Working together to improve health care quality, outcomes, and affordability in Washington State.

Surgical Patient Optimization: Glycemic Control and Anemia 2025

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Executive Summary

This report highlights the critical role of modifiable patient health factors—namely anemia and glycemic control—in perioperative outcomes for individuals undergoing major surgery. Both preoperative anemia and inadequate blood sugar management are linked to increased risks, including prolonged hospital stays[i], higher costs, greater morbidity and mortality[ii iii], and lower quality of recovery. Even mild anemia can significantly impact 30-day postoperative outcomes, while perioperative glucose levels are a strong predictor of short-term mortality. [iv] Significant variability exists across Washington State in practices around A1c optimization, perioperative glycemic protocols and anemia management.

To address these challenges, the workgroup recommends a comprehensive framework focused on improving perioperative glycemic control, optimizing preoperative anemia, fostering multidisciplinary collaboration, and advancing payment reforms. The report calls for system-wide adoption of evidence-based protocols and targeted interventions to reduce health disparities and improve surgical outcomes for Washington residents. This report and set of guidelines is appropriate for surgical management of nonpregnant adults.

Focus Area	**Components**
Preoperative Anemia Optimization	• Early identification and diagnosis, targeted treatment (iron, ESA, etc.) • Nutritional optimization • Coordination of multidisciplinary care, and monitoring before surgery • Population level management of blood products
Perioperative Glycemic Control	• Early screening for glucose dysregulation • Nutritional optimization • Preoperative glucose monitoring • Stress and inflammation management • Judicious use of pharmacologic interventions if needed
Multidisciplinary Collaboration	• Preoperative provider and surgical team collaboration
Payment Reform	• Minimizing financial barriers to glycemic control and anemia optimization • Incorporation of anemia and glycemic control into surgical optimization incentives

Guidelines

Preoperative Clinicians (e.g., Primary Care Clinician, Perioperative Clinician, etc.)

Perioperative Glycemic Control

- **At the time a referral for major elective surgery is considered, evaluate glycemic control** for patients with or at risk for diabetes (e.g., age 45+, BM 30 kg/m2 +, familial history of diabetes, past medical history of gestational diabetes) (AAFP)
- Perform testing as early as possible in presurgical process (i.e. with enough time to be able to make changes to optimize patient health).
- Screen for health-related social needs, including food insecurity
    - Consider using tools (such as the Protocol for Responding to and Assessing Patients' Assets, Risks and Experiences(PRAPARE)) and document results in the medical record.
    - Refer to staff or community organization that can help to address identified needs (e.g., team social worker, local resource hub, etc.)
- **For patients with diabetes**:
    - Perform a preoperative risk assessment for people at high risk for ischemic heart disease, those with autonomic neuropathy or chronic kidney disease, per most updated American Diabetes Association (ADA) guidelines.
    - Discuss and determine goals (e.g., reduction of HbA1c, if using CGM goal of 70% time in range between 70-180 blood glucose) of medical optimization of glycemic control before surgery in collaboration with the patient and their support system as appropriate.
    - Set an HbA1c goal for surgery
        - **Whenever possible, target should be HbA1c <8%.**
        - HbA1c is highly individualized, and goals of optimization should be made between patients and providers considering co-occurring conditions and risks for hypoglycemic events. For patients requiring insulin, a continuous glucose sensor is recommended according to ADA standards of care. **See Appendix D for common clinical conditions that affect HbA1c.**
    - Consider referring to a certified diabetes education specialist and/or registered dietician/nutritionist for support with optimization.
    - Consider referral to a Diabetes Prevention Program as applicable.
    - Plan medication management as appropriate, including but not limited to: [v]
        - Insulin transition plans for insulin-dependent patients with diabetes, including those on automated insulin delivery systems (AID)

        - Basal insulin plus pre-meal short- or rapid-acting coverage supports improved glycemic outcomes and lower perioperative complications.
        - Reduction of 10-25% basal insulin dose given evening before surgery can lower risk of hypoglycemia based on individual patient circumstances.
    - Consider withholding oral diabetes medications
        - Newer oral meds all have prolonged fasting recommendations (currently clears only for 24hrs) and some may require holding for 72+ hrs: GLP-1 RAs and/or GLP-1/GIP Ras, DPP-4 inhibitors
    - Withholding versus continuing other meds will depend on renal function and other patient factors: Oral hypoglycemics, sulfonylureas, meglitinides, thiazolidinediones, etc. Consider holding SGLT2 inhibitors 3-4 days before surgery[vi]
    - If a patient is unable to demonstrate good glycemic control (e.g., HbA1c < 8%, or if appropriate a CGM 60% target in range), or plan for good glycemic control:
        - Consider the benefits and risks of recommending delaying the procedure until reaching the patient's individualized threshold for glycemic control. May also be influenced by availability of intensive perioperative glycemic control resources (e.g. inpatient admission).
        - Consider waiting to schedule the elective procedure until patient reaches their individualized threshold for glycemic control optimization
- **Communicate glycemic control status and optimization plan to surgery team** in referral and/or handoff. Plans should include, but are not limited to:
    - Medication initiation or adjustment points for patients with elevated HbA1c.
    - Perioperative glucose control in perioperative period to reduce adverse outcomes. Intra- and post-operative glucose control is critical to preventing postoperative negative outcomes.
    - Nutritional support as needed, including referral to registered dietician/nutritionist
    - Close follow up plan to re-check blood glucose before procedure and threshold by which to consider delaying procedure

- Plan for and schedule close outpatient follow-up for patients with anticipated intraoperative hyperglycemia (e.g., schedule an appointment within 1-week post-operative for patients with uncontrolled diabetes)

Preoperative Anemia Optimization

As early as possible in the presurgical process in anyone being considered for intermediate, moderate, or high risk surgery, screen for anemia with complete blood count .

- For patients with anemia (Hb <13g/dL), identify underlying cause of anemia. Assessment should include the following
    - Reflexively test iron studies.
    - Comprehensive medical and medication history and physical exam
    - Order other lab tests as indicated to diagnose underlying cause. Consider the algorithm in **Appendix H** and other evidence-based resources for evaluation of anemia in healthy individuals in outpatient setting. Minimize blood draw amount (e.g., Peds tubes) when able
- If iron deficiency anemia is suspected, consider further evaluation to determine underlying cause
    - Blood loss (e.g., gastrointestinal, cancer, gynecological)
    - Autoimmune or chronic disease (e.g. kidney, rheumatoid, etc)
    - Decreased absorption due to gastrointestinal illness (celiac disease, gastrectomy, gastric bypass, resection, H. pylori, inflammatory bowel disease), medications (antacids, proton pump inhibitors, ESAs) or food (calcium, tannins, phytates)
    - Pregnancy
    - Iron-poor diet
- Discuss and determine goals of treatment for anemia with the patient, including likely time course needed for treatments (4-6 weeks or more), including cause of anemia and individual patient factors and circumstances.
- Treat anemia to optimize prior to surgery (ideal goal = Hb > 12 g/dL)
    - For those with identified cause of anemia, treat the underlying cause
    - For patients with isolated iron deficiency anemia, supplement with iron formulation unless contraindicated. Consult pharmacy as able to support selecting iron supplementation methods that meet hemoglobin/iron goals, cost and timeline limitations.
        - If 8+ weeks until surgery, can consider oral iron therapy

        - IV supplementation is recommended in patients with <8 weeks until surgery, oral iron is not effective or tolerated, or with severe anemia (Hb <10g/dL)
        - Consider addition of erythropoietin stimulating agents
            - In patients with anemia of inflammation (e.g., kidney disease, autoimmune disease)
            - Those who cannot accept transfusions
            - Those with severe anemia with urgent surgery needing more rapid response
- Communicate anemia optimization plan with the surgical team, including relevant lab values, underlying cause as identified, and treatment goals and plan.
- Reassess anemia status 2-4 weeks after treatment initiation (target = Hb > 12 g/dL) and minimum of 2 weeks prior to surgery (if already scheduled)
    - Complete repeat lab testing to assess response to treatment (CBC, iron studies, etc.)
        - If response is adequate, proceed to surgery
        - If response is inadequate (Hb <12 g/dL)
            - Consider changing formulation (oral → iv) or adding ESA if response is inadequate
            - For urgent surgery, discussing risks and benefits of further evaluation and timing of determining underlying cause of anemia during the preoperative period.
            - For elective surgery with moderate or high risk of blood loss, recommend delaying surgery to further optimize anemia status.
- Refer as needed to continue treatment for anemia after procedure complete.
- Special considerations for patients that cannot receive blood products:
    - Take a full medical history including history of anemia, abnormal bleeding, coexisting conditions, medical/surgical history, and current medications that could impact hemostasis
    - Consider discontinuation of medications that could induce coagulopathies (e.g., analgesics like NSAIDS, antibiotics like beta-lactams)[vii], anticoagulants and review other medications or supplements that impact coagulations/platelet function

- Take steps to optimize preoperative red blood cell production, such as administering supplementary iron (even with normal iron stores) or using r-HuEPO to increase slightly low hematocrit before anticipated major blood loss or for patients with ischemic heart disease
- Consider higher hemoglobin level goals for preoperative management (e.g., Hb 13-14g/dL)
- Determine with patient what blood products are acceptable/unacceptable. Clearly identify them in the medical record.
- For patients that cannot accept blood products
  - Follow Evidence-informed guidelines for anemia optimization in patients that cannot accept blood products, such as: **Clinical Strategies for Avoiding and Controlling Hemorrhage and Anemia without Blood Transfusion in Surgical Patients** or more updated. Resources can be found here.

Surgery Team

Perioperative Glycemic Control

- Preoperative
  - Plan for day of surgery steps to check and control blood glucose
  - Consider consulting with hospital specialized diabetes or glucose management team as available, including for those experiencing stress hyperglycemia
  - If not done previously, screening for health-related social needs, including food insecurity. Refer to staff or community organization that can support addressing social needs.
- Day of Surgery
  - Check a fasting blood glucose (FBG) preoperatively within 4 hours of start time.
    - Evaluate for presence of diabetes those with elevated FBG/random BG by reflexively checking a HbA1c level.
  - **Do not proceed with procedure if signs or symptoms of diabetic ketoacidosis/HHNKS are present.**
  - For those with risk of elevated blood glucose (e.g., history of diabetes, taking steroids, etc.) check blood glucose every 1-2 hours intraoperatively, starting within 60 minutes of procedure start time.
  - Begin insulin administration following facility protocol, **regardless of diabetes status**.

- Most patients should maintain a blood sugar below 180mg/dL for procedures requiring postoperative admission or having a foreign body implant.
- For patients not requiring postoperative admission, treat with short-acting insulin as necessary.
    - For patients with diabetes, consider the following general guidelines[viii]

	Patients with type 2 diabetes treated with diet	Patients with type 2 diabetes treated with oral or noninsulin injectable meds	Patients with type 1 diabetes or type 2 diabetes treated with insulin
Short surgery (<2 hours)	Check blood glucose intra- and postoperatively.	Monitor every 2 hours – Consider treating with subcutaneous short or rapid acting insulin	Generally, can continue with subcutaneous insulin
Long surgery (>/= 2 hours)	Check BP every 1-2 hours intraoperatively – consider subcutaneous short or rapid acting insulin	Monitor every 2 hours – consider treating with subcutaneous short or rapid acting insulin	Intravenous infusion is often required for long/complex procedures

- Glucose monitoring
    - In general, CGM is not used during procedures to drive medication administration. If utilizing CGM for any reason, corroborate CGM readings by checking capillary blood glucose.
    - Continue automatic insulin devices (AID)/subcutaneous insulin infusion systems for procedures under 2 hours, if device can be placed outside the surgical field, easily visualized and easily accessed.
- Postoperative recovery
    - Monitor blood glucose every 1-2 hours at a minimum while in recovery for those with intraoperative hyperglycemia
    - If an insulin infusion had been started, continue postoperatively until the patient can resume eating before transitioning to subcutaneous as needed
    - Consider inpatient admission to treat hyperglycemia for persistent blood glucose readings above >250mg/dL despite treatment. When determining if to recommend admission for treatment for

hyperglycemia, determine if acute drop in blood sugar may lead to complications.

- Reinstate preoperative diabetes treatments as appropriate once eating
- Upon discharge, for those with intraoperative hyperglycemia
    - Discuss low carbohydrate diet, tailored to cultural and linguistic needs and preferences
    - Refer those newly diagnosed with diabetes to outpatient endocrinology
    - Support scheduling with primary care to continue monitoring and treating hyperglycemia. Refer to establish primary care as applicable.
    - Communicate existence of intraoperative hyperglycemia to primary care provider

Preoperative Anemia Optimization

- When patient is scheduled for surgery, identify if they have a history of anemia; evaluate for presence of anemia
- Discuss goals for anemia optimization with patient and preoperative care team, including when delay of procedure should be considered (e.g., lack of response to treatment, suspected blood loss causing anemia, etc.)
- Ensure recent relevant lab values (hemoglobin, iron studies) were completed

Health Delivery Systems

- In preoperative materials, develop patient-facing education on importance of presurgical optimization that includes glycemic control and anemia

Perioperative Glycemic Control

- Protocolize hyperglycemia treatment for patients **with and without diabetes** in all surgical settings based on most updated guidelines.
    - Recommendations for clinicians should include the following at a minimum:
        - Screening for diabetes in preoperative evaluation
        - Day of surgery blood glucose screening for all major surgery
        - Intraoperative target glycemic control ranges based on surgery risk stratification and patient condition (e.g., most commonly <180mg/dL)
        - Postoperative workflow for patients who receive insulin intraoperatively, including threshold to consider inpatient admission to treat glycemic control
        - Standardized discharge steps for patients with new intraoperative hyperglycemia or diabetes
- Ensure equipment is available perioperatively to check capillary blood glucose at least every 1-2 hours for patients undergoing elective major surgery
- Provide dedicated staff for support in scheduling follow up appointments, including with primary care and endocrinology for those with new intraoperative hyperglycemia

Preoperative Anemia Optimization

- Adopt standardized clinical pathway for identifying anemia and evaluation of underlying cause of anemia, and referral to primary care for ongoing management of anemia
- Promote adjustment of anemia policies through educational opportunities like in-services
- Incorporate auto-reflexive testing of ferritin, iron and transferrin for presurgical patients with Hb <13g/dL (regardless of sex at birth) for procedures with estimated blood loss of 500ml or a risk of transfusion 10% or higher
- Dedicate quality improvement initiatives for anemia optimization in presurgical patients.
    - Identify surgical populations with highest risk for transfusion and/or blood loss in procedure to pilot anemia optimization protocols
    - Identify champion in each targeted surgical specialty to promote change
    - Set relevant quality measures to track progress

        - % of patients receiving appropriate preoperative tests
        - % of patients with iron deficiency anemia (IDA) receiving iron supplementation preoperatively
        - Blood transfusion rates
        - Postoperative anemia rates
- Consider developing dedicated resources/team to direct patients that need further evaluation of underlying cause of anemia (e.g., preoperative anemia optimization clinic)

Health Plans

- Provide preoperative educational material for members undergoing major elective surgery, such as within authorization letter.
    - Include importance of addressing conditions like diabetes and anemia
    - Encouragement to get tested early as possible before surgery and why
- As able, route patients undergoing major elective surgery to preop coordinator and/or case management team to support health education and coordinating care needs.
    - Incorporate standardized universal screening and addressing health-related social needs (e.g., food security, transportation)
- Consider offering point solutions for patients with diabetes/hyperglycemia
- Share data on the rate of preoperative screening for anemia and diabetes with providers and/or facilities for major elective procedures
    - For instance, provider- or facility-facing dashboards with specific rates of HbA1c screening and Hb/Hct screening for major elective procedures
- Payment Redesign
    - Offer modest incentives to facilitate preoperative optimization for anemia and/or glycemic control for those with diabetes
    - Where feasible, integrate preoperative screening for anemia and glycemic control into quality programs for surgical optimization
    - Advanced payment models should embed preoperative screening and/or transfusions into bundles and shared savings contracts with facilities and providers
        - Target procedures that meet general principles defined here.
    - Consider incentives for delivery systems that have accreditation from national organizations in patient blood management (e.g., The Joint Commission)
    - Consider including requirement of preoperative anemia optimization and intraoperative glycemic control protocols in centers of excellence models for surgical centers (e.g., total hip/total knee replacement, spine surgery, etc.)
    - Minimize penalties for appropriate delay of procedure when optimization not achieved

Perioperative Glycemic Control

- Preoperative
    - Approve inpatient admission for major elective procedures for patients with HbA1c over 9%
    - Cover telemedicine/virtual diabetes-related visits

    - Route patients with diabetes to care management team, and outreach once procedure scheduled to support accessing outpatient services for diabetes (nutrition therapy, medication management, diabetes prevention program)
        - Arrange close follow-up as possible within 3-7 days after major elective procedures for patients with uncontrolled diabetes
- Day of Surgery
    - Incorporate day of blood glucose screening and treatment in coverage for major elective procedures regardless of diabetes status.
- Postoperative
    - Incorporate treatment for hyperglycemia that requires intravenous insulin infusion for those with type 2 diabetes as eligibility criteria for inpatient admission for procedures performed in an ambulatory setting.
    - Consider outpatient hospital-based team that manages glucose for 3-7 days postop and facilitates transition to primary care instead of admission.

Preoperative Anemia Optimization

- Remove requirement for prior authorization for intravenous iron formulations that require fewer infusions/have a shorter duration of administration, and lower cost to patients while maintaining effectiveness and safety. See **Appendix F** for iron formulations.
- Remove prior authorization for erythropoietin products, especially for patients who have inflammatory cause of anemia, that cannot accept blood products or who have proven refractory to intravenous iron.
- Minimize cost-sharing for outpatient infusion therapy
- Ensure network adequacy for infusion centers as able

Employers

- Request benefit vendors include strategies to incent surgical optimization, such as pay for performance or shared savings models
- Inquire about center of excellence in surgery models and incorporate glycemic control and anemia optimization interventions
- Require monitoring of preoperative screening for anemia and glycemic control in health plan coverage of major surgical procedures
- Select performance measures related to anemia and glycemic control for surgical quality (e.g., transfusion rate, surgical site infection)

Washington Health Care Authority

- Consider supporting the creation of patient decision aids on presurgical optimization, including a focus specifically on glycemic control and anemia optimization

Background

Optimizing modifiable risk factors before surgery is essential to improving patient outcomes and reducing complications. Among the most prevalent and impactful of these are perioperative hyperglycemia and preoperative anemia, both of which independently increase the risk of infection, longer hospital stays, and mortality. While common occurrences, hyperglycemia in patients with and without diabetes and anemia across surgical populations remain underrecognized and undertreated. Proactive screening, timely intervention, and coordinated care pathways can meaningfully reduce surgical risk, and provide improved outcomes.

Glycemic Control

Intraoperative hyperglycemia is linked to increased complications such as surgical site infection, systemic infection, hospital length of stay, morbidity and mortality across a range of surgical procedure types.[ix] Screening for diabetes as a risk factor for surgery is common, as it's known that increased HbA1c (>8%) increases risk for infection and other postoperative complications.[x] However, patients without diabetes also commonly experience intraoperative hyperglycemia[xi], and often experience worse outcomes than patients with diabetes.[xii] Patients without diabetes are less likely to receive insulin perioperatively,[xiii] even when doing so can reduce postoperative complications.[xiv]

While the exact best target glucose level is unknown perioperatively, most guidelines set a range between 100-110 mg/dL and 180 mg/dL.[xv] For patients with diabetes, intensive glucose control (<120mg/dL versus <160mg/dL) **does not reduce infections**, length of stay or all-cause mortality.[xvi]

It is recommended that patients undergo assessment of glycemic status well in advance of surgery, with particular attention paid to identifying undiagnosed diabetes or poorly controlled hyperglycemia. Delivery systems can improve their patients' outcomes by introducing proactive screening protocols, educating patients about the importance of preoperative glycemic optimization, and providing referrals for assistance through nutrition therapy and counseling as well as resources to support access to healthy foods. Clear thresholds for postponing elective surgery, such as persistent blood glucose above 180 mg/dL or inability to stabilize hyperglycemia, should be defined, and multidisciplinary teams should coordinate closely to optimize glycemic status prior to the procedure.

Anemia

Anemia estimated prevalence ranges from about 20-40%, and patients assigned female at birth and those of advanced age (70+) are more likely to have anemia.[xvii] Preoperative anemia, even mild anemia (Hb 11.0g/dL – 12.9g/dL), is an independent risk factor for

postoperative morbidity and mortality, as well as increased length of stay, and is a predictor of allogenic blood transfusion. Surgical specialties have various prevalence of anemia[xviii], but some studies have shown a higher prevalence in vascular, gynecologic[xix], urologic, and colon surgeries.

The underlying cause of preoperative anemia should be evaluated early in the course of preoperative planning. National guidelines recommend screening for anemia at a minimum 4-6 weeks before the procedure.[xx] Screening for anemia is simple (e.g., complete blood count) and is usually already combined with other preoperative testing. Iron deficiency anemia is one the most common causes of anemia and is usually treatable with iron supplementation. Preoperative guidelines recommend intravenous administration of iron for iron deficiency anemia to raise hemoglobin levels effectively on a preoperative timeline.[xxi] Compared to blood transfusions, IV iron infusions are cost-saving, especially considering the avoidance of increased length of stay and medical complications.

Screening and treatment should be done in the context of a coordinated healthcare team that prioritizes optimization. Preoperative care settings can support providers and patients by developing clinical infrastructure such as workflows that reflexively order iron studies for those who it is appropriate and referral pathways for further evaluation for underlying causes. Clinical teams should help patients make comprehensive plans for preop anemia optimization that includes clearly defined hemoglobin goals, parameters for when it might be recommended to delay the procedure, and referral for continued management of anemia postoperatively. Payors and purchasers can support optimization by providing separate reimbursement specifically for preoperative identification management, such as preoperative testing of hemoglobin and HbA1c and administration of insulin and/or intravenous iron.

Prioritizing Optimization

Decisions to delay a procedure should be guided by clearly defined thresholds and patient-centered goals. For glycemic control, surgery may be postponed if blood glucose levels are persistently above guideline-recommended targets—typically above 180 mg/dL—or if hyperglycemia cannot be stabilized with available interventions, thus raising the risk for postoperative infection and delayed healing. Similarly, when patients present with moderate to severe anemia (for example, hemoglobin below 11.0 g/dL), and especially when the underlying cause is not yet identified or treatable, it is often safer to defer surgery. This allows time for interventions such as iron supplementation or other therapies to achieve safer hemoglobin levels and reduce transfusion risk. By proactively applying protocols that define these safety parameters, multidisciplinary teams can work with

patients to weigh the benefits and risks, ensuring that procedures occur only when patients are optimally prepared for recovery and long-term health.

Measurement

To monitor progress toward improvement in surgical optimization for glycemic control and anemia, the workgroup recommends several process and outcome measures to monitor at the system level to design quality improvement around and monitor progress towards goals. The following are measurement concepts that the workgroup endorses:

- Percent of patients with good glycemic control on admission for surgery
- Percent of patients without anemia on admission
- Fewer post-operative days where blood glucose level is elevated
- Percent of patients undergoing major elective surgery receiving blood transfusions

Process and outcome evaluations should include measurement concepts such as

- Preoperative screening (e.g., HbA1c, Hb/Hct)
- Optimization activities (e.g., intravenous iron for iron deficiency anemia)
- Clinical care processes (intraoperative hyperglycemia treated with insulin)
- Postoperative complications (e.g., surgical site infection) and adverse events

Review the **Process and Outcome Measures** in our **Evaluation Framework** for detailed parameters.

Review the **Bree Collaborative Surgical Optimization Evaluation Framework** for further detailed information

Procedures

Both glycemic control and anemia optimization are critical to many major elective surgeries. National and international guidelines recommend screening and optimization before most major elective procedures – however, the workgroup recommends payors and health systems begin implementing changes for procedures and patient populations that are sensitive to glycemic control and anemia challenges and for which there is enough time to optimize patients before procedures. Each facility or system should evaluate their clinical data to identify priority patient populations and surgical populations, but the workgroup example the following procedure types as potential starting points:

General Principles
Any Operation with entering of body cavity
Any Operation with expected duration >/= 90 minutes
Any operation where blood loss may exceed 500mL or 10% blood volume (*whichever less*)

Surgery
Joint Replacement (*Total Hip/Knee Arthroplasty*) [xxii] [xxiii]
All Spine Surgery (*Excluding Discectomy*) [xxiv]
Abdominal Surgery (*Cholecystectomy, Colon* [xxv]*, Most Gynecologic, Urology, Bariatric* [xxvi] [xxvii])

Paying for Value

Bundled payment programs and shared savings initiatives have emerged as influential strategies in reshaping the economic and clinical landscape of major elective surgical procedures. These payment models shift the focus from volume-based care to value-based care, aligning financial incentives with the quality and efficiency of surgical outcomes. In a bundled payment model, a single payment is made to cover all services associated with a surgical episode, including preoperative optimization, the procedure itself, postoperative care, and any related complications or readmissions. Shared savings programs, by contrast, reward providers for reducing costs below a benchmark while maintaining or improving quality. Together, these approaches encourage care coordination, risk reduction, and evidence-based practice, producing benefits that extend to patients, providers, and payors. [xxviii] [xxix]

One of the primary advantages of bundled payments in elective surgery is the incentivization of preoperative optimization. For procedures such as total hip and knee arthroplasty, spine surgery, and other major elective procedures, controlling modifiable risk factors like hyperglycemia, anemia, and nutritional deficiencies reduces surgical site infections, postoperative complications, and hospital length of stay. Under bundled payment models, financial incentives align to motivate optimization prior to surgery, as complications or readmissions may not be covered. Medicare's Comprehensive Care for Joint Replacement (CJR) program demonstrated reductions in average episode spending and postoperative complications, without negatively impacting patient-reported outcomes. [xxx] Bundled payments for spine surgeries also indicated have shown reduced episode spending and a reduction in readmission inpatient admissions. [xxxi]

Shared savings programs foster continuous improvement and multidisciplinary care delivery. Health systems participating in these programs often establish preoperative clinics, implement enhanced recovery after surgery (ERAS) pathways, and expand patient engagement and education efforts. These strategies have been shown to decrease ICU stays, transfusion requirements, and surgical site infections. [xxxii] [xxxiii] By linking financial rewards to both cost containment and quality metrics, shared savings models support reinvestment into patient-centered initiatives such as prehabilitation programs, targeted risk reduction strategies for at higher risk for surgical complications, and advanced monitoring protocols.

Elective surgeries, with predictable care trajectories, are particularly well suited for these models. Standardized pathways decrease variation, promote adherence to best practices, and reduce wasteful utilization of resources. Importantly, large-scale evaluations suggest that these payment reforms achieve cost reductions without compromising equity or quality, with potential to improve access and outcomes across diverse patient populations.[xxxiv] Bundled payment and shared savings initiatives represent a proven approach to aligning incentives around quality, efficiency, and patient-centered surgical care.

Appendices

Appendix A. Bree Collaborative Members

Name	Title	Organization
June Altaras, MN, NEA-BC, RN	Executive Vice President, Chief Quality, Safety and Nursing Officer	MultiCare Health System
Colleen Daly, PhD	Director, Global Occupational Health, Safety and Research	Microsoft
Jake Berman, MD MPH	Medical Director for Population Health Integration	UW Medicine and UWM Primary Care and Population Health
Gary Franklin, MD, MPH	Medical Director	Washington State Department of Labor and Industries
Colin Fields, MD, AAHIVS	Medical Director, Government Relations & Public Policy	Kaiser Permanente
Darcy Jaffe, MN, ARNP, NE-BC, FACHE	Senior Vice President, Safety & Quality	Washington State Hospital Association
Norifumi Kamo, MD, MPP	Internal Medicine	Virginia Mason Franciscan Health
Kristina Petsas, MD MBA MLS	Market Chief Medical Officer, Employer & Individual	UnitedHealthcare
Greg Marchand	Director, Benefits & Policy and Strategy	The Boeing Company
Kimberly Moore, MD	Associate Chief Medical Officer	Franciscan Health System
Carl Olden, MD	Family Physician	Pacific Crest Family Medicine, Yakima
Nicole Saint Clair, MD	Executive Medical Director	Regence BlueShield
Mary Kay O'Neill, MD, MBA	Partner	Mercer
Susanne Quistgaard, MD	Medical Director, Provider Strategies	Premera Blue Cross
Emily Transue, MD, MHA (Chair)	Chief Clinical Officer	Comagine Health
Judy Zerzan-Thul, MD, MPH	Chief Medical Officer	Washington State Health Care Authority

Appendix B. Surgical Optimization Workgroup Charter and Roster

The Bree Collaborative
Surgical Patient Optimization Charter and Roster

Problem Statement

Modifiable attributes of patient health status such as anemia or blood sugar control can have negative consequences for recovery after surgery. Preoperatively anemic individuals have higher costs generally due to increased length of stay[xxxv] and even mild preoperative anemia is associated with an increase in 30-day morbidity[xxxvi] lower quality of recovery and higher adjusted risk of death and disability.[xxxvii] Some studies suggest poor A1c control preoperatively increases morbidity and mortality,[xxxviii] but perioperative glucose is a stronger predictor of 30-day mortality.[xxxix] Enhanced Recovery After Surgery (ERAS®)[xl] protocols improve length of stay and reduce total cost of care, complications, and readmissions.[xli] However, Washington State has variation for A1c optimization before surgery, perioperative glycemic control protocols, and perioperative anemia control. Black patients are three to four times more likely to experience anemia perioperatively; Black, Hispanic, American Indian/Alaska Native patients more likely to experience uncontrolled diabetes/serum glucose, leading to inequitable outcomes.

Aim

To reduce surgical complications and cost by improving patient optimization before, during, and after surgery in Washington state.

Purpose

To propose evidence-informed guidelines to the full Bree Collaborative on practical and evidence-informed methods for improved surgical patient optimization for elective procedures, including:

- Identify best practices for anemia and glycemic status optimization around surgery, including innovative/emerging strategies (e.g., CGM monitoring)
- Identify and promote evidence-based enhanced recovery after surgery protocols
- Recommend strategies to integrate optimization of anemia and glycemic status (patients with and **without** diabetes) into perioperative protocols
- Recommend strategies to standardize and increase use of enhanced recovery after surgery protocols in Washington state
- Recommend reimbursement structures and employer strategies to incent improved optimization of anemia, glycemic control and use of enhanced recovery after surgery protocols
- Improved collaborative management of surgical patients between primary care and surgical care

- Identify best practices for systems with varying size/resource availability
- Other areas, as indicated

Out of Scope

- <18 years of age
- Emergent procedures
- Best practices for other indicators for surgical optimization (e.g., blood pressure, EtOH, nicotine, opioids)
- Transitions of care (e.g., hospital discharge)
- Intraoperative best practices for specific procedures

Duties & Functions

The workgroup will:

- Research evidence-informed and expert-opinion informed guidelines and best practices (emerging and established).
- Identify current barriers and future opportunities for implementing interventions.
- Consult relevant professional associations and other stakeholder organizations and subject matter experts for feedback, as appropriate.
- Meet for approximately nine months, as needed.
- Provide updates at Bree Collaborative meetings.
- Post draft report(s) on the Bree Collaborative website for public comment prior to sending report to the Bree Collaborative for approval and adoption.
- Present findings and guidelines in a report.
- Recommend data-driven and practical implementation strategies including metrics or a process for measurement. *(can be part of evaluation framework)*
- Create and oversee subsequent subgroups to help carry out the work, as needed.
- Revise this charter as necessary based on scope of work.

Meetings

The workgroup will hold meetings as necessary. Less than the full workgroup may convene to: gather and discuss information; conduct research; analyze relevant issues and facts; or draft recommendations for the deliberation of the full workgroup. A quorum shall be a simple majority and shall be required to accept and approve recommendations to send to the Bree Collaborative.

Bree Collaborative staff will conduct meetings, arrange for the recording of each meeting, and distribute meeting agendas and other materials prior to each meeting. Additional workgroup members may be added at the discretion of the Bree Collaborative director.

Name	Title	Organization
Carl Olden, MD (chair)	UW Residency Program Manager, Family Medicine Physician	Central Washington Family Medicine

Nicholas J. Kassebaum, MD	Medical Director	SCOAP/Spine COAP
Vickie Kolios-Morris, MSHSA, CPHQ	Senior Program Director	Surgical COAP and Spine COAP, Foundation for Health Care Quality
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Dayna Weatherly-Wilson, RN	Manager, Value Based Care	Proliance
Eduardo Smith Singares, MD FACS, FCCM	Medical Director for Trauma & Emergency Surgical Services	Kadlec Medical Center
Rosemary Grant, BSN, RN, CHPQ, CPPS	Director, Clinical Excellence	WSHA
Timothy Barnwell, MD	Anesthesiologist	Confluence
Nawar Alkhamesi, PhD, MBA	Colorectal Surgeon	Kadlec Medical Center
Thien Nguyen, MD	OMC Surgery Section Chair, Director of OC Surgical Subspecialties	Overlake Medical Center
Andrea Allen, RN, MHA	Nurse Consultant, Program Manager, WA Apple Health, Fee For Service	Washington HCA
Irl Hirsch, MD	Medical Director	UW Diabetes Institute
E. Patchen Dellinger, MD	Professor Emeritus	University of Washington, Department of Surgery
Ty Jones, MD, CPPS, CHPW, CAQSM	Medical Director, Patient Safety and Healthcare Quality Leader	Regence
Robert Rush, MD	Chief Medical Officer Surgical Services	PeaceHealth Saint Joseph
Joe Frankhouse, MD, FACS	Colorectal Surgeon	Legacy Health
Scott Helton, MD, FACS	Director of Liver, Biliary, Pancreas Surgery Center of Excellence	Virginia Mason Medical Center
Venu Nemani, MD	Orthopedic Spine Surgeon	Virginia Mason Franciscan Health
Michael Bota, MD	Medical Director Population Health Clinical Value	MultiCare Connected Care
Janice Tufte	Patient Partner	Muslim Resource Center
Sharon Eloranta, MD	Medical Director	Washington Health Alliance (WHA)

Edie Shen, MD	Perioperative Internist	Harborview Medical Center

Appendix C. Guidelines and Systematic Reviews

Source	Guidelines
AHRQ	N/A
Cochrane Collection	Perioperative glycemic control for people with diabetes undergoing surgery (2023) Adverse sides effects of dexamethasone in surgical patients (2018) Iron therapy for preoperative anemia (2019) Erythropoietin plus iron versus control treatment including placebo or iron for preoperative anaemic adults undergoing non-cardiac surgery (2020) Interventions for reducing red blood cell transfusion in adults undergoing hip fracture surgery: an overview of systematic reviews (2023) Pre and peri-operative erythropoietin for reducing allogenic blood transfusions in colorectal cancer surgery (2009)
Specialty Society Guidelines	American Society of Anesthesiologists: Practice Guidelines for Perioperative Blood Management (2015) Society of Thoracic Surgeons, American Society of ExtraCorporeal Technology: Update to the Clinical Practice Guidelines on Patient Blood Management (2021) Recommendations from the International Consensus Conference on Anemia Management in Surgical Patients (ICCAMS) (2022) Centre for Perioperative Care: Guideline for the Management of Anaemia in the Perioperative Pathway (2022) British Society for Haematology: Identification and Management of Preoperatie Anaemia in Adults (2024)
Health Technology Assessment Program	Continuous glucose monitoring (2025)
Center for Disease Control	N/A
Institute for Clinical and Economic Review	N/A
BMJ Clinical Evidence Systematic Overview	Safety and efficacy of intravenous iron therapy in reducing requirement for allogenic blood transfusion: systematic review and meta-analysis of randomized clinical trials (2013) Effect of restrictive versus liberal transfusion strategies on outcomes in patients with cardiovascular disease in a non-cardiac surgery setting: systematic review and meta-analysis (2016)

Veterans Administration Evidence-based Synthesis Program	Enhanced recovery after surgery programs for patients undergoing colorectal surgery (2017)

Appendix D. Common clinical conditions that affect hemoglobin A1c (Cleveland Clinic)[xlii]

Condition	Effect on HbA1c	Mechanism or reason
Asplenia	Increase HbA1c	Decreased red blood cell (RBC) turnover due to increased RBC life span
CKD	Effects vary based on underlying disease and therapy	**Increased hemoglobin A1c**: Carbamyl-hemoglobin production in uremic patientsl; Erythropoietin defi ciency **Decreased hemoglobin A1c**: Shortened RBC survival; Erythropoietin administration ; Hemodialysis (lowering of urea levels reduces carbamyl-hemoglobin concentration
Chronic Liver Disease	Effects vary based on severity of underlying disease and therapies	**Increased hemoglobin A1c**: Jaundice (increased glycation reaction in the presence of higher bilirubin concentrations) **Decreased hemoglobin A1c**: Increased RBC turnover; Antiviral drug therapies may decrease RBC life span
Hemoglobinopathies	Varies with testing method and assay	Multifactorial including anemia and rapid RBC turnover
Hemolytic anemia	Decreases HbA1c	Reduced RBC total volume Increased RBC destruction shortens RBC life span
Iron deficiency anemia	Increases HbA1c	Reduced RBC turnover prolongs RBC survival Greater malondialdehyde concentrations increase hemoglobin glycation reactions
Pregnancy	Decreases HbA1c in first 2 trimesters May increase HbA1c in 3rd trimester	Increased RBC turnover decreases hemoglobin A1c Increased erythropoietin production decreases hemoglobin A1c Hemodilution decreases hemoglobin A1c
Transfusion	Variable HbA1c effects	**Increased hemoglobin A1c:** Elevated glucose concentration in storage medium **Decreased hemoglobin A1c:** Dilutional response
Vitamin B12 and folate deficiency anemias	Increases HbA1c	Reduced RBC turnover prolongs RBC survival

Further commentary here.[xliii]

Appendix E. Considerations for perioperative glycemic control in patient's with diabetes based on surgical and patient risk

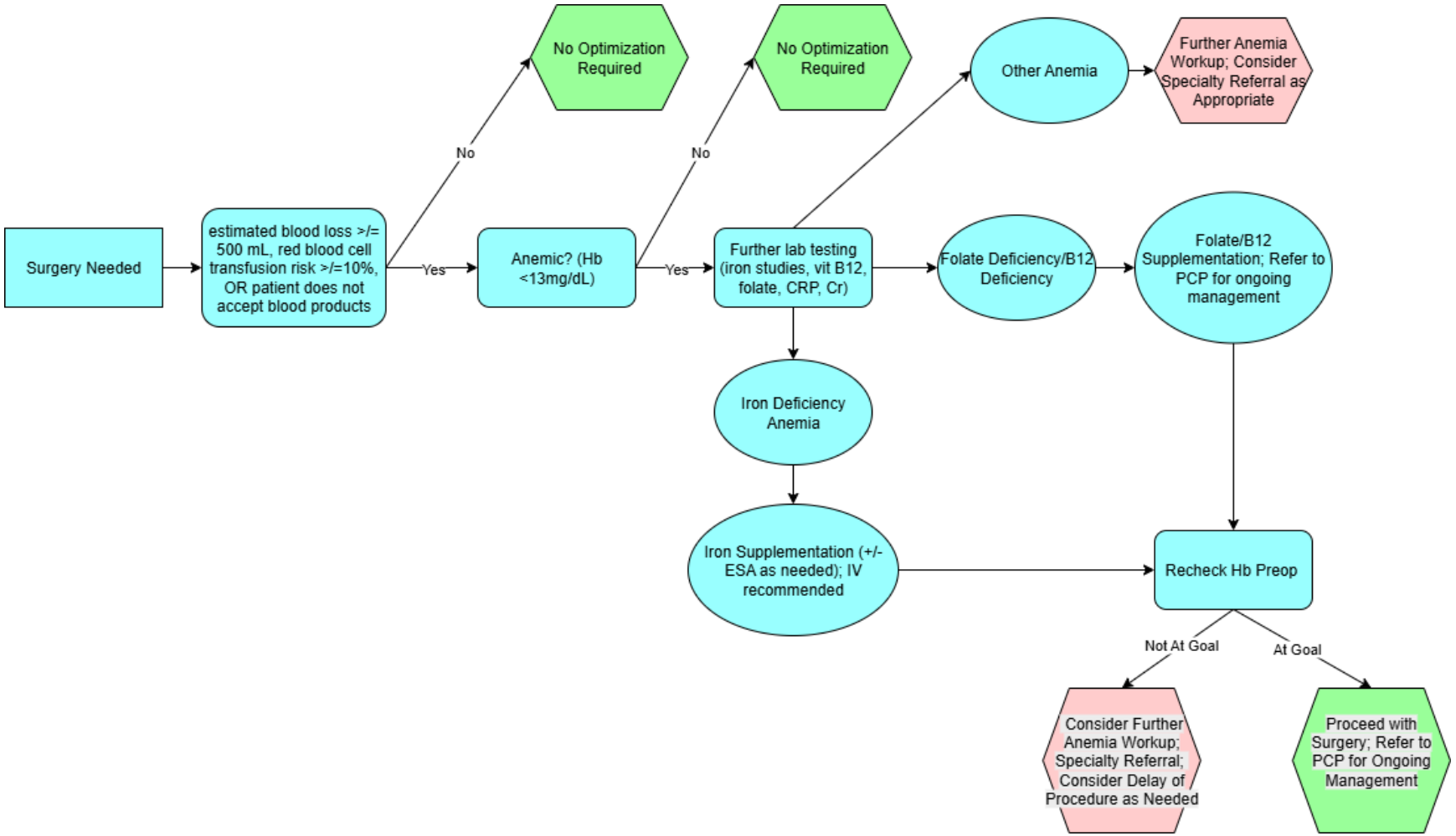
	Surgical Risk Score				
Patient Risk Score	1	2	3	4	5
1-not diabetic	NA	NA	Check a day of surgery blood glucose	Check a day of surgery blood glucose	Check a day of surgery blood glucose
2-people with diabetes (HbA1c<8%)	NA	NA	check a day of blood glucose; schedule close follow up.	Check a day of blood glucose. Schedule close follow up. If unable to do so, **Consider delaying procedure if severely elevated**	Check a day of blood glucose. Schedule close follow up. **Consider delaying procedure if BG severely elevated**
3-people with uncontrolled diabetes (HbA1c >/= 8%)		Optimize HbA1c preoperatively; check a day of blood glucose; schedule close follow up	Optimize HbA1c preoperatively; check a day of blood glucose; schedule close follow up; **Consider delaying procedure if BG severely elevated**	Optimize HbA1c preoperatively; check a day of blood glucose; schedule close follow up; **Consider delaying procedure if BG severely elevated.**	**Consider delaying if BG severely elevated**

Appendix F. Intravenous Iron Formulations[1]

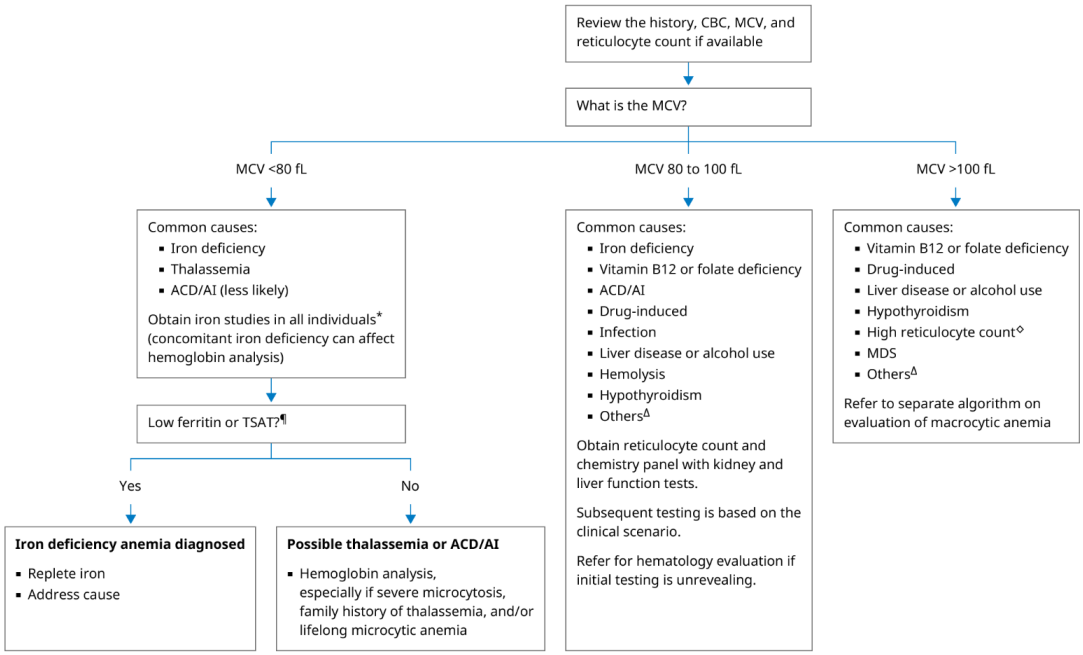
Medication	Concentration of Elemental Iron	Dosing (adults)	Premedication
Ferric Carboxymaltose (FCM)	50 mg/mL	Weight ≥50 kg: 1 or 2 doses of 750 mg, given 7 or more days apart or Weight <50 kg: 1 or 2 doses of 15 mg/kg, given 7 or more days apart	• Do not routinely premedicate for any of the IV iron products. • For patients with asthma or multiple drug allergies, often give methylprednisolone and a histamine 2 (H2) receptor blocker prior to the iron infusion. • For patients with inflammatory arthritis, often give methylprednisolone followed by a brief course of oral prednisone. • Do not give diphenhydramine as a premedication.
Ferric derisomaltose (previously called iron isomaltoside)	100 mg/mL	Weight ≥50 kg: Single dose of 1000 mg **or** Weight ≥50 kg: Up to 3 doses of 500 mg given over 7 days **or** Weight <50 kg: Single dose of 20 mg/kg	
Ferric gluconate	12.5 mg/mL	Multiple doses of 125 to 250 mg	
Ferrumoxytol	30 mg/mL	Single dose of 1020 mg **or** 2 doses of 510 mg, given 3 to 8 days apart	
Iron Dextran, low molecular weight (LMW)	50 mg/mL	Single dose of 1000 mg (diluted in 250 mL normal saline) given over 1 hour **or** Multiple doses of 100 mg	
Iron sucrose	20 mg/mL	Multiple doses of 100 to 300 mg	

[1] Auerbach, M., & DeLoughery, T. G. (2025, June 16). Treatment of iron deficiency and iron deficiency anemia in adults. In UpToDate. Retrieved June 23, 2025, from https://www.uptodate.com

Appendix G. Anemia Optimization Workflow Example



Appendix H Evaluation of Anemia in Adults[xliv]



Anemia evaluation in outpatient settings. This algorithm is part of the UpToDate resource for anemia evaluation, and is a tool that can support evaluation of underlying anemia.

References

[i] Schatz C, Plötz W, Beckmann J, Bredow K, Leidl R, Buschner P. Associations of preoperative anemia and postoperative hemoglobin values with hospital costs in total knee arthroplasty (TKA). Arch Orthop Trauma Surg. 2023 Nov;143(11):6741-6751.

[ii] Musallam KM, et al. . Preoperative anaemia and postoperative outcomes in non-cardiac surgery: a retrospective cohort study. Lancet. 2011 Oct 15;378(9800):1396-407

[iii] Myles, P. S., Richards, T., Klein, A., Wood, E. M., Wallace, S., Shulman, M. A., Martin, C., Bellomo, R., Corcoran, T. B., Peyton, P. J., Story, D. A., Leslie, K., Forbes, A., & RELIEF Trial Investigators (2022). Postoperative anaemia and patient-centred outcomes after major abdominal surgery: a retrospective cohort study. *British journal of anaesthesia*, *129*(3), 346–354. https://doi.org/10.1016/j.bja.2022.06.014

[iv] van den Boom, W., Schroeder, R. A., Manning, M. W., Setji, T. L., Fiestan, G. O., & Dunson, D. B. (2018). Effect of A1C and Glucose on Postoperative Mortality in Noncardiac and Cardiac Surgeries. Diabetes care, 41(4), 782–788.

[v] Khan, N. A., Ghali, W. A., & Cagliero, E. (2018). *Perioperative management of blood glucose in adults with diabetes mellitus*. In D. M. Nathan & S. B. Jones (Section Editors), *UpToDate*. Retrieved [Month Day, Year], from https://www.uptodate.com/contents/perioperative-management-of-blood-glucose-in-adults-with-diabetes-mellitus

[vi] Wagner, M., & Waljee, J. (2025). SGLT2 inhibitors in perioperative care—Continue or hold? JAMA Surgery, 160(4), 430–431. https://doi.org/10.1001/jamasurg.2024.7046

[vii] Penning-van Beest, F. J. A., Koerselman, J., & Herings, R. M. C. (2008). Risk of major bleeding during concomitant use of antibiotic drugs and coumarin anticoagulants. Journal of Thrombosis and Haemostasis, 6(2), 284–290. https://doi.org/10.1111/j.1538-7836.2008.02844.x

[viii]Linnea M. Wilson, Shoshana J. Herzig, Edward R. Marcantonio, Michael A. Steinman, Mara A. Schonberg, Brianna X. Wang, Ella Hileman-Kaplan, Timothy S. Anderson; Management of Diabetes and Hyperglycemia in the Hospital: A Systematic Review of Clinical Practice Guidelines. *Diabetes Care* 20 March 2025; 48 (4): 655–664. https://doi.org/10.2337/dc24-2510

[ix] Frisch A, Chandra P, Smiley D, Peng L, Rizzo M, Gatcliffe C, Hudson M, Mendoza J, Johnson R, Lin E, Umpierrez GE. **Prevalence and clinical outcome of hyperglycemia in the perioperative period in noncardiac surgery**. Diabetes Care. 2010 Aug;33(8):1783-8. doi: 10.2337/dc10-0304. Epub 2010 Apr 30. PMID: 20435798; PMCID: PMC2909062.

[x] Tao, Xu MAa; Matur, Abhijith V. MDb; Palmisciano, Paolo MDa; Conteh, Fatu S. MDc; Onyewadume, Louisa MDd; Duah, Henry O. MPHe; Shukla, Geet BAa; Vorster, Phillip BSa; Gupta, Sahil BSa; Chilakapati, Sai S. BSf; Adogwa, Owoicho MDa. **Preoperative HbA1c and Postoperative Outcomes in Spine Surgery: A Systematic Review and Meta-Analysis.** Spine 48(16):p 1155-1165, August 15, 2023. | DOI: 10.1097/BRS.0000000000004703

[xi] Sermkasemsin V, Rungreungvanich M, Apinyachon W, Sangasilpa I, Srichot W, Pisitsak C. **Incidence and risk factors of intraoperative hyperglycemia in non-diabetic patients: a prospective observational study**. BMC Anesthesiol. 2022 Sep 10;22(1):287. doi: 10.1186/s12871-022-01829-9. PMID: 36088294; PMCID: PMC9463729.

[xii] Chen JY, Nassereldine H, Cook SB, Thornblade LW, Dellinger EP, Flum DR. Paradoxical Association of Hyperglycemia and Surgical Complications Among Patients With and Without Diabetes. JAMA Surg. 2022;157(9):765–770. doi:10.1001/jamasurg.2021.5561

[xiii] Kotagal M, Symons RG, Hirsch IB, Umpierrez GE, Dellinger EP, Farrokhi ET, Flum DR; SCOAP-CERTAIN Collaborative. Perioperative hyperglycemia and risk of adverse events among patients with and without diabetes. Ann Surg. 2015 Jan;261(1):97-103. doi: 10.1097/SLA.0000000000000688. PMID: 25133932; PMCID: PMC4208939.

[xiv] Kwon S, Thompson R, Dellinger P, Yanez D, Farrohki E, Flum D. Importance of perioperative glycemic control in general surgery: a report from the Surgical Care and Outcomes Assessment Program. Ann Surg. 2013 Jan;257(1):8-14. doi: 10.1097/SLA.0b013e31827b6bbc. PMID: 23235393; PMCID: PMC4208433.

[xv] Linnea M. Wilson, Shoshana J. Herzig, Edward R. Marcantonio, Michael A. Steinman, Mara A. Schonberg, Brianna X. Wang, Ella Hileman-Kaplan, Timothy S. Anderson; Management of Diabetes and Hyperglycemia in the Hospital: A Systematic Review of Clinical Practice Guidelines. *Diabetes Care* 20 March 2025; 48 (4): 655–664. https://doi.org/10.2337/dc24-2510

[xvi] Bellon F, Solà I, Gimenez-Perez G, Hernández M, Metzendorf MI, Rubinat E, Mauricio D. Perioperative glycaemic control for people with diabetes undergoing surgery. Cochrane Database Syst Rev. 2023 Aug 1;8(8):CD007315. doi: 10.1002/14651858.CD007315.pub3. PMID: 37526194; PMCID: PMC10392034.

[xvii] Shander, A., Corwin, H. L., Meier, J., Auerbach, M., Bisbe, E., Blitz, J., Erhard, J., Faraoni, D., Farmer, S., Frank, S. M., Girelli, D., Hall, T., Hardy, J.-F., Hofmann, A., Lee, C.-K., Leung, T. W., Ozawa, S., Sathar, J., Spahn, D. R., Torres, R., Warner, M. A., Muñoz, M., … & ICCAMS Panel. (2023). Recommendations from the international consensus conference on anemia management in surgical patients. *Annals of Surgery, 277*(4), 581–590.

[xviii] Fergusson, D., Houston, B., Cagiannos, I., Morash, C., Tinmouth, A., Huton, 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

[xix] 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

[xx] Shander, A., Corwin, H. L., Meier, J., Auerbach, M., Bisbe, E., Blitz, J., Erhard, J., Faraoni, D., Farmer, S., Frank, S. M., Girelli, D., Hall, T., Hardy, J.-F., Hofmann, A., Lee, C.-K., Leung, T. W., Ozawa, S., Sathar, J., Spahn, D. R., Torres, R., Warner, M. A., Muñoz, M., … & ICCAMS Panel. (2023). Recommendations from the international consensus conference on anemia management in surgical patients. *Annals of Surgery, 277*(4), 581–590

[xxi] Ng O, Keeler BD, Mishra A, Simpson JA, Neal K, Al-Hassi HO, Brookes MJ, Acheson AG. Iron therapy for preoperative anaemia. Cochrane Database Syst Rev. 2019 Dec 7;12(12):CD011588. doi: 10.1002/14651858.CD011588.pub3. PMID: 31811820; PMCID: PMC6899074.

[xxii] Marchant, M. H., et al. (2009). The effect of preoperative glycemic control on postoperative infection rates in total joint arthroplasty. The Journal of Bone and Joint Surgery, 91(4), 1177–1185.

[xxiii] Zhang, FQ., Yang, YZ., Li, PF. et al. Impact of preoperative anemia on patients undergoing total joint replacement of lower extremity: a systematic review and meta-analysis. J Orthop Surg Res 19, 249 (2024). https://doi.org/10.1186/s13018-024-04706-y

[xxiv] Seicean, Andreea MPH, PhD*; Seicean, Sinziana MD, MPH, PhD†,‡; Alan, Nima BS§; Schiltz, Nicholas K. PhD*; Rosenbaum, Benjamin P. MD¶; Jones, Paul K. PhD*; Kattan, Michael W. PhD‖; Neuhauser, Duncan PhD*; Weil, Robert J. MD¶. Preoperative Anemia and Perioperative Outcomes in Patients Who Undergo Elective Spine Surgery. Spine 38(15):p 1331-1341, July 01, 2013. | DOI: 10.1097/BRS.0b013e3182912c6b

[xxv] Takashima, J., Kobayashi, H., Koizumi, A., Shigehara, F., Yamazaki, K., Fujimoto, D., & Miura, F. (2025). Impact of preoperative anemia and perioperative transfusion on short-term outcomes in colorectal cancer surgery: The role of iron supplementation. Annals of Gastroenterological Surgery, 9(2), 288–297. https://doi.org/10.1002/ags3.12867

[xxvi] Garg, Rajesh MD∗; Schuman, Brooke BS∗; Bader, Angela MD†; Hurwitz, Shelley PhD∗; Turchin, Alexander MD, MS∗,‡; Underwood, Patricia PhD§; Metzger, Cheyenne NP∗; Rein, Raquel NP∗; Lortie, Meghan NP∗. Effect of Preoperative Diabetes Management on Glycemic Control and Clinical Outcomes After Elective Surgery. Annals of Surgery 267(5):p 858-862, May 2018. | DOI: 10.1097/SLA.0000000000002323

[xxvii] Nie Y, Ping A, Liu B, Meng H. The impact of preoperative anemia on postoperative anemia and related nutritional abnormalities after bariatric surgery: a multicenter cohort study. Front Nutr. 2025 Jul 9;12:1616340. doi: 10.3389/fnut.2025.1616340. PMID: 40709336; PMCID: PMC12288682.

[xxviii] Agarwal, R., Liao, J. M., Gupta, A., & Navathe, A. S. (2020). The impact of bundled payment on health care spending, utilization, and quality: A systematic review. Health Affairs, 39(1), 50–57. https://doi.org/10.1377/hlthaff.2019.00784

[xxix] Dummit LA, Kahvecioglu D, Marrufo G, et al. Association Between Hospital Participation in a Medicare Bundled Payment Initiative and Payments and Quality Outcomes for Lower Extremity Joint Replacement Episodes. JAMA. 2016;316(12):1267–1278. doi:10.1001/jama.2016.12717

[xxx] Barnett ML, Wilcock A, McWilliams JM, Epstein AM, Joynt Maddox KE, Orav EJ, Grabowski DC, Mehrotra A. Two-Year Evaluation of Mandatory Bundled Payments for Joint Replacement. N Engl J Med. 2019 Jan 17;380(3):252-262. doi: 10.1056/NEJMsa1809010. Epub 2019 Jan 2. Erratum in: N Engl J Med. 2019 May 23;380(21):2082. doi: 10.1056/NEJMx190016. PMID: 30601709; PMCID: PMC6504974.

[xxxi] Kilaru AS, Ng GY, Wang E, et al. Savings Associated With Bundled Payments for Outpatient Spine Surgery Among Medicare Beneficiaries. JAMA Health Forum. 2025;6(7):e251907. doi:10.1001/jamahealthforum.2025.1907

[xxxii] Sauro KM, Smith C, Ibadin S, et al. Enhanced Recovery After Surgery Guidelines and Hospital Length of Stay, Readmission, Complications, and Mortality: A Meta-Analysis of Randomized Clinical Trials. JAMA Netw Open. 2024;7(6):e2417310. doi:10.1001/jamanetworkopen.2024.17310

[xxxiii] Kannan V, Ullah N, Geddada S, Ibrahiam A, Munaf Shakir Al-Qassab Z, Ahmed O, Malasevskaia I. Impact of "Enhanced Recovery After Surgery" (ERAS) protocols vs. traditional perioperative care on patient outcomes after colorectal surgery: a systematic review. Patient Saf Surg. 2025 Jan 16;19(1):4. doi: 10.1186/s13037-024-00425-9. PMID: 39819478; PMCID: PMC11737126.

[xxxiv] Navathe AS, Liao JM, Dykstra SE, et al. Association of Hospital Participation in a Medicare Bundled Payment Program With Volume and Case Mix of Lower Extremity Joint Replacement Episodes. JAMA. 2018;320(9):901–910. doi:10.1001/jama.2018.12345

[xxxv] Schatz C, Plötz W, Beckmann J, Bredow K, Leidl R, Buschner P. Associations of preoperative anemia and postoperative hemoglobin values with hospital costs in total knee arthroplasty (TKA). Arch Orthop Trauma Surg. 2023 Nov;143(11):6741-6751.

[xxxvi] Musallam KM, et al. . Preoperative anaemia and postoperative outcomes in non-cardiac surgery: a retrospective cohort study. Lancet. 2011 Oct 15;378(9800):1396-407.

[xxxvii] Myles, P. S., Richards, T., Klein, A., Wood, E. M., Wallace, S., Shulman, M. A., Martin, C., Bellomo, R., Corcoran, T. B., Peyton, P. J., Story, D. A., Leslie, K., Forbes, A., & RELIEF Trial Investigators (2022). Postoperative anaemia and patient-centred outcomes after major abdominal surgery: a retrospective cohort study. *British journal of anaesthesia*, *129*(3), 346–354. https://doi.org/10.1016/j.bja.2022.06.014

[xxxviii] Hart, A., Goffredo, P., Carroll, R., Lehmann, R., Nau, P., Smith, J., Ahad, S., Bao, W., & Hassan, I. (2021). Optimizing Bariatric Surgery outcomes: the impact of preoperative elevated hemoglobin A1c levels on composite perioperative outcome measures. *Surgical endoscopy*, *35*(8), 4618–4623.

[xxxix] van den Boom, W., Schroeder, R. A., Manning, M. W., Setji, T. L., Fiestan, G. O., & Dunson, D. B. (2018). Effect of A1C and Glucose on Postoperative Mortality in Noncardiac and Cardiac Surgeries. *Diabetes care*, *41*(4), 782–788.

[xl] ERAS® Society. (n.d.). Terms & conditions. Retrieved from https://erassociety.org/about/terms-conditions/#:~:text=The%20ERAS%C2%AE%20Society%20holds%20the%20exclusive%20Trademark,and%20development%20of%20computer%20hardware%20and%20software.

[xli] Mazni Y, Syaiful RA, Ibrahim F, Jeo WS, Putranto AS, Sihardo L, Marbun V, Lalisang AN, Putranto R, Natadisastra RM, Sumariyono S, Nugroho AM, Manikam NRM, Karimah N, Hastuty V, Sutisna EN, Widiati E, Mutiara R, Wardhani RK, Liastuti LD, Lalisang TJM. The enhanced recovery after surgery (ERAS) protocol implementation in a national tertiary-level hospital: a prospective cohort study. Ann Med Surg (Lond). 2023 Dec 8;86(1):85-91.

[xlii] Henderson, W. O., Parker, M. H., & Batch, B. C. (2021). How should you assess glycemic control if the hemoglobin A1c is inaccurate or uninterpretable? *Cleveland Clinic Journal of Medicine, 88*(2), 81–85. https://doi.org/10.3949/ccjm.88a.19135

[xliii] Bovee LB, Hirsch IB. Should We Bury HbA1c? Diabetes Technol Ther. 2024 Aug;26(8):509-513. doi: 10.1089/dia.2024.0028. Epub 2024 Mar 8. PMID: 38350127.

[xliv] Means, R. T., Jr., & Brodsky, R. A. (2022, September). Diagnostic approach to anemia in adults. In R. F. Connor (Ed.), UpToDate. Wolters Kluwer. Retrieved August 25, 2025, from https://www-uptodate-com.offcampus.lib.washington.edu/contents/diagnostic-approach-to-anemia-in-adults