Inpatient glycemic control guidelines during Covid pandemic

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Hyperglycemia management in hospitalized patients with COVID-19

Patients With Type 1 Diabetes Hospitalized for COVID-19 in the U.S.

- Compared with patients without diabetes, T1DM was associated with a 21% higher absolute risk of ICU/MV and a 5% higher absolute risk of mortality.
- Compared with T2DM, T1DM was associated with a 9% higher absolute risk of ICU/MV, but no difference in mortality.
- Higher risk of ICU/MV in patients with T1DM than in patients with T2DM was largely accounted for by the presence of DKA.

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Inpatient Hyperglycemia Management and COVID-19

- Inpatient hyperglycemia during this pandemic has been associated with worse outcomes.
- Clinical guidelines recommend maintaining glucose levels between 140 and 180 mg/dL (7.8–10.0 mmol/L) for most critically ill patients
- A target glucose range of 110–180 mg/dL (6.1–10.0 mmol/L) may be appropriate for most critically and noncritically ill patients.
- BG levels; 110_140 mg/dl may be reasonable for stable patients with mild disease without significant hypoglycemia and previous thight glycemic control.
- BG levels > 180 might be acceptable for patients with high risk of hypoglycemia or very labile and critical forms of disease (particularly postprandial continuous tube feeding) and who have limited life expectancy.

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Table 1 Hyperglycemia management in critically and noncritically ill patients with COVID-19

	Glycemic targets	Clinical situation		Insulin regimen	BG monitoring
Critically ill patients	140–180 mg/dL* (7.8–10.0 mmol/L)	Hemodynamically unstable Parenteral nutrition Unstable insulin requirements Corticosteroid therapy		Continuous intravenous insulin infusion	Every hour
		Hemodynamically stable Stable insulin requirements		Subcutaneous insulin Basal-correction or basal-bolus-correction	Every 4–6 h
Noncritically ill patients	110–180 mg/dL** (6.1–10.0 mmol/L)	T1D	Not oral intake	Basal-correction	Every 4–6 h[##]
		T2D on oral agents ± insulin	Oral intake	Basal-bolus-correction	Before meals and at bedtime[##]
		T2D on diet Unknown DM	Glycemia at admission < 180 mg/dL (10.0 mmol/L)	Correction insulin before meals or every 6 h[#]	Before meals and at bedtime or every 6 h[##]
			Glycemia at admission > 180 mg/dL (10.0 mmol/L)	Basal-bolus-correction	Before meals and at bedtime[##]

Inpatient Hyperglycemia Management and COVID-19

- Regarding ICU patients, the integration of computer-guided insulin infusion with CGM or further development of new automated insulin delivery systems may be ideal.

- A continuous intravenous insulin infusion and scheduled basalbolus correction insulin are the preferred regimens for glycemic control in critically and noncritically ill hospitalized patients, respectively.

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DETAILED TREATMENT GUIDANCE BG 200–250 mg/dL		
1.	**NO PRIOR KNOWN DIABETES or KNOWN DIABETES ON <2 ORAL AGENTS**	**MONITORING**
	• Check HbA_{1c} if none available in last 3 months	Check BG every 6 h
a	**Start sliding scale** regular insulin: moderate to high dose and escalate scale if BG >250 mg/dL	
b	**Add scheduled regular insulin every 6 h** if TF initiated (see above for regular insulin dosing based on eGFR and hourly TF rate) + scale	
c	**Add scheduled regular insulin if BG remains>250 mg/dL +** scale even if no TF initiated	
2.	**KNOWN DIABETES PRIOR TO ADMISSION**	Check BG every 6 h
	• Check HbA_{1c} if none available in last 3 months	
a	**T1DM** NPO: **add basal insulin glargine** ASAP (to **avoid DKA**): use 70% of home dose if eGFR >50 and 50% if eGFR <50 **+ scale**	
b	**T1DM on insulin pump and has supplies:** if feasible, continue basal insulin via pump (use increased temporary basal rate if needed); **rare use in ICU so calculate total basal as in a**	
c	**T1DM + TF:** continue basal insulin (to prevent DKA) and add **scheduled regular insulin for TF every 6 h** (guidance above based on eGFR and TF rate) + scale	
d	**T2DM NPO:** on regimen that included insulin prior to admission: start 25–50% basal dose + scale	
e	**T2DM on insulin PTA + TF:** start 25–50% basal dose and regular insulin for TF coverage every 6 h; see above for dose calculations + scale	

BG 200–250 mg/dL*: see details of treatment and titration in Table 2				
a	**START SLIDING SCALE REGULAR** insulin: moderate to high dose scale			**MONITORING**
b	**ADD SCHEDULED REGULAR INSULIN** every 6 h if uncontrolled with scale or if tube feeds started			BG check every 6 h
c	**ADD BASAL INSULIN GLARGINE for patients with the following:**			
	• T1DM (70% of home dose for eGFR >50 and 50% for eGFR <50 to **avoid DKA**)			
	• T2DM on home insulin (25–50% basal dose) or >2 drugs			
	• Uncontrolled glucose on regular insulin alone: use 0.1–0.3 units/kg daily (below)			
	• NPH may be appropriate basal for patients on steroids			
BG 250–350 mg/dL: START SCHEDULED SUBCUTANEOUS INSULIN				
		HIGH SENSITIVITY **No known diabetes, known DM with** renal failure (eGFR<30), insulin naive, mild disease*	**MODERATE SENSITIVITY** **Known DM,** renal failure (eGFR 30–50), intermediate disease course**	**LOW SENSITIVITY** **Known DM,** renal function (eGFR >50), steroids, severe disease***
Type of insulin		**Insulin dose (units/kg)**		
BASAL#	**Glargine daily: noon or 6 P.M.**	0.1 units/kg/day	0.15–0.2 units/kg/day	0.3 units/kg/day
BOLUS	**Scheduled regular insulin every 6 h**	**Approximate start doses (units/kg every 6 h); use clinical judgement**		
	No tube feeds	0.1	0.15	0.2
	Low rate tube feeds (≤25 cc/h)	0.1–0.125	0.1–0.15	0.2–0.25
	High rate tube feeds (≥25 cc/h)	0.15	0.2	0.3
SCALE	**Regular insulin every 6 h**	Moderate	Moderate	High
FOLLOW TRENDS IN INFLAMMATORY MARKERS: PROCALCITONIN, D-DIMER, hsCRP, AND TRIGLYCERIDES TO GUIDE IN UPWARD or DOWNWARD TITRATION OF INSULIN DOSE				

Basal-bolus insulin regimen

- insulin should be initiated at a dose of 0.4 units/kg/day.
- consider lower starting dose of 0.2 units/kg/day in elderly patients or those with liver or renal dysfunction.
- The initial dose can be higher, (e.g., 0.6 units/kg/day) in overweight/obese patients, or those who had a high pill burden before admission.
- achieve and maintain pre-meal glucose values of <140 mg/dl and post-meal glucose values of <180 mg/dl

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Patient on insulin infusion

- The infusion should be initiated at a low dose of 0.05_0.10 units/kg/hour, and the infusion rate should be titrated taking into account several factors.

- Once glucose ranges were within 200–300 mg/dL at lower hourly insulin drip rates, we would transition to subcutaneous insulin as soon as possible given the extenuating health care considerations described above.

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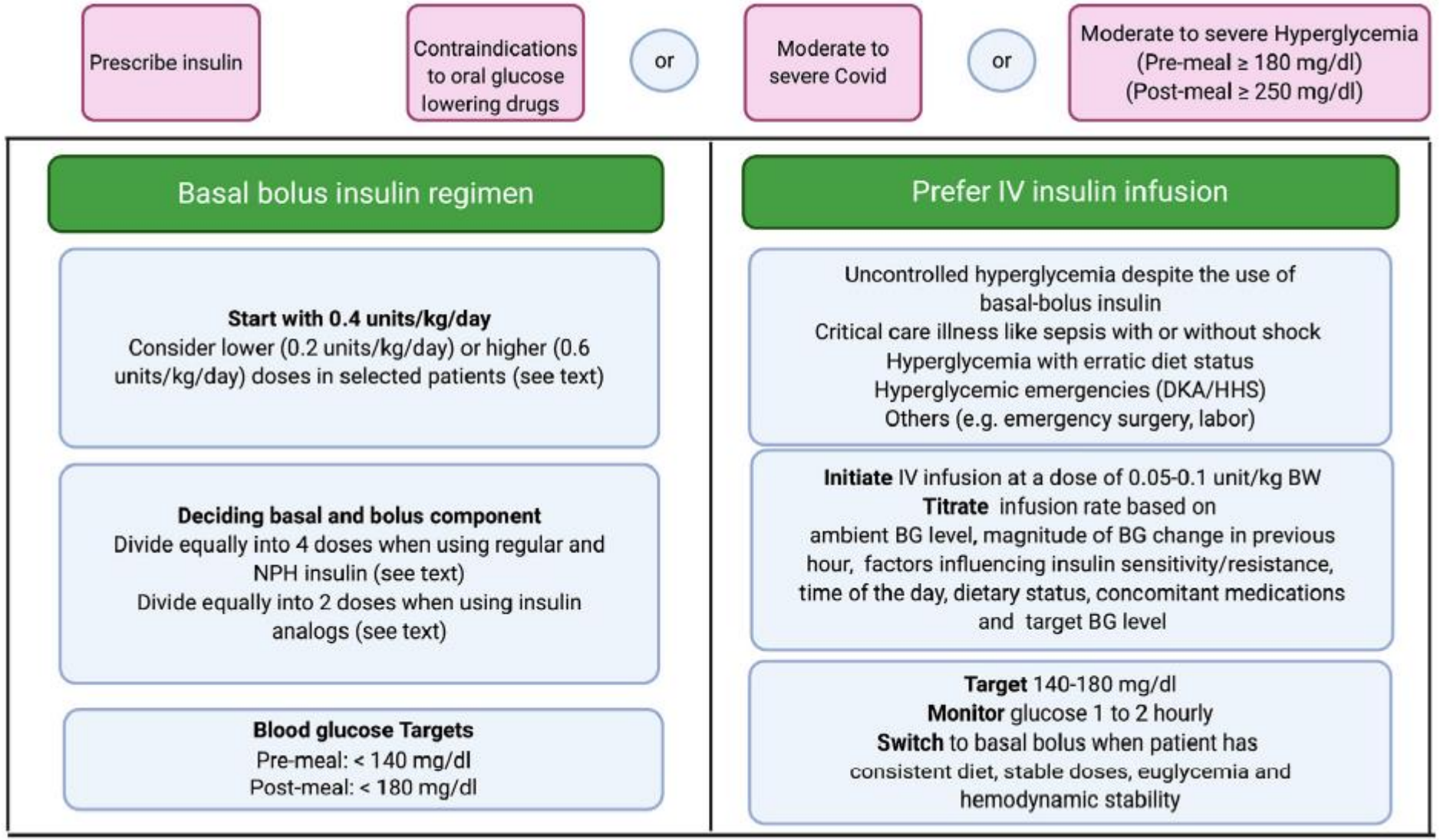
Prescribe insulin
Contraindications to oral glucose lowering drugs
or
Moderate to severe Covid
or
Moderate to severe Hyperglycemia
(Pre-meal ≥ 180 mg/dl)
(Post-meal ≥ 250 mg/dl)
Basal bolus insulin regimen
Start with 0.4 units/kg/day
Consider lower (0.2 units/kg/day) or higher (0.6 units/kg/day) doses in selected patients (see text)
Deciding basal and bolus component
Divide equally into 4 doses when using regular and NPH insulin (see text)
Divide equally into 2 doses when using insulin analogs (see text)
Blood glucose Targets
Pre-meal: < 140 mg/dl
Post-meal: < 180 mg/dl
Prefer IV insulin infusion
Uncontrolled hyperglycemia despite the use of basal-bolus insulin
Critical care illness like sepsis with or without shock
Hyperglycemia with erratic diet status
Hyperglycemic emergencies (DKA/HHS)
Others (e.g. emergency surgery, labor)
Initiate IV infusion at a dose of 0.05-0.1 unit/kg BW
Titrate infusion rate based on ambient BG level, magnitude of BG change in previous hour, factors influencing insulin sensitivity/resistance, time of the day, dietary status, concomitant medications and target BG level
Target 140-180 mg/dl
Monitor glucose 1 to 2 hourly
Switch to basal bolus when patient has consistent diet, stable doses, euglycemia and hemodynamic stability

Manage hyperglycemia in patients on glucocorticoids

- Even patients who have previously well-controlled blood glucose levels may require large doses of insulin (e.g., >2 units/kg/day) to achieve glycemic control following initiation of glucocorticoids.
- For patients receiving twice daily intermediate acting glucocorticoids (e.g., methylprednisolone), it is best to start a basal bolus insulin regimen.
- For patients receiving once a day morning dose of prednisolone: Basal (NPH) in morning and /or Bolus (regular) at lunch for support high blood glucose values in the afternoon and evening hours.
- uncontrolled hyperglycemia despite the use of basal-bolus regimen, the use of intravenous insulin infusion should be considered.

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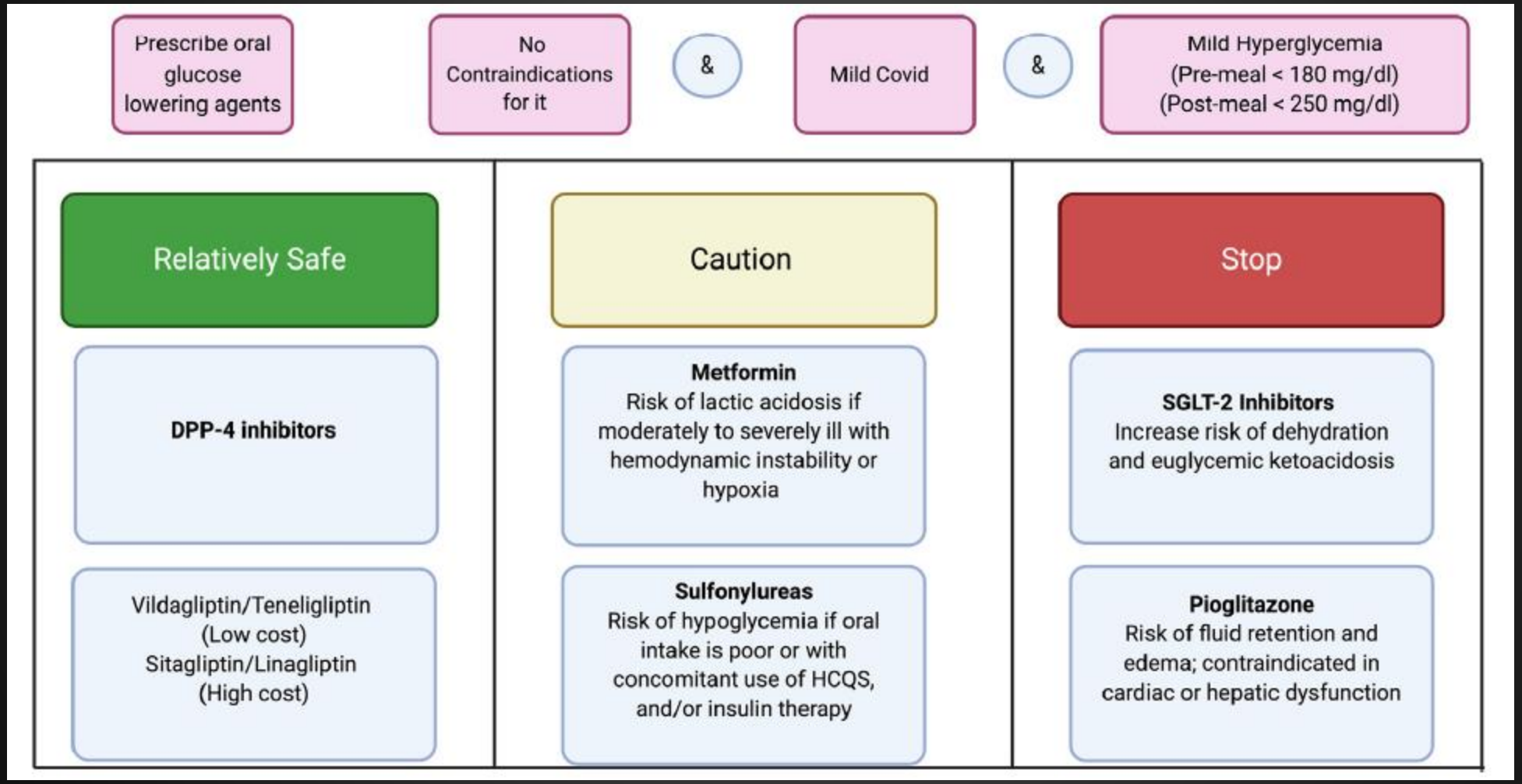
Management of patients T2DM



The Management of patients with T1DM During Surgery

Insulin pump therapy

- in patients on insulin pump therapy who are undergoing short procedures, the CSII can be continued at the usual or slightly reduced overnight basal rate.

- Insulin pump-treated patients can also be maintained on CSII for major procedures, as long as the integrity of the infusion and infusion site is ensured.

- hyperglycemia can be corrected using the standard home ISF

IV Insulin drip during surgery

- IV insulin is typically started at a dose of 0.03 units/kg/hour for patients who are euglycemic at the time of surgery.
- For elective surgeries; 1 unit of regular insulin is infused intravenously for each 4 to 6 g of administered glucose.
- For surgical emergencies: 1 unit of regular insulin for every 2 to 4 g of exogenous glucose
- Concentrations of 120 to 150 mg/dL should be the goal.
- **Glycemic and metabolic goals for surgery (ISPAD)** in a range of 5 – 10 mmol/l (90 – 180 mg/dl)

Rate of insulin administration

Table 583-9 GUIDELINES FOR INTRAVENOUS INSULIN COVERAGE DURING SURGERY		
BLOOD GLUCOSE LEVEL (mg/dL)	**INSULIN INFUSION (U/kg/hr)**	**BLOOD GLUCOSE MONITORING**
<120	0.00	1 hr
121-200	0.03	2 hr
200-300	0.06	2 hr
300-400	0.08	1 hr†
400	0.10	1 hr†

Fluid therapy during surgery

- An infusion of 5% glucose and 0.45% or 0.9% saline solution with 20 mEq/L of potassium acetate is given at 1.5 times maintenance rate.

- If BG <70 mg/dl give bolus of IV 10% Dextrose 1-2ml/kg; recheck BG 15 minutes later and repeat if necessary.
- If still 70 mg/dl, stop IV insulin for 15 min and recheck and discuss with diabetes team.

Thank you