Citation	Abstract	Findings
Guidelines/Consensus Statements		
Shander, Aryeh MD*,†; Corwin, Howard L. MD‡; Meier, Jens MD§,‖; Auerbach, Michael MD¶,#; Bisbe, Elvira MD‖,**; Blitz, Jeanna MD††; Erhard, Jochen MD‡‡; Faraoni, David MD§§; Farmer, Shannon L. DHSc‖‖,¶¶; Frank, Steven M. MD##; Girelli, Domenico MD***; Hall, Tiffany RN†††; Hardy, Jean-François MD‖,‡‡‡; Hofmann, Axel Dr rer medic§§§; Lee, Cheuk-Kwong MD‖‖‖; Leung, Tsin W. MD¶¶¶; Ozawa, Sherri RN###; Sathar, Jameela MD****; Spahn, Donat R. MD††††; Torres, Rosalio MD‡‡‡‡; Warner, Matthew A. MD§§§§; Muñoz, Manuel MD‖‖‖‖‖. **Recommendations From the International Consensus Conference on Anemia Management in Surgical Patients** (ICCAMS). Annals of Surgery 277(4):p 581-590, April 2023. | DOI: 10.1097/SLA.0000000000005721	Background: Perioperative anemia has been associated with increased risk of red blood cell transfusion and increased morbidity and mortality after surgery. The optimal approach to the diagnosis and management of perioperative anemia is not fully established. Objective: To develop consensus recommendations for anemia management in surgical patients. Methods: An international expert panel reviewed the current evidence and developed recommendations using modified RAND Delphi methodology. Results: The panel recommends that all patients except those undergoing minor procedures be screened for anemia before surgery. Appropriate therapy for anemia should be guided by an accurate diagnosis of the etiology. The need to proceed with surgery in some patients with anemia is expected to persist. However, early identification and effective treatment of anemia has the potential to reduce the risks associated with surgery and improve clinical outcomes. As with preoperative anemia, postoperative anemia should be treated in the perioperative period. Conclusions: Early identification and effective treatment of anemia has the potential to improve clinical outcomes in surgical patients.	Prevalence: - Anemia is common in surgical populations - Prevalence of anemia varies across surgical populations (highest in vascular and gynecological, lowest in orthopedic and urologic) Outcomes - Low preoperative HbA1c is a risk for increased transfusion of blood components and/or poor clinical outcomes - Relationship between anemia and outcomes is important in all types of surgery (elective, urgent, emergent) - Patients should be educated about the impact of anemia - Patient's should be educated about relationship between anemia and RBC transfusion and impact of increased RBC transfusion Screening - Prevalence of preoperative anemia and its association with worse clinical outcomes justify screening all patients for anemia before surgery, except those undergoing minor procedures - Screening for preoperative anemia should not be restricted to patients undergoing elective surgery - Never too late to start anemia evaluation in patients undergoing elective or urgent surgery Diagnosis - All patients with anemia should be evaluated for the cause of anemia – wherever possible, early enough preoperatively to enable sufficient time for treatment to be successful - It is important to identify iron deficiency, including in patients with anemia of inflammation (or anemia of chronic disease). - Patients with IDA should be evaluated for the cause of the iron deficiency, whereas patients with anemia and normal iron studies should be evaluated for coexisting causes of anemia (ie, renal disease, primary hematologic disease, and nutrition deficiency). - Evaluation for iron deficiency should include iron studies (serum iron, total iron binding capacity, transferrin saturation (TSAT), serum ferritin); if available, reticulocyte Hb content and/or serum hepcidin should be considered in inflammatory states. - The most important criteria for defining absolute iron deficiency were ferritin <30 ng/mL and/or TSAT <20%; ferritin <100 ng/mL may define iron deficiency in

		inflammatory states. If available, either a reticulocyte Hb <29 pg or a serum hepcidin level <20 µg/L also suggest the presence of iron deficiency in inflammatory states. Treatment of Preoperative Anemia - The aim of treating preoperative anemia is to improve Hb concentration and this may decrease RBC transfusion. - Therapy should be tailored to the etiology of anemia Preoperative Iron Therapy - Iron therapy should be administered as treatment for preoperative IDA, except when it is contraindicated - IV iron is preferable to oral iron in preoperative IDA - Preoperative oral iron therapy and IV iron therapy should be started as early as possible - Administration of IV iron is generally well tolerated and does not increase patient's risk of infection Preoperative Treatment for ESAs - ESAs have a role in preoperative treatment of anemia for surgery - If ESAs are used, supplemental iron should also be given, and postoperative prophylactic treatment for thromboembolism should be considered Perioperative Transfusions of RBCs - RBC transfusion for the treatment of anemia adds risk - The interaction of anemia and RBC transfusion contributes to poor outcomes - Transfusion and anemia represent safety concerns - RBC transfusion may be considered for severe, symptomatic postoperative anemia where clinical need cannot be met with volume replacement or hematinic medication alone Postoperative Anemia - Treatment of postoperative anemia should begin before discharge
CPOC. (2025, April). *CPOC Anaemia guideline 2025*. Centre for Perioperative Care. Retrieved July 2, 2025, from https://cpoc.org.uk/sites/cpoc/files/documents/2025-04/CPOC-AnaemiaGuideline2025.pdf	This guidance includes elective (planned) surgery and emergency (urgent) surgery. It applies to people of all ages, but specifically to two main groups of patients: ■ people planned to have major surgery, with expected blood loss of over 500ml or 10% of their blood volume, who are anaemic or at risk of becoming anaemic ■ people having less major surgery, who have been identified as having anaemia. The Centre for Perioperative Care (CPOC), a cross organisational body, was established in 2019 to facilitate and promote delivery of high-quality, whole pathway, perioperative care. CPOC is therefore in a unique position to collate, develop, implement and evaluate new	Summary of guidelines: To make the best of this approach we need to make sure patients and all healthcare professionals including GPs and multidisciplinary hospital teams work together to: 1. Identify anemia early in the pathway 2. Make the patient aware of this and all actions going forward 3. Find the cause of the anemia 4. Use tried and tested treatments for anemia before surgery. This could include advice on changes in diet, oral treatments such as iron supplements and the use of intravenous iron when necessary 5. Make sure the patient has a personalized treatment program including providing appropriate information

	guidelines across the whole perioperative pathway. Anaemia is common, present in over a third of patients having major surgery. It is associated with adverse outcomes of surgery. Interventions can be effective. A Patient Blood Management (PBM) approach improves postoperative outcomes.1 What is needed is standardised protocols for assessment and generalised advice, but with care individualised to the patient. Best practice guidance exists. Implementation is, however, patchy despite the evidence of benefit. CPOC believes this is because available guidance is written for specific specialties rather than being patient and pathway centred. CPOC have published perioperative guidelines on diabetes and frailty that are being successfully translated into routine clinical care. This perioperative anaemia guideline has been developed using a similar whole pathway approach. It contains recommendations for patients of all ages undergoing surgery and for healthcare professionals in both emergency and elective surgical settings and across specialties.	about the pros and cons of the different approaches suggested to the patient and how long these should be continued 6. Communicate clearly between different members of the team so that operations are not cancelled unnecessarily and improve the interface between primary care and hospitals 7. Talk openly to the patient about the benefits and risks of managing anemia and the surgery Things that can improve the results of patients having surgery who have anemia 1. Nutrition 2. Early diagnosis: a. Of the type of anemia (e.g., IDA, functional iron deficiency, B12 deficiency) b. Of the cause of the anemia (e.g., heavy menstruation, GI loss) 3. Early treatment if there is a clear cause (e.g., bowel cancer causing IDA, or medications that should be stopped) 4. Providing information about oral iron and how to take it, so it is more palatable 5. Reducing blood loss before (if relevant), during and after the operation 6. Using blood transfusion carefully (it can alter immunity and cause other problems) 7. Improving patient fitness to cope with anemia and providing realistic practical advice on how to do this 8. Having good communication between primary care and hospitals 9. Shared decision making (SDM) so the patient and senior clinician can discuss the patient's values, expectations and possible procedure. Talking through benefits, risks, alternatives and what happens if nothing is done 10. Creating local systems that work to pick up anemia early not hampered by GP versus hospital hurdle 11. Ensuring there is an area equipped to give intravenous iron when needed in a stress-free environment 12. Educating staff about putting the patient at the center of the process, communicating appropriately and reducing unnecessary delays including prompt requesting of investigations and acting on results 13. Having a culture where senior clinicians are involved early in complex cases where there is no straightforward intervention 14. Showing good leadership so responsibilities are clear

		15. Having a culture of data collection and audit against best practice so each center is always striving to improve how well they manage anemia around the time of operation
Sigrun Halvorsen, Julinda Mehilli, Salvatore Cassese, Trygve S Hall, Magdy Abdelhamid, Emanuele Barbato, Stefan De Hert, Ingrid de Laval, Tobias Geisler, Lynne Hinterbuchner, Borja Ibanez, Radosław Lenarczyk, Ulrich R Mansmann, Paul McGreavy, Christian Mueller, Claudio Muneretto, Alexander Niessner, Tatjana S Potpara, Arsen Ristić, L Elif Sade, Henrik Schirmer, Stefanie Schüpke, Henrik Sillesen, Helge Skulstad, Lucia Torracca, Oktay Tutarel, Peter Van Der Meer, Wojtek Wojakowski, Kai Zacharowski, ESC Scientific Document Group , 2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing non-cardiac surgery: Developed by the task force for cardiovascular assessment and management of patients undergoing non-cardiac surgery of the European Society of Cardiology (ESC) Endorsed by the European Society of Anaesthesiology and Intensive Care (ESAIC), European Heart Journal, Volume 43, Issue 39, 14 October 2022, Pages 3826–3924, https://doi.org/10.1093/eurheartj/ehac270	The annual volume of major surgery worldwide is estimated to be more than 300 million patients (about 5% of the world population), which is a 34% increase from 2004 to 2012.1,2 Nearly 74% of these operations are performed in countries spending substantial amounts on health care. When applied to European Union countries, which had an overall population of 448 million in 2020 (27 countries), this figure translates into a crude estimate of nearly 22 million major procedures annually.2 Nearly 85% of major operations are non-cardiac surgical procedures.3 In a recent report from the USA National Inpatient Sample database, nearly half of adults aged ≥45 years undergoing major non-cardiac surgery (NCS) presented with at least two cardiovascular (CV) risk factors, 18% had coronary artery disease (CAD), 4.7% had a history of stroke, and 7.7% had a modified Revised Cardiac Risk Index (RCRI) score ≥3 (range 0–6) in 2012–13. These prevalence rates show a substantial increase compared with the equivalent rates in 2008–09.4 In a large registry including 37 915 consecutive patients undergoing percutaneous coronary interventions (PCIs) with drug-eluting stent (DES), the rates of NCS after PCI were 11% and 24%, 1 and 3 years after PCI respectively. The cut-off ages at which NCS was more likely to occur within 1 and 3 years of PCI were 62 and 73 years respectively.5 The prevalence of comorbidities, the clinical condition of patients before surgery, and the urgency, magnitude, type, and duration of the surgical procedure determine the risk of peri-operative complications. In a recent cohort study of 40 000 patients aged ≥45 years undergoing inpatient NCS, one of seven experienced a major cardiac or cerebrovascular complication at 30 days.6 Cardiovascular complications can particularly occur in patients with documented or asymptomatic coronary heart disease, left ventricular (LV) dysfunction, valvular heart disease (VHD), and arrhythmias, who undergo surgical procedures that are associated with prolonged haemodynamic and cardiac stress. In the case of peri-operative myocardial ischaemia, three mechanisms are important: (i) oxygen supply–demand mismatch on the background of coronary artery stenosis that may become flow-limiting by peri-operative haemodynamic fluctuations; (ii) acute coronary syndrome (ACS) due to stress-induced erosion or rupture of a vulnerable atherosclerotic plaque in combination with pro-inflammatory and hypercoagulable states induced by surgery, and the haemodynamic distress resulting from fluid shifts	Major surgery is associate with higher risk of perioperative blood loss – preferred treatment of acute anemia related to perioperative blood loss is transfusion – however, transfusion carries its own adverse impacts. Most kinds of anemia are correctable except for bone marrow dysfunction – oral or IV iron can be used to treat IDA (50% of anemia cases) – preoperative management of patients with anemia can be simplified by making use of standard operating procedures or algorithms in which thresholds for diagnosis and treatment are depicted. Recommendation: 1. Measure hemoglobin preoperatively in patients schedule for intermediate-high risk NCS (1B) 2. Treat anemia in advance of NCS in order to reduce the need for RBC transfusion during NCS (1A) 3. Use of an algorithm to treat anemic patients before NCS should be considered. (2aC)

	and anaesthesia; and (iii) surgery-associated bleeding risk requiring interruption of antiplatelet therapies, which might lead to stent thrombosis among patients undergoing NCS after recent coronary stent placement. Left ventricular dysfunction and arrhythmias may occur for various reasons at all ages. Because the prevalence of CAD, VHD, heart failure, and arrhythmias increases with age, peri-operative CV mortality and morbidity are predominantly an issue in the adult population undergoing major NCS. In Europe, recent systematic data on the annual number and type of operations, and on patient outcomes are unfortunately lacking. Additionally, data definitions vary, as do data quantity and quality. Based on the estimates outlined above, nearly 6.6 million procedures are performed annually in European patients with CAD, peripheral artery disease (PAD), and cerebrovascular disease who are at high risk of CV complications. In a 7 day cohort study, the European Surgical Outcomes Study (EuSOS) group investigated the outcomes of NCS in 498 hospitals across 27 European nations and the UK; up to 8% of patients undergoing NCS required critical care admission, while in-hospital mortality ranged 1.4–21.5% (mean 4.0%), depending on safety precautions.7 In a recent prospective study of 2265 high-risk patients undergoing NCS in Switzerland, one out of five developed major adverse events within 365 days.8 When applied to the population in European Union countries, these figures translate into at least 660 000 major cardiac or cerebrovascular complications occurring annually due to NCS procedures. The 2022 ESC Guidelines on cardiovascular assessment and management of patients undergoing NCS focus on the pre-operative CV risk assessment and peri-operative management of patients in whom cardiovascular disease (CVD) is a potential source of complications during NCS.	
Canadian Journal of Surgery. (2021, October 1). Clinical practice guideline: Evidence, recommendations and algorithm for the preoperative … [Clinical practice guideline]. Canadian Journal of Surgery, 64(5), E491–E509. https://doi.org/10.1503/cjs.011519	Preoperative optimization has not been explored comprehensively in the surgical literature, as this responsibility has often been divided among surgery, anesthesia and medicine. We developed an evidence-based clinical practice guideline to summarize existing evidence and present diagnostic and treatment algorithms for use by surgeons caring for patients scheduled to undergo major elective surgery. We focus on 3 common comorbid conditions seen across surgical specialties - anemia, hyperglycemia and smoking - as these conditions increase complication rates in patients undergoing major surgery and can be optimized successfully as soon as 6-8 weeks before surgery. With the ability to address these conditions earlier in the patient journey, surgeons can positively affect patient outcomes.	Guidelines for optimization of smoking status, glycemic control and anemia prior to surgery – includes workflows proposed for anemia and glycemic control status

	The aim of this guideline is to bring optimization in the preoperative period under the existing umbrella of evidence-based surgical care.	
Reviews		
Ng O, Keeler BD, Mishra A, Simpson JA, Neal K, Al-Hassi HO, Brookes MJ, Acheson AG. Iron therapy for preoperative anaemia. Cochrane Database of Systematic Reviews 2019, Issue 12. Art. No.: CD011588. DOI: 10.1002/14651858.CD011588.pub3. Accessed 21 May 2025.	Background Preoperative anaemia is common and occurs in 5% to 76% of patients preoperatively. It is associated with an increased risk of perioperative allogeneic blood transfusion, longer hospital stay, and increased morbidity and mortality. Iron deficiency is one of the most common causes of anaemia. Oral and intravenous iron therapy can be used to treat anaemia. Parenteral iron preparations have been shown to be more effective in conditions such as inflammatory bowel disease, chronic heart failure and postpartum haemorrhage due to rapid correction of iron stores. A limited number of studies has investigated iron therapy for the treatment of preoperative anaemia. The aim of this Cochrane Review is to summarise the evidence for iron supplementation, both enteral and parenteral, for the management of preoperative anaemia. Objectives To evaluate the effects of preoperative iron therapy (enteral or parenteral) in reducing the need for allogeneic blood transfusions in anaemic patients undergoing surgery. Search methods We ran the search on 30 July 2018. We searched the Cochrane Injuries Group's Specialised Register, Cochrane Central Register of Controlled Trials (CENTRAL, the Cochrane Library), Ovid MEDLINE(R), Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid OLDMEDLINE(R), Embase Classic and Embase (Ovid), CINAHL Plus (EBSCO), PubMed, and clinical trials registries, and we screened reference lists. We ran a top-up search on 28 November 2019; one study is now awaiting classification. Selection criteria We included all randomised controlled trials (RCTs) that compared preoperative iron monotherapy to placebo, no treatment, standard care or another form of iron therapy for anaemic adults undergoing surgery. We defined anaemia as haemoglobin values less than 13 g/dL for males and 12 g/dL for non-pregnant females. Data collection and analysis Two review authors collected data and a third review author checked all collected data. Data were collected on the proportion	Overall low-quality evidence - Intravenous iron therapy produced an increase in preoperative postintervention hemoglobin levels compared to oral iron.

	of patients who receive a blood transfusion, the amount of blood transfused per patient (units), quality of life, ferritin levels and haemoglobin levels, measured as continuous variables at the following predetermined time points: pretreatment (baseline), preoperatively but postintervention, and postoperatively. We performed statistical analysis using the Cochrane software, Review Manager 5. We summarised outcome data in tables and forest plots. We used the GRADE approach to describe the quality of the body of evidence. Main results Six RCTs, with a total of 372 participants, evaluated preoperative iron therapy to correct anaemia before planned surgery. Four studies compared iron therapy (either oral (one study) or intravenous (three studies)) with no treatment, placebo or usual care, and two studies compared intravenous iron therapy with oral iron therapy. Iron therapy was delivered over a range of periods that varied from 48 hours to three weeks prior to surgery. The 372 participants in our analysis fall far short of the 819 required - as calculated by our information size calculation - to detect a 30% reduction in blood transfusions. Five trials, involving 310 people, reported the proportion of participants who received allogeneic blood transfusions. Meta-analysis of iron therapy versus placebo or standard care showed no difference in the proportion of participants who received a blood transfusion (risk ratio (RR) 1.21, 95% confidence interval (CI) 0.87 to 1.70; 4 studies, 200 participants; moderate-quality evidence). Only one study that compared oral versus intravenous iron therapy measured this outcome, and reported no difference in risk of transfusion between groups. There was no difference between the iron therapy and placebo/standard care groups for haemoglobin level preoperatively at the end of the intervention (mean difference (MD) 0.63 g/dL, 95% CI -0.07 to 1.34; 2 studies, 83 participants; low-quality evidence). However, intravenous iron therapy produced an increase in preoperative postintervention haemoglobin levels compared with oral iron (MD 1.23 g/dL, 95% CI 0.80 to 1.65; 2 studies, 172 participants; low-quality evidence). Ferritin levels were increased by intravenous iron, both when compared to standard care ((MD 149.00, 95% CI 25.84 to 272.16; 1 study, 63 participants; low-quality evidence) or to oral iron (MD 395.03 ng/mL, 95% CI 227.72 to 562.35; 2 studies, 151 participants; low-quality evidence).	

	Not all studies measured quality of life, short-term mortality or postoperative morbidity. Some measured the outcomes, but did not report the data, and the studies which did report the data were underpowered. Therefore, uncertainty remains regarding these outcomes. The inclusion of new research in the future is very likely to change these results. Authors' conclusions The use of iron therapy for preoperative anaemia does not show a clinically significant reduction in the proportion of trial participants who received an allogeneic blood transfusion compared to no iron therapy. Results for intravenous iron are consistent with a greater increase in haemoglobin and ferritin when compared to oral iron, but do not provide reliable evidence. These conclusions are drawn from six studies, three of which included very small numbers of participants. Further, well-designed, adequately powered, RCTs are required to determine the true effectiveness of iron therapy for preoperative anaemia. Two studies are currently in progress, and will include 1500 randomised participants.	
Kaufner L, von Heymann C, Henkelmann A, Pace NL, Weibel S, Kranke P, Meerpohl JJ, Gill R. Erythropoietin plus iron versus control treatment including placebo or iron for preoperative anaemic adults undergoing non-cardiac surgery. Cochrane Database of Systematic Reviews 2020, Issue 8. Art. No.: CD012451. DOI: 10.1002/14651858.CD012451.pub2. Accessed 21 May 2025.	Background Approximately 30% of adults undergoing non-cardiac surgery suffer from preoperative anaemia. Preoperative anaemia is a risk factor for mortality and adverse outcomes in different surgical specialties and is frequently the reason for blood transfusion. The most common causes are renal, chronic diseases, and iron deficiency. International guidelines recommend that the cause of anaemia guide preoperative anaemia treatment. Recombinant human erythropoietin (rHuEPO) with iron supplementation has frequently been used to increase preoperative haemoglobin concentrations in patients in order to avoid the need for perioperative allogeneic red blood cell (RBC) transfusion. Objectives To evaluate the efficacy of preoperative rHuEPO therapy (subcutaneous or parenteral) with iron (enteral or parenteral) in reducing the need for allogeneic RBC transfusions in preoperatively anaemic adults undergoing non-cardiac surgery. Search methods We searched CENTRAL, Ovid MEDLINE(R), Ovid Embase, ISI Web of Science: SCI-EXPANDED and CPCI-S, and clinical trial registries WHO ICTRP and ClinicalTrials.gov on 29 August 2019. Selection criteria We included all randomized controlled trials (RCTs) that compared preoperative rHuEPO + iron therapy to control treatment	Erythropoietin with iron supplementation reduced the need for transfusions amongst participants after surgery – higher doses had more significant effect. Cause of concern however s that the specific underlying cause of anemia was not known – if known, then specific targeted treatment can commence before surgery.

	(placebo, no treatment, or standard of care with or without iron) for preoperatively anaemic adults undergoing non-cardiac surgery. We used the World Health Organization (WHO) definition of anaemia: haemoglobin concentration (g/dL) less than 13 g/dL for males, and 12 g/dL for non-pregnant females (decision of inclusion based on mean haemoglobin concentration). We defined two subgroups of rHuEPO dosage: 'low' for 150 to 300 international units (IU)/kg body weight, and 'high' for 500 to 600 IU/kg body weight. Data collection and analysis Two review authors collected data from the included studies. Our primary outcome was the need for RBC transfusion (no autologous transfusion, fresh frozen plasma or platelets), measured in transfused participants during surgery (intraoperative) and up to five days after surgery. Secondary outcomes of interest were: haemoglobin concentration (directly before surgery), number of RBC units (where one unit contains 250 to 450 mL) transfused per participant (intraoperative and up to five days after surgery), mortality (within 30 days after surgery), length of hospital stay, and adverse events (e.g. renal dysfunction, thromboembolism, hypertension, allergic reaction, headache, fever, constipation). Main results Most of the included trials were in orthopaedic, gastrointestinal, and gynaecological surgery and included participants with mild and moderate preoperative anaemia (haemoglobin from 10 to 12 g/dL). The duration of preoperative rHuEPO treatment varied across the trials, ranging from once a week to daily or a 5-to-10-day period, and in one trial preoperative rHuEPO was given on the morning of surgery and for five days postoperatively. We included 12 trials (participants = 1880) in the quantitative analysis of the need for RBC transfusion following preoperative treatment with rHuEPO + iron to correct preoperative anaemia in non-cardiac surgery; two studies were multiarmed trials with two different dose regimens. Preoperative rHuEPO + iron given to anaemic adults reduced the need RBC transfusion (risk ratio (RR) 0.55, 95% confidence interval (CI) 0.38 to 0.80; participants = 1880; studies = 12; I2 = 84%; moderate-quality evidence due to inconsistency). This analysis suggests that on average, the combined administration of rHuEPO + iron will mean 231 fewer individuals will need	

	transfusion for every 1000 individuals compared to the control group. Preoperative high-dose rHuEPO + iron given to anaemic adults increased the haemoglobin concentration (mean difference (MD) 1.87 g/dL, 95% CI 1.26 to 2.49; participants = 852; studies = 3; I2 = 89%; low-quality evidence due to inconsistency and risk of bias) but not low-dose rHuEPO + iron (MD 0.11 g/dL, 95% CI −0.46 to 0.69; participants = 334; studies = 4; I2 = 69%; low-quality evidence due to inconsistency and risk of bias). There was probably little or no difference in the number of RBC units when rHuEPO + iron was given preoperatively (MD −0.09, 95% CI −0.23 to 0.05; participants = 1420; studies = 6; I2 = 2%; moderate-quality evidence due to imprecision). There was probably little or no difference in the risk of mortality within 30 days of surgery (RR 1.19, 95% CI 0.39 to 3.63; participants = 230; studies = 2; I2 = 0%; moderate-quality evidence due to imprecision) or of adverse events including local rash, fever, constipation, or transient hypertension (RR 0.93, 95% CI 0.68 to 1.28; participants = 1722; studies = 10; I2 = 0%; moderate-quality evidence due to imprecision). The administration of rHuEPO + iron before non-cardiac surgery did not clearly reduce the length of hospital stay of preoperative anaemic adults (MD −1.07, 95% CI −4.12 to 1.98; participants = 293; studies = 3; I2 = 87%; low-quality evidence due to inconsistency and imprecision). Authors' conclusions Moderate-quality evidence suggests that preoperative rHuEPO + iron therapy for anaemic adults prior to non-cardiac surgery reduces the need for RBC transfusion and, when given at higher doses, increases the haemoglobin concentration preoperatively. The administration of rHuEPO + iron treatment did not decrease the mean number of units of RBC transfused per patient. There were no important differences in the risk of adverse events or mortality within 30 days, nor in length of hospital stay. Further, well-designed, adequately powered RCTs are required to estimate the impact of this combined treatment more precisely.	
Nisi F, Ratibondi L, Hagger M, Giustiniano E, Piccioni F, Badalamenti G, Lepidi S, D'Oria M. Prognostic Impact of Anemia and Blood Transfusions on Cardiovascular Outcomes in Patients Undergoing Vascular Surgery: A Scoping Review. J Cardiothorac Vasc Anesth. 2025	Objective: Prior studies suggest an association of anemia and blood transfusion with increased morbidity and mortality in patients undergoing cardiac surgery. However, the impact of perioperative anemia and blood transfusion on clinical outcomes in patients undergoing major vascular surgery has been poorly	Anemia and blood transfusions are associated with negative outcomes/cardiovascular complications for vascular surgery

Feb;39(2):511-525. doi: 10.1053/j.jvca.2024.10.033. Epub 2024 Oct 24. PMID: 39547866.	defined yet. The primary objectives of this scoping review were to determine the extent of the evidence base that links anemia and blood transfusions to mortality and cardiovascular outcomes in patients undergoing major vascular surgery, and identify recurring themes or gaps in the literature to guide future research. Methods: A scoping review of the literature from PubMed, Cochrane, and EMBASE databases was conducted up to December 2023 to identify articles related to the impact of anemia and blood transfusions on postoperative cardiovascular outcomes on patients undergoing vascular surgery. Methodology followed the PRISMA Protocols Extension for Scoping Reviews. Results: Twenty-two articles met the inclusion criteria, including 15 retrospective and 6 observational prospective studies. Anemia definition varied across studies, mainly based on hemoglobin cut-off levels. An association with older age, coronary artery disease, hypertension, diabetes, and other comorbidities was reported. Particularly in peripheral and endovascular aortic surgery, anemia was linked consistently with higher mortality, major adverse cardiac events, and other postoperative complications, such as respiratory and renal issues, surgical site infections, and longer hospital stays, depending on hemoglobin levels. Anemia itself is an important predictor of transfusions. Transfusions in anemic patients were associated with increased mortality, postoperative complications, and increased need for major amputation. Conclusions: The weight of the evidence suggests that anemia carries a substantial burden of cardiovascular complications, mortality, and multiorgan complications, resulting in increased health care costs. Peripheral and endovascular aortic surgery are affected deeply by the impact of anemia. Anemia itself stands out as a crucial predictor for requiring transfusions. In turn, the effect of transfusion of blood products is associated with worse outcomes and complications.	
Fernandez H, Lasocki S, Capdevila X, Chapron C. Perioperative iron deficiency and anaemia in scheduled gynaecological surgery: An update based on findings from the PERIOPES and CARENFER studies: Iron deficiency in gynaecological surgery. J Gynecol Obstet Hum Reprod. 2025 Jun;54(6):102960. doi: 10.1016/j.jogoh.2025.102960. Epub 2025 Apr 18. PMID: 40254134.	Major gynaecological surgery is a significant risk factor for intra and postoperative blood loss. Effective iron deficiency (ID) and anaemia management is critical for ensuring patient safety. The aim of this update was to take an in-depth look at two recently published studies focusing on the assessment and management of ID and anaemia in subgroups of patients undergoing gynaecological surgery from the CARENFER PBM (2023) and PERIOPES (2023 and 2024) studies. Among the 6999 patients included in the three studies, 354 involved gynaecological procedures. Within this cohort, the prevalence of preoperative ID ranged from 70 % to 78 %, with 88 % considered absolute ID, while preoperative anaemia affected 28 %-59 % of women.	ID and IDA are very common for individuals undergoing gyneacologic surgery. ID workup and anemia treatment were low -. There needs ot be systematic procedures for screening and treatment of anemia and/or ID, wherever feasible, and postponement of surgery if restoration of blood and iron stores isconsidered necessary before proceeding “Patient Blood Management in the perioperative setting state that preoperative anaemia and ID must be systematically screened early enough in case of surgery at risk of bleeding [10]. These evidence-based recommendations indicate that in the preoperative context, ID is defined as a blood ferritin level < 100 µg/L and/or a transferrin

	Indeed, several gynaecological conditions that require surgery (e.g., uterine fibroids and gynaecological malignancies) are frequently associated with significant blood loss. Nonetheless, preoperative iron workup was only performed in 5 %-33 % of the patients. Furthermore, anaemia and/or ID were only treated in 12.5 %-24 % preoperatively and 25 % postoperatively. In conclusion, there seems to be a need to optimise perioperative ID and anaemia management in gynaecologic surgery by ensuring systematic preoperative screening and treatment for anaemia and/or ID and, wherever feasible, postponing surgery if restoration of the blood mass and iron stores is considered necessary prior to surgery.	saturation (TSAT) < 20 % and that in the presence of anaemia due to ID, iron supplementation, preferably intravenous, is recommended [11]"
Ali M, Dort JC, Sauro KM. Preoperative hemoglobin and perioperative blood transfusion in major head and neck surgery: a systematic review and meta-analysis. J Otolaryngol Head Neck Surg. 2023 Jan 24;52(1):3. doi: 10.1186/s40463-022-00588-4. PMID: 36691071; PMCID: PMC9872343.	Background There is a growing concern with inappropriate, excessive perioperative blood transfusions. Understanding the influence of low preoperative hemoglobin (Hgb) on perioperative blood transfusion (PBT) in head and neck cancer (HNC) surgery with free flap reconstruction may help guide clinical practice to reduce inappropriate treatment among these patients. The objective is to synthesize evidence regarding the association between preoperative Hgb and PBT among major HNC free flap surgeries. Methods Terms and synonyms for HNC surgical procedures, Hgb and PBT were used to search MEDLINE, Embase, CINAHL, Cochrane Central Register of Controlled Trials and Cochrane Database of Reviews from inception to February 2020. Reference lists of included full texts and studies reporting the preoperative Hgb, anemia or hematocrit (exposure) and the PBT (outcome) in major HNC surgery with free flap reconstruction were eligible. Studies examining esophageal, thyroid and parathyroid neoplasms were excluded; as were case reports, case series (n < 20), editorials, reviews, perspectives, viewpoints and responses. Two independent, blinded reviewers screened titles, abstracts and full texts in duplicate. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses was followed. A random-effects model was used to pool reported data. The primary outcome was the proportion of patients who had a PBT. Subgroup analysis examined sources of heterogeneity for perioperative predictors of PBT (age, sex, flap type, flap site and preoperative Hgb). We also examined mean preoperative Hgb in the PBT and no PBT groups. Results Patients with low preoperative Hgb were transfused more than those with normal Hgb (47.62%, 95% CI = 41.19–54.06, I2 = 0.00% and 13.92%, 95% CI = 10.19–17.65, I2 = 20.69%, respectively). None of the predictor variables explained PBT. The overall pooled	Review of literature evaluating influence of low preop Hb on perioperative blood transfusion in head and neck cancer surgery with free flap constructions - Modest reductions in Hb level (e.g., mild anemia) associated with increased transfusion rates

	mean preoperative Hgb was 12.96 g/dL (95% CI = 11.33–14.59, I2 = 0.00%) and was 13.58 g/dL (95% CI = 11.95–15.21, I2 = 0.00%) in the no PBT group and 12.05 g/dL (95% CI = 10.01 to 14.09, I2 = 0.00%) in the PBT group. Conclusions The heterogeneity between studies, especially around the trigger for PBT, highlights the need for additional research to guide clinical practice of preoperative Hgb related to PBT to enhance patient outcomes and improve healthcare stewardship.	
Warner MA, Shore-Lesserson L, Shander A, Patel SY, Perelman SI, Guinn NR. Perioperative Anemia: Prevention, Diagnosis, and Management Throughout the Spectrum of Perioperative Care. Anesth Analg. 2020 May;130(5):1364-1380. doi: 10.1213/ANE.0000000000004727. PMID: 32167979.	Anemia is common in the perioperative period and is associated with poor patient outcomes. Remarkably, anemia is frequently ignored until hemoglobin levels drop low enough to warrant a red blood cell transfusion. This simplified transfusion-based approach has unfortunately shifted clinical focus away from strategies to adequately prevent, diagnose, and treat anemia through direct management of the underlying cause(s). While recommendations have been published for the treatment of anemia before elective surgery, information regarding the design and implementation of evidence-based anemia management strategies is sparse. Moreover, anemia is not solely a concern of the preoperative encounter. Rather, anemia must be actively addressed throughout the perioperative spectrum of patient care. This article provides practical information regarding the implementation of anemia management strategies in surgical patients throughout the perioperative period. This includes evidence-based recommendations for the prevention, diagnosis, and treatment of anemia, including the utility of iron supplementation and erythropoiesis-stimulating agents (ESAs).	Summary of prevalence and etiology of anemia, etiology based approaches to treatment (iron for IDA) and associated proposed treatments. Iron therapy - IV iron 3-4 weeks before elective surgery is ideal - Benefit even if given 1 day before surgery - Oral iron can be considered when there is ample time before surgery and anemia is mild ESAs - Can be effective when given with IV iron, but must be given with VTE prophylaxis Folate - Those with folate deficiency should receive oral supplementation B12 - Those with B12 deficiency should receive B12 supplementation Intra and postop measures - Preservation of hemodynamics, limiting transfusion of allogenic products - Minimizing iatrogenic blood loss - Alternative treatment to blood components (iron, B12, folate, nutrition) - Restrictive transfusion protocols - Anticoag reintroduction management - Early ambulation and PT for VTE prophylaxis
Other		
Fergusson, D., Houston, B., Cagiannos, I., Morash, C., Tinmouth, A., Hutton, B., Mallick, R., Flaman, A., & Breau, R. H. (2020). The top 20 surgical procedures associated with the highest risk for blood transfusion. *British Journal of Surgery, 107*(13), e642–e643. https://doi.org/10.1002/bjs.12005	Due to potential adverse effects, limited supply, and cost, much effort has been made to limit patient blood loss and the subsequent need for allogeneic red blood cell (RBC)transfusion 1,2 . Properly conducted multi-centre randomized controlled trials are considered a gold-standard in clinical research, however they are associated with significant cost and logistical challenges3 . Over 300 registered clinical trials are assessing the effect of interventions on transfusion of surgical patients, highlighting the importance of the subject, but also the lack of research focus	**Procedures most likely to require blood transfusion:** Cardiac valve replacement, CABG, aortic aneurysm repair, radical cystectomy with urinary diversion, open femoral fracture repair, open radical nephrectomy repair, abdominal/retroperitoneal tumor excision >10 cm, vascular bypass, spenectomy, amputatiohn of leg (above and below knee), pancreatectomy (partial or total), liver resection, resection of bowel or rectum, spinal arthrodesis, arterial embolectomy, gastrectomy (partial or total), myomectomy, open

	(https://clinicaltrials.gov/, accessed May 15,2020). To efficiently allocate research funding toward interventions aimed at reducing surgical blood loss and trans-fusion, we must first understand where blood products are being used. There-fore, we sought to identify common surgical procedures at the highest riskfor RBC transfusion. This was a cross-sectional study of The American College of Surgeons 'National Surgical Quality Improvement Program (ACS-NSQIP), using the Participant Use Files from 2005-2017 4 . Over 500 hospitals worldwide presently contribute to this database, of which approximately 60% are large academic institutions. In 2008, the overall NSQIP surgical data col-lection agreement rate was 98·4% indicating highly reliable and accurate data capture.	radical prostatectomy, total abdominal hysterectomy, endovascular repair of thoracic or abdominal aortic aneurysm
MacLean, B., Weyand, A., Lim, J., & Richards, T. (2023). Preoperative iron therapy: Where are we? Best Practice & Research: Clinical Anaesthesiology, 37(4), 503–510. https://doi.org/10.1016/j.bpa.2023.10.003	Preoperative anemia affects one-third of patients undergoing major surgery and is associated with worse perioperative and postoperative outcomes; including length of hospital stay, allogeneic blood transfusion, morbidity, and mortality. Iron deficiency is the most common cause of anemia, and associative data suggests that preoperative correction of iron deficiency anemia could improve postoperative patient outcomes. However, data from randomized controlled trials (RCTs) do not appear to support the routine use of iron therapy to treat preoperative anemia. We present a literature review of large RCTs examining the efficacy of preoperative intravenous iron. We discuss the observation that although preoperative intravenous iron treatment can increase hemoglobin concentration prior to surgery in certain patient groups, the data do not clarify whether there is a direct benefit to patients. We address that preoperative intravenous iron may not be a feasible option and highlight the need to explore the mechanism and management of iron deficiency anemia in surgical patients	**a good summary of benefits from preop iron therapy, his main points:** **-Preoperative anemia is bad. Anemia + iron deficiency is worse.** **-The lower the hemoglobin, the worse it is.** **-Iron preoperatively improves hemoglobin.IV > oral in terms of effectiveness and side effect profile.** **-Impact in short term outcomes was mixed, but there is consistent evidence for improved post-op and long-term outcomes, including long term survival and QOL.** **A few notes on the trials:** **-Nearly all trials only gave one dose of iron and did not test for treatment effectiveness prior to surgery. This is a weakness and would add to inconsistency of findings.** **-All trials that looked at "more severe" subgroups found an outsize benefit in them.** **-All of the trials used ferric carboxymaltose as the iv iron treatment (not iron sucrose, the less effective and higher-side-effect version that is the only one on formulary at UW and likely many other WA hospitals**
Richards, T., Musallam, K. M., Nassif, J., Ghazeeri, G., Seoud, M., Gurusamy, K. S., & Jamali, F. R. (2015). *Impact of preoperative anaemia and blood transfusion on postoperative outcomes in gynaecological surgery*. **PLoS ONE, 10**(7), e0130861. https://doi.org/10.1371/journal.pone.0130861	Objective: To evaluate the effect of preoperative anaemia and blood transfusion on 30-day postoperative morbidity and mortality in patients undergoing gynecological surgery. Study Design: Data were analyzed from 12,836 women undergoing operation in the American College of Surgeons National Surgical Quality Improvement Program. Outcomes measured were; 30-day postoperative mortality, composite and specific morbidities (cardiac, respiratory, central nervous system, renal, wound, sepsis, venous thrombosis, or major bleeding). Multivariate logistic regression models were performed using adjusted odds ratios (OR<inf>adj</inf>) to assess the independent effects of preoperative anaemia (hematocrit <36.0%) on outcomes, effect estimates were performed before and after adjustment for perioperative transfusion requirement. Results: The prevalence of preoperative anaemia was 23.9% (95%CI: 23.2-24.7). Adjusted for	**Shows a dose response curve with increased risk faster than linear – anemia associated with increased transfusion and mortality odds in gynecological surgery**

	confounders by multivariate logistic regression; preoperative anaemia was independently and significantly associated with increased odds of 30-day mortality (OR: 2.40, 95%CI: 1.06-5.44) and composite morbidity (OR: 1.80, 95%CI: 1.45-2.24). This was reflected by significantly higher adjusted odds of almost all specific morbidities including; respiratory, central nervous system, renal, wound, sepsis, and venous thrombosis. Blood Transfusion increased the effect of preoperative anaemia on outcomes (61% of the effect on mortality and 16% of the composite morbidity). Conclusions: Preoperative anaemia is associated with adverse post-operative outcomes in women undergoing gynecological surgery. This risk associated with preoperative anaemia did not appear to be corrected by use of perioperative transfusion.	
Trentino, K. M., Mace, H., Symons, K., Sanfilippo, F. M., Leahy, M. F., Farmer, S. L., Watts, R. D., Hamdorf, J. M., & Murray, K. (2021). Associations of a preoperative anemia and suboptimal iron stores screening and management clinic in colorectal surgery with hospital cost, reimbursement, and length of stay: A net cost analysis. Anesthesia & Analgesia, 132(2), 344–352. https://doi.org/10.1213/ANE.0000000000005241	BACKGROUND: In 2016, a preoperative clinic was implemented to screen, evaluate, and manage anemia and suboptimal iron stores at a major tertiary care medical center in Western Australia. Few studies compare the costs and reimbursements associated with preoperative anemia and suboptimal iron stores management. The objective of our study was to conduct a net cost analysis associated with the implementation of this clinic. METHODS: We designed a retrospective cohort study involving elective colorectal surgical admissions over a 3-year period. The baseline year selected was the 2015-2016 financial year, with outcomes in the 2016-2017 and 2017-2018 year compared to baseline. The study perspective was the Western Australian Health System. Hospital costs were extracted from the health service clinical costing system, which captures costs at the admission level. The primary outcome was net cost, defined as gross cost minus reimbursement (or funding) received. RESULTS: Our 3-year study included 544 admissions for elective colorectal surgery. After the implementation of the preoperative clinic, 73.4% (n = 257) of admissions were screened for anemia and suboptimal iron stores, and 31.4% (n = 110) received intravenous iron. In our adjusted analysis, when comparing the final year (2017-2018) with baseline (2015-2016), the units of red blood cells transfused per admission decreased 53% (142 vs 303 units per 1000 discharges; P =.006), and mean hospital length of stay decreased 15% (7.7 vs 9.1 days; P =.008). When comparing the final year with baseline, rectal resection admissions were associated with a mean decrease in the net cost of Australian dollar (A$) 7619 (95% confidence interval, 4230-11,008; P <.001) between 2015-2016 and 2017-2018. For small and large bowel procedures, there was a mean decrease of A$6744 (95% confidence interval, 2430-11,057; P =.002). CONCLUSIONS: The implementation of a preoperative anemia and suboptimal iron stores screening and management clinic in elective colorectal surgery was associated	**retrospective cohort study of elective colorectal surgical admissions over 3year period to conduct a net cost analysis associated with implementation of a preop clinic at a tertiary medical care center in Western Australia - RBC transfusion decreased 53%, mean LOS decreased 15% - decrease in net cost of over 7000 Australian dollars.**

	with reductions in red cell transfusions, length of stay, and net costs.	
Warner, Matthew A. MD*; Ferreira, Renata MD†; Raphael, Jacob MD‡; Shore-Lesserson, Linda MD§; Grant, Michael C. MD‖; Sykes Hill, Shanna MD¶; Morewood, Gordon MD#; Popescu, Wanda M. MD**; Schwann, Nanette MD††,‡‡; Guinn, Nicole R. MD, MBA§§. Return on Investment of Preoperative Anemia Management Programs in Cardiac Surgery: An Advisory From the Society of Cardiovascular Anesthesiologists Clinical Practice Improvement Committee With Endorsement by the Society for the Advancement of Patient Blood Management. Anesthesia & Analgesia ():10.1213/ANE.0000000000006721, November 07, 2024. | DOI: 10.1213/ANE.0000000000006721	Despite multiple recent guidelines recommending the diagnosis and treatment of anemia before elective cardiac surgery, few institutions have formal programs or methods in place to accomplish this. A major limitation is the perceived financial shortfall and the leadership buy-in required to undertake such an initiative. The purpose of this advisory from the Society of Cardiovascular Anesthesiologists (SCA) Clinical Practice Improvement Committee with endorsement by the Society for the Advancement of Patient Blood Management (SABM) is to provide an overview of preoperative anemia management programs with an emphasis on the associated financial implications. This advisory reviews the evidence for preoperative anemia management programs in both cardiac and noncardiac surgery, discusses options for managing preoperative anemia, provides novel financial modeling regarding the implementation of preoperative anemia management programs, and describes implementation challenges, potential solutions, and opportunities for improvement.	**Advisory statement emphasizing financial benefit of anemia management in acardiac and noncardiac surgery**
Guinn NR, Guercio JR, Hopkins TJ, Grimsley A, Kurian DJ, Jimenez MI, Bolognesi MP, Schroeder R, Aronson S; Duke Perioperative Enhancement Team (POET). How do we develop and implement a preoperative anemia clinic designed to improve perioperative outcomes and reduce cost? Transfusion. 2016 Feb;56(2):297-303. doi: 10.1111/trf.13426. Epub 2015 Nov 23. PMID: 26592207.	Treatment of anemia is one of the four pillars of patient blood management programs. Preoperative anemia is common and associated with increased perioperative morbidity after surgery and increased rates of blood transfusion. Effective treatment of preoperative anemia, however, requires advanced screening, diagnosis, and initiation of therapy weeks before elective surgery. Here we describe the development and implementation of a preoperative anemia screening and treatment program at Duke University Hospital.	**Example of anemia optimization clinic at Duke University**
Guinn, N. R., Fuller, M., Murray, S., & Aronson, S.; Duke Perioperative Enhancement Team (POET). (2022). Treatment through a preoperative anemia clinic is associated with a reduction in perioperative red blood cell transfusion in patients undergoing orthopedic and gynecologic surgery. Transfusion, 62(4), 809–816. https://doi.org/10.1111/trf.16847	Background Preoperative anemia is associated with increased morbidity, mortality, and risk of transfusion. Treatment through a preoperative anemia clinic (PAC) may improve outcomes. Study Design and Methods Adult patients undergoing elective orthopedic and gynecologic surgery with preoperative anemia were identified and referred for hemoglobin optimization with iron and/or erythropoietin from a single-site academic health center. Treated patients were propensity matched to untreated controls and compared on outcomes of erythrocyte transfusion, length of stay (LOS), and readmission. Changes in hemoglobin relative to treatment time before surgery were also measured in the treated cohort. Results One thousand three hundred thirty-two patients were evaluated between July 2015 and March 2021, of which 161 underwent optimization through the PAC. After propensity matching, 127 (98 orthopedic and 29 gynecology) PAC-treated patients were	**Preop anemia clinic for ortho and gynecological surgery showed reduction in periop transfusion and possible reduction in LOS and readmission compared to matched controls** **Greater treatment time correlated with greater increase in Hb up to 2 months prior to surgery**

	compared to 127 (98 orthopedic and 29 gynecology) control patients who did not undergo treatment. The primary outcome of perioperative transfusion was significantly lower in treated patients compared with matched controls (12.60% vs. 26.77%, *p* = .005). A lower LOS was demonstrated in the gynecologic PAC subgroup (2.2 [1.5, 2.4] vs. 3.1 [2.2, 3.4], *p* = .002). Each day of treatment time before surgery was associated with an increase of 0.040 g/dL hemoglobin (*p* < .001) until 65 days, after which further time did not increase hemoglobin. Conclusion Treatment through a preoperative anemia clinic is associated with a reduction in perioperative transfusion and possible reduction in LOS and readmission compared with matched controls. Additionally, treatment time before surgery is correlated with a greater increase in hemoglobin up until 2 months prior to surgery.	
Guinn, N. R., … Aronson, S. (2020). Perioperative Outcomes of Patients Treated in an Anemia Clinic before Spine Surgery [Abstract]. Blood, 140(Suppl 1), 10763. https://doi.org/ (see ASH abstract supplement listings)	**BACKGROUND**: Patients with preoperative anemia are at increased risk of postoperative blood transfusion, as well as other adverse outcomes, including infection, prolonged length of stay (LOS), and death. Requirement of intraoperative transfusions may be an independent risk factor for mortality among patients undergoing noncardiac surgery. As such, efforts have emerged internationally to establish clinical decision support tools, dedicated preoperative anemia clinics, and clinical trials studying the effects of preoperative treatment of patients to improve outcomes after surgery. While studies to date have shown mixed results, some suggest that treatment with intravenous (IV) iron improves anemia and decreases transfusion requirements. Treatment with erythropoietin-stimulating agents (ESA) has also been associated with fewer transfusions in patients undergoing orthopedic surgery. **METHODS**: We established a preoperative clinic in 2019 with a pilot for patients undergoing spine surgery. Patients who were found to have a hemoglobin (Hgb) < 13.0 g/dL on preadmission testing were automatically referred, and when possible, had iron studies reflexively added on to their samples. Patients were offered an appointment with a nurse practitioner or physician in Hematology and treated with IV iron or a combination of IV iron and ESA at the discretion of the provider. Importantly, if time did not allow for a visit or the patient declined an appointment or preoperative treatment, surgeries were not cancelled or delayed. This retrospective study included patients undergoing elective spine surgeries between August 1, 2019 and June 1, 2021 at Thomas Jefferson University Hospital and Jefferson Hospital for Neuroscience. Patients were eligible if they were automatically referred to the preoperative anemia clinic based on preadmission	**While pre-op treatment with IV iron and ESAs did not reduce transfusions, it increased postop Hb levels and had promising trend toward reduction in LOS**

	testing results. The primary outcome was postoperative allogeneic red blood cell (RBC) transfusion during the index admission. Secondary outcomes included decrease in Hgb postoperatively, LOS, and 30-day readmission rate. **RESULTS**: The study included 108 patients (53.7% female) who underwent a total of 112 distinct elective spine surgeries. The median age at the time of surgery was 65 years. The most common surgery was decompression and fusion (73.2%), followed by decompression (17.0%) and fusion (9.8%). 16.1% of surgeries were revisions of a prior surgery. The median preoperative Hgb was 11.6 g/dL. Prior to the 112 surgeries, 45 (40.2%) patients were seen by a Hematology provider and 37 (33.0%) received preoperative treatment for anemia, including 28 (25.0%) who got IV iron plus ESA, 8 (7.1%) IV iron alone, and 1 (0.9%) ESA alone. The final treatment was given a median of 5 days before surgery (IQR 3-9.5 days). There was a nonsignificant trend toward lower mean preoperative Hgb in patients who were treated before surgery and those who were not (mean 11.2 vs 11.6 g/dL, p=.162) and greater mean estimated blood loss during surgery when reported (392 vs 315 mL, p=.462). Compared to untreated patients, those who were treated before surgery were significantly more likely to be iron deficient (ferritin < 30 ng/mL or iron saturation < 15%) (45.9% vs 26.7%, p=.041). The primary outcome of allogeneic RBC transfusion occurred in 18.9% of patients who received pre-treatment and 9.3% of those who did not (p=.149). The degree of initial Hgb drop postoperatively from last pre-op value was significantly lesser in pre-treated patients (-0.93 vs -1.56 g/dL, p=.015), and a nonsignificant improvement was observed in the change from baseline to nadir Hgb during the index admission (-1.54 vs -2.15 g/dL, p=.074). A trend toward shorter LOS was observed in pre-treated patients (3.30 vs 3.47 days, p=.739), though that group also experienced more 30-day inpatient readmissions (18.9 vs 12.0%, p=.325). No deaths were observed during the study period. **CONCLUSION**: In this preoperative anemia clinic pilot, treatment with IV iron and/or ESA before major spine surgery was not associated with a reduction in allogeneic RBC transfusions or hospital readmission. However, those who received pre-treatment had significantly lesser declines in Hgb after surgery and a trend toward shorter LOS. Patients who received treatment were significantly more likely to be iron deficient before surgery and had lower mean Hgb levels, which confounds the results. Larger prospective studies of preoperative anemia therapy are needed.	

Munting, K. E., & Klein, A. A. (2019). Optimisation of pre-operative anaemia in patients before elective major surgery – why, who, when and how? Anaesthesia, 74(Suppl 1), 49–57. https://doi.org/10.1111/anae.14466	**Anaemia in surgical patients is a common and serious problem; around 40% of patients presenting for major surgery are anaemic. Patients with pre-operative anaemia have significantly higher rates of morbidity and mortality and are likely to be transfused red cells. In addition, red cell transfusions are independently associated with worse outcomes. Pre-optimisation of anaemia in surgical patients leads to higher pre-operative haemoglobin concentrations and less need for transfusion. Patients undergoing major surgery (defined as blood loss > 500 ml expected or possible) should be optimised if their haemoglobin concentration is less than 130 g.l-1 on screening. Detection of anaemia should follow listing for surgery as soon as possible to allow enough time for optimisation. The most common cause of pre-operative anaemia is iron deficiency, which can be treated with iron therapy. Iron clinics should be set up in either primary or secondary care to allow for optimal treatment. In this review, we present literature supporting the optimisation of pre-operative anaemia and propose a treatment algorithm.**	**Proposed treatment algorithm for preoperative anemia**

Table 1 Top 20 high-transfusion risk surgical procedures

Rank	Procedure	CPT codes	Procedures (n)	Transfusions (n)	Patients transfused
1	Cardiac valve replacement	33405, 33406, 33410, 33411, 33412, 33413, 33430, 33465, 33475	8454	4557	53·9%
2	Coronary artery bypass graft	33510, 33511, 33512, 33513, 33514, 33515, 33516, 33533, 33534, 33535, 33536	14375	7203	50·1%
3	Aortic aneurysm repair (includes thoracic and abdominal)	33860, 33863, 33864, 33870, 33875, 33877, 34830, 34831, 34832, 35081, 35082, 35091, 35092, 35102, 35103	21301	10188	47·8%
4	Radical cystectomy with urinary diversion	51570, 51575, 51580, 51585, 51590, 51595, 51596, 51597	13431	5101	38·0%
5	Open femoral fracture repair	27236, 27244, 27245, 27248, 27269, 27506, 27507, 27511, 27513, 27514, 27519	95977	28351	29·5%
6	Open radical nephrectomy	50220, 50225, 50230, 50234, 50236	12054	3204	26·6%
7	Abdominal/retroperitoneal tumor excision >10 cm	49205	4084	1083	26·5%
8	Vascular bypass	35537, 35539, 35540, 35637, 35638, 35646, 35647, 35521, 35533, 35621, 35654, 35556, 35566, 35656, 35666	62971	13260	21·0%
9	Splenectomy	38100, 38101, 38102, 38120	10263	2148	20·9%
10	Amputation of leg (above and below knee)	27590, 27591, 27592, 27594, 27596, 27598, 27880, 27881, 27882, 27884, 27886, 27888, 27889,	44843	7998	17·8%
11	Pancreatectomy (partial or total)	48105, 48120, 48140, 48145, 48146, 48150, 48152, 48153, 48154, 48155, 48160	62680	10956	17·5%
12	Liver resection	47120, 47122, 47125, 47130	37413	6480	17·3%
13	Resection of bowel or rectum	44140, 44141, 44143, 44144, 44145, 44146, 44147, 44150, 44151, 44155, 44156, 44157, 44158, 44160, 45110, 45111, 45112, 45113, 45114, 45116, 45119	239226	34134	14·3%
14	Spinal arthrodesis	22595, 22590, 22610, 22612, 22614, 22616, 22533, 22632, 22630, 22634	44367	6220	14·0%
15	Arterial embolectomy	34001, 34051, 34101, 34111, 34151, 34201, 34203	14333	1978	13·8%
16	Gastrectomy (partial or total)	43610, 43611, 43620, 43621, 43622, 43631, 43632, 43633, 43634	18407	2502	13·6%
17	Myomectomy	58140, 58145, 58146	11452	1411	12·3%
18	Open radical prostatectomy	55840, 55842, 55845	11045	1357	12·3%
19	Total abdominal hysterectomy	58150, 58152, 58180, 58200, 58210, 58240, 58953, 58954, 58956	87811	10021	11·4%
20	Endovascular repair of thoracic or abdominal aortic aneurysm	33880, 33881, 34800, 34802, 34803, 34804, 34805 34808, 34825, 34826,	53856	6081	11·3%

*CPT = common procedural terminology

[1] Montroy, J., Lavallée, L. T., Zarychanski, R., Fergusson, D., Houston, B., Cagiannos, I., Morash, C., Tinmouth, A., Hutton, B., Mallick, R., Flaman, A., & Breau, R. H. (2020). The top 20 surgical procedures associated with the highest risk for blood transfusion. *British Journal of Surgery, 107*(13), e642–e643. https://doi.org/10.1002/bjs.12005