Adult Diabetes & Surgery Guidelines

These guidelines are based on the Joint British Diabetes Societies guidelines (www.diabetologists-abcd.org.uk/JBDS/JBDS_IP_Surgical_Guideline_2015_Full.pdf), update to CPOC guidelines 2021 (1) which have been adapted for local use in conjunction with other diabetes guidelines. The January 2025 revision is based on a consensus guideline published in Anaesthesia January 2025 (https://anaesthetists.org/Portals/0/PDFs/Guidelines%20PDFs/GLP%20updated%20v2%20final.pdf?ver=2025-01-21-092830-780×tamp=1737459580907) (2). The following are intended as guidelines only, there is no one size fits all as individual patients and circumstances vary. Clinical judgement is also required. If in doubt, contact the locality Diabetes team.

The guideline is divided into 7 sections

1. General considerations
2. Targets for glucose monitoring
3. Day or elective surgery

A. Patients treated with non-insulin diabetes medication

B. Patients treated with insulin

4. Emergency surgery and surgery with predicted prolonged starvation
5. Post-operative care
6. Rescue treatment
7. Patients treated with CSII

Adult Diabetes & Surgery Guidelines

1. General considerations

- The stress of surgery and anaesthesia is often associated with poor glucose control and increased insulin requirements especially if the operation is an emergency. The aims of good perioperative control are: -
  1. To **avoid Diabetic ketoacidosis (DKA) in insulin dependent patients**.
  2. To **avoid hypoglycaemia** during anaesthesia.
  3. To **prevent hyperglycaemia**, associated risk of dehydration, impaired healing & recovery.
- The emphasis of elective perioperative diabetes management should be to avoid prolonged starvation, aiming for one missed meal. The goal is to cause minimal disruption to the patient's routine diabetes medication plan and to collaborate with the patient.
- Glycated haemoglobin (HbA_{1c}) is a marker of long-term glucose control. An elevated HbA_{1c} (>69 mmol/mol) is associated with a worse outcome across a number of surgical specialties. There is currently no clear data demonstrating that actively reducing HbA_{1c} before surgery improves outcome. However, a high preoperative HbA_{1c} is predictive of poor perioperative glycaemic control and therefore may highlight patients who will require a variable-rate intravenous insulin infusion (VRIII) in the perioperative period to achieve optimal glycaemic control. Therefore, an elevated HbA_{1c} may preclude patients from day surgery.
- Elective surgical patients with **HbA_{1c} >69 mmol/mol** should be referred for preoperative review of their glycaemic control by their General Practitioner/Diabetes team if this has not been reviewed in the past 12 months. For non-urgent surgery the outcome of this review should be awaited prior to listing for theatre. The process must strike a balance between delayed surgery and optimisation of glycaemic control, the benefit of awaiting improvement in HbA_{1c} should be taken on a case-by-case basis.
- **When admitted to hospital** aim for target blood glucose of 6.0-10.0 mmol/L, with 6.0-12.0 mmol/L being an acceptable range.
- Whenever possible, patients with diabetes should be placed **first** on the theatre list, i.e. they should undergo surgery in the morning rather than waiting until the afternoon.
- The pre-operative blood glucose level **must** be measured and recorded before the induction of anaesthesia.
- The **fluids** suggested in the **variable rate intravenous insulin infusion (VRIII) for perioperative surgical patients** will be prescribed by the anaesthetist in the immediate post-op period, but will need ongoing review by the surgical staff.

2. Targets for glucose monitoring

Target glucose range: 6.0 –10.0 mmol/L (up to 12.0 mmol/L being an acceptable range)

- Ideally, blood glucose should aim for a target value of 6.0-10.0 mmol/L. Although values of 6.0-12.0 mmol/L are acceptable.
- Blood glucose values > 12.0 mmol/L merit active treatment to restore glucose to the target range.
- If a patient becomes unwell or has a persistent blood glucose > 14.0 mmol/L check blood ketones.
- Blood glucose values < 4.0 mmol/L should be managed according to hypoglycaemia policy
- **Looming hypoglycaemia: 4.1 – 5.9 mmol/L, recheck blood glucose in 30 minutes**
- Blood glucose values below 6.0 mmol/L identify patients at risk of looming hypoglycaemia. In this situation intravenous insulin infusion should temporarily stop & treatment to correct glucose to the target range should be considered in those taking insulin or a Sulphonylurea such as Gliclazide.

Monitoring frequency

On the day of the surgery, check blood glucose level on admission then

In patients who are fasted

- Hourly if on Surgical VRIII, sedated or anaesthetised
- Hourly if taking subcutaneous insulin and fasted for surgery
- 2 hourly if fasted and treated with non-insulin treatment or diet

Maintain this until the patient is established postoperatively on their usual diabetes medication.

Not fasting

- 3-4 times daily on subcutaneous insulin or taking a Sulphonylurea (e.g. Gliclazide)
- Twice daily if only on non-insulin diabetes medication
- Twice daily if diet controlled and CBG < 10.0 mmol/L

3. Day or elective surgery, where it is predicted the patient will miss only one meal (separated into tablet & insulin management)

A. Patients treated with non-insulin diabetes medication

- Most patients **should take** their usual prescribed diabetes medication on the **day prior** to surgery. However, **SGLT2 inhibitors (Dapagliflozin, Empagliflozin, Canagliflozin and Ertugliflozin)** should be omitted the day before surgery (2). Patients who need specific pre-operative diet restriction or bowel preparation for specific procedures should stop SGLT2i to coincide with the reduced food intake.

- SGLT2is can be associated with euglycaemic ketosis. Patients who are starved, dehydrated or under physiological stress are especially prone to this. Hence the reason for early omission of the drug and the need to monitor blood ketones daily.

- **On the day of surgery:**

  - All patients should have their capillary blood glucose checked & recorded on admission.
  - See section 2 '**Targets for glucose monitoring'**.
  - Consult Table 1 below (adapted from JBDS-IP guidelines).

- After Surgery:

- Don't restart SGLT2i until patients are eating and drinking normally again (2).

B. Patients treated with insulin

- Patients with **Type 1 diabetes should never be without insulin**. Basal insulin should be continued and adjusted as described below because of the risk of Diabetic ketoacidosis (DKA).

- **Prior to surgery:**

  - All patients should have the capillary blood glucose checked & recorded on admission.
  - See section on '**Target for glucose monitoring**'
  - Consult Table 2 below (adapted from JBDS-IP guidelines).

Table 1: Oral diabetes therapies adjustment for day & elective surgery

Tablets	Day before surgery	Patient for a.m. surgery	Patient for p.m. surgery
Acarbose	Take as normal	Omit	Take morning dose if eating
Meglitinides (e.g. repaglinide or nateglinide)	Take as normal	Omit	Take morning dose if eating
Metformin (eGFR >60 & procedure not requiring use of contrast media)	Take as normal	If taken once or twice a day - take as normal If taken three times a day, omit lunch time dose	If taken once or twice a day - take as normal If taken three times per day, omit lunch time dose
Sulphonylureas (e.g. glibenclamide, gliclazide, glipizide, glimepiride)	Take as normal	Once daily - Omit Twice daily - Omit morning dose	Omit
Pioglitazone	Take as normal		
DPP IV inhibitor (e.g. alogliptin, linagliptin sitagliptin, vildagliptin, saxagliptin,)	Take as normal		
GLP-1 analogue (e.g. semaglutide, liraglutide, lixisenatide, dulaglutide, exenatide, rybelsus)	Take as normal		
SGLT-2 inhibitors (dapagliflozin, canagliflozin, empagliflozin, ertugliflozin)	Omit	Monitor capillary ketones daily until normal eating and drinking pattern restored. N.B. risk of euglycaemic DKA	

Table 2: Insulin adjustment for day & elective surgery

Insulin	Day prior to admission	Patient for a.m. surgery	Patient for p.m. surgery
Once daily Basal/Background (evening) (e.g. Lantus, Levemir, Tresiba, Insulatard, Humulin I, Semglee, Toujeo, Abasaglar)	Reduce dose by 20%	No dose adjustment necessary	No dose adjustment necessary
Once daily (morning) (Lantus, Levemir, Tresiba, Insulatard, Humulin I, Semglee, Toujeo, Abasaglar, Xultophy)	Reduce dose by 20%	Reduce dose by 20%	Reduce dose by 20%
Twice daily mixed (Novomix 30, Humulin M3, Humalog Mix 25, Humalog Mix 50)	No dose change	Reduce am dose by 50%** Resume usual dose with evening meal	Reduce am dose by 50%**. Resume usual dose with evening meal
Daily multiple injections (3, 4, 5 injections) (e.g. an injection of mixed insulin (Humulin M3, Humalog Mix 25, Humalog Mix 50, Novomix 30) 3 times a day **or** 3 meal time (bolus) injections of rapid/fast acting Insulin (Novorapid, Humalog, Apidra) **with** once/twice daily basal/background insulin (e.g. Lantus, Levemir, Tresiba, Insulatard, Humulin I, Semglee, Toujeo, Abasaglar)	No dose change	**Rapid/fast & long-acting insulins** • Omit morning dose of fast acting insulin if no breakfast. • If taking a basal insulin in the morning reduce dose by 20%. **Premixed insulin three times/day**** • If taking a premixed insulin, reduce dose by 50%. • Omit lunchtime dose. • Resume usual insulin dose with evening meal.	Take usual morning insulin dose(s). Omit lunchtime dose. Resume usual insulin dose with evening meal
Ensure that the patient takes their usual insulin dose the morning after surgery. However, advise that their blood glucose may be higher than usual for a day or so.			

4. Emergency surgery & surgery with predicted prolonged starvation (more than one missed meal)

- Under these conditions, the need for intense control of blood glucose is likely and therefore there is a need for an **INTRAVENOUS VARIABLE RATE INTRAVENOUS INSULIN INFUSION (VRIII) WITH IV FLUID** (Surgical VRIII).
- Ensure all emergency admissions with diabetes have glycaemic status (CBG) and metabolic status (renal profile, lactate and ketones) documented.
- Ensure patients with type 1 diabetes have ketone levels checked and insulin prescribed (either basal insulin or intravenous insulin infusion). Failure to prescribe will lead to Diabetic ketoacidosis (DKA)
- Ensure SGLT2i are omitted and ketones are checked daily during the admission
- Refer to medics if
    - Metabolic derangement
    - Recurrent or severe hypoglycaemia
    - Persistent hyperglycaemia or ketonaemia >0.6 mmol/L
- Prioritise surgery to minimise fasting

Surgical VRIII is the preferred method to maintain glucose control if

- T1DM or T2DM if undergoing surgery with a prolonged fasting period with more than one missed meal
- Patients needing prolonged fasting pre-operatively may require earlier admission for surgical VRIII during the fasting period
- Type 1 DM and not had background/basal insulin
- Sub-optimal DM management and starting HbA1c > 69 mmol/mol
- Most patients with Diabetes needing emergency surgery
- Patients with persistent blood glucose > 12.0 mmol/L

Please ensure that

- If the person is already on long-acting background/basal insulin this should continue at 80% of usual dose. The bolus/mealtime insulin is discontinued while on VRIII
- Medication used for type 2 diabetes can be withheld whilst on VRIII **until usual diet resumes**
- Initial insulin dose should be based on capillary blood glucose (CBG)
- Hourly CBG should be monitored in those on VRIII
- If CBG is above 12.0 mmol/l for more than 3 readings or not dropping by 3.0 mmol/l/hr then increase the rate of insulin delivery
- In patients using a Surgical VRIII consider using the lower scale if there is risk of hypoglycaemia (CKD, AKI, low body weight, low total daily insulin dose (TDD) <25 units/day or insulin naïve
- If a patient develops Diabetic ketoacidosis (DKA) or Hyperosmolar Hyperglycaemic State (HHS) they need senior medical review and should be managed according to the specific hospital DKA or HHS protocol

5. Post-operative care

- Monitor and maintain CBG 6.0-10.0 mmol/L
- Monitor electrolytes and fluid balance daily and correct accordingly
- Proactively treat post-op nausea and vomiting
- Promote restoration of usual diet and restoration of usual glucose lowering treatment Although, doses may need adjusting
- Don't restart SGLT2i until patients are eating and drinking normally again (2)
- When transferring back to subcutaneous insulin injections please see instructions on Surgical VRIII chart and seek support from the diabetes team
- Aim to convert from intravenous insulin to subcutaneous insulin at a meal time when the patient is able to eat and drink. There should be at least 30 minutes between giving the fast acting mealtime insulin and stopping intravenous insulin infusion. The basal insulin or pre-meal mixed insulin must have been administered prior to stopping intravenous insulin.
- Never stop the insulin infusion in patients with type 1 diabetes unless subcutaneous basal (background) insulin (or mixed insulin for those on this type regime) has been given and ketones are < 0.6 mmol/L for two consecutive readings and for at least 2 hours
- Ensure that those prescribing and adjusting insulin are competent in their roles
- Promote drinking, eating and mobilising and appropriate food options
- Support patients with diabetes to resume self-management as soon as possible

6. Rescue treatment

Hypoglycaemia: < 4.0 mmol/L

- A measured capillary blood glucose < 4.0 mmol/L requires urgent treatment.
- If blood glucose <4.0 mmol/L, refer to the inpatient treatment of hypoglycaemia in adults with diabetes guidance on COIN (CID208)). Remember that the patient may be nil by mouth. Notify the anaesthetist who may consider dextrose infusion (+/- VRIII).
- Treatment to prevent hypoglycaemia maybe considered in a surgical patient taking glucose lowering treatment (Gliclazide or insulin) if CBG is below 6.0 mmol/L
- Follow hospital guidelines for management of hypoglycaemia

Hyperglycaemia: > 12.0 mmol/L

Surgery is a stressful time and hyperglycaemia is common. Data supports a target glucose of < 10.0 mmol/L. However, it is also recognised that excess insulin treatment is also associated with harm. Therefore, for pragmatic reasons it is suggested that whilst a target CBG of 6.0-10.0 mmol/L is recommended treatment should occur once CBG > 12.0 mmol/L.

- If blood glucose > 12.0 mmol/L in patients with type 1 or 2 diabetes, **recheck in 30 minutes**

If glucose remains > 12.0 mmol/L

- Rule out DKA and HHS according to hospital criteria
- If no evidence DKA or HHS consider a corrective dose of subcutaneous rapid/fast acting insulin

Insulin correction does

Type 1 DM

- Assume 1 unit of insulin will drop CBG by 3.0 mmol/L although take advice from patient with diabetes who may have a personal correction ratio
- Recheck in 1 hour to ensure CBG is falling, a second dose can be repeated after 2 hours if CBG not falling and remains above 12.0 mmol/L.
- Re check after 1 hour and consider the need for VRIII if CBG remains above target

Type 2 Diabetes

- Give 0.1 u/kg of subcutaneous rapid/fast acting insulin and recheck after 1hr to ensure glucose is falling
- Repeat after 2hr if CBG remains > 12.0 mmol/l

- Repeat after 60-90 minutes and if remains above target commence a Surgical VRIII infusion

7. Patients treated with a continuous subcutaneous insulin infusion pump (CSII)

- About 15% of patients with T1DM use a continuous subcutaneous insulin infusion (CSII) or insulin pump. CSII delivers a continuous fast acting insulin (e.g. Humalog, Novorapid, Apidra or Fiasp) via an insulin pump, and at meal times the person with diabetes delivers a bolus dose of insulin according to the carbohydrate content of the meal eaten via the pump
- These devices are used alongside self monitored blood glucose (SMBG), flash glucose monitoring (FGM)/Libre systems and real-time continuous glucose monitoring (RT-CGM). RT-CGM assesses subcutaneous interstitial glucose and there can be a 15 minute lag behind serum glucose. Therefore, it's use is not advocated for clinical decision making in the sedated anaesthetised patient.
- The use of continuous subcutaneous insulin infusion (CSII) during surgery should be agreed between the anaesthetist & diabetes team in advance of surgery.

Benefits of CSII

- Avoidance of VRIII
- Less risk hospital acquired DKA
- Risks of electrolyte disturbance eliminated
- Avoidance of changing to and from multi dose injections (MDI)
- Patient familiarity

Risks of CSII

- Pump failure
- Manufactures outside warranty
- Clinicians unfamiliar so cannot titrate
- Anaesthetist may not be familiar
- No basal insulin so rapid ketogenesis in event of pump failure

- CSII should **never** be stopped unless replaced by an alternative insulin infusion (usually intravenous), or Diabetic ketoacidosis (DKA) will occur

- For patients undergoing prolonged procedures (>2 hours or prolonged starvation likely more than 1 meal missed). The CSII should be replaced with a Surgical VRIII as section 4. Once the VRIII has commenced the CSII can be removed.
- If the surgical procedure is short (<2 hours and the patient expected to drink within 2-3 hours), CSII can potentially continue during surgery, provided the blood glucose is regularly checked. Patients who snack regularly or often have glucose values < 6.0 mmol/L need to reduce their basal infusion rate by 20% perioperatively

- The cannula must be Teflon and not steel, and the CSII should be positioned away from the operative field & diathermy
- CBG must be measured regularly (hourly). We do not recommend the use of flash device measurements for monitoring in this situation and it's important to be aware of the time lag (approximately 15 minutes) of flash device measurements

Steps to take

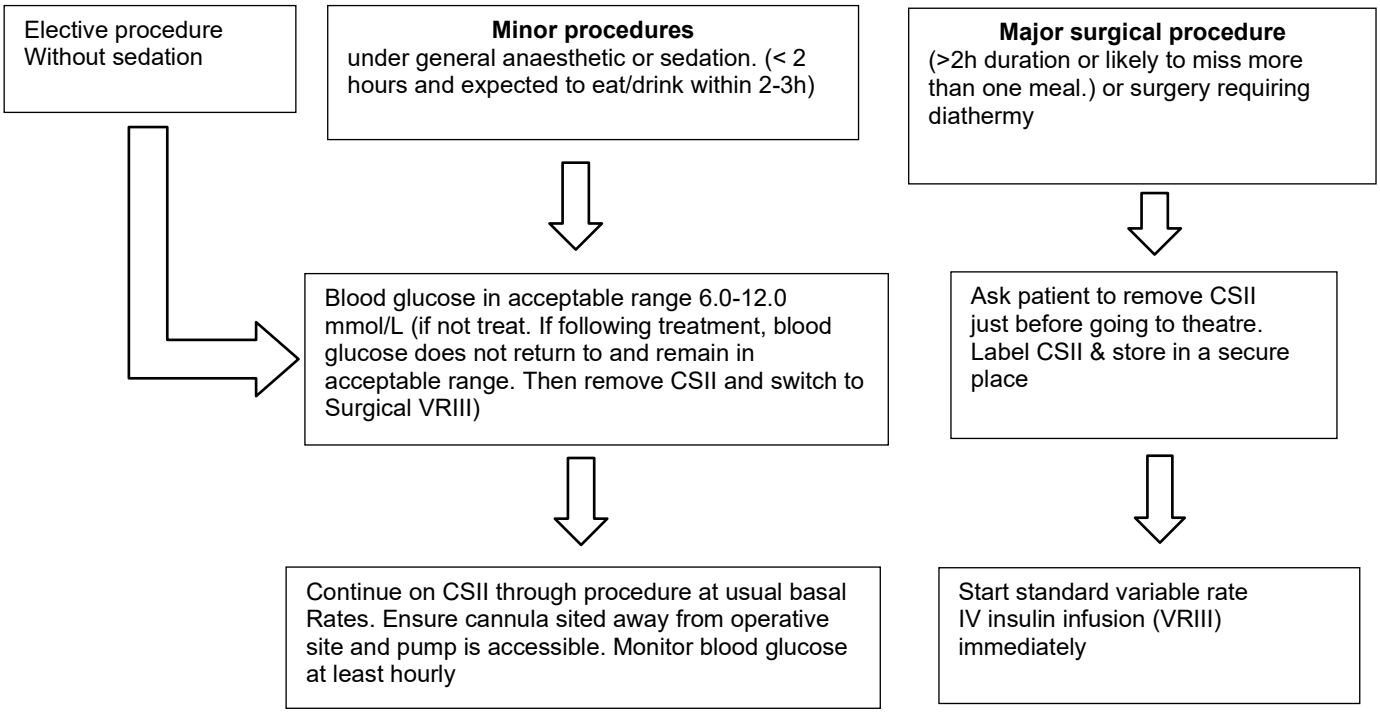
Please refer to the CSII guideline on COIN (CID143) and Figure 1 below.

- The day before surgery continue the usual insulin infusion rates & the evening meal can be taken with usual bolus dose. Once the patient is nil by mouth, continue with the usual basal/background rate of insulin overnight, **unless patients usually wake with a fasting glucose < 6.0 mmol/L, in this situation change the basal rate to 80% of the normal rate at bedtime the day before surgery**. The patient should ensure the blood glucose is in the target range 6.0-10.0 mmol/L (6.0-12.0 mmol/L is acceptable) pre-procedure

- On day of surgery continue insulin at the usual basal rate with hourly blood glucose monitoring. However, if patients often get glucose levels < 6.0 mmol/L during the day change the basal rate to 80% of normal on the morning of surgery. Aim for a glucose range of 6.0-10.0 mmol/L (although 6.0-12.0 mmol/L is acceptable). If not within the target range, then one round of bolus correction via the pump can be allowed to achieve this target range. If that fails there should be conversion to a variable rate insulin infusion (as described in section 4)
- During surgery, check blood glucose hourly. Target blood glucose values are as above.
  - If during surgery blood glucose falls <6.0 mmol/L correct hypoglycaemia as per section relating to "**Rescue treatment**". Recheck blood glucose after 15 minutes to ensure resolution. Once hypoglycaemia is corrected, **commence a VRIII & stop the CSII**.
  - If blood glucose >12.0 mmol/L **convert to a VRIII & stop the CSII**.
- Post procedure
  - Mealtime bolus doses should recommence when eating & drinking. Patients should consider using a correction dose if blood glucose is >10.0 mmol/L. Consider starting a Surgical VRIII if blood glucose is >12.0 mmol/L.
  - If the CSII has been discontinued & replaced with a Surgical VRIII, then the CSII should re-start when eating & drinking normally. The Surgical VRIII should continue for 30 minutes after the first mealtime bolus dose.

- **Please liaise closely with the diabetes team regarding any patient who is using insulin pump therapy and undergoing surgery**

Figure 1. Flow chart of a patient using insulin pump undergoing surgery



References:

1. *Guideline for Perioperative Care for People with Diabetes Mellitus Undergoing Elective and Emergency Surgery* (2021). Centre for Perioperative Care (CPOC).

2. El-Boghdadly, K. *et al.* (2025) "Elective peri-operative management of adults taking glucagon-like peptide-1 receptor agonists, glucose-dependent insulinotropic peptide agonists and sodium-glucose cotransporter-2 inhibitors: a multidisciplinary consensus statement," *Anaesthesia* [Preprint]. Available at: https://doi.org/10.1111/anae.16541.