

## Guidelines for Managing Insulin Pumps in Hospitalised Patients

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### Overview of insulin pumps/Continuous Subcutaneous Insulin Infusion therapy (CSII)

CSII is used in people with type 1 diabetes to improve glucose control and/or reduce the risk of hypoglycaemia. CSII involves a continuous “basal” insulin infusion (the rate usually varies over the 24 hour period), in combination with meal-time bolus insulin. Both basal and bolus insulin are delivered by an insulin pump, which infuses short acting insulin (either novorapid or humalog lispro) through a catheter attached to a fine bore subcutaneous cannula (typically sited in the abdomen). The basal infusion rates are pre-programmed by the patient (or their diabetes nurse/doctor) and will continue to run until the insulin cartridge is empty; boluses are delivered under the patient’s direction, to cover food intake and to correct for high blood glucose levels. **People on CSII do NOT take any long acting insulin so if there is any interruption to insulin delivery (e.g. if the cannula is blocked or dislodged) hyperglycaemia and then ketoacidosis can develop very quickly**, unless the problem is identified and rectified, e.g. by re-siting the cannula, changing the tubing, or starting alternative insulin such as an intravenous infusion. The pump should only be adjusted by its owner (who has received extensive training) or a member of the Diabetes team in possession of the correct knowledge and skills. If the patient is unable to manage their pump, and no specialist advice immediately available, remove pump and start a conventional intravenous insulin infusion or SC basal bolus insulin regimen: see below. **Insulin pumps are expensive and steps should be taken to ensure they are not lost when a patient is admitted to hospital.** If a patient is unconscious or incapacitated ask a relative to look after the pump, store the pump in the patient’s medication locker if this is not possible. Document the location of the pump in the medical notes.

**Please discuss all pump patients with a member of the Diabetes team: contact Diabetes specialist nurse team (ext. 52963, bleep 0989) or Diabetes consultant of the day via the Diabetes smartphone (via switchboard)**

## 1. Pump Management for DKA and unconscious/incapacitated patient

(See appendix 1 for summary)

**It is usually best for the patient to continue to self-manage their diabetes with the pump except:**

- If unconscious, confused or incapacitated e.g. if illness/pain prevents self-management
- If undergoing major procedures under General Anaesthetic lasting >2 hours
- Diabetic ketoacidosis (DKA)

### **The unconscious or incapacitated patient**

If patient unable to self-manage their pump (i.e. unconscious or incapacitated): remove cannula/detach pump. **Place pump in a safe place and document** - ask a relative to take the pump home for safe keeping if possible. Immediately start alternative insulin e.g. variable rate IV insulin (see Staffnet: “Guidelines for managing blood glucose in adults for Perioperative/fasting/unstable diabetes”) or sub cut insulin (see below: “alternatives to CSII”) unless hypoglycaemic. If hypoglycaemic, start alternative insulin *once* hypoglycaemia is treated. CSII can be restarted once patient recovered (see below: “stopping and restarting CSII”).

### **Diabetic ketoacidosis (DKA):**

The altered tissue perfusion in DKA affects insulin absorption, making CSII unreliable. CSII should be temporarily discontinued in patients presenting in DKA: remove cannula/detach pump. For further management, follow standard DKA protocol (on Staffnet). CSII can be restarted once DKA treated (see below: “stopping and restarting CSII”). **All patients should have specialist diabetes input before discharge** to review CSII settings which may need adjusting to prevent subsequent DKA and to re-enforce “sick day rules”.

## 2. Pumps and radiology investigations

The pump must be suspended and removed prior to MRI scanning, and should not be taken into the scanning room. Pump manufacturers also advise removing the pump prior to CT scan. For plain x-rays, there is no need to remove the pump, unless its position obscures the area of interest. The patient should reconnect the pump immediately following any radiological investigation. Pumps can be safely suspended/removed for up to an hour at a time without needing alternative insulin. A correction bolus may be needed on reconnecting the pump (see below: “starting and stopping CSII”).

### **Pump management for procedures**

(see appendix 2 for summary)

Fasting is not usually a problem for pump users, so being “nil by mouth” does *not necessarily* mean removal of the pump or need for IV insulin. Although the insulin pump is a “device”, most patients will be able to manage their pump post sedation/anaesthesia as safely as any patient using standard insulin therapy (MDI: multi-dose injections, i.e. an insulin pen) and are more likely to achieve stable glucose control. Hence it is not necessary to admit day-case patients overnight for variable rate IV insulin infusion simply because they manage their diabetes by CSII. However, some patients will feel unable to self-manage post-procedure and should discuss this with their diabetes pump team in advance; they may require alternative management such as prior conversion back to MDI insulin (see below: “alternatives insulin regimens”), or hospital admission. Pre-procedure, if continuing on CSII, patient should ensure SC pump cannula is sited away from operative site and accessible to healthcare team.

#### **Major surgical procedures (>2 hours duration and/or unlikely to eat/drink within 2-3 hrs post-op):**

Patient removes pump and hands over to family/friend for safe-keeping. Once pump removed, start variable rate IV insulin infusion immediately (use “Guidelines for managing blood glucose in adults for perioperative/fasting/unstable diabetes” on Staffnet). CSII can be restarted once patient recovered and able to manage pump (see: “stopping and restarting CSII”).

#### **Minor procedures (<2 hours and expected to eat/drink within 2-3hrs) under general anaesthetic or sedation:**

Patient should ensure blood glucose in the acceptable range pre-procedure i.e. 4-12mmol/l (if not, start variable rate IV insulin as for major surgical procedures using “Guidelines for managing blood glucose in adults for perioperative/fasting/unstable diabetes” on Staffnet). Whilst on CSII (or VRII), the healthcare team must monitor patient’s capillary glucose levels **at least hourly**; start VRII insulin infusion if any reading >12 mmol/l. Post procedure, the patient on CSII should also use a correction bolus if capillary glucose >10 mmol/l.

If the pump alarms during the procedure, do not attempt to rectify; monitor blood glucose every 30 mins and start IV insulin if >12mmol/l. If the pump alarm becomes intrusive, remove pump plus cannula, allow pump to continue to run (the amount of insulin “lost” is minimal) and store safely in a suitable receptacle. **Do not misplace the pump!**

If variable rate IV insulin used during procedure, see below for transferring back to CSII (“stopping and restarting CSII”); a correction bolus is less likely to be required in this situation.

#### **Minor procedures without sedation:**

The insulin pump can be continued with regular glucose monitoring as for any person with diabetes.

#### **4. Pregnant women with Type 1 Diabetes on CSII admitted in labour**

(See appendix 3 for summary)

Women may continue to use their pump during labour or elective caesarean section provided their blood glucose levels are within the **target range of 4 – 7 mmol/L** and patient/partner able to manage insulin pump. Insert IV cannula in case variable rate IV insulin/dextrose is required. Measure and record blood glucose levels hourly using approved hospital blood glucose meter. Patient should continue her usual basal infusion rates, aiming to keep blood glucose levels between 4 - 7 mmol/L. Bolus correction doses (**see below**) should be made by the patient via the insulin pump to maintain target blood glucose levels 4 to 7mmol/l.

**If patient/partner unable to manage the pump, or if blood glucose rising >7mmol/l for >2 hours despite correction doses (see below and appendix 3), switch from CSII (remove pump and place in suitable container; no need to turn off pump nor to remove SC cannula) to standard IV insulin/dextrose infusions: see Staffnet “Guideline for the management of blood sugars for women with diabetes in labour”.**

##### **Correction doses during labour:**

If blood glucose greater than 7mmol/L, advise a correction bolus dose, aiming for a blood glucose of 5mmol/L, using a patient’s personal correction dose (also known as “ISF” = insulin sensitivity factor) or if not known, calculate 1 unit of insulin to reduce blood glucose levels by 2.5mmol/L e.g. if blood glucose 10.0 mmol/L, give 2 units bolus. After 1 hour, if that correction bolus is ineffective i.e. blood glucose still above 7.0 mmol/L, give another correction bolus dose (using the same calculation advice as above). After a further ½ hour, if blood glucose levels still not below 7.0 mmol/L then switch to IV insulin as above.

##### **Hypoglycaemia during labour:**

If blood glucose < 4.0mmol/L treat hypoglycaemia as per hospital policy. Suggest using either glucose tablets or glucose in water as quick-acting carbohydrate, in the first instance.

If the woman has **more than one** hypoglycaemic event, ask her to reduce her basal rate on the pump to 50% using a temporary basal rate setting. The basal rate setting should then continue as this throughout the remainder of the labour, and should not be increased back to the full 100% basal rate.

##### **Post delivery**

Towards the end of pregnancy, in conjunction with the diabetes team, the patient should have made a record of her planned post-delivery basal profile: typically the same as her pre-pregnancy basal profile, or if pump started during pregnancy, 50% of pre-delivery basal rates. This post-partum basal profile can be entered into the pump memory in advance, prior to labour, ready for post-delivery. If breastfeeding, rates may need reducing by a further 10-20%.

**Inform Diabetes Specialist antenatal team of any woman using pump therapy admitted to hospital.**

## 5. Hypoglycaemia in patients on CSII

### **Patients able to manage their pump:**

Treat hypoglycaemia with rapid acting carbohydrates (e.g. dextrose tablets, Lucozade). Unlike patients on long acting insulin, follow-up with long acting carbohydrates is *not usually* needed. Pump infusion rates may need adjustment, especially if history of recurrent hypoglycaemia: **consult diabetes team**.

### **The unconscious/incapacitated patient:**

Initial treatment of hypoglycaemia is as standard hospital policy. If persistent hypoglycaemia, remove cannula and pump. Once normoglycaemic, re-start insulin, either CSII if patient now alert and able to self-manage, or alternative regimen (see below); this is needed to prevent the development of ketoacidosis.

## 6. Stopping and re-starting CSII

### **Stopping:**

The pump/tubing may be removed leaving the SC cannula in place, unless cannula site is infected or in surgical field. It is important not to cut pump tubing or disconnect the pump from the tubing as the remaining insulin in the tube may infuse quickly risking hypoglycaemia. Place the pump into a suitable container and do not attempt to turn off; the amount of insulin “lost” into the container will be minimal. Document where the pump is stored or to whom it has been given. The insulin in a pump is very short acting therefore **alternative insulin must be started immediately i.e. within an hour** (see below) to avoid risk of ketoacidosis. If the patient is able to do so, he/she should make a record of their current basal and bolus settings, as this data may be lost if the pump is stopped for any significant length of time.

### **Restarting:**

If pump has been only temporarily removed or suspended (i.e. no IV insulin infusion has been required) and SC cannula still in position, patient should perform a “fixed prime” to refill the dead space within the tubing, then simply reconnect pump, and restart basal infusion. If capillary glucose >10mmol/l, he/she should bolus a correction dose once pump re-connected, using their personal correction ratio or ISF (insulin sensitivity factor). If transferring from IV insulin infusion: ask patient to insert new cannula and re-start pump after performing a fixed prime (there is no need to wait until a meal); wait 30 minutes before discontinuing IV insulin.

If transferring from subcutaneous insulin: patient inserts new cannula, performs a fixed prime and re-starts pump. Pump settings may need to be re-programmed. Patient may need to temporarily reduce background insulin infusion rate (e.g. drop to a 70% temporary basal rate for 24hrs) while long acting subcutaneous insulin is still active - increased glucose monitoring may be required. No further sub cut insulin doses should be required once CSII restarted. Contact pump team via diabetes centre for further advice.

## **7. Alternative insulin regimens for hospitalised patients unable to continue on CSII**

All the guidelines below can be found in the Diabetes section of Clinical Guidelines on Staffnet.

The appropriate alternative insulin regimen depends on the clinical scenario:

For **patients with DKA**, use a fixed rate IV insulin infusion as per “Guidelines for Diabetic ketoacidosis”.

For **patients who are fasted and/or have unstable glucose levels** (but not DKA), use a variable rate IV insulin infusion (VRIII) as per “Guidelines for managing blood glucose in adults for perioperative/fasting/unstable diabetes”.

For **women in labour**, use “Guideline for the management of blood sugars for women with diabetes in labour”.

For **patients who are unable to self manage their insulin pump, but do not have unstable blood glucose levels** and are not NBM, a basal-bolus insulin regimen is preferable to VRIII.

Calculate appropriate starting doses based on the patient’s recent (e.g. 7day) average total daily insulin dose (TDD); this information can be obtained by the patient or DSN from the pump.

Prescribe 50% of the TDD as once daily levemir insulin.

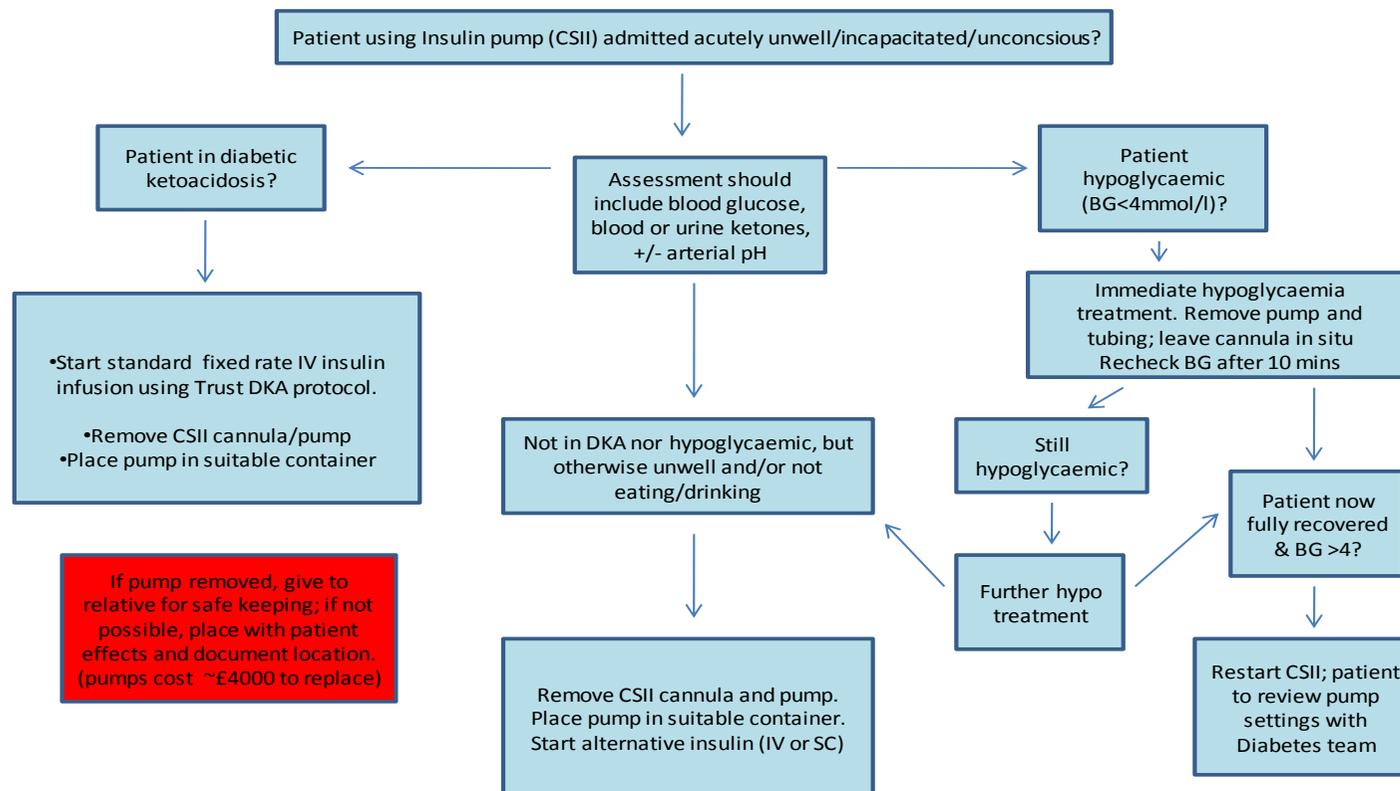
For meal-time insulin (novorapid) dose: 50% of TDD/ 3 plus a safety adjustment (e.g. minus 30%) to minimise risk of hypoglycaemia. Titrate doses according to response. Alternatively, if the patient is able to continue to carbohydrate count, prescribe a variable novorapid dose for self administration.

e.g. a patient’s average pump insulin TDD for last 7 days is 48 units/day.

50% of 48 units = 24 units as once daily levemir insulin.

50% of 48units/3 = 8 units of novorapid insulin with each meal: after safety adjustment = 6 units

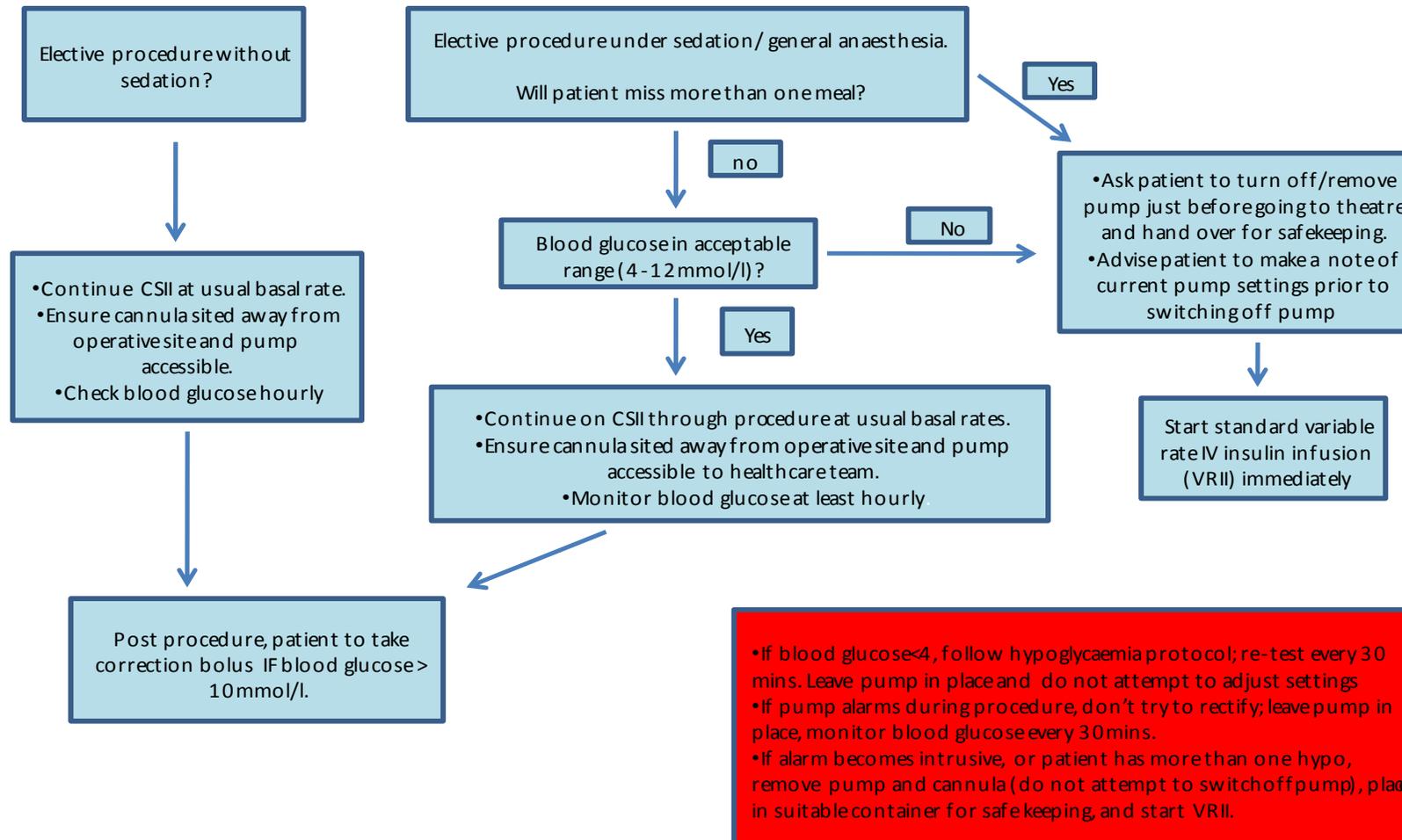
## Appendix 1: Emergency admissions and pump management



**Please discuss all pump patients with a member of the Diabetes team.**

**Contact Diabetes specialist nurse team (ext. 52963, bleep 0989) or diabetes doctors via Diabetes smartphone.**

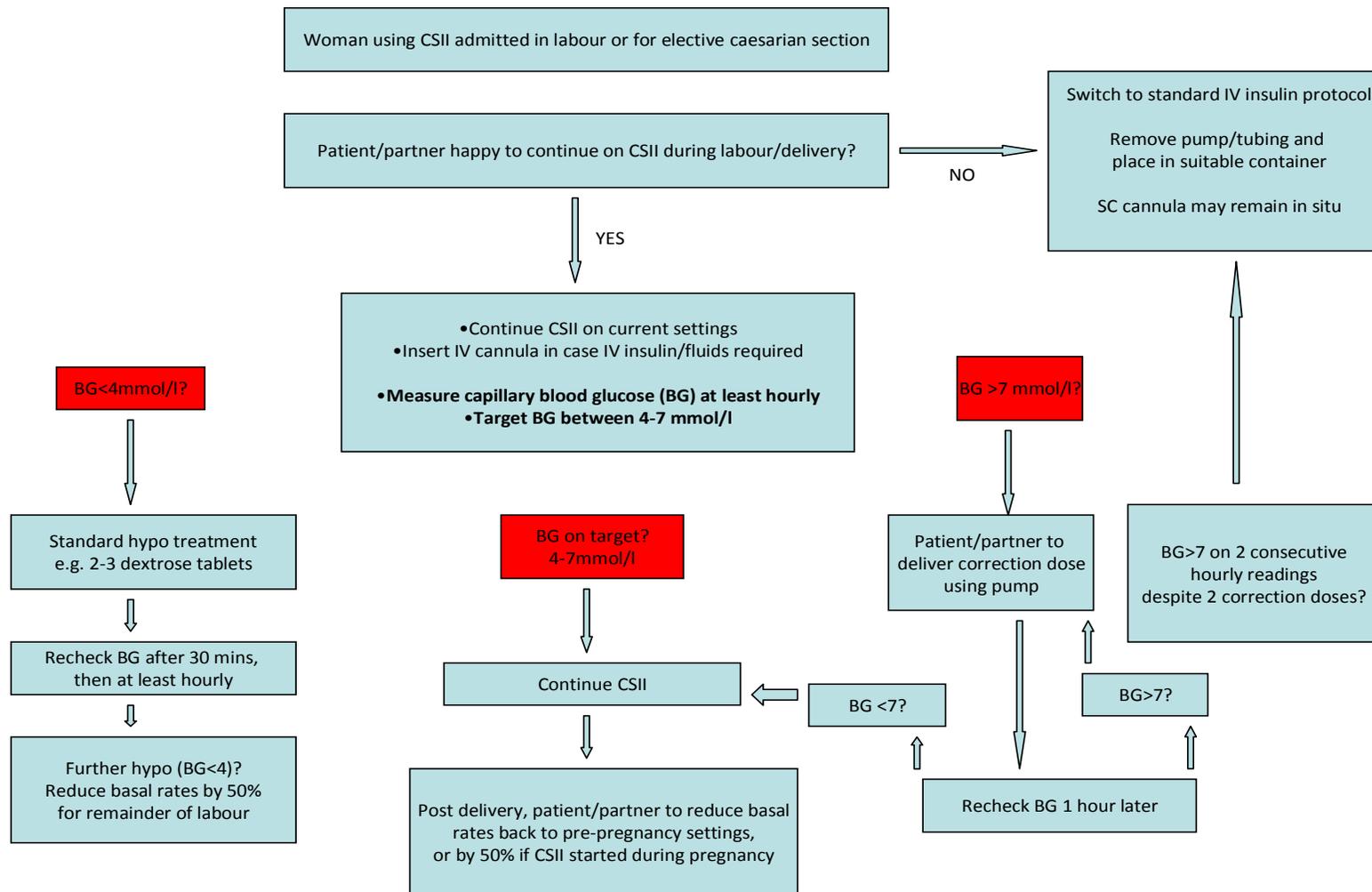
## Appendix 2: Pump management for elective procedures under sedation or anaesthesia



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### Appendix 3: Guidance for management of insulin pumps (CSII) during labour or for elective caesarean section



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Contact Diabetes specialist nurse team (ext. 52963, bleep 0989) or diabetes doctors via Diabetes smartphone