0.580	13.86	0.1	0.580	9.05
4.04.03.17-3	ABO/RH blood typing	0.1	1.209	26.73	0.1	0.930	13.80
4.04.03.26-2	Nucleic acid amplification testing/HCV per blood component	0.1	11.870	244.96	0.1	11.870	162.25
4.04.03.28-9	Nucleic acid amplification testing/HIV per blood component	0.1	11.870	244.96	0.1	11.870	162.25
4.04.03.35-1	Irregular erythrocyte antibodies screening – gel	0.1	2.470	52.54	0.1	1.500	21.53
4.04.03.40-8	Pretransfusion compatibility testing – tube	0.04	4.461	92.11	0.1	0.970	14.34
4.04.03.42-4	Combined anti-HTLV-I + HTLV-II assay per blood component	0.04	6.164	126.97	0.1	3.010	42.02
4.04.03.44-0	Chagas screening – enzyme immunoassay per blood component	0.1	1.400	30.64	0.1	1.400	20.18
4.04.03.46-7	S. hepatitis B anti-HBC per blood component	0.1	1.360	29.82	0.1	1.360	19.63
4.04.03.48-3	Anti-HCV assay per blood component	0.1	3.070	64.83	0.1	3.070	42.84
4.04.03.50-5	HIV screening – enzyme immunoassay per blood component	0.1	2.850	60.32	0.1	2.850	39.85
4.04.03.60-2	Syphilis VDRL per blood component	0.1	0.220	6.49	0.1	0.220	4.16
4.04.03.66-1	Hepatitis B (HBsAg) radio or enzyme-immunoassay per blood component	0.1	1.260	27.78	0.1	1.260	18.28
4.04.03.89-0	Nucleic acid amplification testing /HBV – per blood component	0.1	11.870	244.96	0.1	11.870	162.25
<b>Subtotal 1</b> (One-time transfusion)				1,415.77			815.86
4.04.03.14-9	Other red cell group phenotypes – per phenotype – gel	0.1	3.796	79.69	0.1	2.920	40.80
4.04.03.15-7	RH-HR (D, C, E, C, E) phenotypes – gel	0.1	2.652	56.27	0.1	2.040	28.86
4.04.02.11-8	Leukoreduction – per unit	0.1	17.170	353.45	0.1	17.170	234.17
<b>Subtotal 2</b> (Additional procedures required in chronic transfusion)				489.41			303.83
<b>Total</b> (Chronic transfusion: Subtotal 1 + Subtotal 2)				1,905.18			1,119.69

<sup>a</sup> Total cost 2018 = (operating cost of the procedure X R\$ 20.47 [UCO]) + fraction of R\$ 19.84 (1A).

<sup>b</sup> Total cost 2010 = (operating cost of the procedure X R\$ 13.57 [UCO]) + fraction of R\$ 11.78 (1A).

CBHPM: Brazilian Hierarchical Classification of Medical Procedures.

set of transfusion procedures that seemed accurate for the Brazilian context. However, the cost estimated based on 2018 CBHPM parameters did not correspond to the values practiced by health care plans in 2019. In this scenario, the present approach combining CBHPM parameters and a reimbursement survey may be a useful strategy to estimate and update transfusion cost in the Brazilian private health care sector.

Knowledge regarding transfusion cost is meaningful in a variety of contexts, from disorders requiring chronic transfusion, such as thalassemia (Burns *et al.*, 2019) and MDS (Kuhne *et al.*, 2010), to acute blood loss (Garcia-Roa *et al.*, 2017). In the United Kingdom, a study focusing on lower vs. liberal levels of RBC administration to treat perioperative anemia associated

with cardiac surgery (Stokes *et al.*, 2016) has argued that the cost difference between the groups was “largely associated with the higher cost of red blood cells in the liberal group.” According to the authors, considering the 30,000 cardiac surgery procedures performed in the study period, even a modest difference of £200 (about 1% of total costs) between the groups might have resulted in savings of £6.8 million. However, the economic burden of transfusion is especially meaningful in the context of chronic transfusion therapy or transfusion dependence – defined as  $\geq 2$  transfusion events in an 8-week period, or at least one additional transfusion 3-6 months from the initial procedure (Frytak *et al.*, 2005) – for which the present results are particularly important.

Some studies have claimed that the need for transfusion, a routine medical procedure, would probably increase with the process of population ageing (Williamson & Devine, 2013). However, an opposite trend has been noted in the UK, where the NHSBT has seen a 33% decline in the demand for blood in the past 10 years (NHS, 2018). In terms of RBC, the forecast is 2.8% lower for 2019 and 2020 than originally planned for the period. Nevertheless, the need to make investments in core systems in the blood supply chain has determined a proposal to increase the price for RBC. Thus, regardless of the trend, it is clear that knowledge of transfusion cost plays an important role in the sustainability of systems.

The present study has some limitations, including the fact that the blood centers covered in the survey were not representative of all Brazilian regions. However, the effort to obtain this information was essential to gauge the only standard providing a comprehensive list of medical treatment and diagnostic procedures in the country, i.e., the CBHPM. As a result, the present study was able to produce a reliable estimate of RBC transfusion cost in Brazil, and outlined the item costs to be considered in future estimates. The present findings are extremely useful for a variety of stakeholders, including the agency (ANS) in charge of regulating the private health care sector and of evaluating new technologies to be covered by health plans in Brazil, given that cost-effectiveness is one of the main criteria guiding such evaluations (Brasil, 2018b).

In conclusion, the present study using a payer perspective analysis and expert advisory board was successful in producing a cost estimate for chronic RBC transfusion in Brazil, despite the broad variation in the amounts reimbursed. The present approach combining CBHPM cost items and a survey of health plan reimbursement values is useful to estimate transfusion cost.

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