

PREOPERATIVE Management

I. PREOPERATIVE Assessment for Elective Procedures

For patients with poorly controlled diabetes ($HbA1c \geq 8$), refer to PCP, Perioperative Surgical Home (PSH) or endocrinologist for management to optimize glycemic control prior to surgery. Aim for $HbA1c < 8$.

II. PREOPERATIVE Home Medication Instructions for Patients with Diabetes and/or Hyperglycemia

Medication	Night Before Surgery	Day of Surgery**	
		Type I DM	Type II DM
Insulins			
<u>Basal Insulins (long acting)</u> Glargine, Basaglar, Semglee, Detemir, Degludec	80% of usual dose PM dose	80% of usual AM dose	80% of usual dose if patient uses morning only or twice daily basal therapy
<u>Insulin/GLP1 Combinations</u> (degludec/liraglutide, glargine/lixisenatide)	80% of usual dose PM dose	80% of usual insulin dose (Hold GLP1)	80% of usual insulin dose if patient uses morning only or twice daily basal therapy (Hold GLP1)
<u>Intermediate Acting or Pre-Mixed</u> NPH, 70/30, 75/25	80% of usual PM dose	80% of usual AM dose	50% of usual AM dose if BG ≥ 120 mg/dL. Hold if BG < 120 mg/d
U-500	70% of usual PM dose	50% of usual AM dose	
<u>Rapid or Short Acting</u> lispro, aspart, glulisine, regular	Usual dose	HOLD any meal bolus doses If on correction scale, treat BG > 180 mg/dl	
Insulin Pump	Usual basal rate and boluses	75-100 % of usual basal rate; may give correction bolus for BG > 180 mg/dl Check blood sugar q2h or sooner if symptoms of hypoglycemia experienced If closed loop system, continue without adjustments.	
Oral and Non-insulin Injectables			
<u>Sulfonylureas</u> glyburide, glipizide, glimepiride	Take with meals	HOLD	
<u>Thiazolidinediones</u> rosiglitazone, pioglitazone	Take		
<u>Meglitinides</u> repaglinide, nateglinide	Take with meals		
<u>Alpha-glucosidase inhibitors</u> acarbose, miglitol	Take with meals		
<u>GLP-1 Receptor Agonists</u> Daily - liraglutide (Victoza) - Oral semaglutide (Rybelsus) Twice a day - exenatide (Byetta) Weekly - exenatide XR (Bydureon Bcise) - dulaglutide (Trulicity) - lixisenatide (Adlyxin) - semaglutide (Ozempic) <u>Dual GIP/GLP-1 Receptor Agonist</u> - tirzepatide (Mounjaro) - weekly	Take if on "daily or twice daily dosing" Consider holding a week prior to surgery if on "weekly dosing" and hold daily oral dose the day prior. Consider bridging with other anti-diabetic meds. See below for guidance - <i>"Diabetes Management Recommendations if GLP-1 RA are Held Prior to Surgery"</i>	HOLD - If GI symptoms (e.g. severe nausea/vomiting/retching, abdominal bloating or pain) are present, consider delaying elective procedure. - If the patient has no GI symptoms - and the GLP-1 agonist was held as advised, proceed as usual - and the GLP-1 agonist was NOT held as advised, proceed with 'full stomach' precautions. Discuss the concerns of potential risk of regurgitation and pulmonary aspiration of gastric contents with the surgeon and patient.	
Pramlintide	Take before meals	HOLD	
<u>DPP-IV inhibitors</u> sitagliptin, saxagliptin, linagliptin, alogliptin	Take	Take	
Metformin	Take	May resume post procedure if diet resumed	
<u>SGLT2 Inhibitors</u> canagliflozin, dapagliflozin, empagliflozin, ertugliflozin	**Discontinue for at least 3-4 days prior to surgery** - canagliflozin, dapagliflozin & empagliflozin: 3 days before surgery - ertugliflozin: 4 days before surgery	HOLD	

VMFH Perioperative Glycemic Control Guidelines for Adults (non OB)

**Day of Surgery:

- If you have a glucose meter, check your blood sugar when you wake up and every 4 hours until you reach the hospital.
- **For symptoms of hypoglycemia or blood sugar less than 80 mg/dl while fasting:**
 - o Drink 4 ounces of clear sugar-containing beverage such as apple juice or ginger ale or 15gm of chewable glucose tablets (read bottle for dosage instructions)
 - o Check blood sugar in 15 minutes and repeat as necessary to get blood sugar greater than 80 mg/dl.
 - o Notify RN of hypoglycemia and time of treatment upon arrival to hospital

Diabetes Management Recommendations if GLP-1 RA are Held Prior to Surgery

Recommendations may be utilized by PCP, PSH, and/or endocrinology/diabetes team

- Provide "Patient Standard Instructions" (see below)
- If weekly GLP 1 A is held for ≤ 10 days: no intervention is likely needed
- If GLP 1 A is held for more than 10 days: see algorithm below

A. If NOT already on insulin treatment

Target Glucose: Fasting Blood Glucose (FBG) or overnight glucose < 160 mg/dl or Random/premeal <180 mg/dl

- 1) If Glucose remain within target range: monitor only
- 2) If Glucose are not within target range: see pre-op guidance below

GLP1 A held > 10 days	A1c < 8% and FBG <160	A1c \geq 8% and FBG \geq 160
Age >70/ GFR <45/ BMI <25	Monitor. If out of range switch to →	Start Basal insulin analog [†] at dose 0.1 units/kg/day**
BMI 25-30	Monitor. If out of range switch to →	Start Basal insulin analog [†] at dose 0.2 units/kg/day**
BMI >30	Monitor. If out of range switch to →	Start Basal insulin analog [†] at dose 0.3 units/kg/day**

**** If fasting BG is still > 160 X 2 days, then can increase dose by 20% and repeat if necessary. Do not start insulin or increase dose within 48 hours of surgery date.**

[†]Basal insulin = glargine (Basaglar, Semglee, Lantus, Toujeo, Rezvoglar), degludec (Tresiba), detemir (Levemir), NPH;

Not for other insulin types: Mixed insulin Humulin or Novolin mix 70/30, 75/25 AND Concentrated Humulin Regular U-500

B. If ALREADY on insulin treatment

FBG >140 mg/dl (range 80-140)	Basal insulin: adjust <u>current dose up by 10-20%</u> to attain target
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If the above treatment regimen(s) are not successful, please contact the surgery team and make a referral to Endocrinology.

"Patient Standard Instructions":

- 1) Check blood sugars when you first wake up. Keep a journal of glucose values and all nutrition intake. Whenever possible, use CGM (continuous glucose monitor)
- 2) Meal limit for carbohydrate portions <45 gm and abstain from simple carbohydrates and sugar-sweetened beverages
- 3) Read [Hypoglycemia prevention and management hand-out](#)

BG <85 mg/dl	Reduce next insulin dose by 20%
BG <70 mg/dl	Treat hypoglycemia. Hold insulin dose and contact prescriber to review journal and for dose adjustment

III. PREOPERATIVE Management upon Hospital Arrival

A. Check capillary blood glucose (BG) level upon arrival to preoperative area if:

Patient with diabetes mellitus (DM)	Patient without known diagnosis of diabetes, with the following risk factors (take within 24 hours of surgery start time):
	<ul style="list-style-type: none"> Age > 45 OR <ul style="list-style-type: none"> BMI > 30
A. Check BG every 2 hours and treat per Glycemic Control Guidelines (Table B) B. Confirm most recent diabetes medication/insulin dose and time taken	<ul style="list-style-type: none"> If BG > 180 mg/dl, notify Anesthesia. <ul style="list-style-type: none"> Check BG every 2 hours and treat per Glycemic Control Guidelines (see Table B) Provide "Preoperative screening for hyperglycemia letter" to patient

B. Table B – Hospital Preoperative Glycemic Control Guidelines

- Enter all insulin orders as **"STAT"**. Lispro insulin will be available in Pyxis. Basal (intermediate or long-acting) insulin and insulin infusions will come from central pharmacy.
- Patients with Insulin Pumps** – Continue 75-100% basal rate. Treat per Table B and C.

Table B – Hospital Preoperative Glycemic Control Guidelines

BG Level	Initial Treatment	Ongoing Management
1. RN TO CONFIRM/OBTAIN ALL INITIAL INSULIN ORDERS WITH ANESTHESIA. 2. For patients with diabetes, confirm the most recent diabetes med/insulin dose and time taken. For insulin-dependent DM, give insulin per Table C-AM SQ insulin table if AM basal dose was not administered at home. Order STAT. 3. RN may continue ongoing treatment per insulin drip protocol or lispro correction scale.		
BG < 50	<ul style="list-style-type: none"> Start D51/2NS at 100 ml/hr Give 50ml (1 amp) D50W IVP 	<ul style="list-style-type: none"> Notify Anesthesia. Recheck BG every 15 min and treat accordingly until BG is \geq 80 mg/dl. Once BG > 80 mg/dl, recheck BG in 1 hour Treat according to BG values on this table
BG 50-79	<ul style="list-style-type: none"> Start D51/2NS at 100 ml/hr Give 25ml (1/2 amp) D50W IVP 	
BG 80-139		<ul style="list-style-type: none"> Recheck BG in 2 hours If BG rises above 150, give lispro correction insulin per scale below.
BG 140-180 (Goal)	If patient has diabetes: <ul style="list-style-type: none"> For major surgery, critically ill patients or anticipated OR time > 2 hours, start insulin infusion per protocol ** For all other patients, with or without DM, administer lispro correction scale prn	Insulin infusion: <ul style="list-style-type: none"> Glucommander : Recheck BG per Glucommander directions Non-Glucommander: Recheck BG hourly until 3 consecutive BG results within 100-180 mg/dL, then every 2 hrs
BG 181-300	<ul style="list-style-type: none"> For major surgery, critically ill patients or anticipated OR time > 2 hours, start insulin infusion per protocol** For all other patients with or without DM, administer lispro correction scale prn 	Subcutaneous insulin: <ul style="list-style-type: none"> Recheck BG in 2 hours DO NOT re-dose correction lispro insulin more frequently than every 2 hours If two lispro insulin doses given in previous 4 hours and BG > 180, consider starting insulin infusion per protocol**.
BG > 300	<ul style="list-style-type: none"> Contact Anesthesia to start insulin infusion per protocol** Consider rescheduling elective procedures 	<ul style="list-style-type: none"> Recheck BG per protocol.

** Insulin protocols available include Glucommander insulin infusion or non-Glucommander insulin algorithm – see Preoperative Glycemic Control Order Set. In order to transition to Glucommander SubQ it is recommended to stabilize patients on the Glucommander insulin infusion for a minimum of 6 hours. If shorter time frames are desired, recommend using the non-Glucommander insulin infusion

VMFH Perioperative Glycemic Control Guidelines for Adults (non OB)

Lispro Insulin Subcutaneous Correction Scale: **DO NOT give lispro insulin more frequently than every 2 hours**			
	LOW DOSE TDD < 40 units/day or BMI < 24 or CKD or hepatic failure, insulin sensitive	MEDIUM DOSE TDD 40-80 units/day or BMI 24-30	HIGH DOSE TDD > 80 units/day or BMI > 30, insulin resistant
Blood Glucose (mg/dl)	Lispro insulin Units		
< 150	0 unit	0 unit	0 unit
150-200	1 units	2 units	4 units
201-250	2 units	4 units	8 units
251-300	3 units	6 units	12 units
> 300	Notify Anesthesia to discuss starting insulin infusion		

C. Table C - AM Subcutaneous Insulin Dose (DO NOT GIVE IF ALREADY GIVEN IN AM PRIOR TO ARRIVAL)

	Home Insulin	Insulin (Subcutaneous) Dose to Administer		
		Type 2 Diabetes	Type 1 Diabetes	
Insulin Dependent DM	Once daily (PM) glargine/ detemir	None	None	+ lispro correction scale
	Once daily (AM) glargine/ detemir	Glargine 80% of AM dose	Glargine 80% of AM dose	
	Twice daily Glargine/ detemir	Glargine 80% of AM dose	Glargine 80% of AM dose	
	NPH	50% of usual AM dose if BG \geq 120 mg/dL. Hold if BG < 120 mg/dL	NPH 80% of AM dose	
	U-500	50% of usual AM dose	50% of usual AM dose	
	70/30 or 75/25	50 % of total AM dose as NPH if BG \geq 120 mg/dL. Hold if BG < 120 mg/dL	80% of total AM dose as NPH	
	Insulin pump*	75-100% basal rate, no pump boluses	100% basal rate; no pump boluses	

D. Non-Glucomander Insulin Infusion* – Use the “Preoperative Glycemic Control” order set. **Check BG hourly.**

- Start insulin infusion** when BG is 180 mg/dL or greater.
- Calculate **initial** drip rate using the following formula: **$[(BG-60) \times 0.03 = \text{drip rate}]$** , round to the nearest unit.
- Ongoing drip management:

BG (mg/dl)	Insulin Infusion Titration	Ongoing Management/BG Monitoring
< 70	Turn off the drip. If awake give 25 ml D50W IVP. If obtunded, give 50 ml D50W IVP.	Recheck BG in 15 min. Repeat treatment if BG < 70 mg/dl. Recheck BG every 30 min until BG > 70 mg/dl then resume hourly BG checks. Restart infusion after BG > 120 mg/dl (decrease multiplier by 0.01)
70-99	Decrease multiplier by 0.01	<ul style="list-style-type: none"> Infusion rate = $[(BG-60) \times \text{multiplier}]$, round to the nearest unit Hourly BG checks
100-180	No change in multiplier	
> 180	Increase multiplier by 0.01	

E. Glucomander Insulin Infusion – Use “Glucomander Insulin Infusion ED/IP” order set in Epic. Provider to specify multiplier and goal BG range. **Adjust infusion rate and check BG per Glucomander directions.**

INTRAOPERATIVE Management

IV. INTRAOPERATIVE Insulin (Select appropriate option A or B or C)

A. Non-Glucomander Insulin infusion*:

- Infusions are recommended for all major surgery, critically ill patients, or surgery anticipated to last > 2 hours
- If BG drops below 150 mg/dL, consider infusing dextrose for NPO patients with diabetes at 5 gm/hr (e.g. D51/2NS at 100 ml/hr, D10W at 50 ml/hr).
 1. **Start insulin infusion** when BG is 180 mg/dL or greater.
 2. Calculate **initial** drip rate using the following formula: $[(BG-60) \times 0.03 = \text{drip rate}]$, round to the nearest unit.
 3. Ongoing drip management:

BG (mg/dl)	Insulin Infusion Titration	Ongoing Management/BG Monitoring
< 70	Turn off the drip. If awake give 25 ml D50W IVP. If obtunded, give 50 ml D50W IVP.	Recheck BG in 15 min. Repeat treatment if BG < 70 mg/dl. Recheck BG every 30 min until BG > 70 mg/dl then resume hourly BG checks. Restart infusion after BG > 120 mg/dl (decrease multiplier by 0.01)
70-99	Decrease multiplier by 0.01	<ul style="list-style-type: none"> • Infusion rate = $[(BG-60) \times \text{multiplier}]$, round to the nearest unit • Hourly BG checks
100-180	No change in multiplier	
> 180	Increase multiplier by 0.01	

B. Glucomander Insulin Infusion – For new starts, specify multiplier and goal BG range. **Adjust infusion rate and check BG per Glucomander directions.**

C. Lispro correction scale:

- BG monitoring every 2 hours
- Do **NOT** give subcutaneous lispro insulin more frequently than every 2 hours
- Identify last dose if given in pre-admit or pre-op holding area

Lispro Insulin Subcutaneous Correction Scale: **DO NOT give lispro insulin more frequently than every 2 hours**			
	LOW DOSE TDD < 40 units/day or BMI < 24 or CKD or hepatic failure, insulin sensitive	MEDIUM DOSE TDD 40-80 units/day or BMI 24-30	HIGH DOSE TDD > 80 units/day or BMI > 30, insulin resistant
Blood Glucose (mg/dl)	Lispro insulin Units		
< 50	Give 50 ml (1 amp) of D50W; repeat BG/treatment every 10-15 min until BG > 80		
51-79	Give 25 ml (½ amp) of D50W; repeat BG/treatment every 10-15 min until BG > 80		
80-149	0 unit	0 unit	0 unit
150-200	1 units	2 units	4 units
201-250	2 units	4 units	8 units
251-300	3 units	6 units	12 units
> 300	Start insulin infusion		

POSTOPERATIVE Management

V. Immediate POSTOPERATIVE Management

A. Outpatient Procedures:

- If on insulin drip, stop infusion.
- Check BG upon arrival to PACU and every 2 hours for **all patients with DM and/or those patients with the following risk factors: BMI > 30 or age > 45)**
 - If BG < 70 mg/dl, give 25 ml (1/2 amp) D50W IVP and recheck in 15 minutes
 - If BG > 200 mg/dl, contact Anesthesia for additional orders.

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- c. Medication instructions upon discharge:
- i. Non-insulin diabetes meds may be resumed once the patient is eating. If eGFR is less than 30 ml/min, recommend holding metformin and having patients receive a follow-up serum creatinine/eGFR assessment prior to resuming metformin. Metformin should only be resumed if eGFR is greater than 30 ml/min.
 - ii. For insulin:
 1. Resume intermediate-acting or long-acting insulin at the next scheduled dose. Resume prandial insulin once a patient eats. May need additional units of rapid-acting insulin until resumption of regularly scheduled insulin.
 2. For insulin pumps, continue basal rate and resume bolus doses once able to eat/drink.
 3. Check BG frequently during the first 24 hours post-procedure.
 - iii. If glycemic control has been suboptimal, close follow-up with PCP is recommended.

2. Inpatient Procedures:

- a. Check BG upon arrival to PACU for **all patients with DM and/or those patients with the following risk factors: BMI > 30 or age > 45**. If new hyperglycemia (BG > 180 mg/dl) is identified, notify anesthesia.
- Treat with correction scale dose:

Lispro Insulin Subcutaneous Correction Scale: **DO NOT give lispro insulin more frequently than every 2 hours**			
	LOW DOSE TDD < 40 units/day or BMI < 24 or CKD or hepatic failure, insulin sensitive	MEDIUM DOSE TDD 40-80 units/day or BMI 24-30	HIGH DOSE TDD > 80 units/day or BMI > 30, insulin resistant
Blood Glucose (mg/dl)	Lispro insulin Units		
< 150	0 unit	0 unit	0 unit
150-200	1 units	2 units	4 units
201-250	2 units	4 units	8 units
251-300	3 units	6 units	12 units
> 300	Notify Anesthesia and start insulin infusion		

- b. Ensure plan for postsurgical glycemic control is addressed with surgeon
- i. **Insulin infusion patients**
 1. Continue insulin infusion if patient is critically ill or unstable with elevated BG levels > 200 mg/dl
 2. Transition to scheduled subcutaneous basal insulin dosing + correction scale if:
 - a. Insulin-dependent DM (type 1 or 2)
 - b. Non-insulin-dependent type 2 DM with a mean infusion rate of ≥ 1 unit/hr
 - c. Stress hyperglycemia with mean infusion rate of ≥ 1 units/hr
 - d. Persistent hyperglycemia (BG > 180)

For patients on the Glucomander insulin infusion, enter the Glucomander Transition to SubQ Insulin order set if the patient meets criteria to transition. For patients on non-Glucomander insulin infusions:

- **Insulin-dependent DM:** Evaluate total daily insulin dose prior to admission. Use Glucomander SubQ Insulin orders custom dosing feature. Order basal insulin at $\leq 50\%$ of total daily dose. If eating, order $\leq 50\%$ of the remaining total daily dose as nutritional insulin (usually equally divided three times a day with meals).
 - **If insulin naïve,** use Glucomander SubQ insulin orders. Evaluate appropriate multiplier to start insulin dosing. Use basal/correction if NPO and basal/bolus/correction if the patient will be eating or **if anticipated to eat within 72 hours. Give 1st basal insulin dose 2 hours prior to stopping the infusion.**
3. **If not appropriate for basal insulin or if requirements for basal insulin are unknown,** stop insulin infusion and transition to blood glucose monitoring or correction scale insulin therapy. This is suggested for:
 - a. Non-insulin-dependent type 2 DM with a mean infusion rate of < 1 unit/hr
 - b. Stress hyperglycemia with mean infusion rate < 1 units/hr
 - c. Well controlled DM on diet alone or single oral anti-diabetic medication
 - ii. **Non-insulin infusion patients**
 2. Transition to correction scale insulin if:
 - a. No previous history of diabetes and single isolated elevated BG value

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- b. Well controlled DM on diet alone or single oral anti-diabetic medications
 - c. Perioperative dose of dexamethasone and/or other corticosteroid given
3. Transition to Glucommander SubQ insulin orders if:
 - a. Insulin-dependent DM (type 1 or 2). Use the custom dosing feature to provide a similar total daily dose of insulin at home. Ensure basal insulin is provided at $\leq 50\%$ of total daily dose of insulin at home.
 - b. Non-insulin-dependent type 2 DM with BG > 180 x 2
 - c. Stress hyperglycemia with BG > 180 X 2.
4. Notify provider for BG < 70 or > 300 mg/dl.

VI. Ongoing POSTOPERATIVE Management

1. Glycemic goals: preprandial or fasting 100-140 mg/dl, random: less than 180 mg/dl
2. **Insulin therapy is the preferred inpatient treatment strategy.** Oral antidiabetic medications may be considered in the following scenarios:
 - **Metformin** may be restarted if patients take this prior to admission once diet is resumed
 - **Saxagliptin +/- basal insulin + correction scale** may be initiated in patients with mild to moderate hyperglycemia (BG < 180, A1C < 8 and those not on insulin PTA)
 - Other formulary agents may be resumed close to or immediately prior to discharge if the patient is eating well without hypoglycemia and no other contraindications noted.
 - **Currently empagliflozin should be continued for HF and/or CKD only.** This agent should only be resumed if the patient is eating well and no other contraindications noted.
3. Initiate insulin orders via appropriate order set. *Inpatient Glycemic Control Guidelines located at end of order sets.*
 - Glu - Glucommander Insulin Infusion ED/IP
 - Glu - Glucommander DKA and HHS Insulin Infusion ED/IP
 - Glu - Glucommander Transition to Basal SubQ Insulin
 - Glu - Glucommander / Other Insulin Subcutaneous Initial Regimen (for first time insulin ordering)
 - Glu - Non Glucommander – Subcutaneous Regimen Adjustment (for adjusting insulin orders after initial orders placed for non-Glucommander regimens.
 - Glu - Glucommander Modify Orders (use if next basal, bolus, or correction orders need to be changed)
 - Glu - Initiation of Glucose Monitoring (to order BG to assess for insulin needs)
4. Sole use of correction scale insulin is discouraged due to increased rates of hyper-and hypoglycemia.
5. For type 1 DM, patients always require basal insulin even in fasting states to prevent ketoacidosis.
6. **For patients with insulin pumps,** may continue home insulin orders if the patient is able to operate the pump. Use Glucommander / Other Insulin Subcutaneous Initial Regimen, “other insulins” panel to order insulin pump and pharmacist consult to identify home insulin pump and dose settings. If a patient is unable to operate a pump, recommend stopping the insulin pump and making note of this in the chart. Ensure pump is disconnected, discontinue any active insulin pump orders and order either insulin infusion or subcutaneous basal/bolus insulin using the ‘Glucommander / Other Insulin Subcutaneous Initial Regimen order set.

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