| Citation | Abstract | Findings | Top Procedures with Blood Loss/Transfusion Risk |
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| 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, December 1). 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) transfusion1, 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 (https://clinicaltrials.gov/, accessed May 15, 2020). To efficiently allocate research funding toward interventions aimed at reducing surgical blood loss and transfusion, we must first understand where blood products are being used. Therefore, we sought to identify common surgical procedures at the highest risk for RBC transfusion. | Cross-sectional study of NSQIP participant use files, over 500 hospitals worldwide contributing to database, 60% are large academic institutions<br><br>Limited analysis to commonly performed procedures<br><br>Following procedures place patients at highest risk and account for 50% of surgical patients exposed to RBC transfusion | • Cardiac valve replacement<br>• Coronary artery bypass graft<br>• Aortic aneurism repair (thoracic and abdominal)<br>• Radical cystectomy with urinary diversion<br>• Open femoral fracture repair<br>• Open radical nephrectomy<br>• Abdominal retroperitoneal tumor excision > 10cm<br>• Vascular bypass<br>• Splenectomy<br>• Amputation of leg (above and below the knee)<br>• Pancreatectomy (partial or total)<br>• Liver resection<br>• Resection of bowel or rectum<br>• Spinal arthrodesis<br>• Arterial embolectomy<br>• Gastrectomy (partial or total)<br>• Myomectomy |

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| | | | • Open radical prostatectomy<br>• Total abdominal hysterectomy<br>• Endovascular repair of thoracic or abdominal aortic aneurysm |
| Shah A, Acheson A, Sinclair RCF. Perioperative iron deficiency anaemia. BJA Educ. 2023 Oct;23(10):372-381. doi: 10.1016/j.bjae.2023.06.001. Epub 2023 Jul 6. PMID: 37720558; PMCID: PMC10501883. | Key points.<br>•Iron deficiency is the most common cause of anaemia, affecting at least 1.2 billion people worldwide.<br>•Iron is essential for haemoglobin synthesis, cell growth and differentiation, oxygen sensing, muscle energetics and cellular immunity.<br>•Systemic iron homeostasis is finely regulated by hepcidin.<br>•Pre- and postoperative anaemia affects nearly all groups of patients and is an independent risk factor for poor clinical outcomes after both elective and non-elective surgery.<br>•Perioperative iron deficiency anaemia is commonly treated with oral or i.v. iron with some evidence of improved clinical outcomes. Ongoing research will provide further evidence on the use of erythropoiesis-stimulating agents. | Preop anemia affects 30-60%of patients and varies according to types of surgeries<br><br>Major cause of anemia in gynecological and colorectal cancer resection surgery is iron deficiency anemia<br><br>40% of patients undergoing cardiac surgery have preop anemia, nearly 1 in 2 patients are iron deficient before surgery. | Elective noncardiac surgery<br>• Gynecologic surgery<br>• Colorectal cancer resection<br>Cardiac surgery<br>Urgent and emergent surgery<br>• Emergency laparotomy<br>• Hip fracture surgery |
| Guinn, Nicole R. MD*; Schwartz, Jonathon MD†; Arora, Rakesh C. MD, PhD‡; Morton-Bailey, Vicki DNP, MSN, AGNP-BC§; Aronson, Solomon MD, MBA, FASA, FACC, FCCP, FAHA, FASE‖; Brudney, | Preoperative anemia is common in patients presenting for cardiac surgery, with a prevalence of approximately 1 in 4, and has been associated with worse outcomes including increased risk of blood transfusion, kidney injury, stroke, | Cardiac surgery prevalence of anemia is 1 in 4; preop anemia associated with increased risk of transfusion, kidney injury, stroke, infection ,death; | • 30-80% of cardiac surgery patienst with preop anemia have IDA, additional 20-50% of nonanemic cardiac surgery patients have |

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| Charles Scott MC, ChB¶; Bennett-Guerrero, Elliott MD†; on behalf of the Perioperative Quality Initiative (POQI-8) and the Enhanced Recovery After Surgery-Cardiac Society (ERAS-C) Investigators. Perioperative Quality Initiative and Enhanced Recovery After Surgery-Cardiac Society Consensus Statement on the Management of Preoperative Anemia and Iron Deficiency in Adult Cardiac Surgery Patients. Anesthesia & Analgesia 135(3):p 532-544, September 2022. \| DOI: 10.1213/ANE.0000000000006148 | infection, and death. Iron deficiency, a major cause of anemia, has also been shown to have an association with worse outcomes in patients undergoing cardiac surgery, even in the absence of anemia. Although recent guidelines have supported diagnosing and treating anemia and iron deficiency before elective surgery, details on when and how to screen and treat remain unclear. The Eighth Perioperative Quality Initiative (POQI 8) consensus conference, in conjunction with the Enhanced Recovery after Surgery-Cardiac Surgery Society, brought together an international, multidisciplinary team of experts to review and evaluate the literature on screening, diagnosing, and managing preoperative anemia and iron deficiency in patients undergoing cardiac surgery, and to provide evidence-based recommendations in accordance with Grading of Recommendations, Assessment, Development and Evaluation (GRADE) criteria for evaluating biomedical literature. | Evidence based recommendations for screening, diagnosing and managing preop anemia and iron deficiency in patients undergoing cardiac surgery<br><br>Screen all patients for anemia and iron deficiency as soon as surgery is contemplated<br>Use hemoglobin measurement as screening tool for anemia<br>Recommend measurement of ferritin and transferrin saturation as screening tool for iron deficiency<br>Recommend further workup for patients identified as being anemia to determine etiology (lab workup including CBC, if anemia identified by POC steting, Cr, Vit B 12, folate, reticulocyte count, H&P)<br>Recommend preop treatment of iron deficiency with or without anemia<br>Recommend treatment with IV iron when limited time before surgery<br>Recommend referral for consultation for ESAs for | iron deficiency without anemia |

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| | | following patients: decline red cell transfusion, have moderate to severe anemia, or anemia secondary to chronic kidney disease or chronic inflammation<br>Recommend structured clinical pathway to evaluated and treat preop anemia<br>Recommend leveraging EMR to provide alerts to clinicians to identify patients who are anemic before surgery and prompt further evaluation<br>Recommend use of preop anemia care coordination program as cost effective method to improve outcomes | |
| Zhang FQ, Yang YZ, Li PF, Ma GR, Zhang AR, Zhang H, Guo HZ. Impact of preoperative anemia on patients undergoing total joint replacement of lower extremity: a systematic review and meta-analysis. J Orthop Surg Res. 2024 Apr 18;19(1):249. doi: 10.1186/s13018-024-04706-y. PMID: 38637795; PMCID: PMC11027536. | Purpose<br>Preoperative anemia increases postoperative morbidity, mortality, and the risk of allogeneic transfusion. However, the incidence of preoperative anemia in patients undergoing total hip arthroplasty and total knee arthroplasty (TKA) and its relationship to postoperative outcomes has not been previously reported.<br><br>Methods<br>We conducted a comprehensive literature search through PubMed, Cochrane Library, Web of Sincien, and | Prevalence of preop anemia in patients undergoing total hip arthroplasty and total knee arthroplasty (TJA) was 22% | • TJA, higher in TKA patients and female patients undergoing revision |

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| | Embase from inception to July 2023 to investigate the prevalence of preoperative anemia in patients undergoing Total Joint Arthroplasty, comorbidities between anemic and non-anemicpatients before surgery, and postoperative outcomes. postoperative outcomes were analyzed. Overall prevalence was calculated using a random-effects model, and heterogeneity between studies was examined by Cochran's Q test and quantified by the I2 statistic. Subgroup analyses and meta-regression analyses were performed to identify sources of heterogeneity. Publication bias was assessed by funnel plots and validated by Egger's test.<br><br>Results<br>A total of 21 studies with 369,101 samples were included, all of which were retrospective cohort studies. 3 studies were of high quality and 18 studies were of moderate quality. The results showed that the prevalence of preoperative anemia was 22% in patients awaiting arthroplasty; subgroup analyses revealed that the prevalence of preoperative anemia was highest in patients awaiting revision of total knee arthroplasty; the highest prevalence of preoperative anemia was found in the Americas; preoperative anemia was | | |

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| | more prevalent in the female than in the male population; and preoperative anemia with a history of preoperative anemia was more common in the female than in the male population. patients with a history of preoperative anemia; patients with joint replacement who had a history of preoperative anemia had an increased risk of infection, postoperative blood transfusion rate, postoperative blood transfusion, Deep vein thrombosis of the lower limbs, days in hospital, readmission within three months, and mortality compared with patients who did not have preoperative anemia.<br><br>Conclusion<br>The prevalence of preoperative anemia in patients awaiting total joint arthroplasty is 22%, and is higher in TKA and female patients undergoing revision, while preoperative anemia is detrimental to the patient's postoperative recovery and will increase the risk of postoperative complications, transfusion rates, days in the hospital, readmission rates, and mortality. | | |
| Spahn DR. Anemia and patient blood management in hip and knee surgery: a systematic review of the literature. Anesthesiology. 2010 Aug;113(2):482-95. doi: | A systematic search was conducted to determine the characteristics of perioperative anemia, its association with clinical outcomes, and the effects of patient blood management interventions on these outcomes in | Preop anemia is prevalence in patients undergoing total hip or knee arthroplasty and hip fracture surgery, ranging from 25% +/9% to 44% +/- 9% respectively | • TJA<br>• Hip fracture surgery |

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| 10.1097/ALN.0b013e3181e08e97. PMID: 20613475. | patients undergoing major orthopedic surgery. In patients undergoing total hip or knee arthroplasty and hip fracture surgery, preoperative anemia was highly prevalent, ranging from 24 +/- 9% to 44 +/- 9%, respectively. Postoperative anemia was even more prevalent (51% and 87 +/- 10%, respectively). Perioperative anemia was associated with a blood transfusion rate of 45 +/- 25% and 44 +/- 15%, postoperative infections, poorer physical functioning and recovery, and increased length of hospital stay and mortality. Treatment of preoperative anemia with iron, with or without erythropoietin, and perioperative cell salvage decreased the need for blood transfusion and may contribute to improved patient outcomes. High-impact prospective studies are necessary to confirm these findings and establish firm clinical guidelines. | | |
| Suresh KV, Wang K, Sethi I, Zhang B, Margalit A, Puvanesarajah V, Jain A. Spine Surgery and Preoperative Hemoglobin, Hematocrit, and Hemoglobin A1c: A Systematic Review. Global Spine J. 2022 Jan;12(1):155-165. doi: 10.1177/2192568220979821. Epub 2021 Jan 21. PMID: 33472418; PMCID: PMC8965292. | Objectives:<br>Synthesize previous studies evaluating clinical utility of preoperative Hb/Hct and HbA1c in patients undergoing common spinal procedures: anterior cervical discectomy and fusion (ACDF), posterior cervical fusion (PCF), posterior lumbar fusion (PLF), and lumbar decompression (LD).<br><br>Methods: | PCF and ACDF: Decreased Hb/Hct predicted increased postop morbidity (including return to operating room), pulmonary complications, transfusions, increased LOS | Spine surgeries<br>• Anterior cervical discectomy and fusion<br>• Posterior cervical fusion<br>• Posterior lumbar fusion<br>• Lumbar decompression |

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| | We queried PubMed, Embase, Cochrane Library, and Web of Science for literature on preoperative Hb/Hct and HbA1c and post-operative outcomes in adult patients undergoing ACDF, PCF, PLF, or LD surgeries.<br><br>Results:<br>Total of 4,307 publications were assessed. Twenty-one articles met inclusion criteria.<br><br>PCF and ACDF:<br>Decreased preoperative Hb/Hct were significant predictors of increased postoperative morbidity, including return to operating room, pulmonary complications, transfusions, and increased length of stay (LOS). For increased HbA1c, there was significant increase in risk of postoperative infection and cost of hospital stay.<br><br>PLF:<br>Decreased Hb/Hct was reported to be associated with increased risk of postoperative cardiac events, blood transfusion, and increased LOS. Elevated HbA1c was associated with increased risk of infection as well as higher visual analogue scores (VAS) and Oswestry disability index (ODI) scores.<br><br>LD: | | |

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| | LOS and total episode of care cost were increased in patients with preoperative HbA1c elevation.<br><br>Conclusion:<br>In adult patients undergoing spine surgery, preoperative Hb/Hct are clinically useful predictors for postoperative complications, transfusion rates, and LOS, and HbA1c is predictive for postoperative infection and functional outcomes. Using Hct values <35-38% and HbA1c >6.5%-6.9% for identifying patients at higher risk of postoperative complications is most supported by the literature. We recommend obtaining these labs as part of routine pre-operative risk stratification. | | |
| Phan K, Dunn AE, Kim JS, Capua JD, Somani S, Kothari P, Lee NJ, Xu J, Dowdell JE, Cho SK. Impact of Preoperative Anemia on Outcomes in Adults Undergoing Elective Posterior Cervical Fusion. Global Spine J. 2017 Dec;7(8):787-793. doi: 10.1177/2192568217705654. Epub 2017 Jun 30. PMID: 29238644; PMCID: PMC5722000. | Study design: Retrospective analysis of prospectively collected data.<br><br>Objectives: Few studies have investigated the role of preoperative anemia on postoperative outcomes of posterior cervical fusion. This study looked to investigate the potential relationship between preoperative anemia and postoperative outcomes following posterior cervical spine fusion.<br><br>Methods: Data from patients undergoing elective posterior cervical fusions between 2005 and 2012 was | Preop anemia linked to a number of postop complications which can increase hospital length of stay, likelihood of reoperation<br><br>Prevalence of preop anemia undergoing elective posterior cervical fusions was 22.4% | • Elective posterior cervical fusions |

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| | collected from the American College of Surgeons National Surgical Quality Improvement Program database using inclusion/exclusion criteria. Multivariate analyses were used to identify the predictive power of anemia for postoperative outcomes.<br><br>Results: A total of 473 adult patients undergoing elective posterior cervical fusions were identified with 106 (22.4%) diagnosed with anemia preoperatively. Anemic patients had higher rates of diabetes (P = .0001), American Society of Anesthesiologists scores ≥3 (P < .0001), and higher dependent functional status prior to surgery (P < .0001). Intraoperatively, anemic patients also had higher rates of neuromuscular injuries (P = .0303), stroke (P = .013), bleeding disorders (P = .0056), lower albumin (P < .0001), lower hematocrit (P < .0001), and higher international normalized ratio (P = .002). Postoperatively, anemic patients had higher rates of complications (P < .0001), death (P = .008), blood transfusion (P = .001), reoperation (P = .012), unplanned readmission (P = .022), and extended length of stay (>5 days; P < .0001).<br><br>Conclusions: Preoperative anemia is linked to a number of postoperative | | |

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| | complications, which can increase length of hospital stay and increase the likelihood of reoperation. Identifying preoperative anemia may play a role in optimizing and minimizing the complication rates and severity of comorbidities following posterior cervical fusion. | | |