

## Goal

Assist in optimizing glucose control at the pre-op/procedure visit, upon admission, and immediately following surgery/procedure. Please see the inpatient guideline links for further management.

## Key Points

- Patients with type 1 diabetes need some form of basal insulin (basal insulin injection, insulin pump, IV drip) at ALL times.
- Patients with type 1 diabetes or who are receiving significant doses of prandial insulin need minimal adjustments in basal insulin prior to surgery/procedure, while patients with type 1 or type 2 diabetes on basal heavy regimens need larger reductions of 20-50%.
- Please see accompanying Patient Education Handouts. [Diabetes Education Resources](#)

**Table 1. Perioperative / Periprocedure Management of Hyperglycemia and [Hypoglycemia](#)**

Blood Glucose (BG) Levels	Initial BG Check	Ongoing Management																				
BG < 45 mg/dl	<ul style="list-style-type: none"> <li>• Confirm most recent diabetes medication / insulin dose and time taken.</li> <li>• Insert IV of 0.9% normal saline.</li> <li>• Administer 25 g Dextrose D50% (50ml) IV**.</li> <li>• Notify Anesthesiologist.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Re-check every 15 min and treat accordingly until BG is ≥ 80 mg/dl.</b></li> <li>• <b>Once BG &gt; 80 mg/dl, re-check in 30 min and resume hourly glucose monitoring and management according to glucose values on this table.</b></li> </ul>																				
BG 45-59 mg/dl	<ul style="list-style-type: none"> <li>• Confirm most recent diabetes medication / insulin dose and time taken.</li> <li>• Insert IV of 0.9% normal saline.</li> <li>• Administer 12.5 g Dextrose D50% (25ml) IV**.</li> <li>• Notify Anesthesiologist.</li> </ul>																					
BG 60-79 mg/dl	<ul style="list-style-type: none"> <li>• Confirm most recent diabetes medication / insulin dose and time taken.</li> <li>• Insert IV of 0.9% normal saline.</li> <li>• Administer 7.5 g Dextrose D50% (15ml) IV**.</li> <li>• Notify Anesthesiologist.</li> </ul>																					
BG 80-139 mg/dl	<ul style="list-style-type: none"> <li>• Confirm most recent diabetes medication / insulin dose and time taken.</li> </ul>	<ul style="list-style-type: none"> <li>• Re-check in 1 hour.</li> </ul>																				
BG 140-180 mg/dl <b>GOAL</b>	<ul style="list-style-type: none"> <li>• Confirm most recent diabetes medication / insulin dose and time taken.</li> </ul>																					
BG > 180 mg/dl	<ul style="list-style-type: none"> <li>• If anticipated procedure time &gt; 3 hours, consider insulin drip**.</li> <li>• If anticipated procedure time &lt; 3 hours, confirm most recent diabetes medication / insulin dose and time taken.</li> <li>• If diabetes medication / insulin dose taken within last 2 hours, monitor patient, re-check BG in 1 hr.</li> <li>• If no diabetes medication / insulin dose given for &gt; 2 hours, <b>order and give lispro or aspart SQ based on the chart below.</b></li> </ul> <table border="1" data-bbox="344 1575 1107 1929"> <thead> <tr> <th rowspan="2">Blood Glucose</th> <th colspan="2">Dose of Lispro Insulin</th> </tr> <tr> <th>Type 1 DM or Insulin-Naïve Patients</th> <th>Type 2 DM Patients</th> </tr> </thead> <tbody> <tr> <td>180-200</td> <td>1 unit</td> <td>2 units</td> </tr> <tr> <td>201-250</td> <td>2 units</td> <td>4 units</td> </tr> <tr> <td>251-300</td> <td>3 units</td> <td>6 units</td> </tr> <tr> <td>301-349</td> <td>4 units</td> <td>8 units</td> </tr> <tr> <td>&gt; 350</td> <td colspan="2">If BG &gt;350 mg/dl, notify Anesthesiologist and surgeon. Consider delaying case. Start IV insulin drip**</td> </tr> </tbody> </table>	Blood Glucose	Dose of Lispro Insulin		Type 1 DM or Insulin-Naïve Patients	Type 2 DM Patients	180-200	1 unit	2 units	201-250	2 units	4 units	251-300	3 units	6 units	301-349	4 units	8 units	> 350	If BG >350 mg/dl, notify Anesthesiologist and surgeon. Consider delaying case. Start IV insulin drip**		<ul style="list-style-type: none"> <li>• Re-check BG in 1 hr.</li> <li>• If 2 doses given in previous 5 hours and BG &gt; 200 mg/dl, start IV insulin drip.</li> <li>• <b>DO NOT</b> re-dose supplemental insulin more frequently than Q2H.</li> </ul>
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\*\*Start insulin drip according to hospital guidelines. See OSUWMC [Type 1 DM](#) [Type 2 DM](#) guidelines.

## Preoperative/Preprocedure Phase

### General Considerations

- **Prior to Scheduling Procedure/Surgery**
  - Morning procedures are preferred.
  - Check A1C (i.e. for intermediate / high-risk surgery) if patient is known to have diabetes or risk factors, and if not available within the last 30 days. See OSUWMC [Preoperative Medication Management Guideline](#).
  - If poor glycemic control (A1C >9%):
    - Patient to contact referring physician for medication adjustment.
    - Consider postponing non-emergent surgery/procedure until medication adjustments are made.
- **Hypoglycemia Assessment**
  - Frequency, severity, hypoglycemia unawareness, or fasting hypoglycemia.
  - History of renal or liver disease.

## Preoperative/Preprocedure Diabetes Medication Adjustment

- **Note:** This guideline is intended for use in patients whose glucose is reasonably well controlled. See links in other guidelines for poorly controlled patients.
- Adjust medications based on:
  - Diabetes type
  - Glycemic control
  - Duration of procedure
  - Time of day

### Oral Medications

**Metformin:** Instruct patients to hold all oral (including metformin containing products) or non-insulin injectable diabetes medications the morning of the procedure.

### Insulin

#### Rapidly Acting Insulin (lispro, aspart, glulisine)

- Hold the morning of procedure unless patient uses correction dosing in the fasting state.

#### Short-Acting Insulin (Regular)

- Hold the morning of procedure unless patient uses correction dosing in the fasting state.

#### Basal Insulin (NPH, glargine, detemir, degludec)

- Patients with type 1 and type 2 diabetes may require dose reduction prior to surgery.
- The dose reduction depends upon glucose control prior to surgery and the total daily insulin dose (basal + prandial) before surgery (approximately 50% or less of the total daily dose is truly basal insulin).
- **Do not withhold basal insulin in patients with type 1 diabetes. Consider 20% reduction of evening dose.**

#### Regular Insulin (U500)

- Instructions per the patient's endocrinologist.
- See [Regular Insulin U-500 Policy](#) by OSUWMC Pharmacy.

### NPH

- For a.m. procedure, reduce evening dose by 20% and morning-of dose by 50%.
- For p.m. procedure, reduce morning-of dose by 50%.

### Glargine (U100, U300), Detemir, Degludec (U100, U200)

- Patients with type 1 diabetes typically only need to reduce the dose by  $\leq 20\%$ .
- Patients with type 2 diabetes will need larger dose reductions (50%), particularly if basal insulin accounts for more than 50% of the total daily insulin dose.

### Split-Mixed Insulin (70/30, 75/25, 50/50)

- Reduce evening dose prior to procedure by 20%, and reduce morning-of dose by 50%.

### Pump Basal Insulin

- Consider 20% reduction to basal rates to begin at midnight prior to procedure.

Table 2. Preparation and Pharmacokinetics of Insulin

Preparation	Action Onset	Peak	Action Duration
<b>Bolus Insulin</b>			
Regular q.a.c.	30 min.	2-4 hr.	6-10 hr.
Aspart q.a.c.	5-15 min.	1-2 hr.	4-6 hr.
Glulisine q.a.c.	5-15 min.	1-2 hr.	4-6 hr.
Lispro q.a.c.	5-15 min.	1-2 hr.	4-6 hr.
<b>Basal Insulin</b>			
NPH daily or bid	1-2 hr.	4-8 hr.	10-20 hr.
Detemir daily or BID	3-4 hr.	Nearly flat	Approx. 24 hr.
Glargine daily	3-4 hr.	Nearly flat	Approx. 24 hr.
Glargine U300	6 hr.	Nearly flat	24-30 hr.
Degludec U100/U200	1 hr.	Nearly flat	24-30 hr.
<b>Other</b>			
70/30, 75/25, 50/50 BID	5-15 min.	1-2 hr.	10-20 hr.
Regular U500	30 min.	4-8 hr.	18-23 hr.

## Intra-operative / Intra-procedure Phase

### Glucose Target

- Intraoperative/Intraprocedure target:
  - 140-180 mg/dl.
- Refer to **Table 1**.

### Glucose Monitoring

- **Patients with diabetes:**
  - Check blood glucose upon arrival to the ASU/Preoperative/Preprocedure holding area.
  - Blood glucose checks should be performed hourly while in ASU/ Preoperative/ Preprocedure area and intraoperatively.
    - For patients undergoing monitored anesthesia care, frequency of monitoring will be determined by the attending anesthesiologist. However, if preoperative BG >70, glucose should be monitored hourly.
  - If blood glucose is out of acceptable range, follow **Table 1** regarding hypoglycemic/hyperglycemic management.

### Continuous Subcutaneous Insulin Pump (CSII)

- Diabetes consult is required for all hospitalized patients on insulin pumps. For elective procedures, please place order for "Inpatient Referral Endocrinology-Diabetes" (specify Main, James or East) in day of admission or pre-admission orders. Alternatively, you may contact Team 2 Diab (see Web Exchange for CNP – first call).
- CSII may be continued for procedures lasting <3 hours, at discretion of person performing procedure.
- Reduce basal rates by 20%, starting at midnight.
  - Basal adjustments should be discussed with pump prescriber prior to procedure.
- If CSII discontinued for more than 1 hour, coverage with supplemental insulin **MUST** be provided with aspart/lispro in hourly doses commensurate with usual basal rate.
- If CSII will be discontinued for >3 hours, start IV insulin infusion per OSUMC policy: [Continuous Subcutaneous Insulin Infusion \(CSII\) Pumps and Continuous Glucose Monitors \(CGM\)](#).
- The catheter should be in a site that will not interfere with the surgical field. Continuous glucose monitoring can be considered for outpatient procedures but should not be considered a substitute for point of care blood glucose checks.

### IV Insulin Infusion - Indications

- Procedures > 3 hours.
- Poor glycemic control:
  - A1C >9%.
  - BG > 300 mg/dl.
  - BG > 200 mg/dl refractory to supplemental insulin.

## Postoperative/Postprocedure Phase

- Check blood glucose immediately upon arrival to PACU/Postprocedure holding area and hourly thereafter until blood glucose is within the acceptable range.
- If blood glucose is not within the acceptable range, follow **Table 1** on page 1 for blood glucose correction.
- If patient is to be discharged to home, check blood glucose readings prior to patient leaving the hospital.
- If patient arrives to PACU on insulin drip and will be admitted to the floor service, continue the insulin drip when discharged to the floor following appropriate OSUWMC guidelines for insulin infusion:
  - [Type 1 DM](#)
  - [Type 2 DM](#)

## Same Day Procedures

### Oral Medication

- Diabetes medications may be resumed once the patient is eating.
- Metformin:
  - If no contrast dye is used perioperatively, medications containing metformin may be resumed without delay.
  - If contrast dye is used, see OSUWMC [Preventing and Responding to Contrast Induced Nephropathy](#) Guideline.
- If glycemic control has been suboptimal, close follow-up with primary physician is recommended for healing and prevention of infection.

### Insulin

- Resume intermediate-acting or long-acting insulin as previously scheduled.
- May need additional units of rapidly acting or short-acting insulin between completion of procedure and next regularly scheduled insulin.
  - Consider using sliding scale.
- For insulin pumps, resume usual basal rates and bolus schedule once able to eat/drink.
- Check blood glucose frequently during the first 24 hours post-procedure or same-day surgery.

## Inpatient Procedures and Medication Adjustments

See OSUWMC [Diabetes Mellitus in Non-Pregnant Adults: Inpatient Management](#) Guideline.

## Discharge

- Patients may resume home diabetes medications at discharge provided they are eating, stable, and close to discharge.
  - Patients should not resume home diabetes medications at discharge if glycemic control has been suboptimal or other contraindications exist.

## References

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- Joshi GP, et al. (2010). Society for Ambulatory Anesthesia Consensus Statement on Perioperative Blood Glucose Management in Diabetic Patients Undergoing Ambulatory Surgery. *Anesthesia & Analgesia Journal*, 111(6):1378-87.
- Moghissi ES, et al. (2009). American Association of Clinical Endocrinologists and American Diabetes Association Consensus Statement on Inpatient Glycemic Control. *Diabetes Care*, 32(6):1119-31.
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- Duggan EW, Carlson K, Umpierrez GE. Perioperative Hyperglycemia Management: An Update. *Anesthesiology*. 2017 Mar; 126(3):547-560.
- Rosenblatt SI, Dukatz T, Jahn R, Ramsdell C, Sakharova A, Henry M, Arndt-Mutz M, Miller V, Rogers K, Balasubramaniam M. Insulin glargine dosing before next-day surgery: comparing three strategies. *J Clin Anesth*. 2012 Dec; 24(8):610-7.

## Quality Measures

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- Patients with a current A1C (within 30 days).
- Point of care blood glucose checks performed before and after surgery as well as approximately hourly if case > 1 hour (Monitored anesthesia care cases will be excluded).
- Procedures with two or more glucose measures > 250 mg/dl x 2 where there is no documented insulin administration intraoperatively  $\geq 3$  hours of anesthesia stop time.

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## Guideline Approved

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August 29, 2018. Eighth Edition.

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