

CHI Franciscan Health Perioperative Glycemic Control Guidelines

I. Preoperative Assessment for Elective Procedures

For patients with poorly controlled diabetes (HbA1c \geq 8), refer to PCP 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			
Basal Insulins (long acting) Glargine, Basaglar, Semglee, Detemir, Degludec Insulin/GLP1 Combinations (degludec/liraglutide, glargine/lisinenatide)	80 % of usual dose	75% of usual AM dose	a. If also on oral DM medications: give 50% of usual AM dose b. If also on meal-time insulin (with or without oral diabetes medications): give 75% of basal insulin c. Insulin/GLP1 combinations*: give 50% of usual AM dose if also on oral diabetes medications, otherwise give 75% of usual AM dose
Intermediate Acting NPH U-500	- Usual dose if with dinner - 50% of usual dose if given at bedtime	50% of usual AM dose	a. If also on oral DM medications: give 50% of usual AM dose b. If also on meal-time insulin (with or without oral diabetes medications): give 75% of usual intermediate-acting insulin
Pre-mixed 70/30, 70/25	Usual Dose	50% of usual AM dose	30% of usual AM dose
Rapid Acting lispro, aspart, glulisine	Usual dose	HOLD any meal bolus doses	
Short Acting Regular Insulin		If on correction scale, treat BG > 180 mg/dl	
Insulin Pump	Usual basal rate and boluses	Usual basal rate; no boluses Check blood sugar q4h or sooner if symptoms of hypoglycemia experienced	
Oral and Non-insulin Injectables			
Sulfonylureas glyburide, glipizide, glimepiride	Give with meals	HOLD	
Metformin	Give		
Thiazolidinediones rosiglitazone, pioglitazone	Give		
Meglitinides repaglinide, nateglinide	Give with meals		
Alpha-glucosidase inhibitors acarbose, miglitol	Give with meals		
DDP-IV inhibitors sitagliptin, saxagliptin, linagliptin, alogliptin	Give with meals		
SGLT2 Inhibitors canagliflozin, dapagliflozin, empagliflozin, ertugliflozin			
Any combination oral DM medication	Give	HOLD	
Incretin Mimetics exanatide, liraglutide, exanatide XR, albiglutide, dulaglutide	Give		
Pramlintide	Give before meals		

**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:**
 - 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)
 - Check blood sugar in 15 minutes and repeat as necessary to get blood sugar greater than 80 mg/dl.
 - Notify RN of hypoglycemia and time of treatment upon arrival to hospital

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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 (may omit if fasting BG \leq 130 or random BG < 180 on BMP/CMP completed within the last 4 weeks):
	<ul style="list-style-type: none"> • Age > 45 <li style="text-align: center;">OR • 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	A. 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 "Pre-operative 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 100% basal rate. Treat per Table B and C.
- **If BG < 150 mg/dL for fasting patients with diabetes receiving insulin**, consider infusing dextrose* at 5 gm/hr (e.g. D51/2NS at 100 ml/hr, D10W at 50 ml/hr)

* Sufficient glucose is recommended to prevent catabolism, starvation ketosis, and insulin-induced hypoglycemia.

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 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 minutes 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)	<p>If patient has diabetes:</p> <ul style="list-style-type: none"> • For major surgery, critically ill patients or anticipated OR time > 2 hours, start insulin infusion per protocol ** <p>For all other patients, with or without DM, administer lispro correction scale prn</p>	<p>Insulin infusion:</p> <ul style="list-style-type: none"> • Glucommander : Recheck BG per Glucommander directions • Non-Glucommander: Recheck BG hourly until 3 consecutive BG results within 100-180mg/dL, then every 2 hrs <p>Subcutaneous insulin:</p> <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 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 	
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.

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Lispro Insulin Subcutaneous Correction Scale:			
DO NOT give lispro insulin more frequently than every 2 hours			
	BMI < 25	BMI 25-30	BMI > 30
Blood Glucose (mg/dl)	Lispro insulin Units (Subcutaneous)		
< 150	0 unit	0 unit	0 unit
150-200	2 units	3 units	4 units
201-250	4 units	6 units	8 units
251-300	6 units	9 units	11 units
> 300	Notify Anesthesia and start insulin infusion.		

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

Admission BG	Home Insulin	Insulin (Subcutaneous) Dose to Administer		
		80-180 mg/dl	>180 mg/dl	
Insulin Dependent DM	Once daily (PM) glargine/ detemir	None	Glargine 50% of PM dose	+ lispro correction scale
	Once daily (AM) glargine/ detemir	Glargine 75% of AM dose	Glargine 100% of AM dose	
	Twice daily Glargine/ detemir	Glargine 75% of AM dose	Glargine 100% of AM dose	
	NPH	NPH 50% of AM dose	NPH 75% of AM dose	
	70/30 or 75/25	35% of total AM dose as NPH	50% of total AM dose as NPH	
Insulin pump*	100% basal rate, no pump boluses	100% basal rate; no pump boluses		

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

1. **Start insulin infusion** when BG is 140mg/dL or greater.
2. Calculate **initial drip rate** using the following formula: **[(BG-60) x 0.03 = drip rate]**, round to the nearest unit.
3. Ongoing drip management:

BG (mg/dl)	Insulin Infusion Titration	Ongoing Management/BG Monitoring
< 70	Turn off 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) x multiplier], round to the nearest unit • Hourly BG checks
100-180	No change in multiplier	
> 180	Increase multiplier by 0.01	

* Harrison uses a different insulin infusion algorithm; refer to preoperative glycemic control order set.

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.

IV. Intraoperative Management (Select appropriate option A or B)

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 -140 mg/dL or greater.
2. Calculate **initial drip rate** using the following formula: **[(BG-60) x 0.03 = drip rate]**, round to the nearest unit.
3. Ongoing drip management:

BG (mg/dl)	Insulin Infusion Titration	Ongoing Management/BG Monitoring
< 70	Turn off 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) x multiplier], round to the nearest unit • Hourly BG checks
100-180	No change in multiplier	
> 180	Increase multiplier by 0.01	

* Harrison uses a different insulin infusion algorithm; refer to preoperative glycemic control order set.

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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			
	BMI < 25	BMI 25-30	BMI > 30
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	2 units	3 units	4 units
201-250	4 units	6 units	8 units
251-300	6 units	9 units	11 units
> 300	Start insulin infusion		

V. Immediate Postoperative Management

A. Outpatient Procedures:

- a. If on insulin drip, stop infusion.
- b. Check BG upon arrival to PACU and every 2 hours.
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.
- c. Medication instructions upon discharge:
 - i. Non-insulin diabetes meds may be resumed once patient is eating. If eGFR is less than 30 ml/min, recommend holding metformin and having patient 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 next schedule dose. Resume prandial insulin once patient eating. 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 first 24 hours post-procedure.
 - iii. If glycemic control has been suboptimal, close follow-up with PCP is recommended.

B. 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.
 - i. Treat with correction scale dose:

Lispro Insulin Subcutaneous Correction Scale:			
DO NOT give lispro insulin more frequently than every 2 hours			
	BMI < 25	BMI 25-30	BMI > 30
Blood Glucose (mg/dl)	Lispro insulin Units (Subcutaneous)		
< 150	0 unit	0 unit	0 unit
150-200	2 units	3 units	4 units
201-250	4 units	6 units	8 units
251-300	6 units	9 units	11 units
> 300	Notify Anesthesia provider or surgeon		

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- b. Ensure plan for postsurgical glycemic control is addressed with surgeon
 - i. Insulin infusion patients
 1. Continue insulin infusion if:
 - a. Patient critically ill
 - b. Patient 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 ≥ 1.5 units/hr
 - d. Persistent hyperglycemia (BG > 180)

For patients on the Glucomander insulin infusion, enter the Glucomander Transition to SubQ Insulin order set if 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 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 (use “Initiation of Glucose Monitoring” order set). 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 < 1.5 units/hr
 - c. Well controlled DM on diet alone or single oral anti-diabetic medications
 - ii. Non-insulin infusion patients
 1. Transition to glucose monitoring (use “Initiation of Glucose Monitoring” order set) if:
 - a. No previous history of diabetes and single isolated elevated BG value
 - b. Well controlled DM on diet alone or single oral anti-diabetic medications
 2. Transition to Glucomander SubQ insulin orders if:
 - a. Insulin-dependent DM (type 1 or 2). Use custom dosing feature to provide 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.
 3. Notify provider for BG < 70 or > 300 mg/dl.

VI. Postoperative Management

1. Glycemic goals: preprandial or fasting 100-140 mg/dl, random: less than 180 mg/dl
2. **Insulin therapy is preferred inpatient treatment strategy.** Oral antidiabetic medications should be held until patient stabilized. May be resumed prior to discharge if:
 - Patient eating greater than 50-75% of meals
 - No acute kidney failure
 - No hypoglycemia within last 24 hours
3. Initiate insulin orders via appropriate order set. *Inpatient Glycemic Control Guidelines located at end of order sets.*
 - Glu - Glucomander Insulin Infusion ED/IP
 - Glu - Glucomander DKA and HHS Insulin Infusion ED/IP

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- 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 for to assess for insulin needs)
4. Sole use of correction scale 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 patient able to operate 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 patient unable to operate pump, recommend stopping 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.

VII. References

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