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Patient Blood Management PBM: an effective, safe, cost-effective and evidence-based way to provide medical treatment in the face of scarcity of blood bags caused by the COVID-19 pandemic

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(ENGLISH TRANSLATION)

Abstract

Introduction: The COVID-19 pandemic caused a significant shortage of blood stocks in several countries. Different strategies used in this scenario, such as suspension of elective surgeries, calling for more donors and loosening of regulations used in blood centers have limitations. The objective of this study was to evaluate the effectiveness, safety and cost-effectiveness of a set of medical care called Patient Blood Management (PBM) through a narrative review of the literature.

Methods: Non-systematic literature search, without restriction of type of study, date or language, in the scientific databases: MEDLINE, LILACS, EMBASE, Cochrane Library, SciELO, Scopus and Web of Science.

Results: Randomized clinical trials and meta-analysis of observational studies demonstrated that the use of PBM promoted a reduction in blood transfusions, length of hospital stay, complications such as acute renal failure, infection, thromboembolic events, and mortality. Economic analysis studies have observed significant savings in financial resources in the places where the PBM was implemented.

Conclusion: PBM is effective, safe and cost-effective, promoting a reduction in blood transfusions, improving clinical outcomes and saving financial resources, characteristics that make it relevant in the face of a health system overburdened by the pandemic.

Keywords: Blood Conservation, Bloodless Medical and Surgical Procedures, Blood Transfusion, Coronavirus Infections, Coronavirus

Introduction

The World Health Organization (WHO) has declared Coronavirus Disease 2019 (COVID-19), caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), a pandemic.[1] According to data provided by WHO, more than 3 million of people have been infected worldwide, with more than 200,000 deaths[1]. In many countries, medical care is hampered by a critical shortage not only of hand sanitizers, personal protective equipment, ventilators and hospital beds, but also impediments to the supply of donated blood.[2]

Iran showed a significant reduction in blood donations compared to previous years after the COVID-19 outbreak, resulting in a stockpile of less than three days, considered a critical level. This reduction was due to precautions related to COVID-19 issued by government and social media to avoid unnecessary crowds and displacements.[3] In Italy there was a 10% drop in donations per week with the onset of contagion.[4] Washington State in the States -Unidos showed a precipitous drop in donations with the onset of the outbreak.[5] In fact, in all the United States, numerous hospital collections were canceled due to institutional concerns regarding donors who could contaminate hospitalized patients with COVID-19 or vice versa . These cancellations resulted in a drop of 130,000 blood donations in just a few weeks.[2] In Brazil, news reported by the media mentioned high drops in donations in several locations, reaching 80% in some blood banks.[6]

Different strategies are used by blood centers to mitigate the impacts of the pandemic that causes shortage of blood supplies, such as canceling elective surgeries, calling more donors and relaxing some regulations used in their procedures. However, such strategies have their limitations.[2] A set of medical care, called Patient Blood Management (PBM), can contribute to facing these challenges posed by the COVID-19 pandemic. The aim of this study is to assess the scientific evidence of the efficacy, safety and cost-effectiveness of PBM through a narrative review of the literature.

Methods

The present study is a narrative review. The literature search was carried out in a non-systematic way, without restriction of study type, date or language, in scientific databases: MEDLINE, LILACS, EMBASE, Cochrane Library, SciELO, Scopus and Web of Science. The following descriptors were used: blood donors, blood transfusion, bloodless medical and surgical procedures, blood preservation, operative blood recovery, anemia, coronavirus. Studies whose abstracts were related to the theme were read in full, categorized using the Mendeley® reference manager and critically analyzed.

Results and discussion

Strategies used to face the scarcity of blood bags and their limitations

Faced with the abrupt and vertiginous reduction in blood donations, different strategies were and still are adopted by the affected countries. A standard response is the suspension of elective surgeries.[3] However, urgent and emergency surgeries, which may be accompanied by large blood loss, cannot be included in this strategy. In addition,

[1] Data acccesed at https://covid19.who.int on April 29th, 2020

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depending on the type of elective surgery canceled, postponing the surgery may allow the disease to worsen, resulting in a more complex and urgent situation.[2]

Another commonly used strategy is to move blood bags from blood centers from the least affected areas of the country to those most affected, in order to keep the stock stable.[3,5] In addition to this measure having the potential to harm supplying blood centers in times of pandemic, supply chains are often affected by travel restrictions, plant closures and decreased production, which in turn can affect the ability of blood centers globally to maintain their testing and production facilities in times of increasing demand.[2]
Calling more donors is another measure used by several countries to address the shortage of blood supplies.[3,7] These campaigns need to be accompanied by changes in the logistics of donations, such as: providing more personal protective equipment for employees and donors , increased disinfection of all contact surfaces in blood centers, expansion of service hours and changes in the scheduling of donations to avoid crowding[3,5]. Scheduling changes impose a physical limit on the number of donors that can be present simultaneously at the collection site. In addition, during a pandemic, the pressure on blood collection facilities and their staff intensify, as more staff members need to be quarantined or become ill[8], while personal protective equipment and disinfectants become increasingly scarcer.[2]

Another worrying factor is the possibility of transmission of the SARS-CoV-2 virus through blood transfusion. Although transmission of the virus through transfusion has not been proven, the presence of viral RNA has already been detected in donated blood by asymptomatic infected people.[9] Korean researchers reported the existence of donors who, despite intensified screening, turned out to be confirmed cases of COVID-19 after blood donation.[10] As the pandemic progresses, a considerable percentage of the population is expected to be infected with SARS-CoV-2, including young blood donors who, attracted to donation by intensified campaigns, may be asymptomatic carriers or be in the incubation phase.[2] However, the infectivity rate of people who are in the incubation period remains uncertain and there are no data on the viral load in the plasma, serum or lymphocytes of individuals during this period.[11]

The American Food and Drug Administration (FDA) has published a series of recommendations to be used by blood centers during the duration of the pandemic to avoid a shortage of blood supplies.[12] Among these recommendations are: release blood centers from discarding collections for errors in donor blood pressure, pulse, weight, or donation interval; allow 72 hours for blood centers to clarify donor responses or information omitted after collection, instead of 24 hours; allow release of source plasma 45 days after collection from paid donors instead of 60 days. In Washington State, the blood center laboratory developed processes to split platelets if shortages became severe and began devising new bacterial testing procedures to prolong platelet expiration from 5 to 7 days.[5] Although the FDA mentions the recommendations published do not compromise the safety of the blood collected or of the donors[12], such guidelines constitute a relaxation of the norms usually employed by blood centers to promote a high level of safety.

Patient Blood Management: definition and origin

Given the limitations of the aforementioned strategies, the medical community must adopt new solutions in order to effectively and safely provide medical treatment for patients. Something that can make a strong contribution to this challenge is the implementation of

Patient Blood Management (PBM). PBM is defined as a set of evidence-based care to optimize patients' medical and surgical outcomes by managing and clinically preserving the patient's own blood (www.ifpbm.org). Another definition is the timely application of evidence-based medical concepts designed to maintain hemoglobin concentration, optimize hemostasis and minimize blood loss in an effort to improve patient outcomes (www.sabm.org).[2]
The term Patient Blood Management (PBM) was first used in 2005 by Professor James Isbister, an Australian hematologist, who concluded that the focus of medicine should be shifted from blood products to patients.[13] Something that contributed to develop the concept of PBM was the scientific evidence that had been accumulating over the decades about the effects of blood transfusions.[14]

Blood Transfusion and Evidence-Based Medicine

Blood transfusion is a widely used medical treatment and was the most frequently performed procedure during hospital admissions in 2011 in the United States.[15] Empirically applied in the 1800s to reduce hemorrhage-related deaths in childbirth, blood transfusion showed an exponential growth after the discovery of blood typing in the early 20th century and the trauma produced by the two world wars.[14] However, over the years, published studies began to associate blood transfusion with worse clinical outcomes as well as questioning the lack of scientific evidence about its effectiveness.[16,17]
In fact, according to Carson et al., we know very little about the benefits of blood transfusion.[18]

Randomized clinical trials are the type of primary study with the highest level of scientific evidence and are currently used for approval of new drugs by regulatory agencies. However, such studies comparing blood transfusion with placebo have never been performed both before and after the release of blood transfusion for medical use.[18] For these reasons, Kumar mentions that the transfusion was never subjected to safety and efficacy assessment by the FDA. .[19] Although RCTs comparing blood transfusion with placebo have not been performed, several RCTs comparing a liberal versus a restrictive transfusion strategy have been conducted.[20–22] A systematic review with meta-analysis of these RCTs has shown that a more restrictive strategy has decreased the blood transfusions as well as mortality.[23]
The main purpose of blood transfusion is to improve tissue oxygenation. However, a systematic review of the literature that evaluated the effects of blood transfusion on tissue oxygenation in critically ill patients concluded that in most studies (11/17) transfusion did not improve tissue oxygenation or microcirculation.[24]

A systematic review with meta-analysis of observational studies that evaluated the effectiveness of blood transfusion on clinical outcomes in critically ill patients found 45 studies covering 272,596 patients.[25] In 42 of 45 studies, the risks of transfusions outweighed the benefits. Another systematic review that included only observational studies containing more than 1000 patients found that most studies showed a statistically significant higher mortality rate in patients who received transfusion compared to those who did not, even when these rates were adjusted for factors of confusion.[26] The harms observed with blood transfusion are mainly attributed to the deleterious effects that the transfusion can generate on the recipient's immune system, called immunomodulation associated with transfusion[27], as well as the morphological, biophysical and biochemical changes that

occur in stored red cells, some of them irreversible[28], that could harm their physiology, called storage injury.[29]

A possible explanation for the association between blood transfusion and worse clinical outcomes present in observational studies is that patients with a worse prognosis are precisely the patients who receive a greater indication for blood transfusion.[30] In fact, the association does not imply in causality. In order to confirm a causal link Austin Bradford Hill proposed nine criteria, many of which he and Richard Doll used in establishing the causal link between smoking and lung cancer.[30] Isbister and colleagues applied these same criteria to analyze the effects of blood transfusion and concluded that all criteria were met in the causal link between blood transfusion and adverse outcomes.[16]

The transfusion issue becomes even more complex and confusing when analyzing the quality of the guidelines that recommend this treatment. A systematic review of the literature that analyzed the quality of these guidelines using the main instrument for assessing methodological rigor in guideline development called the Appraisal of Guidelines for Research & Evaluation II (AGREE II) concluded that there was limited rigor in developing these guidelines, in addition to duplications and inconsistencies in recommendations for the same topic.[31]

Patient Blood Management (PBM) and Evidence-Based Medicine

Parallel to the findings on the deleterious effects of blood transfusion, the principles of PBM were being developed and improved.[32] The concept of PBM proactively focuses on the patient's needs and the conditions that usually lead to transfusions, such as blood loss, coagulopathies, platelet dysfunction and anemia. PBM shifts the focus from reactive transfusion of patients with allogeneic blood components to preventive measures, optimally managing the patient's own blood.[2]

Several randomized controlled trials have been published demonstrating better clinical outcomes using PBM principles.[33–35] A systematic review with meta-analysis covering 17 observational studies and 235,779 patients concluded that the use of PBM is associated with a reduction in blood transfusions, in the time to hospital admission, complications such as acute renal failure, infection, thromboembolic events, and mortality.[36]

Economic analysis studies have also shown significant cost savings when using PBM.[37,38] Published experience of implementing a PBM program in the Canadian city of Ontario reports savings of around 45 million Canadian dollars per year for the entire system [39] A retrospective study that evaluated the impacts of implementing PBM in four Australian high-complexity hospitals concluded that the program reduced transfusions by 41%, representing direct savings of US$18 million and between US$78 million to US$97 million indirectly.[40]

Different medical societies were created to contribute to the development and dissemination of the PBM concept. Among them, it is relevant to mention the Society for the Advancement of Patient Blood Management (SABM) in the United States (http://sabm.org/), the Network for the Advancement of Patient Blood Management, Haemostasis and Thrombosis (NATA) in Europe (https://nataonline.com/) and the International Foundation for Patient Blood Management (IFPBM), an international society (https://www.ifpbm.org/).

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The concept of PBM was approved in 2010 by the World Health Assembly through resolution WHA63.[12] and was the focus of the Global Forum for Blood Safety promoted by the WHO in 2011.[41] In 2017 it was recommended as a standard of care by the European Commission and in 2019 it became Standard for patient management in all hospitals in Australia.[42,43] The Joint Commission International (JCI), the world leader in certifying healthcare organizations, promotes PBM as an effective modality of quality improvement for hospitals and other organizations of health care.[14]

Despite these recommendations and the available evidence that PBM is not just an option, but a necessity, the change in practice is still far from what is desired. A prospective study carried out in European and Canadian centers to evaluate the use of PBM principles observed a significantly different incidence of transfusion between centers for the same surgical procedures, such as total hip arthroplasty (range 7 to 95%), total knee arthroplasty (range, 3 to 100%) and coronary artery bypass graft surgery (range, 20 to 95%).[44] In fact, the existence of scientific evidence, even if at a high level, may not be able to promote changes in medical practice. [45]

In the current pandemic scenario, both the severe limitations of available health resources and the growing scarcity of blood clearly demonstrate that the need to implement the PBM is even more urgent. The intense demand for support to health professionals, provision of products and adequate infrastructure to care for patients who occur during a pandemic consume a large amount of financial resources from health institutions, both public and private. Strategic implementation of PBM can be of great help by providing an approach that not only improves patient outcomes, but is also cost-effective.[39] In addition, PBM's improvements in clinical outcomes, such as reducing infections, renal failure and length of hospital stay can further reduce the burden of an overburdened health care system.[2]

Pillars of Patient Blood Management (PBM)

PBM seeks better patient outcomes by relying on the patient's own blood rather than the donor's blood and goes beyond the concept of appropriate use of blood products because it significantly anticipates and reduces transfusion indications by addressing risk modifiable factors that can increase the risk of a transfusion indication long before a transfusion is considered.[46] Such goals can be achieved through the so-called three pillars of PBM, which are strategic to implement the PBM paradigm shift: 1) optimize erythropoiesis of the patient; 2) minimize bleeding; and 3) take advantage of and optimize the specific physiological reserve of patients with anemia.[46]

Several guidelines have been published for the use of PBM in different clinical situations, such as: Massive Hemorrhage[47], Surgery[48], Intensive Care Unit[49], Obstetrics and Gynecology[50], Neonatology and Pediatrics[51], Oncology[52] among others. Australia's National Blood Authority has also published a series of evidence-based PBM guidelines drawn from an exhaustive systematic review of the literature and rigorous methodology for developing recommendations (available at https://www.blood.gov.au/pbm-guidelines).[53–59] In addition, a step-by-step Guidelines for implementing PBM at the hospital level[60] as well as at the national level[61] have also been published.

According to Shander et al.[2], healthcare and medical leaders are called upon to improve their infrastructure and institutional processes to implement the following five recommendations:

1) **Identify, assess and treat iron deficiency and anemia in clinical and surgical patients with appropriate pharmacological agents.[62]**

Prevention, early diagnosis, and prompt treatment guided by the etiology of anemia can decrease the indication for blood transfusion and improve patient outcomes.[2] Iron deficiency, with and without anemia, is common and can be treated with oral supplementation or intravenous iron.[62] Oral therapy is often poorly tolerated, has a slower onset of action than intravenous iron, and is insufficient to correct iron deficiency in the presence of ongoing bleeding. Intravenous iron therapy is preferred for those with intolerance to oral therapy, severe anemia (hemoglobin <10 g/dL) or surgical procedures planned in less than six weeks.[62] Systematic review with meta-analysis of randomized clinical trials concluded that the administration of Intravenous iron is not associated with an increase in adverse events, such as anaphylaxis, or infection.[63]

A serum ferritin level < 30 ng/mL is the most sensitive and specific test used to identify absolute iron deficiency. However, in the presence of inflammation (C-reactive protein > 5 mg/dL) and/or transferrin saturation < 20%, a serum ferritin level < 100 ng/mL is indicative of iron deficiency. When treating preoperative anemia, the target hemoglobin (Hb) concentration should be ≥ 13 g/dL in both sexes, to minimize the risk of unfavorable outcomes associated with transfusion, especially in patients with predicted blood loss above 500 mL.[62]

The total iron deficit (TFD) can be calculated using the Ganzoni formula: DTF (mg) = weight (kg) × (ideal Hb - current Hb) (g / dl) × 0.24 + 500 (mg iron from deposit). According to this formula, a person weighing 70 kg with an Hb level of 9 g/dl would have a body iron deficit of about 1400 mg.[64]

In Brazil, there are currently two iron formulations for intravenous application: iron sucrose (Noripurum® 100 mg) and ferric carboxymaltose (Ferinject®).[65] Iron sucrose can be administered up to 300 mg a day, with each vial containing 100 mg of iron. A possible administration is 200 mg (2 vials) diluted in 200 ml of 0.9% sodium chloride solution, infused within 2 hours, three times a week, until replacement of the total calculated iron deficit.[66] Ferric carboxymaltose, on the other hand, can be administered intravenously at a dose of 15 mg/kg, with a maximum dose of 1000 mg, with each vial containing 500 mg. A possible administration is 500 mg (10 ml) diluted in 100 ml of 0.9% sodium chloride, in 20 minutes, twice a week, until replacement of the total calculated iron deficit.[33] The main contraindications of iron by intravenous route are known hypersensitivity to medication and situations of iron overload.

Most patients have a rapid response to intravenous iron infusion, with an increase in hemoglobin of 50% in 5 days, 75% in 10 to 14 days, and maximum in 3 weeks.[62] Anemia related to other nutritional deficiencies, like folate and vitamin B12, can, in many cases, be corrected with oral therapy, with folate and vitamin B12 typically given at a dose of 1 mg per day.[2]

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In the scenario of a pandemic, performing preoperative evaluations and laboratory tests may be more problematic. Telemedicine consultations have become much more widespread, making it possible to remotely investigate the most common symptoms of iron deficiency and anemia: fatigue/tiredness; mental confusion; palpitations, shortness of breath; dizziness; aching and restless legs; alopecia, brittle nails, and pica (appetite for non-nutritive substances).[67] Patients with these symptoms should be referred for therapy with iron supplementation.

Erythropoiesis-stimulating agents are exogenous forms of erythropoietin, including erythropoietin alfa, longer-acting darbepoetin alfa, as well as other emerging forms of erythropoietin that can be used to stimulate erythropoiesis. Its main contraindications are the presence of uncontrolled hypertension and medication hypersensitivity. In preoperative patients with severe anemia (hemoglobin < 10 g/dL), the administration of erythropoietin at a weekly dose of 600 IU/kg subcutaneously or intravenously, on days 21, 14 and 7 before surgery and on the day of surgery, has the potential to promote higher hemoglobin levels.[2] A 60 kg patient would need 36,000 IU weekly, which could be provided with 9 vials of 4000 IU of erythropoietin each, diluted in 20 mL of saline in 20 minutes intravenously. A double-blind placebo-controlled randomized clinical trial published in the Lancet journal demonstrated that even a dose on the day before surgery of 40,000 IU of subcutaneous epoetin alfa, together with the administration of 20 mg/kg of ferric carboximaltose, 1 mg of subcutaneous vitamin B12 and 5 mg of oral folic acid, reduced blood transfusions, with no increase in adverse events.[34]

2) Identify and quickly treat coagulation or hemostatic problems in the perioperative period.[48]

Coagulopathy, when not readily recognized and corrected, can perpetuate a cycle of bleeding, blood utilization, and patient morbidity. The guidelines of the European Society of Anesthesiology recommend preoperatively conducting a structured patient interview or using a standardized questionnaire that considers the patient's clinical history, family history of bleeding, and detailed information about the patient's medications. These guidelines consider the use of standardized questionnaires more relevant than the routine use of conventional coagulation screening tests, such as Partially Activated Thromboplastin Time (PTT), International Normalized Ratio (INR) and Platelet Count.[48] A questionnaire designed for screening patients at high risk of bleeding, consisting of seven questions, called HEMSTOP, had a specificity of 98.6% and a sensitivity of 89.5% in patients who had two or more positive responses (Table 1).

The use of hemostatic agents, such as fibrin sealants, can reduce blood loss and indications for blood transfusion, as demonstrated in a systematic review with meta-analysis of randomized clinical trials.[69] Antifibrinolytic agents, such as tranexamic acid, are broadly pharmacological agents available, inexpensive, highly effective, and safe that can be used to stabilize clot formation and reduce bleeding.[2] Meta-analysis of randomized clinical trials has shown that a single preoperative intravenous bolus dose of tranexamic acid resulted in less blood loss and blood transfusion in a variety of surgical specialties, without increasing thromboembolic events, the most used dose being 15 mg/kg.[70] Tranexamic acid is sold in 1 mL vials containing 50 mg of the compound and can be administered directly intravenously, without any type of dilution, slowly (1 ml/min). Its absolute contraindications are the presence of disseminated intravascular coagulation and a state of hypercoagulation.[67]

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3) Use all effective methods of blood conservation in clinical and surgical patients.[71]

According to guidelines from the Association of Anesthesiologists of England, the use of intraoperative blood recovery equipment (Cell Saver) is recommended when it is expected to reduce the likelihood of blood transfusion and/or severe postoperative anemia. These same guidelines encourage and recommend that it be available for immediate use 24 hours a day in any hospital performing surgery where blood loss is a recognized potential complication.[72] Systematic review with meta-analysis of randomized clinical trials demonstrated that the use of intraoperative recovery of cells not only reduced blood transfusion, but also the risk of infection and the length of hospital stay.[73]

Acute normovolemic hemodilution (ANH) is another option that can be considered individually to reduce blood transfusion.[74] After anesthesia induction and before heparinization, a specific amount of whole blood volume is removed from the patient and temporarily stored at the edge of the bed. This is followed by replacement with sufficient volumes of crystalloid or colloid solutions to maintain intravascular volume. Hemodilution reduces the patient's hemoglobin concentration throughout the surgery, therefore, less red blood cells are lost during hemorrhagic events. Stored autologous blood, rich in red blood cells, platelets, and coagulation factors, is then returned to the patient intraoperatively as needed.[74] A systematic review with meta-analysis of randomized clinical trials in cardiac surgery concluded that HNA reduces blood loss and blood transfusions.[75]

The randomized clinical trial Transfusion Requirements in Critical Care (TRICC trial), published in 1999, concluded that a restrictive transfusion strategy (maintaining Hb > 7 g/dL) is at least as effective and possibly superior to a liberal strategy (maintaining Hb > 10 g/dL) in critically ill patients.[20] This study is considered the most impactful in the history of transfusion medicine.[76] Several randomized clinical trials were published later comparing a restrictive strategy with a liberal one in different scenarios. One of them, called TRACS trial, carried out at the *Instituto do Coração* (InCor) at the *Hospital das Clínicas of the Faculty of Medicine of USP* (HCFMUSP), concluded that a restrictive strategy is effective and safe in patients undergoing cardiac surgery and that blood transfusion was a risk factor for complications, including mortality. A systematic review with meta-analysis of these randomized controlled trials concluded that a more restrictive transfusion strategy reduces blood transfusion and mortality.[23]

In addition to not using a liberal transfusion strategy, another essential measure to reduce blood transfusions is to limit iatrogenic blood loss in both clinical and surgical patients, which often occurs through diagnostic phlebotomy.[77] Methods to reduce iatrogenic blood loss include minimizing unnecessary blood draws and using small vacuum pediatric blood collection tubes.[78]

4) Carefully monitor the condition of patients after surgery and intervene quickly by interventional radiology and/or endoscopy for unexpected bleeding, depending on the source.[2]

Postoperative patients should be constantly monitored for the presence of bleeding through the assessment of hemodynamic parameters, amount of fluid present in drains and physical examination. In patients with suspected bleeding or coagulopathy, viscoelastic coagulation tests such as thromboelastography (TEG) and rotational thromboelastometry

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(ROTEM), which are bedside tests that show the full capacity of clot formation, can be used for rapid identification of coagulation abnormalities. A systematic review with meta-analysis of randomized clinical trials concluded that the use of these tests can reduce the use of all types of blood transfusions and improve morbidity in patients with bleeding.[79] The digital hemoglobinometer has high sensitivity and specificity for diagnosing anemia and it is another resource that can be used at the bedside.[80] The rapid use of interventional radiology or endoscopy can allow bleeding control depending on the source.[2]

5) Inform and educate physicians, patients and their caregivers about the importance of PBM.[81]

It is well documented that the publication of scientific evidence, even at a high level, is insufficient to produce changes in medical practice.[82] Clinical practice is influenced by a multitude of social, cultural and environmental factors.[83] In addition, the implementation of new evidence depends on physicians' willingness to change their clinical practice by implementing an evidence-based clinical intervention or by disapplying an obsolete, non-evidence-based practice. When doctors judge situations, make decisions and solve problems, they routinely use cognitive shortcuts, also called 'heuristics', to make the decision-making process simpler, faster and less tiring. While mental shortcuts can help clinicians make decisions in a short amount of time, they also have the potential to impede rational, evidence-based decisions.[84]

Studies evaluating the level of knowledge in transfusion medicine among physicians and residents show that this level of knowledge is low. An international study of internal medicine residents with a previously validated test to assess "transfusion medicine-related knowledge that is absolutely essential for non-transfusion medicine specialists" found an average accuracy of 45.7%.[85] In another study that evaluated the knowledge of physicians in a tertiary hospital with a validated test, the average of correct answers was only 47.8%.[86]

Among the most common barriers reported in studies to implement the PBM are prior knowledge and beliefs about the intervention, access to knowledge and information, and tension to change.[87] Interventions to overcome such barriers include information distribution (eg, pamphlets, social media), training local opinion leaders, creating online learning portals, conducting educational sessions, developing protocols and guidelines, conducting educational visits, providing technical assistance, implementing performance dashboards, conducting auditing with feedback and reminders, involving patients and families, and conducting a needs assessment.[87] A systematic review with meta-analysis of different types of behavior modification interventions has shown that they are effective in reducing blood transfusions when implemented.[81] Certainly, in a pandemic scenario, the faster and easier interventions to implement should be prioritized.

Experience published by Benites and Addas-Carvalho demonstrates that a PBM program can be implemented in a Brazilian public university hospital without increasing costs or requiring large financial contributions.[88] According to the authors, the implementation of PBM, due to its multidisciplinary nature, allows for interaction between different areas and medical specialties, which results in more comprehensive patient care. According to Benites and Addas-Carvalho, the implementation of the PBM was considered strategic by the hospital's senior management, comprising measures that increase patient safety and the quality of services provided, which certainly leads to a better image of the hospital in external audits and in accreditation processes.[88]

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Limitations

The present study is a narrative review of the literature. Narrative review articles are broad publications suitable for describing and discussing the development or 'state of the art' of a given subject, from a theoretical or conceptual point of view.[89] Despite the impossibility of reproducing their methodology and the possibility of bias selection, narrative reviews have a fundamental role in continuing education as they allow the reader to acquire and update knowledge on a specific theme in a comprehensive manner in a short period of time, which is relevant in a pandemic scenario.[90]

Conclusion

Given the enormous challenges posed by the COVID-19 pandemic that have affected healthcare systems around the world, different medical contributions, whether large or small, can help provide the care that patients need. The implementation of PBM in hospitals, which until then was necessary and important, became with the pandemic necessary, important and urgent. May this moment of crisis contribute so that health leaders and physicians are sensitized to provide primordial attention to the concept of PBM, as well as to carry out the essential actions to implement this effective, safe, cost-effective treatment modality and evidence-based practice.

Table 1. HEMSTOP Questionnaire

1. Have you ever seen a doctor or been treated for prolonged or unusual bleeding (such as nosebleeds, minor injuries)?
2. Do you have bruises/bruises larger than 2 cm without trauma or severe bruises/bruises after minor trauma?
3. After a tooth extraction, have you ever had prolonged bleeding that required a medical/dental visit?
4. Have you ever had excessive bleeding during or after surgery?
5. Is there anyone in your family who suffers from a clotting disorder (such as hemophilia, von Willebrand's disease, etc.)?
For women: 6. Have you ever seen a doctor or been treated for heavy or prolonged menstrual flows (birth control pill, iron, etc.)?
7. Have you had prolonged or excessive bleeding after giving birth?

As published by Bonhomme et al.[68]

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