

This Medicines Information Leaflet is produced locally to optimise the use of medicines by encouraging prescribing that is safe, clinically appropriate and cost-effective to the NHS.

Managing Diabetes in Adults Before, During and After Surgery and Procedures

The aim of this MIL is to provide guidance to support the care and management of adults with diabetes (type 1 and type 2) undergoing operative or investigative procedures involving a period of fasting. This MIL applies to patients for endoscopy without bowel preparation. For patients undergoing bowel preparation prior to endoscopy or surgery follow separate local guidance. Specific guidance for specialist patients are not within the scope of this MIL e.g., maternity, Oxford Heart Centre, bariatrics, and islet cell transplant.

Diabetes is common, affecting around one in six inpatients throughout the Trust. Both the number and complexity of patients with diabetes are increasing. Patients with diabetes who have poor perioperative glycaemic control are at significantly increased risk of post-operative infection. Improving blood glucose control leads to better postoperative outcomes and a reduced length of stay.

Target blood glucose concentration is 6-10 mmol/L but up to 12mmol/L may be acceptable.
Blood ketone concentration should be less than 1 mmol/L.

Refer to the Diabetes Specialist Team if blood glucose targets are not achieved by following the management guidelines below:

- ★ **URGENTLY** for patients experiencing **persistent hypo(Low)glycaemia**
- ★ Patients experiencing **persistent hyper(High)glycaemia**

Refer by EPR: Request & Prescribing – inpatient Diabetes. Working hours Mon-Sun 0800-1600hrs

Out of hours contact the on-call Diabetes Registrar via switchboard.

Referral criteria for the diabetes team can be found on the [diabetes intranet site](#).

Table 1: Monitoring capillary blood glucose (CBG) and ketone requirements appropriately throughout the inpatient stay

Current Diabetes treatment	Minimum monitoring frequency	
	Glucose	Ketones
- Unwell patients or those with unstable diabetes - All insulin treatment	Four times daily (pre-meals and pre-bed)	If CBG over 12 mmol/L
- Diet controlled - Metformin	Once daily	
Other diabetes medicines*	Twice daily	
SGLT2 inhibitor** (including if stopped on or pre-admission)	Once daily	Daily for first 3 days AND if CBG over 12mmol/L

*Pioglitazone, DPP-4 inhibitor e.g., alogliptin, GLP-1 analogue e.g., liraglutide, sulphonylurea e.g., gliclazide, acarbose, meglitinide e.g., repaglinide.

** [Safety Message 065](#) contains link to guidelines and flowchart for SGLT2 inhibitors.

SGLT2 inhibitors before procedures

SGLT2 inhibitors have recently been licensed for heart failure and chronic kidney disease as well as type 2 diabetes. For simplicity, this guidance adopts a single approach irrespective of the indication.

SGLT2 inhibitors should be stopped:

- 72 hours before planned major surgery
- As soon as possible (for example on admission) when patients are acutely unwell.
- Consider stopping 24 hours before admission for minor surgery or procedures where the person will be NBM.

SGLT-2 inhibitors (e.g., empagliflozin, dapagliflozin, canagliflozin and ertugliflozin) can cause diabetic ketoacidosis while blood sugar levels remain below 12 mmol/L. This is known as **Euglycaemic Diabetic**

Ketoacidosis (euDKA). EuDKA is life threatening and needs urgent treatment. The MHRA have issued a [Drug Safety Update](#) on this topic and the Trust [Safety Message 065](#) contains further information and links. A [Patient Information Leaflet](#) is also available if required.

Patients must have ketone levels measured daily for the first three days even if blood glucose levels are below 12 mmol/L.

If the patient had ketoacidosis during admission, the SGLT2 inhibitor should be replaced with a different medication for Type 2 diabetes which has proven cardiovascular benefits e.g., GLP-1 analogue.

Management of diabetes medicines before, during and after procedure

Patients should be reminded to bring a supply of their usual medication, device, and consumables into hospital with them in the original packaging. This helps prevent delayed and omitted doses.

There are new medicines and combinations continually being brought on the market. The following tables contain the commonly encountered agents on the hospital formulary. Check the BNF on-line for new products. If the patient is on a combination medicine, follow the guidance for each component separately. Be aware that this might involve arranging a supply of a component from pharmacy where the advice for the individual components differs.

Non-insulin diabetes medicines:				
Type of diabetes medicine	Day before procedure	On the day of procedure		Following procedure
		If procedure in the morning	If procedure in the afternoon	
Pioglitazone	Continue as usual	Take as usual	Take as usual	Continue if eating and drinking adequately
DPP- 4 inhibitor (e.g., sitagliptin, alogliptin, linagliptin)				
GLP-1 analogue (e.g., liraglutide, exenitide)				
Metformin (where no injection of contrast required, eGFR over 60mL/min/1.73m ²)				
Metformin (where having contrast injection or if eGFR less than 60mL/min/1.73m ²)	Continue as usual	Omit	Omit	Restart 48 hours after procedure
Sulphonylurea (e.g., gliclazide, glibenclamide)	Continue as usual	Omit	Omit	Restart once eating and drinking adequately
Acarbose	Continue as usual	Omit if NBM	Take as usual with breakfast	
Meglitinide (e.g., repaglinide)				
SGLT2 inhibitor (e.g., empagliflozin, dapagliflozin, canagliflozin, ertugliflozin)	Stop 72 hours before for major surgery. Consider stopping day before for minor surgery/procedure	Stop on admission and omit during inpatient stay		One week after discharge

Insulins- Check blood glucose on admission					
Examples of insulin types	Usual frequency	Days pre-procedure	Morning procedure	Afternoon procedure	Following procedure
Long-acting insulin and intermediate acting insulin:					
Long acting: E.g., Lantus® Abasaglar® Levemir® Semglee® Toujeo® Tresiba® Intermediate acting: E.g., Humulin I® Insuman Basal® Insulatard® Animal isophane	Once daily in the morning	If basal given in the evening or at night take 80% of usual dose (usual dose x 0.8) Otherwise continue as usual	Take 80% of usual dose (usual dose x 0.8)	Take 80% of usual dose (usual dose x 0.8)	Restart usual dose once eating and drinking
	Once daily in the evening or night		Not applicable	Take usual evening/night dose	
	Twice daily		Take half morning dose, take usual evening dose	Take half morning dose and usual evening dose	
Pre-mixed insulin					
E.g., Novomix 30® Humulin M3® Humalog Mix ® or 50® Insuman Comb 25® Hypurin porcine 30/70 mix®	Twice daily with meals, occasionally three times a day	Continue as usual	Take half of usual morning dose If on three times a day OMIT lunchtime dose	Take half of the morning dose with breakfast. If on three time a day OMIT lunchtime dose	Restart usual dose with evening meal. Give half dose if meal size reduced.
Basal (long acting)/bolus (short acting) insulin regimen					
Long acting (basal) insulin see above for examples Short acting (mealtime) insulin: E.g., Actrapid® Novorapid® Humalog®	Multiple daily injections	If basal given in the evening or at night give 80% of usual dose (usual dose x 0.8) Otherwise continue as usual	Basal: Give 80% of usual dose (usual dose x 0.8) + Bolus: Omit morning and lunchtime doses	Basal: Give 80% of usual dose (usual dose x 0.8) + Bolus: Take usual morning dose, omit lunchtime dose	Restart usual doses of bolus insulins with evening meal
Continuous Subcutaneous Insulin Infusion (CSII) – i.e., uses an insulin pump to deliver insulin at home					
Contact the Inpatient Diabetes team for advice when procedure is booked, or patient admitted (if unplanned admission). Patients must bring in spare consumables i.e., cannula, giving sets and cartridges					

Management during admission

Key inpatient points to remember:

1. Monitor Capillary blood glucose (CBG):
 - **Always** on admission to hospital
 - At least **four times on the day** of the procedure and as in Table 1- Monitoring blood glucose and ketone requirements appropriately throughout the inpatient stay
 - **Hourly** during anaesthesia and whilst in recovery for patients on insulin and sulphonylureas, as hypoglycaemia may be difficult to detect.
2. **Variable Rate Intravenous Insulin Infusions**
Check Capillary Blood Glucose (CBG) levels **hourly (day and night)** whilst on [Variable Rate IV Insulin Infusion](#) [Variable RIII]
 - This is important to prevent low blood glucose
 - Check ketones when CBG over 12 mmol/L
 - Standard fluid with IV insulin is 4% glucose and sodium chloride 0.18% with potassium as needed.
3. **Correct hyper(High)glycaemia if not on Variable RIII** (high blood glucose, over 12 mmol/L) unless tight glycaemic management is inappropriate e.g., frail, elderly with higher target BG range) using the flow chart in the appendix.
4. **Treat [hypo\(Low\)glycaemia as per MIL](#):**
 - ALL patients with **CBG less than 4 mmol/L**
 - Where **CBG is 4-6 mmol/L and both the following** apply to the patient:
 - Takes medicine (oral/injection) to treat diabetes
 - Has symptoms of hypo(Low)glycaemia
 - Ideally hypo(Low)glycaemia will be treated orally
 - Prescribe 75mL intravenous 20% glucose infusion if required for hypo(Low)glycaemia. This ensures prompt treatment if the patient is unconscious or unable to co-operate.
 - Responsible medical/surgical team to review for potential causes.
5. Manage nausea and vomiting to promote early return to normal diet and usual diabetes management. Avoid dexamethasone where possible.

Variable Rate Intravenous Insulin Infusion – Detailed guidance is contained within the [Variable RIII MIL](#):

- a. Use VRIII for:
 - i. patients treated with **insulin who are likely to miss more than one meal**
 - ii. people for urgent surgery with high CBG over 12mmol/L
1. **other patients where CBG is more than 12mmol/L for more than 2 hours AND the patient is nil-by-mouth**
- b. **For people with planned short starvation period** (only one missed meal)
 - i. Avoid Variable RIII wherever possible
 - ii. Manage by modification of existing diabetes medication (see table “Management of medicines before, during and after procedures”)



DO NOT STOP VARIABLE RIII DURING OPERATION/PROCEDURE UNLESS HYPO (LOW) GLYCAEMIA (as per [MIL](#))

Post-operative (procedure) care

If starting enteral feeding or TPN seek specialist diabetes advice.

Restarting oral hypoglycaemic medication

- Restart oral hypoglycaemic agents at preoperative doses once the patient is ready to eat and drink.
- Be prepared to withhold or reduce sulphonylureas (e.g., gliclazide) if the food intake is likely to be reduced.
- Metformin should only be recommenced if the renal function is back to baseline.
- SGLT2 Inhibitors can be restarted once **all** the following apply:
 - ✓ One week after discharge OR when the patient had made a full recovery after discharge (whichever is later)
 - ✓ Once eGFR is more than 45 ml/min
 - ✓ When patient is aware of the risks, signs and symptoms of euglycaemic DKA.
- Do NOT restart SGLT2 inhibitors if the patient:
 - ✗ Has active foot disease.
 - ✗ Has experienced DKA (*unless discussed and agreed with Diabetes Consultant*).
 - ✗ Has or had experienced Fournier's Gangrene.
 - ✗ Is aged 75 years and over
 - ✗ Has an eGFR 45ml/minute or less.

Restarting subcutaneous insulin for patients on insulin pre-operative (procedure)

- Once daily long-acting basal insulin should have been continued alongside the VRIII. Where this is the only regular insulin, the insulin infusion can be taken down when appropriate.
- Conversion to subcutaneous **meal-time insulin** should be delayed until the patient is able to eat and drink without nausea or vomiting.
- Make sure the subcutaneous insulin is available to be administered before stopping the variable rate insulin infusion.
- Once ready give usual meal-time insulin dose and continue the Variable RIII for one hour after the subcutaneous meal-time insulin has been administered
- Continue 2 hourly CBG monitoring for 6 hours (i.e., three occasions).
 - If then in target range, revert to appropriate monitoring as per guidance on first page
 - If out of target range continue 2 hourly CBG monitoring
- Insulin requirements may change as a result of postoperative stress, infection or altered food intake and doses may need adjusting.
- Consult the diabetes specialist team if CBG levels are outside the acceptable range (6-12mmol/L) or if a change in diabetes management is required.

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Rachel Pollard, Consultant Anaesthetist; Debbie Hempstead – Diabetes Specialist Nurse; Alistair Lumb, Rustam Rea, Garry Tan - Diabetes Consultants; Clare Crowley – Consultant Pharmacist –Medicines Safety, Maggie Hammersley – Consultant – Perioperative Medicine **Revised by (2020):** Rachel Pollard, Consultant Anaesthetist; Alistair Lumb, Diabetes Consultant; Cate Leon, Clare Crowley – Medicines Safety Pharmacists

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Peri-operative management of hyper(High)glycaemia

If the patient's capillary blood glucose (CBG) falls below 12mmol/L, continue monitoring as per guidance on page 1.

Capillary Blood Glucose (CBG) **above** 12mmol/L

Check Blood Ketone

Is the patient on Variable RIII?

NO

YES

Inform Doctor covering ward and proceed with flowchart

Refer to [Variable RIII MIL](#)

Ketones less than 1 mmol/L

Ketones between 1-3 mmol/L

Prescribe and give subcutaneous NovoRapid® (or patient's own rapid-acting insulin instead of NovoRapid®) according to patient's CBG as per table, and check CBG hourly.

Ketones above 3 mmol/L

Ketones less than 1 mmol/L

Ketones between 1-3 mmol/L

If CBG remains above 12 mmol/L 4 hours after first dose of NovoRapid®, give a second dose of NovoRapid® as per subcutaneous insulin correction dose table. Continue hourly CBG monitoring.

If CBG remains above 12 mmol/L and ketones are between 1-3 mmol/L, 4 hours after first dose of NovoRapid®, inform your doctor and start Variable RIII, Regimen A. Continue hourly CBG monitoring.

URGENT request for U+E, glucose & venous blood gas.

Start DKA treatment – refer to [MIL](#)

URGENT referral:

- Wards using CareVue – refer to inpatient DSN via EPR.
- Use of the Cerner DKA Power Plan will alert Inpatient Diabetes Team
- Out of hours: Bleep Diabetes SpR via Switchboard

NBM

Eating & Drinking

If CBG remains above 12 mmol/L, 4 hours after second dose of NovoRapid®, inform your doctor and start Variable RIII as per [MIL](#)

If CBG remains above 12 mmol/L, 4 hours after second dose of NovoRapid®, inform your doctor and contact Adult Diabetes Team for advice:

- Refer to Inpatient DSN via EPR
- Out of hours: Bleep Diabetes SpR via Switchboard

If CBG remains above 12 mmol/L, and ketones are between 1-3 mmol/L 4 hours after starting Variable RIII, escalate as per the [Variable RIII MIL](#) inform your doctor and contact Adult Diabetes Team for advice:

- In hours: Refer to Inpatient DSN via EPR
- Out of hours: Bleep Diabetes SpR via Switchboard

Subcutaneous Insulin Correction Dose Table

CBG (mmol/L)	Insulin units
12 – 14.9	1
15 – 17.9	2
18 – 20.9	3
21 – 23.9	4
24 – 27	5
Above 27	6 and contact Diabetes Team