

Implementing a patient blood management programme in Brazil: challenges and implications for developing countries

B. D. Benites  & M. Addas-Carvalho

Hematology and Transfusion Medicine Center, University of Campinas, Campinas, Brazil

Background Patient blood management (PBM) programmes have the intention of promoting the rational use of blood, relying on up-to-date medical-scientific evidence in a multidisciplinary approach, where the patient is the main focus of transfusion decisions. These programmes not only increase patient safety levels, but they also have the potential of lowering hospital costs. The aim of this study was to describe the implementation of a PBM programme at a University hospital in Brazil.

Study design and methods The discussions regarding this PBM project were initially undertaken among the managers of the hospital's Transfusion Unit. Audits of transfusion practices were carried out, and these indices were presented in meetings with the Transfusion Committee and with other important stakeholders, in order for this information to support the delineation of the programme's work fronts.

Results The project was promptly approved by the hospital's Board of Directors due to the relevance of the proposal, which required few financial resources as the project is mainly based on reorganization of workflows. The measures implemented included the following: didactic sessions aimed at the hospital staff, reformulation of the computerized system for the prescription of blood components, elaboration of a protocol for the use of antifibrinolytic drugs during the perioperative period and the institution of an outpatient clinic for evaluation of preoperative anaemia.

Conclusion The benefits and challenges of a PBM project in a country with limited resources are analysed, discussing specificities in the scope of Brazilian Transfusion Medicine in a pioneering way.

Key words: blood banks, patient blood management, transfusion.

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Introduction

Blood transfusions constitute an indispensable therapeutic arsenal in diverse clinical and surgical situations, without any possible artificial substitute produced in large-scale. However, this therapy is also imbued with potential risks that can negatively affect the prognosis of patients, ranging from haemolytic reactions and the transmission of

infectious diseases to immunomodulation and consequent deleterious effects, such as susceptibility to infections, tumour recurrence and increased mortality [1–3]. In addition, there is the threat of progressive shortage of inventories, caused by the unequal balance between the demand for blood components and the availability of suitable donors. This imbalance will become increasingly evident as the global population ages, greatly increasing the need for complex medical procedures such as transfusion medicine and major surgeries, whereas the number of donors of adequate age for donation reduces [4, 5].

In this perspective, and as a response to future pressures on the inventories of blood components, 'patient

Correspondence: Bruno Deltreggia Benites, Hematology and Transfusion Medicine Center, University of Campinas, Rua Carlos Chagas, 480, CEP: 13083-970, Campinas, São Paulo, Brazil
E-mail: benites@unicamp.br

blood management' (PBM) programmes have emerged in recent decades, in which the focus of transfusion decisions is placed on the patient, personalizing transfusion decisions based on better scientific evidence and using alternatives that minimize the need for blood [6]. This multidisciplinary approach has the potential to improve the therapeutic and prognostic success of patients, as well as improve inventory management of blood banks, optimizing the use of available resources. These objectives are achieved through specific managerial measures, which include the following: continuing education of the clinical staff of the hospitals, emphasizing the correct indications of blood components; computerized prescription systems that use filters and barriers for requests that do not comply with the established protocols; evaluation and treatment of anaemia in the preoperative period; and increased use of new haemostatic techniques, autologous transfusion and other alternatives to allogeneic transfusion [7].

In this context, a relevant factor to be considered also refers to the costs associated with unnecessary or poorly indicated transfusions. The implementation of PBM programmes, in addition to increasing transfusion safety, is also associated with significant reductions in hospital costs [8]. This is particularly important in resource-limited situations, as in the case of Brazil and other developing countries.

In the particular case of Brazil, there is at present no description of the implementation of any type of PBM programme in public and private hospitals. Therefore, this work had the objective of testing and describing the process of creation and implementation of a PBM programme specific to the Brazilian reality, considering potentialities and challenges.

Materials and methods

The central idea of this project was to evaluate and test the implementation of a PBM programme at the Celso Pierro hospital, located in the city of Campinas, SP, Brazil, and linked to the Medical School of the Catholic University of Campinas. The choice of this particular institution was based on the fact that despite being a university centre with the benefit of different medical specialties, and the hospital's physical and operational size is not overly extensive, which could otherwise render the operation of this pilot project difficult.

Celso Pierro hospital is the University hospital of the Faculty of Life Sciences of the Catholic University of Campinas. It is a reference centre in the west region of the city, which has approximately 400,000 inhabitants, largely dependent on the public health system. Of the 353 active beds, 243 are destined exclusively for public service by agreement with the municipal government. The

hospital has a monthly average of 20,000 outpatient consultations, 11,000 emergency consultations and more than 1,000 hospitalizations.

Due to the complexity of the hospital, encompassing surgical interventions of various specialties, obstetric procedures and a transfusion medicine centre, there is evidently a great demand for blood supply. This is accomplished through an agreement with the Hematology and Transfusion Medicine Center of the University of Campinas (UNICAMP). Celso Pierro hospital has a permanent Collection and Transfusion Unit managed by the UNICAMP Blood Center. Currently, 750–850 transfusions are performed per month, with approximately 80–85% of them as public care and the remainder in private hospitalizations.

Data collection, definition of measures to be implemented and recruitment of stakeholders

The discussions on the implementation of the PBM project at the Celso Pierro hospital began in May 2016, initially among the managers of the transfusion unit based at the hospital. Since August 2016, we started collecting data that could generate an updated picture of the transfusion practices of the hospital. Indices related to the management of the transfusion protocol, that is, the adequacy of prescriptions of blood components performed by the clinical staff, were evaluated. These data were acquired through audit of requests for blood components, in which the appropriateness of the requests was evaluated for the type of blood product requested, the prescribed dose and the correct relationship between the clinical situation, laboratory data and transfusional need. This evaluation was performed by a transfusion medicine specialist, according to criteria established by the updated medical literature [9–11].

These data were then taken to the meetings of the Transfusion Committee, as well as other meetings with the stakeholders to be involved in the project, in order to support the delineation of the PBM programme's work fronts for this hospital.

Elaboration of the work fronts of the PBM project for the Celso Pierro hospital

The data on the prescription of blood components demonstrated the need for intensification of educational measures encompassing concepts of Transfusion Medicine for the clinical staff of the hospital. In addition, they further supported the need to implement the project and highlighted the relevance of the project to the stakeholders involved.

Based on the data previously described, the project was initially presented at a meeting of the Transfusion Committee, so that it could be appreciated by other members,

being composed, in addition to haematologist, medical coordinators of diverse specialties who depend directly on transfusion therapy (surgery, anaesthesia, gynaecology and obstetrics and emergency department), nursing professionals coordinating these same sectors and a member of the Board of Directors of the hospital. The Transfusion Committee in this service holds quarterly meetings, with the participation of representatives from each of the units and specialties described above. The project was described in detail to those individuals who are responsible for these various sectors of fundamental importance to the success of project implementation.

After suggestions of these members and minor adjustments, the project was then forwarded to the hospital's Board of Directors and was promptly approved for its importance and relevance. The facilitators of this acceptance noted the fact that the project was considered strategic for the institution, requiring few financial resources as the project is mainly based on reorganization of workflows. The project was well accepted, possibly reflecting the receptive vision of innovations and measures that increase the level of safety and quality of care, leading to better performance in external audits and improving the image of the hospital.

Following the face-to-face meetings, the specific measures to be implemented were defined, based on the possibilities of the hospital and suggestions of the members of the meetings. These included the following: institution of an educational programme, reformulation of the computerized medical prescription system for blood components and minimization of perioperative blood use (establishment of a protocol for the use of antifibrinolytics in surgery and development of a preoperative anaemia management outpatient clinic).

Results

Audit of hospital transfusion practices

As shown in Fig. 1, there is a higher prevalence of inappropriate RBC transfusions than other components. We believe that this is due to an existing culture of discussion of the cases of fresh frozen plasma (FFP) and platelet concentrates' (PC) transfusions with the transfusion specialist before the request; these numbers do not include the requests that were avoided after expert advice.

Educational programme

Despite well-defined protocols for most clinical situations, transfusion practices vary from one institution to another, reflecting different perceptions regarding the indications and use of blood components that are more based on

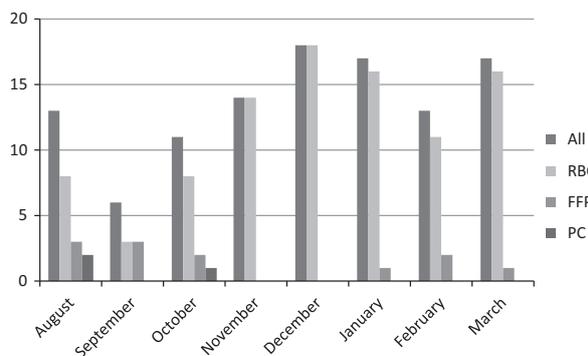


Fig. 1 Requests for transfusions with protocol deviations, from August 2016 to March 2017: the percentages of out-of-protocol requests (all requests and requests separated by components) are demonstrated. RBC: red-blood-cell concentrates, FFP: fresh frozen plasma, PC: platelet concentrates.

experience and personal belief of the prescribing physician than on adequate scientific knowledge [12]. Educational sessions, as well as direct counselling to physicians when the protocol is not followed, are associated with a significant decrease in the use of RBC concentrates [13].

In the case of this project, in March 2017, we made an update to the Institutional Protocols for Medical Residents, including a section with Guidelines for the Use of Blood. This manual is delivered annually at the admission of the new medical residents of all specialties, contemplating standardized procedures for the different areas of the hospital. In the specific case of the Transfusion Medicine section, the manual now includes information regarding the dynamics of the blood bank, the modalities of transfusion (as surgical reserve, emergency transfusion, etc.) and the management of transfusion reactions. In addition, a telephone number for direct contact with the on-call transfusion medicine specialist is provided, encouraging the discussion of cases and improving the dissemination of information.

In addition to the delivery of this manual, on the day of reception of the new residents, a lecture was also delivered to the participants of all specialties, as part of the educational programme and emphasizing the need for rational use of blood components.

Reformulation of the computerized system for the prescription of blood components

Aid in the transfusion decision provided by computerized prescription systems also offers an interesting opportunity for behavioural changes in relation to transfusion indications and greater adherence to protocols and can significantly reduce allogeneic transfusion rates and associated costs [14, 15]. In this project, changes were also proposed in the hospital computerized system for prescribing blood products, with the creation of filters with the specific

indications of the various products requested, based on the best scientific evidence currently available [9, 10].

In our proposed computerized system, the prescribing physician should include his patient in one of the categories listed (Fig. 2), providing the opportunity to reflect on the actual indication of the blood component based on current scientific evidence. The completion of the request will only occur after choosing the item related to the patient or completing the justification.

The use of these filters has not yet been incorporated into the computerized system, which is currently being reformulated as a whole. This request has been already taken to the Information Technology sector of the hospital and was approved both by the coordinator of this sector and by the administration of the hospital. The changes will take effect when the new system is implemented, scheduled for April 2018.

Protocol for the use of antifibrinolytics in surgical patients

Meticulous surgical techniques, as well as adequate anaesthetic assistance, maintenance of body temperature and hydroelectrolytic balance, can considerably help in the prevention of severe intraoperative blood loss [16]. These measures fall outside the field of specific action and control of the blood bank; however, other measures

may be guided by the transfusion medicine specialist in an attempt to achieve a better intraoperative haemostasis.

Among them is the incentive to use antifibrinolytic drugs, such as tranexamic acid and aminocaproic acid. Several studies have previously demonstrated the efficacy of these drugs in the reduction in acute bleeds in a cost-effective way, even in low-resource situations and locations [17, 18]. The use of antifibrinolytics can substantially reduce the use of allogeneic transfusions during and after various surgical procedures, with a satisfactory safety profile [19].

Therefore, a protocol was developed for the use of tranexamic acid in patients submitted to elective orthopaedic surgery at Celso Pierro hospital. According to the report of the hospital's anaesthetist team, this was already a practice of some professionals, however, sparsely and with no fixed protocol to follow.

Institution of an outpatient clinic for evaluation and management of preoperative anaemia and indication of autologous donation

The presence of anaemia in the preoperative period is directly related to the need for RBC transfusion during and after the surgical procedure, which in itself increases

RED BLOOD CELLS CONCENTRATES
Hct \leq 21% or Hgb \leq 7.0 g/dl Hct \leq 21% or Hgb \leq 9.0 g/dl and cardiovascular disease Hct \leq 21% or Hgb \leq 9.0 g/dl with acute or chronic lung disease and PO ₂ <80 mmHg Hct \leq 21% or Hgb \leq 9.0 g/dl in patients with acute tissue ischemia Acute bleeding Others (please specify)
FRESH FROZEN PLASMA
Treatment of patients with thrombotic thrombocytopenic purpura Reversal of dicumarin poisoning with bleeding or before invasive procedure Dilutional Coagulopathy Deficiency of coagulation factors: active bleeding and RNI/R \geq 1.6 Deficiency of coagulation factors: preoperative and RNI/R \geq 1.8 Other (please specify)
CRYOPRECIPITATE
Hypofibrinogenemia (<100 mg/dl) and active bleeding or preprocedure Proven dysfibrinogenemia with active bleeding Other (please specify)
PLATELET CONCENTRATES
Count less than 10 000, or less than 20 000/mm ³ with other risk factors Count \leq 50 000/mm ³ with bleeding or preprocedure Count \leq 100 000/mm ³ with Central Nervous System bleeding Count \leq 100 000/mm ³ before neurosurgery or ophthalmic surgery Count \leq 100 000/mm ³ after Cardiopulmonary Bypass Congenital or acquired bleeding platelet dysfunction (specify) Other (please specify)

Fig. 2 Filters with the possible indications of the various blood components available for medical prescription at Hospital Celso Pierro. To finalize the request, the prescribing physician must choose, among the available items, the one that is appropriate for the clinical situation of the patient to be transfused.

morbidity and mortality in the postoperative period [20–22]. Current evidence suggests that patients who undergo elective orthopaedic surgeries, for example, ideally have their haemoglobin levels measured at least 28 days in advance of the procedure [23]. Patients with anaemia should then be investigated and treated for nutritional deficiencies (mainly iron deficiency), chronic renal failure or concomitant inflammatory diseases, as normalization of preoperative haemoglobin levels is associated with better outcomes in these patients [24].

In relation to the transfusion requests related specifically to surgical procedures (an important focus of PBM projects), we chose, as a pilot, the orthopaedic specialty to verify: adequacy of the number of RBC requested for each surgery, percentage of patients submitted to surgery previously presenting with anaemia and the relation of the presurgical haemoglobin levels with the need for intra- and postoperative transfusion. This specialty was chosen following the trend of what was done in other PBM programmes in other continents [23, 25], and considering the fact that this specialty does not generally have patients that require specific transfusion triggers or that require large volume transfusions (as in the case of cardiac surgeries), which facilitates their evaluation.

Considering only orthopaedics, from August 2016 to March 2017, 537 requests for preoperative blood reservation were received by the blood bank, corresponding to 357 patients, of which 147 (41.2%) were female and 210 (58.8%) were male. The common preoperative practice in our hospital was the 'standard' request of two RBCs for all patients, even for those who underwent simple procedures.

To assess the prevalence of anaemia in this group of patients, cut-off points were as follows: haemoglobin levels below 13 g/dl for male patients and 12 g/dl for female patients. According to these criteria, there was a prevalence of anaemia of 47.8% in the preoperative period (55.7% of the male patients and 36.7% of the female patients). Of these patients, 44.4% required transfusion of RBC concentrates in the perioperative period (39.3% of men and 55.5% of women). This number differs significantly from that found in the group of patients who had normal haemoglobin levels prior to surgery: only 7% of these patients required transfusion of packed RBC intra- or postoperatively. These results confirmed the association between preoperative anaemia and the need for transfusion of RBC, as previously described in other studies [26, 27].

Therefore, we proposed the implementation of a Preoperative Anemia Evaluation Outpatient Clinic. This service is intended for patients diagnosed with anaemia prior to elective surgeries (therefore, with possibility of timely evaluation by a haematologist and treatment of possible

identifiable causes). For the creation of the clinic, close contact among the various agents involved was necessary: the blood bank coordinator, the outpatient clinics coordinator, nursing coordinator, laboratory coordinator and medical coordinators of the orthopaedics and anaesthesiology.

Two additional appointments were added per week in the existing Hematology Outpatient Clinic. This initial pilot project would include only the patients undergoing major orthopaedic surgeries (hip and knee arthroplasty), with haemoglobin levels lower than 11 g/dl.

When a patient is identified as fulfilling these criteria during the pre-anaesthetic consultation, the anaesthesiologist refers them to the Preoperative Anemia Outpatient Clinic, together with a request for laboratory tests containing: complete blood counts, iron profile, vitamin B12 level, haemoglobin electrophoresis, evaluation of renal and thyroid function (other tests are requested in cases of a specific clinical indication). To assure greater efficiency to the process, blood sampling is performed immediately after the end of the consultation with the anaesthesiologist. A specific stamp was used in these requests for laboratory tests, identifying this collection as a priority. Thus, the patient can be evaluated by the haematologist within a maximum of 1 week.

Injectable iron can be administered in the hospital; this is an established routine for other patients seen in the haematology outpatient clinic. Orthopedics and Anesthesia teams were also advised as to the possibility of collecting autologous blood for patients who are undergoing surgeries with high probability of bleeding.

In the operating models that were proposed for this new outpatient clinic, there was no need to hire new physicians nor did the dynamics of the other clinics and the laboratory suffer any interference, factors that also contributed to the acceptance and implementation of the project. This workflow can be seen in more detail in Fig. 3.

Discussion

The implementation process of this specific PBM programme, from the idealization and study to the final stages of implementation, has provided a rich experience regarding the perception of potentialities and peculiarities in the transfusion services, not yet properly explored in Brazil.

This work demonstrated the importance of the appropriate and dynamic use of patient blood management measures without increasing costs or requiring large financial contributions. In fact, decision-making and engagement of stakeholders who until then did not know much regarding the topics of this project enabled the

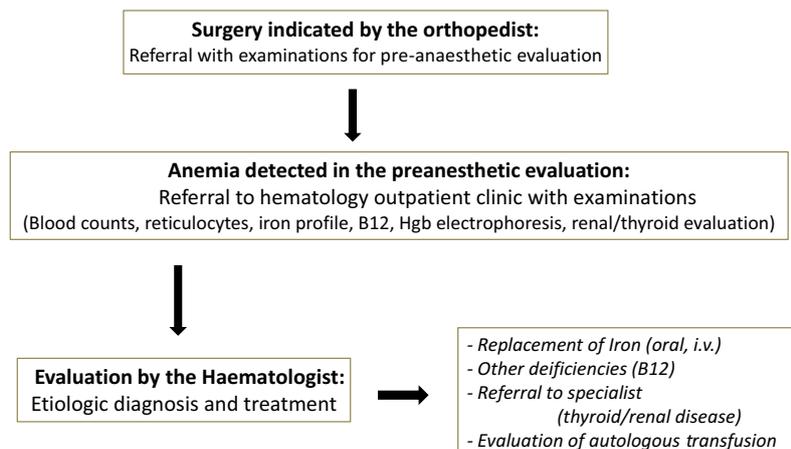


Fig. 3 Preoperative Anaemia Evaluation Outpatient Clinic workflow.

realization of the project with no need to raise funds beyond those until then made available by the hospital.

The absence of need for additional financial resources made the acceptance and applicability of the process more immediate. Another positive point in favour of the continuation and acceptance of this project by the other sectors of the hospital may have been the great impact that the issue of blood inventories exerts, as situations of shortages and eventual cancellation of procedures and surgeries have been seen by most of these professionals or at least construed as a potentially real situation in the future.

In addition, the project, due to its multidisciplinary nature, allows the interaction between several areas and medical specialties, which results in more comprehensive assistance to the patient, qualifying the process of patient care as a whole. In this respect, the implementation of the project was considered strategic by the hospital's senior management, composing measures that increase patient safety and quality of services provided, and which certainly leads to a better image of the hospital in external audits and accreditation processes, for example.

However, we should also point out that without investment, PBM programmes tend to stagnate. What we described in this work are basic and elementary measures; however, there is a much wider range of activities and procedures that can and should be performed to achieve the objective of rationalizing the consumption of blood components and maintaining inventories in a darker future scenario of shortages. In this era of more specialized and more costly procedures, we can mention the possibility of dissemination of more robust and refined surgical techniques, such as minimally invasive techniques using laparoscopy and robotics. In the same way, the vast majority of Brazilian hospitals (mainly in the public sector) cannot afford on technologies that also have the potential to minimize the unnecessary use of

blood components. We must emphasize that we still lack more basic elements that could positively influence PBM programmes. For example, we do not have medications such as erythropoietin (only available in the public system for anaemia secondary to chronic kidney disease), or even injectable iron formulations, which are not freely available to the general population.

Another important point that merits consideration in national policies affecting transfusion medicine in Brazil is the expansion of haematology and transfusion medicine in the curricula of Brazilian medical schools. This is an area that has not been adequately addressed in most Brazilian medical undergraduate courses, which is evident on transfusion practices that are not always updated or consistent with the patients' clinical situation. Likewise, continuing education programmes (inside and outside PBM programmes) should be encouraged and should other professionals (such as nursing staff and laboratories).

Another aspect to be emphasized in the PBM programmes is the role of the Transfusion Committees during their implementation and also for their monitoring and improvement. In the specific case of the Celso Pierro hospital Transfusion Committee, the meetings were scheduled quarterly until 2016 and consisted of designated members (medical specialty coordinators, nursing coordinators, hospital administration, etc.). However, a recurring problem was the low attendance by designated members, even with prior scheduling and reminders of meeting dates by email. It is worth mentioning that, despite the fact that all the members who were active and decisive for the implementation of this PBM were also members assigned to the Transfusion Committee, the development of the project was carried out with several meetings outside this committee. Therefore, to optimize the use of time and better efficiency in the processes, since the beginning of 2017, the meetings have been convened every

2 months and no longer quarterly, and the designated members have been questioned regarding their absence by the President of the Committee, who evaluates the need for a gradual change in members according to the suggestion of names that would attend more frequently.

In the special case of the PBM programme developed for the Celso Pierro hospital, for the moment, the project is incipient, with simpler measures and limited scope, however, with the expectation of a future re-evaluation with positive results. These results will be important for the consolidation and expansion of the project, insofar as they will justify the need to raise more resources and investments for continuation and growth. This could include, for example, the hiring or relocation of medical specialists, and the implementation of new technologies (such as intraoperative red cell recovery devices). This model, currently in application and shaped for the reality of Brazilian public hospitals, can hopefully be expanded to other centres, not only in Brazil and Latin America, with adaptations that reflect the scope and capacities of each institution.

Conflicts of interest

The authors declare no conflicts of interest.

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