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Blood management during the COVID-19 pandemic

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■ ABSTRACT

The worldwide COVID-19 pandemic has required healthcare systems to implement strategies for effective healthcare delivery while managing blood supply chain disruptions and shortages created by infection-limiting practices that have reduced blood donations. At Cleveland Clinic, we have made multiple synchronous efforts: a call for increased blood collection, alignment of efforts among transfusion medicine departments (blood banks), enhanced monitoring and triage of blood product use, and increased education on patient blood management practices regarding blood utilization and anemia management. In addition, we created an algorithm to assess anemia risks in patients whose elective surgery was cancelled to optimize preoperative hemoglobin levels.

■ INTRODUCTION

The worldwide COVID-19 pandemic has created a need for healthcare providers to respond, innovate, and adapt quickly to address the continued demand for emergency care and necessary healthcare services amid this pandemic. Thus, healthcare systems have had to determine how best to care for patients, keep caregivers safe, and manage supply chain disruptions and shortages, including shortages in blood products.

In March 2020, states began issuing social distancing guidelines and escalated school and business closures. In response, healthcare facilities cancelled all elective surgical procedures and nonessential care. These measures also caused cancellation of blood drives and reduced the number of blood donors who could be at a collection site, which severely affected the availability of blood products.¹ Blood centers and

hospitals have had to collaborate to ensure continued blood collections.²

At the start of the COVID-19 pandemic in Ohio, blood suppliers for the Cleveland Clinic informed us of the potential for blood shortages and a possible 25% cutback of standard inventory orders, creating a need to adjust inventory and blood utilization. Blood utilization services include transfusion medicine (blood bank) and patient blood management (PBM) departments. Plans were instituted to actively monitor and triage blood product orders. Electronic health record blood orders were modified to enhance and facilitate triaging efforts. PBM amplified its educational efforts regarding restrictive blood utilization and anemia management. In addition, PBM took a proactive approach in reviewing cancelled elective surgical cases to identify opportunities for preoperative hemoglobin optimization once these surgeries were restarted.

■ BACKGROUND ON PATIENT BLOOD MANAGEMENT

PBM practices have existed for decades, but have not been fully integrated as a universal standard of care. PBM is defined as an evidence-based medical and surgical approach to minimize the need for and use of blood transfusion in patients as a means to improve their clinical outcomes.³ It encompasses a comprehensive integration of a patient-centric, multidisciplinary standard of care centralized on blood health, which involves all functions of maintaining blood volume, anemia management, coagulation management, and surgical technique, not just blood transfusion therapy.

To achieve optimal patient outcomes, PBM implements a variety of treatment strategies to minimize or reduce the use of blood products as well as decrease overall healthcare costs.⁴⁻⁷ The practice and standards of PBM are universal across specialties as well as inpatient, outpatient, surgical, and medical disciplines.

The statements and opinions expressed in COVID-19 Curbside Consults are based on experience and the available literature as of the date posted. While we try to regularly update this content, any offered recommendations cannot be substituted for the clinical judgment of clinicians caring for individual patients.

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Cleveland Clinic blood management - Inpatient RBC transfusion management

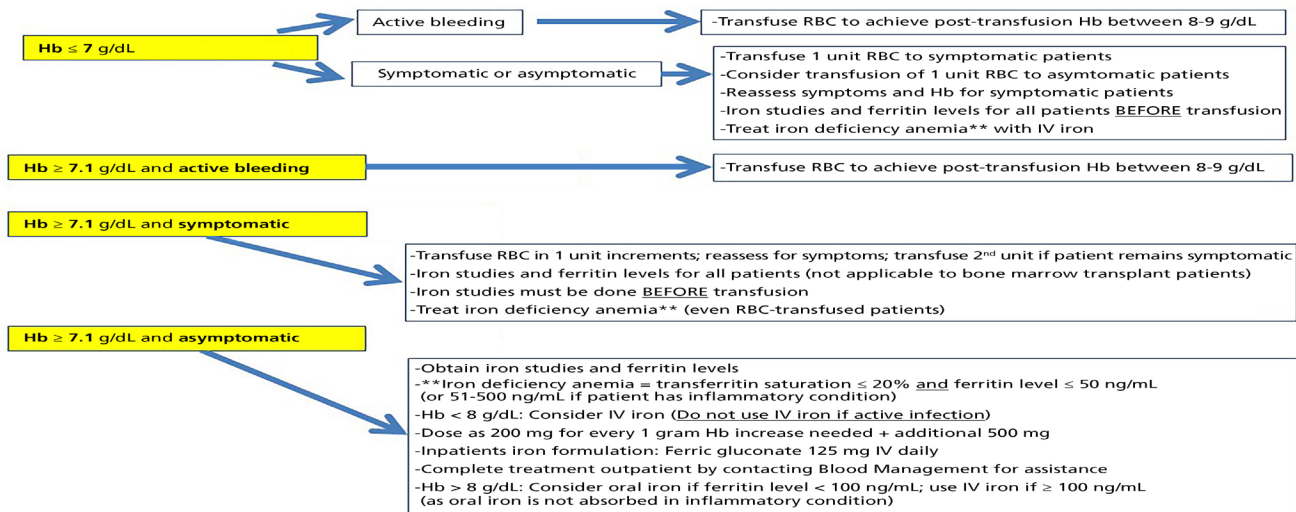


Figure 1. Patient blood management guidelines for inpatient RBC use based on hemoglobin levels. Hb = hemoglobin; RBC = red blood cells

The pillars of PBM prove valuable in both normal daily patient care as well as during a global pandemic. They focus on optimizing hemoglobin values, minimizing blood losses (eg, frequent phlebotomy, intraoperative), managing coagulopathy, and enhancing tolerance to anemia.⁸

Practitioners of PBM consistently consider the hypothetical situation of caring for patients without the availability of blood products when describing its relevance and value. The US blood supply depends on volunteer donors. The stay-at-home orders created unprecedented cancellations of blood drives, placing the blood supply at risk for shortages. Blood suppliers began notifying hospitals of these shortages, which led to preparations and actions to address the shortages while maintaining care delivery.

■ PATIENT BLOOD MANAGEMENT AND COVID-19: CLEVELAND CLINIC EXPERIENCE

The COVID-19 pandemic highlighted the need for PBM guidelines to be mainstream practice. First, there is the immediate risk that blood shortages impose on acutely ill patients. Second, there is the surge of need for innovation in delivery of PBM services given new opportunities to optimize patients such as after cancellation of elective surgeries.

In the event of blood shortage, the most meaningful areas of concern are the decreased availability of O-negative red blood cells (RBCs) and platelets.

These require a well-structured and formal system that triages orders for blood products to ensure allocation to patients at greatest need.⁹⁻¹¹ This system needs to outline specific triaging criteria as well as implementing workflows that can be adapted for each individual organization.

At Cleveland Clinic, the following efforts occurred simultaneously:

- Transfusion medicine established guidelines for issuing all Rh (D)-negative RBC units, not just O-negative, and issuing Rh (D)-negative platelets. Transfusion medicine had a well-established process in place for triaging all platelets when the inventory fell below a prescribed level. In addition, transfusion medicine personnel alerted institutes to the potential for blood shortages and the plans to curtail blood use.
- PBM implemented guidelines for RBC use and anemia management (Figure 1). These guidelines strongly support a consistent blood management strategy regardless of blood product supply. Restrictive trigger and target thresholds are supported by evidence-based literature.^{12,13}

Anemia management is a vital pillar of PBM. It is not uncommon for our PBM program to have pre-surgical referrals of patients with a longstanding history of moderate anemia, which may have not been formally addressed. The assessment of anemia focuses

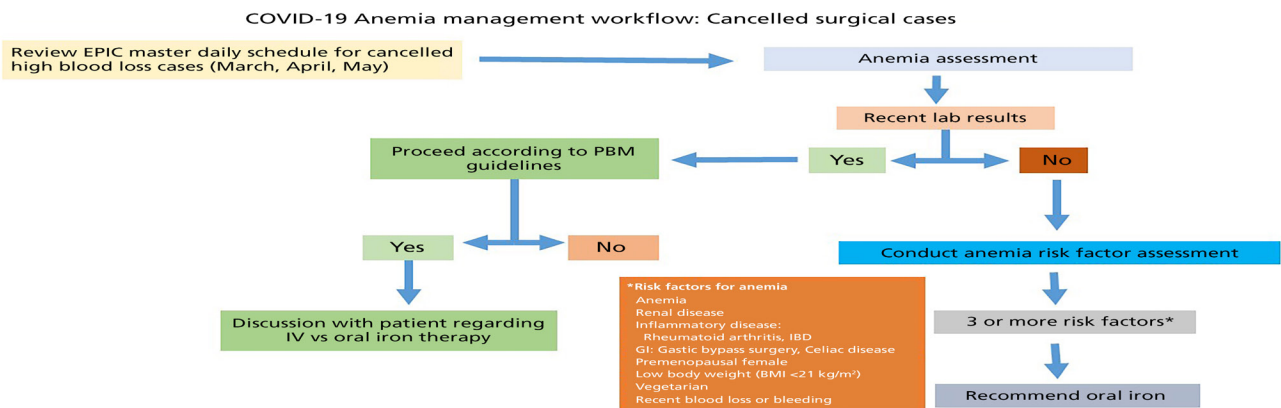


Figure 2. Anemia assessment approach in patients with cancelled surgeries. GI = gastrointestinal; IBD = inflammatory bowel disease; PBM = patient blood management

on immediate hematinic supplementation, especially parenteral iron, as iron deficiency is the most common hematinic deficiency,¹⁴ and noncorrected preoperative iron deficiency has been strongly associated with poor perioperative patient outcomes.¹⁵

PBM personnel worked collaboratively with pharmacy to ensure availability of intravenous iron formulations and monitored the operational aspects of infusion centers that could potentially disrupt the ability to treat patients, such as ease of access and appointment availability. In addition, to minimize the risk of virus exposure, more patients were prescribed oral iron formulations to help them avoid visits to infusion centers, with follow up on tolerance and clinical response. We advocate administering oral iron every other day in a single nighttime dose to maximize enteral absorption.¹⁶

In normal operations, our PBM program has a referral system for preoperative anemia management. However, the cancellation of elective surgeries and transition to virtual patient visits decreased referrals by 70% during April and May 2020. The PBM team discussed the best approach to continue anemia care for patients whose surgeries were postponed and created a workflow management plan for assessing these cases (Figure 2). Surgical services were notified that the PBM team would assess these patients without the need for a formal referral.

This process provides us with additional time to optimize patients' hemoglobin values, time that was not previously available. Once regular surgical services are restored, patients will be re-screened for anemia, including measurement of iron stores.

Efforts in the inpatient and surgical arena have not been changed. There is still intraoperative optimiza-

tion of coagulation using monitoring with thromboelastography,¹⁷ use of tranexamic acid,¹⁸ as well as cell-saver use.¹⁹ For critical care patients, the current approaches support restrictive over liberal fluid management, reinforcing the use of a restrictive transfusion approach to minimize the risk of transfusion-associated circulatory overload.²⁰

IMPACT OF COVID-19 ON BLOOD DONATIONS

The COVID-19 pandemic has had a major impact on blood donations, both in cancellation of blood drives and in social distancing rules that affect the number of donors allowed at blood drives and blood centers. Hospitals, such as ours, continue to collaborate with blood centers to hold blood drives in large spaces to minimize donor contact and maximize collections. The criteria for regular blood donations remained the same until the Food and Drug Administration (FDA), in an effort to increase blood donations, modified some of their more stringent criteria.²¹ For example, the deferral period for accidental needle stick or a blood transfusion is now 3 months instead of the previous 12 months. Individuals diagnosed with COVID-19 (symptomatic or asymptomatic) and those suspected of having COVID-19 should not donate for at least 14 days after complete resolution of symptoms or the date of the positive diagnostic test, whichever is longer. Blood centers may be more stringent, so blood donors need to register on-line with the blood collection facility to determine eligibility.

CONVALESCENT PLASMA UTILIZATION FOR COVID-19 SURVIVORS

Patients who have recovered from COVID-19 have

helped patients with COVID-19 by donating plasma. This plasma, called COVID-19 convalescent plasma (CCP), is considered an investigational new drug by the FDA and can only be administered under an approved Institutional Review Board (IRB).²² The FDA has introduced two IRBs, an emergency investigational new drug, which requires FDA registration for each patient, and an extended access program under the Mayo Clinic IRB, which allows registered hospitals to request CCP for any qualified patient. The FDA also approves randomized controlled trials using CCP.

Hospitals must place orders for CCP through their blood banks, which then request the plasma from their blood suppliers. Blood suppliers use apheresis machines to collect CCP from qualified blood donors, which has resulted in a balancing act between collection of apheresis platelets and CCP, both of which are collected on the same apheresis instruments.

■ PATIENT BLOOD MANAGEMENT AND COVID-19: WHAT HAPPENS NEXT?

PBM practices must continue reinforcing best practices for patient-centric anemia optimization as well as decreasing the risk for blood losses. There must be stringent criteria to triage blood utilization and pursue parsimonious transfusion practices. Among patients with COVID-19, there should be growing evidence on best ways to manage anemia, ideally with a nontransfusional approach, especially as fluid administration strategies are focusing on a restrictive approach, especially among critically ill patients.

The duration of the pandemic is still unknown and the challenges for blood availability will remain present for an unknown duration. Efforts to correct anemia in the general population as well as implementation of safe blood drive protocols must remain in place, aiming to mitigate the risk of viral exposure.

■ CONCLUSIONS

Pandemics and active crises act as a catalyst for innovation and implementation of novel strategies to overcome barriers for effective healthcare delivery. Blood management also is affected as it plays a crucial role for enhanced patient optimization, especially before surgical interventions. Clinicians must balance the need to optimize anemia while minimizing the risk for patient blood loss in order to mitigate the need for blood transfusion. In our experience, blood use by patients with COVID-19 is no different from other patients. Also of note, there have been no

documented cases of transfusion-transmitted respiratory viruses, such as the coronaviruses, including SARS-CoV-2.

■ REFERENCES

1. **US Food and Drug Administration.** Coronavirus (COVID-19) update: blood donations. <https://www.fda.gov/news-events/press-announcements/coronavirus-covid-19-update-blood-donations>. Accessed July 9, 2020.
2. **Gniadek TJ, Mallek J, Wright G, et al.** Expansion of hospital-based blood collections in the face of COVID-19 associated national blood shortage. *Transfusion* 2020; May 23. doi:10.1111/trf.15869
3. **Franchini M, Marano G, Veropalumbo E, et al.** Patient blood management: a revolutionary approach to transfusion medicine. *Blood Transfus* 2019; 17(3):191–195. doi:10.2450/2019.0109-19
4. **Murphy MF, Goodnough LT.** The scientific basis for patient blood management. *Transfus Clin Biol* 2015; 22(3):90–96. doi: 10.1016/j.traccli.2015.04.001
5. **Advancing Transfusion and Cellular Therapies Worldwide.** Definitions and concepts in patient blood management. <http://www.aabb.org/pbm/Pages/definitionsconcepts.aspx>. Accessed on July 9, 2020.
6. **Kaserer A, Rössler J, Braun J, et al.** Impact of a patient blood management monitoring and feedback programme on allogeneic blood transfusions and related costs. *Anaesthesia* 2019; 74(12):1534–1541. doi: 10.1111/anae.14816
7. **Meybohm P, Straub N, Füllnabach C, et al.** Health economics of patient blood management: a cost-benefit analysis based on a meta-analysis. *Vox Sang* 2020; 115(2):182–188. doi: 10.1111/vox.12873
8. **Sullivan HC, Roback JD.** The pillars of patient blood management: key to successful implementation. *Transfusion* 2019; 59(9):2763–2767. doi: 10.1111/trf.15464
9. **Dunbar NM, Yazer MH; OPTIMUS Study Investigators on behalf of the Biomedical Excellence for Safer Transfusion (BEST) Collaborative.** O- product transfusion, inventory management, and utilization during shortage: the OPTIMUS study. *Transfusion* 2018; 58(6):1348–1355. doi: 10.1111/trf.14547
10. **Guan L, Tian X, Gombor S, et al.** Big data modeling to predict platelet usage and minimize wastage in a tertiary care system. *Proc Natl Acad Sci U S A* 2017; 114(43):11368–11373. doi:10.1073/pnas.1714097114
11. **Shortt J, Polizzotto MN, Waters N, et al.** Assessment of the urgency and deferability of transfusion to inform emergency blood planning and triage: the Bloodhound prospective audit of red blood cell use. *Transfusion* 2009; 49(11):2296–2303. doi: 10.1111/j.1537-2995.2009.02305.x
12. **Auron M, Duran Castillo MY, Kumar A.** Parsimonious blood use and lower transfusion triggers: what is the evidence? *Cleve Clin J Med* 2017; 84(1):43–51. doi: 10.3949/ccjm.84a.15134
13. **Warner MA, Shore-Lesserson L, Shander A, et al.** Perioperative anemia: prevention, diagnosis, and management throughout the spectrum of perioperative care. *Anesth Analg* 2020; 130(5):1364–1380. doi: 10.1213/ANE.0000000000004727
14. **Rössler J, Hegemann I, Schoenrath F, et al.** Efficacy of quadruple treatment on different types of pre-operative anaemia: secondary analysis of a randomised controlled trial. *Anaesthesia* 2020; Apr 27. doi:10.1111/anae.15062
15. **Rössler J, Schoenrath F, Seifert B, et al.** Iron deficiency is associated with higher mortality in patients undergoing cardiac surgery: a prospective study. *Br J Anaesth* 2020; 124(1):25–34. doi: 10.1016/j.bja.2019.09.016
16. **Stoffel NU, Zeder C, Brittenham GM, et al.** Iron absorption from supplements is greater with alternate day than with consecutive day dosing in iron-deficient anemic women. *Haematologica* 2020; 105(5):1232–1239. doi: 10.3324/haematol.2019.220830

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17. **Thai C, Oben C, Wagener G.** Coagulation, hemostasis, and transfusion during liver transplantation. *Best Pract Res Clin Anaesthesiol* 2020; 34(1):79–87. doi: 10.1016/j.bpa.2020.03.002
 18. **Styron JF, Klika AK, Szubski CR, Tolich D, Barsoum WK, Higuera CA.** Relative efficacy of tranexamic acid and preoperative anemia treatment for reducing transfusions in total joint arthroplasty. *Transfusion* 2017; 57(3):622–629. doi: 10.1111/trf.13955
 19. **Klein AA, Bailey CR, Charlton AJ, et al.** Association of Anaesthetists guidelines: cell salvage for peri-operative blood conservation 2018. *Anaesthesia* 2018; 73(9):1141–1150. doi: 10.1111/anae.14331
 20. **Malbrain MLNG, Langer T, Annane D, et al.** Intravenous fluid therapy in the perioperative and critical care setting: Executive summary of the International Fluid Academy (IFA). *Ann Intensive Care* 2020; 10(1):64. doi:10.1186/s13613-020-00679-3
 21. **US Food and Drug Administration.** Updated information for blood establishments regarding the novel coronavirus (COVID-19) outbreak. <https://www.fda.gov/vaccines-blood-biologics/safety-availability-biologics/updated-information-blood-establishments-regarding-novel-coronavirus-covid-19-outbreak>. Accessed on July 9, 2020.
 22. **US Food and Drug Administration.** Investigational COVID-19 Convalescent Plasma Guidance for Industry. Updated May 1, 2020. <https://www.fda.gov/media/136798/download>. Accessed on July 9, 2020.

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