**Background**

Patient optimization before, during and after surgery improves outcomes and reduces length of stay and readmissions.[[1]](#endnote-2) 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[[2]](#endnote-3) and even mild preoperative anemia is associated with an increase in 30-day morbidity[[3]](#endnote-4) lower quality of recovery and higher adjusted risk of death and disability.[[4]](#endnote-5) Some studies suggest poor A1c control preoperatively increases morbidity and mortality,[[5]](#endnote-6) but perioperative glucose is a stronger predictor of 30-day mortality.[[6]](#endnote-7) Enhanced Recovery After Surgery (ERAS) protocols shorten length of stay and reduce total cost of care, complications, and readmissions.[[7]](#endnote-8) 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.

**Narrative Evidence Review**

Hyperglycemia intraoperatively is linked to complications such as surgical site infection, systemic infection, increased hospital length of stay, morbidity and mortality.[[8]](#endnote-9) Screening for diabetes as a risk factor for surgery is a common, as it's known that increased HbA1c (most studies have cut off point of >8%) increases risk for infection and other complications postoperatively.[[9]](#endnote-10) However, patients without diabetes also commonly experience hyperglycemia[[10]](#endnote-11), and often experience worse outcomes than patients with diabetes, across a wide variety of surgery types.[[11]](#endnote-12) Patients without diabetes are less likely to receive insulin perioperatively,[[12]](#endnote-13) but a study of Washington State surgical patients showed that insulin administration is associated with lowered risk for postoperative complications like infection, re-operative interventions, interventions, and mortality. [[13]](#endnote-14)

While the exact best target glucose level is unknown perioperatively, most guidelines set a range between 100-110 mg/dL and around 180 mg/dL.[[14]](#endnote-15) For patients with diabetes, intensive glucose control (<120mg/dL versus <160mg/dL) does not reduce infections, length of stay or all-cause mortality – however it is linked to increased hypoglycemic incidents.[[15]](#endnote-16)

**The following guidelines pertain to patients above 18 years of age, undergoing elective procedures.**

[UCLA Risk Stratification Before Elective Surgery](https://www.uclahealth.org/departments/anes/referring-providers/risk-stratification)

|  |  |
| --- | --- |
| Surgical Risk Score | Surgery Types |
| 1. Very low risk | Procedures that usually require only minimal or moderate sedation and have few physiologic effects   * Eye surgery that can be performed under Monitored Anesthesia Care * Simple GI endoscopy (without stents) * Dental procedures | |
| 1. Low risk | Procedures associated with minimal physiologic effect   * Hernia repair * ENT procedures without planned flap or neck dissection * Diagnostic cardiac catheterization * Interventional radiology * Interventional GI endoscopy * Eye surgery that requires General Anesthesia * Cystoscopy | |
| 1. Intermediate risk | Procedures associated with moderate changes in hemodynamics, risk of blood loss   * Intracranial and spine surgery * Gynecologic and urologic surgery * Intra-abdominal surgery without bowel resection * Intra-thoracic surgery without lung resection * Cardiac catheterization procedures including electrophysiology studies, ablations, AICD, pacemaker | |
| 1. High risk | Procedures with possible significant effect on hemodynamics, blood loss   * Colorectal surgery with bowel resection * Kidney transplant * Major joint replacement (shoulder, knee, and hip) * Open radical prostatectomy, cystectomy * Major oncologic general surgery or gynecologic surgery * Major oncologic head and neck surgery * Spine deformity surgery | |
| 1. Very high risk | Procedures with major impact on hemodynamics, fluid shifts, possible major blood loss   * Aortic surgery * Cardiac surgery * Intra-thoracic procedures with lung resection * Major transplant surgery (heart, lung, liver) | |

**Table X. Considerations for perioperative glycemic control based on surgical and patient risk**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Surgical Risk Score | | | | | |
| Patient Risk Score |  | 1 | 2 | 3 | 4 | 5 |
| 1-not diabetic |  |  | 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%) |  |  | 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**  inpatient admission if scheduled outpatient. | Check a day of blood glucose. Schedule close follow up. |
| 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** inpatient admission if unable to do so. | Optimize HbA1c preoperatively; check a day of blood glucose; schedule close follow up; **Consider delaying if elective.** | **Consider delaying if elective** |

*This set of guidelines pertains to patients over the age of 18 who are undergoing procedures for which there is a risk of infection or other complications. Routine endoscopies and biopsies are excluded from these guidelines for their low risk of postoperative surgical complications.*

**Primary Care**

Preoperative

* When referring patients for procedures, as part of preoperative evaluation, evaluate glycemic control in patients with diabetes/prediabetes or at risk for diabetes: ([AAFP](https://www.aafp.org/pubs/afp/issues/2000/0715/p387.html)) Testing should be performed with enough time before surgery to potentially correct abnormalities or perform further evaluation as necessary
  + Patients with risk factors such as:
    - >/= 45 years old
    - >/= BMI 30 kg/m2
    - Familial history of diabetes
    - Past medical history of gestational diabetes
* A preoperative risk assessment should be performed for people with diabetes who are at high risk for ischemic heart disease and those with autonomic neuropathy or renal failure. ([ADA 2025](https://diabetesjournals.org/care/article/48/Supplement_1/S321/157551/16-Diabetes-Care-in-the-Hospital-Standards-of-Care?searchresult=1))
  + Discuss and determine goals of medical optimization of glycemic control and anemia before surgery with patient and/or support system.
  + Decide together with the patient what thresholds would indicate a potential need to postpone referral for elective procedure.
  + For patients with diabetes, discuss setting a HbA1c goal for surgery in the preoperative period. Consider guidelines of 8% or lower at a minimum. HbA1c is highly individualized, and goals of optimization should be made between patients and providers considering co-occurring conditions and risks for hypoglycemic events. See Table A. for common clinical conditions that affect HbA1c.
  + If a patient has diabetes, consider referring to a certified diabetes education specialist and/or registered dietician/nutritionist for support with optimization. Consider referral to diabetes prevention program as applicable.
* Communicate glycemic control status and optimization plan to surgery team in referral and/or handoff. Plans should include:
  + Medication initiation or adjustment points for patients with elevated HbA1c
  + Follow up plan to re-check blood sugar before procedure and threshold by which to consider inpatient admission
* Screen for health-related social needs, including food insecurity, following state and national guidelines. Connect to resources for healthy foods if food insecurity identified.
* Educate patients about dietary carbohydrate intake prior to and after surgery to reduce blood glucose levels. Consider culturally safe recommendations around meal-planning as appropriate.

Postoperative

* Consider post-op day 1 follow-up appointments for patients with uncontrolled hyperglycemia undergoing procedures in an ambulatory setting.

**Surgical Team**

Preoperative

* Identify if the patient has a past medical history of prediabetes or diabetes.
* Screen patients at risk for diabetes (>/= 45 years old, >/= BMI 30 kg/m2, familial history of diabetes, past medical history of gestational diabetes) if not screened within the past 3 months.
  + For all patients, including those who are not diabetic, identify and document a plan for glycemic control optimization. Discuss with the patient that it is recommended to keep their blood sugar under control during and after the procedure, and that if it is significantly elevated, that it might require treatment with insulin.
  + For patients with diabetes, review or develop glycemic control plan with/from PCP/Endocrinology. Document this plan in the medical record.
* A perioperative glycemic control plan should include: (also refer to **Table X. Considerations for perioperative glycemic control based on surgical and patient risk**)
  + Dietary consultation to reduce blood sugar in the perioperative period that is tailored to cultural needs of the patient and their family.
  + Insulin transition plans for insulin-dependent patients with diabetes, consider individual patient factors (meals, activity, perioperative stress, medications that might increase glucose)[[16]](#endnote-17)
  + Day of surgery blood glucose check, and blood glucose checks every 1-2 hours intraoperatively for all patients
  + Threshold to begin insulin administration, following facility protocol to monitor and treat intra- and post-operative periods (typically 180-200mg/dL)
  + Postoperative transition plan for patients that might require insulin intraoperatively. (e.g., BG monitoring in recovery)
  + Close follow up plan to monitor and control blood glucose in the immediate postoperative period (first 2-3 days); For example, coordinating a follow up appointment with their PCP the day after surgery if the patient is expected to experience uncontrolled hyperglycemia intra- and post-operatively. If patient remains admitted after a procedure, ensure frequent blood sugar monitoring and treatment.
* Medication management for patients with diabetes before surgery includes the following[[17]](#endnote-18):
  + Stop SGLT2 inhibitors 3-4 days before surgery per American Diabetes Association Standards
  + Hold other oral diabetes medications the morning of surgery (metformin, sulfonylureas, meglitinides, thiazolidinediones,
  + Consider holding DPP-4 inhibitors for potential to alter gastrointestinal motility.
  + Consider holding GLP-1 RAs and/or GLP-1/GIP RAs
* If a patient is unable to demonstrate good glycemic control or plan for good glycemic control, consider the benefits and risks of recommending delaying the procedure until reaching the patients individualized threshold for glycemic control.
* Consider waiting to schedule procedure until patient reaches their individualized threshold for glycemic control optimization

Day of Surgery

* Preoperatively
  + Check a fasting blood sugar (FBG) within 4 hours of start time for planned procedures:
  + If fasting blood glucose is >100 mg/dL or random BG > 200mg/dL, reflexively test a HbA1c.
  + **Do not proceed with procedure if patient has signs or symptoms of diabetic ketoacidosis/hyperosmolar hyperglycemic Nonketotic Syndrome**
* Intraoperatively,
  + Check blood glucose within 60 minutes of procedure start time
  + Administer insulin per facility protocol for elevated blood sugar, regardless of diabetes status (e.g., blood glucose reading >180mg/dL)[[18]](#endnote-19)
  + For patients with diabetes, consider the following general guidelines [[19]](#endnote-20)

|  |  |  |  |
| --- | --- | --- | --- |
|  | Type 2 treated with diet | Type 2 with oral or noninsulin injectable meds | Type 1 or insulin treated Type 2 |
| Short surgery | Check BG preop and postop | Monitor every 2 hours – subq short or rapid acting insulin | Generally, can continue with subq insulin |
| Long surgery | Check BP every 1-2 hours intraop – give subq short or rapid acting | Monitor every 2 hours – subq short or rapid acting insulin | IV infusion often required for long/complex procedures |

* + For patients with continuous glucose monitoring on during procedure, corroborate CGM readings by checking capillary blood glucose.
* For emergency surgery
  + In the critically ill, hyper- and hypoglycemia are both associated with poor clinical outcomes
  + Optimal blood glucose target is less restrictive (140-180mg/dL) rather than intensive (80-110mg/dL)
  + Carefully monitor blood glucose, (e.g., every 60 minutes for patients on intravenous insulin)
  + Consider using intermittent subcutaneous sliding scale insulin for BG >180mg/dL consistently and transitioning to IV insulin infusion if it continues to be uncontrolled. ([UpToDate](https://www.uptodate.com/contents/perioperative-management-of-blood-glucose-in-adults-with-diabetes-mellitus#H27486643))

Postoperative

* In the immediate postoperative period for those with intraoperative hyperglycemia:
  + Check a blood glucose within 60 minutes of the last insulin dose; continue to monitor blood glucose every 1-2 hours at a minimum.
  + If an insulin infusion has been started, continue it postoperatively in patients until they resume eating. Then transition to subcutaneous insulin. Reinstate preoperative diabetes treatments once the patient is eating, unless otherwise contraindicated ([UpToDate](https://www.uptodate.com/contents/perioperative-management-of-blood-glucose-in-adults-with-diabetes-mellitus#H27486643))
  + Ensure orders for insulin are placed when transferred to recovery units and/or other units if remaining inpatient.
* Post-discharge glucose management for those with intraoperative hyperglycemia
  + Provide education on low carbohydrate intake in first postoperative days
  + As needed
* Communicate on the day of discharge with a patient’s primary care provider if they had new hyperglycemia perioperatively.
  + Schedule follow up appointments with primary care providers as able through care management/coordination teams.
* If the patient does not have a regular primary care provider or medical home, provide referral to establish care. Consider referral to endocrinology as available as well.
  + If patient needed insulin for new hyperglycemia in the perioperative period (day of surgery, immediately postop) consider next day post-op appointment with surgical team to assess glucose control and adjust treatment
* Provide discharge teaching to the patient if they had perioperative hyperglycemia.
  + For patients with new hyperglycemia, consider recommending minimization of carbohydrate intake if not contraindicated
    - Consider culturally safe practices regarding dietary management recommendations
  + Communicate with provider who can manage blood glucose in the days following surgery (PCPs)

**Health Delivery Systems**

* Protocolize hyperglycemia treatment for patients with and without diabetes in all surgical settings based on most updated guidelines.
  + Include recommendations for clinicians:
    - Screening for diabetes in preoperative evaluation
    - Criteria for day of surgery blood glucose screening
    - Intraoperative target glycemic control ranges based on surgery risk stratification and patient condition (e.g., critically ill often require less restrictive glycemic targets)
    - Postoperative workflow for patients who receive insulin intraoperatively, including threshold to consider inpatient admission to treat glycemic control
    - Standardized discharge recommendations for patients with new intraoperative hyperglycemia or diabetes
* Ensure equipment is available perioperatively to check a capillary blood glucose at least every 60 minutes for patients undergoing intermediate-high risk surgery
* For patients with new intraoperative hyperglycemia, provide a disposable continue glucose monitor at discharge with data access to managing surgical team to review postoperative blood sugar levels

**Health Plans**

* Preoperative
  + Incorporate treatment for hyperglycemia as eligibility criteria for inpatient admission for intermediate risk procedures performed in an ambulatory setting *(BMCC criteria?)*
  + Incentivize surgical teams to optimize HbA1c for patients with diabetes before surgery
  + Provide care coordination support for patients with diabetes, including assistance specifically with arranging postoperative follow up appointments
* Day of Surgery
  + Incorporate day of blood glucose screening and treatment in coverage for intermediate-high risk procedures regardless of diabetes status
* Postoperative
  + *CGM interpretation RVU could be billed daily postoperatively (POD 1-3) for primary care providers to review CGM for patients that previously didn’t have CGM preoperatively*
* General
  + For members with prediabetes or diabetes, provide education on preoperative optimization of blood glucose

**Health Care Authority**



Table A. Common clinical conditions that affect hemoglobin A1c (Cleveland Clinic)[[20]](#endnote-21)

|  |  |  |
| --- | --- | --- |
| 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 |



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