

East of England Paediatric Diabetes Network

Guidelines

Management of Children and Adolescents with Diabetes Requiring Elective or Emergency Surgery and Other Procedures



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Management of Children and Adolescents with Diabetes Requiring Elective or Emergency Surgery and Other Procedures

1 Background

During surgery or other procedures under sedation or anaesthesia, the aim is to maintain normal glycaemic control with optimal hydration while preventing hypoglycaemia.

These guidelines are based on the International Society of Paediatric and Adolescent Diabetes (ISPAD) clinical practice consensus guidelines^{1,2}. Modifications have been made in the light of recently published adult guidelines³ and from the guidelines published in the anaesthetic literature⁴.

2 Purpose & Scope

- To be available in all departments within East of England Paediatric Diabetes Network.
- To ensure quality of patient care is standardised but individual units may make adjustments to fit with local practice.

3 Glycaemic Targets for Surgery

In adult studies it has been shown that sub optimal glycaemic control before surgery has a significant impact on the risk of post-operative infection^{5,6,7,8}. Similarly near normal glycaemic control (4.6-6.0 mmol/L) reduced the mortality and morbidity in patients who required post-operative intensive care and mechanical ventilation after surgery⁹. Enhanced catabolism stimulated by surgical trauma can lead to hyperglycaemia and even ketoacidosis¹⁰. Because the data in adults show adverse effects of hyperglycaemia, and support tight blood glucose (BG) levels in patients undergoing surgery, ISPAD clinical practice consensus guidelines¹ aim BG levels between 5 and 10 mmol/L during surgical procedures in children. Other studies have also demonstrated that near normal BG levels (5.5 to 8.3 mmol/L) can be readily achieved by intravenous insulin infusion in the peri-operative period in children and adolescents with type 1 diabetes¹¹.

4 General Recommendations

4.1 Planning

It is recommended that children undergoing surgery (especially planned surgery or procedure) be informed as early as possible to the diabetes team so that there is opportunity to optimise the metabolic control to improve outcomes and prevent complications (see [appendix 1](#)). Careful planning is essential and key to successful surgery and outcome.

- Patient and parents should be involved in the planning process.
- Paediatric diabetes team should be involved during planned surgery as soon as the procedure is planned.
- Paediatric diabetes team should help patient and parents to improve diabetes control before surgery.
- Paediatric diabetes team should make a written plan regarding peri-operative diabetes management or choose the appropriate guideline sheet to the patient's insulin regimen, flow chart 1-8 using the appropriate section on page 2.
- Patient/parents should be instructed to bring their own insulin to hospital so that the child can be restarted on the usual insulin as soon as possible.
- Ward staff should ensure that timing and choice of food and snacks is appropriate.
- Patients with diabetes should be the first case on the surgical list to minimise the starvation period.

- Routine overnight admission before surgery is not necessary.
- Paediatric diabetes team should continue to be involved during patient's hospital stay.

4.2 Pre-operative adjustment of insulin

- For commonly used insulin preparations and insulin regimens see appendix 2.
- Patient should continue their basal insulin, and generally dose reduction in the preceding evening is not necessary.
- Consider reducing the preceding evening's basal insulin only up to 20% if there is a pattern of low capillary blood glucose (CBG) values in the preceding 3 to 4 mornings (see appendix 3).
- Parents/child should be provided with appropriate information leaflet regarding pre-operative adjustment of insulin (see appendix 4 & 5).

4.3 Capillary blood glucose monitoring

- CBG should be monitored and recorded hourly pre-operatively and in the immediate post-operative period.
- It is recommended that during the procedure/surgery the CBG should be measured every 30 minutes especially in young children and in those undergoing major surgery.

4.4 Emergency surgery

- There is no opportunity for pre-admission planning in children having emergency surgery. The patient may have taken their normal insulin doses and therefore intravenous fluids should be started and the CBG should be closely monitored to prevent the risk of hypoglycaemia.
- Check weight, serum electrolytes, capillary gases, and blood ketones before anaesthesia.
- If ketoacidosis is present, follow BSPED guidelines for management of ketoacidosis and delay surgery until circulating volume and deficits are corrected.
- If there is no ketoacidosis start intravenous insulin infusion as for elective surgery (see flow chart 5) and continue intravenous fluids.

4.5 Insulin pump therapy/continuous subcutaneous insulin infusion

- **It is recommended that if possible children on Continuous Subcutaneous Insulin Infusion (CSII) should continue on pumps during the surgery/procedure.**
- For minor surgery (see page 5), pump therapy should be continued and patient should remain on their basal rates.
- For procedures requiring very short anaesthesia (use flow chart 6), CSII can be discontinued and CBG monitored before and after the procedure.
- If the anaesthetic team is not comfortable using insulin pump during surgery then such children can be managed using the variable rate intravenous insulin infusion (VRIII) guideline (use flow chart 5).
- If the CSII has been discontinued and replaced with VRIII, the CSII should be restarted once the patient is ready to eat and VRIII should be discontinued 10 minutes after the first mealtime bolus, using pump bolus wizard.

4.6 Safer administration of insulin

Errors in the administration of insulin are very common. A wide range of insulin preparations and devices increase the risk of errors. All staff involved in prescribing and administration of insulin should have appropriate training and

follow national patient safety agency rapid response report on safer administration of insulin¹².

- All regular and single insulin (bolus) doses are measured and administered using an insulin syringe or commercial insulin pen device. **Intravenous syringes should never be used for insulin administration.**
- The term 'units' is used in all contexts. Abbreviations, such as 'U' or 'IU', should not be used while prescribing.
- An insulin syringe must be used to measure and prepare insulin for an intravenous infusion. Intravenous infusions are administered in 50 ml intravenous syringes.
- When an intravenous insulin infusion is used, fluids containing dextrose should be infused continuously. If insulin infusion is stopped, there will be no insulin in the circulation after 3 to 5 minutes¹³ leading to immediate catabolism.
- The first choice of fluids should be 0.45% saline with 5% glucose. If CBG drops below 5 mmol/L despite adjustment in the VRIII then infuse 0.45% saline with 10% glucose.
- A training programme should be put in place for all healthcare staff expected to prescribe, prepare and administer insulin. NHS Diabetes has launched new e-learning module on the safe use of intravenous insulin infusions¹⁴.
- Ward nurse responsible for the care of child during admission should go through the suggested check list before surgery (see appendix 6).

5 Definitions

These definitions (1, 2 and 3) are adopted from recently published document 'Management of adults with diabetes undergoing surgery and elective procedures', (www.diabetes.nhs.uk).

1. **Variable rate intravenous insulin infusion:** In this document previously used term '*Sliding Scale*' for intravenous insulin has been replaced by the term '*Variable Rate Intravenous Insulin Infusion*' (VRIII). This is required during prolonged procedures (more than one missed meal), complex or abdominal surgery.
2. **Minor surgery:** If the starvation period is short (only one missed meal) the patient can be managed without intravenous insulin.
3. **Major surgery:** If the starvation period is likely to omit more than one meal, VRIII will be required (use flow chart 5).
4. **Procedures requiring very short anaesthesia or sedation:** Children who require anaesthesia/sedation (up to 30 minutes) for procedures and when rapid recovery is anticipated (use flow chart 6).

6 Insulin sensitivity factor (ISF) or Insulin correction factor (ICF)

ISF helps to calculate the dose of rapid acting insulin required to correct high blood glucose above 12 mmol/L. ISF can be calculated by using the rule of 100 (see example below). The diabetes team should calculate ISF before surgery.

Rule of 100:

Divide 100 by total daily dose, e.g. if total daily dose is 50 units ($100 \div 50 = 2$). Means 1 unit of rapid acting insulin (see appendix 2) would drop CBG by 2 mmol/L. (i.e., ISF = 2). Aim to drop CBG to 10 mmol/L.

Example:

If CBG= 16, target CBG =10 and ISF=2

$(\text{Actual CBG} - \text{Target CBG}) \div \text{ISF}$

$(16 - 10) \div 2, 6 \div 2 = 3$

Patient would need 3 units of rapid acting insulin to drop CBG from 16 to 10mmol/L.

Always check CBG 2 hours after the correction dose of rapid acting insulin

Flow Chart 1

Peri-operative Management for Twice Daily Mixed (biphasic) Insulin Regimen (Minor Surgery)

The day before surgery

Administer usual doses of insulin (see appendix 3)
Some patients receive 3 injections of "Mix Insulin" per day they can also be managed using this flow chart

On the day of surgery

For major surgery use VR111 (use flow chart 5)

(Morning operation scheduled 08:00 to 09:00 h)



Nil by mouth (omit breakfast)
On admission check CBG, cannulate
Give 50% of the usual morning dose S/C as intermediate insulin (Insulatard®)
Commence 5% dextrose in 0.45% saline
If CBG < 5mmol/L infuse 10% dextrose in 0.45% saline. Measure CBG hourly, target range (5-10 mmol/L)
If CBG > 12 mmol/L correct with rapid acting insulin (Humalog®, NovoRapid®) S/C using ISF (see page 5)

(Afternoon operation scheduled 13:00 to 14:00 h)



Allow breakfast but omit lunch
On admission check CBG, cannulate
Give 50% of the usual morning dose of mix insulin S/C
Commence 5% dextrose in 0.45% saline at least 2 hours after breakfast or no later than midday
If CBG < 5 mmol/L infuse 10% dextrose in 0.45% saline
Measure CBG 2 hour after breakfast and then hourly
If CBG > 12 mmol/L correct with rapid acting insulin (Humalog®, NovoRapid®) S/C using ISF (see page 5)

During surgery

Measure CBG half hourly, and continue 5% dextrose in 0.45% saline. If CBG < 5 mmol/L infuse 10% dextrose in 0.45% saline
Caution: Make sure 10% dextrose in 0.45% saline is available in the theatre. **To prepare 500ml 10% dextrose 0.45% saline - withdraw 50 ml fluid from a 500 ml bag of 5% dextrose 0.45% saline and add 50 ml of 50% glucose.**

After surgery

Recovery room: Monitor CBG half hourly and continue IV 5% dextrose infusion in 0.45% saline. If CBG < 5 infuse 10% dextrose in 0.45% saline

Ward: Measure CBG hourly and continue IV 5% dextrose in 0.45% saline till the child is well enough to tolerate orally

CBG > 12 mmol/L

Yes

No

Give rapid-acting insulin (Humalog® or NovoRapid®) S/C (maximum 2 hourly) to correct CBG > 12 mmol/L using ISF (see page 5)

Aim to keep CBG 5-10 mmol/L

If CBG between 5-10 mmol/L continue intravenous 5% dextrose in 0.45% saline until patient tolerating orally

If CBG < 4 mmol/L and not tolerating orally infuse IV 10% dextrose (1-2ml/kg), otherwise offer Lucozade (20ml) or alternative sugary drink or Glucogel

The dinner or evening dose of insulin is given as usual. If the child is fully recovered consider discharge

Flow Chart 2

Peri-operative Management for Basal Bolus Insulin Regimen (Minor Surgery)

For definition of basal bolus insulin regimen see appendix 2

The day before surgery

Children should receive basal insulin as usual; consider reducing the evening basal insulin if there is a pattern of low CBG in the preceding 3 to 4 mornings (see appendix 3)

On the day of surgery

For major surgery use VR111 (use flow chart 5)
If patient takes basal insulin in the morning then give the usual dose on the morning of the procedure
If patient takes basal insulin in the morning and in the evening (see appendix 3)

Withhold usual morning dose of rapid acting insulin

If CBG > 12 mmol/L correct with rapid acting insulin (Humalog®, NovoRapid®) S/C using ISF (see page 5)

Caution: If the patient has forgotten to take basal insulin in the evening before the procedure then administer 50% of the basal insulin dose in the morning. In this situation the evening basal insulin on the day of procedure would also need to be reduced by 50%

(Morning operation scheduled 08:00 to 09:00 h)

Nil by mouth (omit breakfast). On admission check CBG, cannulate

Commence 5% dextrose in 0.45% saline
If CBG < 5mmol/L infuse 10% dextrose in 0.45% saline. Measure CBG hourly, target range (5-10 mmol/L)

(Afternoon operation scheduled 13:00 to 14:00 h)

Allow breakfast and give 50% of the usual rapid acting insulin S/C
On admission check CBG, cannulate. Omit lunch
Commence 5% dextrose in 0.45% saline at least 2 hours after breakfast or no later than midday
If CBG < 5mmol/L infuse 10% dextrose in 0.45% saline. Measure CBG 2 hour after breakfast and then hourly

During surgery

Measure CBG half hourly, and continue 5% dextrose in 0.45% saline. If CBG < 5 mmol/L infuse 10% dextrose in 0.45% saline

Caution: Make sure 10% dextrose in 0.45% saline is available in the theatre. **To prepare 500ml 10% dextrose 0.45% saline - withdraw 50 ml fluid from a 500 ml bag of 5% dextrose 0.45% saline and add 50 ml of 50% glucose.**

After surgery

Recovery room: Monitor CBG half hourly and continue IV 5% dextrose infusion in 0.45% saline. If CBG < 5 infuse 10% dextrose in 0.45% saline

Ward: Measure CBG hourly and start oral intake or continue IV 5% dextrose in 0.45% saline depending on the child's condition

Yes

CBG > 12 mmol/L

No

Give rapid-acting insulin (Humalog® or NovoRapid®) S/C (maximum 2 hourly) to correct CBG > 12 mmol/L using ISF (see page 5)
Aim to keep CBG 5-10 mmol/L

If CBG between 5-10 mmol/L continue intravenous 5% dextrose in 0.45% saline until patient tolerating orally
If CBG < 4 mmol/L and not tolerating orally give IV 10% dextrose (1-2ml/kg), otherwise offer Lucozade (20ml) or alternative sugary drink or Glucoquel

The dinner or evening dose of insulin is given as usual. If the child is fully recovered consider discharge

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Flow Chart 3

Peri-operative Management for 3 Injections a Day Insulin Regimen (Minor Surgery)

Children on 3 injections a day receive Mix (biphasic) insulin with breakfast, rapid acting insulin at tea time and basal insulin in the evening

The day before surgery

Patient should receive the evening basal dose of insulin as usual; consider reducing the evening basal insulin dose only if there is a pattern of low CBG in the preceding 3 to 4 mornings (see appendix 3)

On the day of surgery

For major surgery use VRIII (use flow chart 5)

(Morning operation scheduled 08:00 to 09:00 h)

Withhold usual morning dose of mix insulin

Caution: If the patient has forgotten to take basal insulin in the evening before the procedure then administer 50% of the basal insulin dose in the morning. In this situation the evening basal insulin on the day of procedure would also need to be reduced by 50%

Nil by mouth (omit breakfast). On admission check CBG, cannulate

If CBG > 12 mmol/L give rapid acting insulin (Humalog®, NovoRapid®) S/C dose using ISF (see page 5)

Commence 5% dextrose in 0.45% saline. If CBG < 5 mmol/L infuse 10% dextrose in 0.45% saline. Measure CBG hourly, target range (5-10 mmol/L)

(Afternoon operation scheduled 13:00 to 14:00h)

Allow breakfast but omit lunch. On admission check CBG, cannulate

Give 50% of the usual Mix insulin dose S/C

Commence 5% dextrose in 0.45% saline at least 2 hours after breakfast or no later than midday

If CGB < 5mmol/L infuse 10% dextrose in 0.45% saline. Measure CBG 2 hour after breakfast and then hourly

If CBG > 12 mmol/L correct with rapid acting insulin (Humalog®, NovoRapid®) S/C using ISF (see page 5)

During surgery

Measure CBG half hourly, and continue 5% dextrose in 0.45% saline. If CBG < 5 mmol/L infuse 10% dextrose in 0.45% saline.

Caution: Make sure 10% dextrose in 0.45% saline is available in the theatre. **To prepare 500ml 10% dextrose 0.45% saline - withdraw 50 ml fluid from a 500 ml bag of 5% dextrose 0.45% saline and add 50 ml of 50% glucose.**

After surgery

Recovery room: Monitor CBG half hourly and continue IV 5% dextrose infusion in 0.45% saline. If CBG < 5 infuse 10% dextrose in 0.45% saline

Ward: Measure CBG hourly and start oral intake or continue IV 5% dextrose in 0.45% saline depending on the child's condition

CBG > 12 mmol/L

Yes

No

Give rapid-acting insulin (Humalog® or NovoRapid®) S/C (maximum 2 hourly) to correct CBG > 12 mmol/L using ISF (see page 5)

Aim to keep CBG 5-10 mmol/L

If CBG between 5-10 mmol/L continue intravenous 5% dextrose in 0.45% saline until patient tolerating orally

If CBG < 4 mmol/L and not tolerating orally give IV 10% dextrose (1-2ml/kg), otherwise offer Lucozade (20ml) or alternative sugary drink or Glucogel

The dinner or evening dose of insulin is given as usual. If the child is fully recovered consider discharge

Flow Chart 4

Peri-operative Management for Children on Insulin Pump Therapy (Minor Surgery)

The day before surgery

See appendix 4

On the day of surgery

Secure the insulin infusion site to prevent dislodgement

For major surgery or if the surgical/ anaesthetic team not comfortable using insulin pump then follow VR111 (use flow chart 5)

(Morning operation scheduled 08:00 to 09:00 h)

Yes

Nil by mouth (omit breakfast). On admission check CBG, cannulate

Continue S/C insulin delivery via insulin pump at the usual basal rates

Commence 5% dextrose in 0.45% saline

If CBG < 5 mmol/L infuse 10% dextrose in 0.45% saline

If CBG > 12 mmol/L correct with correction bolus using pump's bolus wizard

Measure CBG hourly, target range (5-10 mmol/L)

(Afternoon operation scheduled 13:00 to 14:00 h)

Yes

Allow breakfast and give bolus insulin as usual using pump's bolus wizard

On admission check CBG, cannulate. Omit lunch

Continue S/C insulin delivery via insulin pump at the usual basal rates

Commence 5% dextrose in 0.45% saline at least 2 hours after breakfast or no later than midday

If CBG < 5 mmol/L infuse 10% dextrose in 0.45% saline

Measure CBG hourly, target range (5-10 mmol/L)

During surgery

Measure CBG half hourly, and continue 5% dextrose in 0.45% saline. If CBG < 5 mmol/L infuse 10% dextrose in 0.45% saline.

Caution: Make sure 10% dextrose in 0.45% saline is available in the theatre. **To prepare 500ml 10% dextrose 0.45% saline - withdraw 50 ml fluid from a 500 ml bag of 5% dextrose 0.45% saline and add 50 ml of 50% glucose.**

After surgery

Recovery room: Monitor CBG half hourly and continue IV 5% dextrose infusion in 0.45% saline. If CBG < 5 infuse 10% dextrose in 0.45% saline

Ward: Measure CBG hourly and start oral intake or continue IV 5% dextrose in 0.45% saline depending on the child's condition

CBG > 12 mmol/L

Yes

Give correction bolus using pump's bolus wizard

Aim to keep CBG 5-10 mmol/L

No

If CBG between 5-10 mmol/L continue intravenous 5% dextrose in 0.45% saline until patient tolerating orally

If CBG < 4 mmol/L and not tolerating orally give IV 10% dextrose (1-2ml/kg), otherwise offer Lucozade (20ml) or alternative sugary drink or Glucogel

The dinner or evening dose of insulin is given as usual. If the child is fully recovered consider discharge

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Flow Chart 5

Peri-operative management for Children Undergoing Major Surgery Requiring VRIII

Patients with diabetes requiring variable rate intravenous insulin infusion (VRIII)

VRIII will be required if the starvation period is likely to be more than one meal, or during emergency surgery
Planned major surgery should be **First Case** on the morning list

The day before surgery

Administer usual doses of insulin (see appendix 3)

On the day of surgery

For planned surgery nil by mouth, omit breakfast and **Do Not Give** any insulin in the morning
For emergency surgery manage appropriately (see page 4)

Administer insulin infusion and maintenance fluids on the morning of procedure

Add soluble insulin 50 units to 50 ml sodium chloride 0.9%, making a solution of 1 unit insulin/ml

Caution: only use insulin syringe to measure and prepare insulin for an intravenous infusion (see page 4). Start infusion according to CBG.

To prepare 500ml 10% dextrose 0.45% saline - withdraw 50 ml fluid from a 500 ml bag of 5% dextrose 0.45% saline and add 50 ml of 50% glucose.

Infusion rate

CBG

0.025 ml/kg/h (i.e. 0.025 Units/kg/h)	<6-7mmol/L
0.05 ml/kg/h (i.e. 0.05 Units/kg/h)	8-12 mmol/L
0.075 ml/kg/h (i.e. 0.075 Units/kg/h)	12-15 mmol/L
0.1 ml/kg/h (i.e. 0.1Units/kg/h)	>15 mmol/L

Monitor CBG half hourly

If CBG **5-6** mmol/L do not stop insulin as this will cause rebound hyperglycaemia, adjust the VRIII as above

If CBG **< 5** despite adjustment of VRIII, infuse 10% dextrose in 0.45 % saline

If CBG **< 4** mmol/L insulin infusion can be stopped temporarily but only for 10-15 minutes

Maintenance fluids

5% dextrose in 0.45% sodium chloride; 10% dextrose in 0.45% saline if there is concern about hypoglycaemia. (If CBG **>14** mmol/L, consider using saline 0.9% and increase insulin infusion rate but change to 5% dextrose in 0.45% saline when CBG **< 14**mmol/L

After surgery

When patient tolerating orally give S/C insulin. Discontinue insulin infusion 60 minutes after the subcutaneous dose if using Mix, Insulatard, or basal insulin (see appendix 2). Discontinue insulin infusion 10 minutes after the subcutaneous dose if using rapid acting insulin

Check CBG 2 hours after the meal CBG > 12 mmol/L

Yes

No

Give rapid-acting insulin (Humalog® or NovoRapid®) S/C (maximum 2 hourly) to correct CBG **>12** mmol/L using ISF (see page 5)
Aim to keep CBG **5-10** mmol/L

The dinner or evening dose of insulin is given as usual
If the child is fully recovered consider discharge

Flow Chart 6

Peri-operative Management of Children Requiring Short Anaesthesia for Procedures

Endoscopies/bronchoscopy/biopsies/insertion of long lines/joint injections/lumbar punctures/dental extractions etc.

Pre-procedure instructions

- Patient should follow the pre-procedure instruction provided by the team carrying out the procedure
- Please ensure that patient monitor CBG in the morning of the procedure

Pre-procedure adjustment of insulin

For children on insulin injections (see appendix 3)
Or
For children on insulin pump therapy (see appendix 5)

On the day of procedure

- For insulin adjustment (**see appendix 3**)
- Continue CBG monitoring hourly before and after the procedure
- Maintain CBG levels between **5-10** mmol/L
- If CBG <5 mmol/L infuse 5% dextrose in 0.45% saline at maintenance rate

For very short anaesthesia or sedation (up to 30 minutes) and early morning procedures (e.g. 08:00-09:00) and when rapid recovery is anticipated, delay morning dose of insulin or insulin pump can be discontinued until immediately after completion of the procedure. Monitor CBG before and after the procedure.

After the procedure

Aim to keep CBG **5-10** mmol/L

If CBG > 12 mmol/L

For children on insulin injections:

Give rapid-acting insulin (Humalog® or NovoRapid®) S/C (maximum 2 hourly) to correct CBG >12 mmol/L using ISF (see page 5)

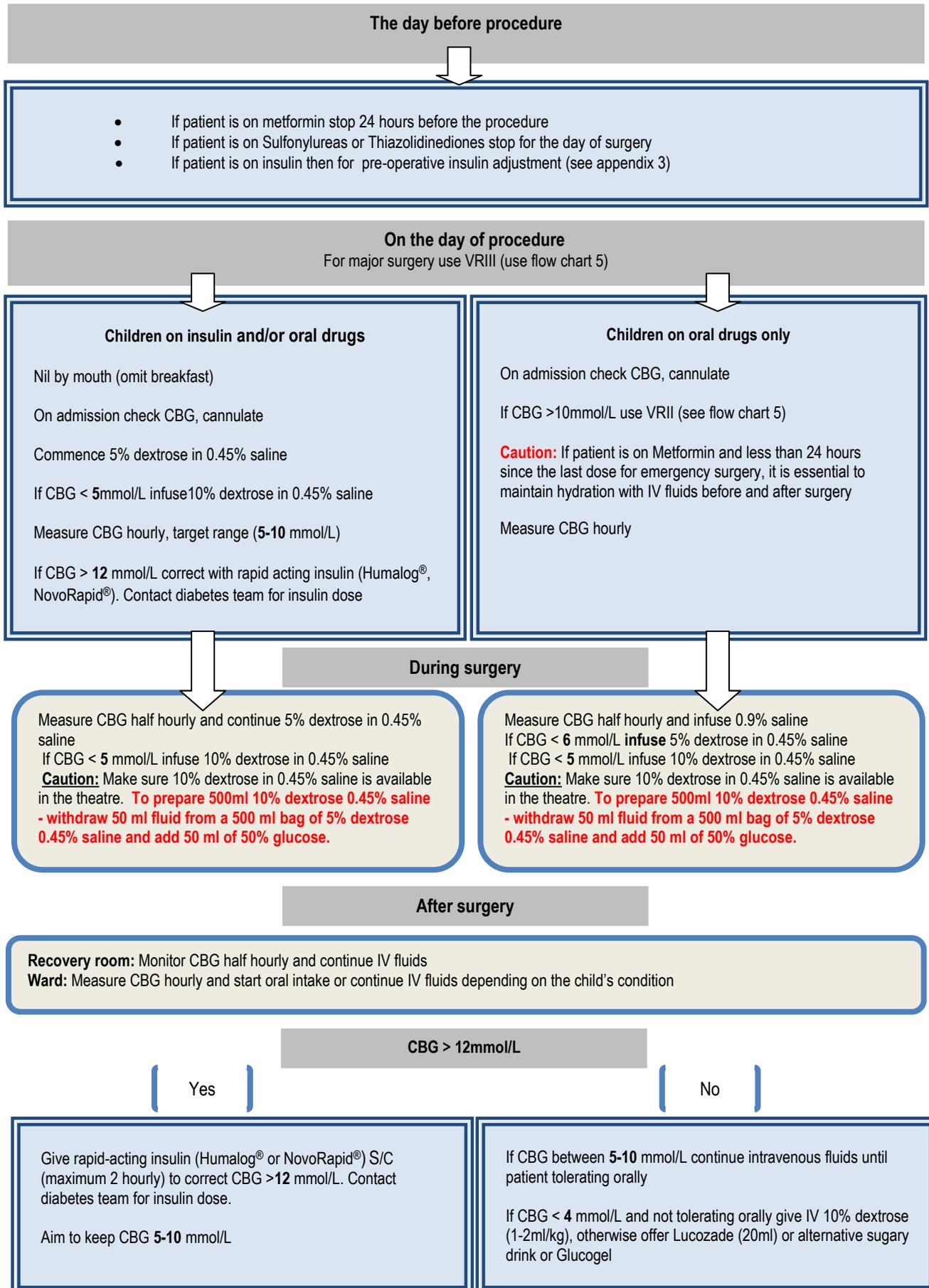
For children on insulin pump:

Give correction bolus using pump's bolus wizard

If CBG < 4 mmol/L

If CBG < 4 mmol/L and not tolerating orally give IV 10% dextrose (1-2ml/kg), otherwise offer Lucozade (20ml) or alternative sugary drink or Glucogel

Flow Chart 7 Peri-operative Management for Type 2 Diabetes (Minor Surgery)



Flow Chart 8

Peri-operative Management for CFRD (Minor Surgery)

Pre-operative insulin dose adjustment

First determine the insulin regimen of the patient and advise accordingly as below

- If patient is on once daily evening basal insulin give half the dose in the evening before surgery
- If patient is on once daily morning basal insulin give the usual dose the day before surgery
- If the patient also takes rapid acting insulin with meals continue the usual dose the day before surgery
- If patient is on twice daily "Mix Insulin" (see appendix 3)

On the day of procedure

For major surgery use VRIII (use flow chart 5)

- Omit morning rapid acting insulin (if on basal bolus)
- If patient is on once daily morning basal insulin give the usual dose at admission
- If patient is on twice daily basal insulin omit the morning basal insulin
- If patient on twice daily mix insulin (see appendix 3)

Nil by mouth (omit breakfast). On admission check CBG, cannulate

Commence 5% dextrose in 0.45% saline. If CBG < 5mmol/L infuse 10% dextrose in 0.45% saline

Measure CBG hourly, target range (5-10 mmol/L)

If CBG > 12 mmol/L correct with rapid acting insulin (Humalog®, NovoRapid®) S/C. Contact diabetes team for insulin dose

During surgery

Measure CBG half hourly, and continue 5% dextrose in 0.45% saline. If CBG < 5 mmol/L infuse 10% dextrose in 0.45% saline

Caution: Make sure 10% dextrose in 0.45% saline is available in the theatre. **To prepare 500ml 10% dextrose 0.45% saline - withdraw 50 ml fluid from a 500 ml bag of 5% dextrose 0.45% saline and add 50 ml of 50% glucose.**

After surgery

Recovery room: Monitor CBG half hourly and continue IV 5% dextrose infusion in 0.45% saline. If CBG <5 infuse 10% dextrose in 0.45% saline

Ward: Measure CBG hourly and start oral intake or continue IV 5% dextrose in 0.45% saline depending on the child's condition

CBG > 12 mmol/L

Yes

No

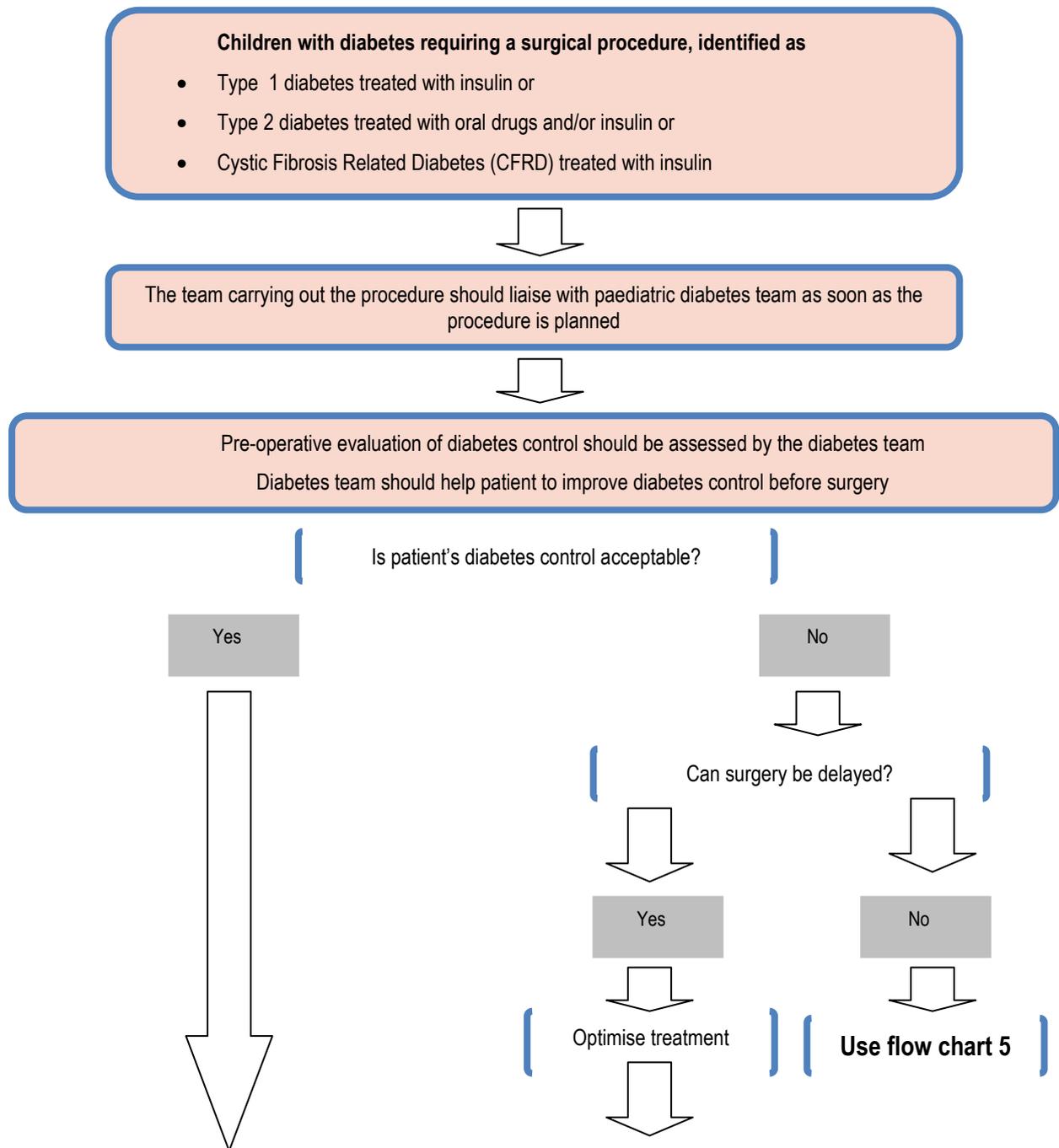
Give rapid-acting insulin (Humalog® or NovoRapid®) S/C (maximum 2 hourly) to correct CBG >12 mmol/L. Contact diabetes team for insulin dose.

Aim to keep CBG 5-10 mmol/L

If CBG between 5-10 mmol/L continue intravenous 5% dextrose in 0.45% saline until patient tolerating orally

If CBG < 4 mmol/L and not tolerating orally give IV 10% dextrose (1-2ml/kg), otherwise offer Lucozade (20ml) or alternative sugary drink or Glucogel

Appendix 1: Planning



Diabetes team should instruct parents to bring their own insulin to hospital

Diabetes team to choose the appropriate guideline sheet to the patient's insulin regimen; **flow chart 1-8**

Diabetes team should write the ISF on the guideline sheet

Surgical team to discuss with anaesthetist to schedule surgery as **FIRST CASE** on a surgical list

Ward sister/named nurse for the patient should staple the appropriate guideline sheet on the front of the patient notes (see appendix 6)

Appendix 2: Commonly used insulin preparations and regimens

Commonly used Insulin preparations

Rapid acting insulin analogues

Insulin lispro (Humalog[®])

Insulin aspart (NovoRapid[®])

Insulin glulisine (Apidra[®])

Short acting Insulin

Regular [Soluble] (Actrapid[®]/or Humulin S[®])

Intermediate acting

Insulatard[®]/or Humulin I[®]/or Insuman[®]

Long acting basal insulin analogue

Insulin glargine (Lantus[®])

Insulin detemir (Levemir[®])

Biphasic Insulin's (Mixed insulins)

NovoMix 30[®]

Humulin M3[®]

Humalog Mix 25[®]

Humalog Mix 50[®]

Insuman[®] Comb 25

Insuman[®] Comb 50

Biphasic insulin's are pre mixed insulin preparations containing various combinations of short acting or rapid acting and intermediate acting insulin. These preparations are normally used in 2 and 3 injections a day insulin regimens (see below).

Twice Daily Mix Insulin Regimen:

Children on this regimen receive one injection of the Mix (biphasic) insulin preparation in the morning and one at tea time or in the evening. In some centres patients are managed on 3 injections of Mix (biphasic) insulin at breakfast, lunch and with tea. Such patients can also be managed using flow chart for twice daily mix insulin regimen (use flow chart 1).

Twice Daily Free Mix Insulin Regimen:

Rarely children take free mix injections of rapid acting e.g. Humalog[®], NovoRapid[®] and intermediate acting e.g. Insulatard[®], Humulin I[®] through insulin syringe. They should be managed as twice daily mix insulin regimen (see appendix 3 and use flow chart 1).

Three Injections a Day Insulin Regimen:

Children on 3 injections a day receive Mix (biphasic) insulin with breakfast, rapid acting insulin with tea and basal insulin in the evening.

Basal Bolus Insulin Regimen:

Children on basal bolus insulin regimen take once daily basal insulin in the morning or evening (and sometimes split the basal insulin in the morning and evening) and rapid acting insulin with each meal. This is also called multiple daily injections (MDI) and involves 4 to 5 injections per day.

Appendix 3:

Adjustment of insulin before surgery – “Quick guide”

Insulin regimen	Day before procedure	Day of surgery	
		Morning list	Afternoon list
Once daily (evening) Basal insulin Lantus®/Glargine or Levemir®/Detemir or	Continue usual dose	Continue usual dose Consider reducing dose up to 20% if there is a pattern of low CBG in the morning	Continue usual dose
Once daily (morning) Basal insulin Lantus®/Glargine or Levemir®/Detemir or	Continue usual dose	When patient arrives in the ward Take usual dose Check CBG at admission Follow flow sheet for further management	When patient arrives in the ward Take usual dose Check CBG at admission Follow flow sheet for further management
Twice Daily Mix insulins NovoMix 30®, Humulin M3®, Humalog Mix 25®, Humalog Mix 50® Insuman® Comb 25, Insuman® Comb 50 Separate or free mix injections of rapid acting e.g. Humalog®, NovoRapid® and intermediate acting e.g. Insulatard®, Humulin I®	Continue usual dose	When patient arrives in the ward For Mix insulins give 50% of the usual morning dose as intermediate insulin e.g. (Insulatard®) <i>For free Mix give 50% of the total morning dose (add rapid and intermediate acting insulin dose) as intermediate insulin e.g. (Insulatard®)</i> Take usual insulin dose with evening meal	When patient arrives in the ward Give 50% of the usual morning dose Allow child to eat light breakfast Take usual insulin dose with evening meal
Basal Bolus insulin regimen Patients take once daily basal insulin in the morning or in the evening or sometimes split the basal insulin in the morning and evening and rapid acting insulin with each meal, this is also called MDI and involves 4 to 5 injections daily	Continue usual dose	Withhold usual morning dose of rapid acting insulin Basal insulin advice as above <i>If patient takes basal insulin both in the morning and in the evening consider reducing the morning basal insulin dose</i>	Take usual morning rapid acting insulin with breakfast Omit lunch time dose Basal insulin as usual <i>If patient takes basal insulin both in the morning and in the evening consider reducing the morning basal insulin dose</i>

Caution: If patient is likely to be managed with VRIII then **Do NOT GIVE** any S/C insulin in the morning of the surgery
 After surgery the children can take their usual insulin dose next morning provided they are tolerating orally

This table is adopted from management of adults with diabetes undergoing surgery and elective procedures: (www.diabetes.nhs.uk)

Appendix 4:

Pre-operative advice for children with type 1 diabetes on insulin injections

Diabetes team should provide this sheet to the parents/child

Pre-operative advice for children with type 1 diabetes on insulin injections (Minor surgery)

The day before surgery/procedure

- Administer usual dose of insulin
- Consider reducing the night time insulin by 20% only if there is a **pattern** of low blood glucose in the preceding 3 to 4 mornings
- Check blood glucose before bed time and take appropriate action, if in doubt contact your diabetes team or out of hours diabetes advice service
- Follow the advice provided by the surgical team regarding nil by mouth

On the day of surgery/procedure

- Check blood glucose before going to hospital
- If the surgery is in the **morning** then omit breakfast and do not give any insulin
- If the surgery is in the **afternoon** then you may be allowed to take light breakfast. Please take appropriate dose of rapid acting insulin (Humalog[®] or NovoRapid[®] or Apidra[®]). If on Mix insulin take half the usual dose at breakfast.
- On admission your blood glucose will be checked again
- You may need intravenous fluids with glucose to prevent hypoglycaemia
- If you take basal insulin in the morning (Lantus[®]/Glargine or Levemir[®]/Detemir) then give the usual dose on the morning of the procedure preferably on arrival to the ward

*For **major surgery** your child will be managed using intravenous insulin infusion during surgery. **Do Not Give** morning dose of S/C insulin. You should confirm this with your diabetes team*

If you have any questions regarding this advice, please ask your diabetes team for further information

Appendix 5: Pre-operative advice for children/parents on insulin pump therapy

Diabetes team should provide this sheet to the parents/child

Pre-operative advice for children/parents on insulin pump therapy The day before surgery/procedure

- Administer usual dose of insulin and continue with the same basal rates
- Consider reducing the night time basal rates by 20% (set up temporary basal rates) only if there is a **pattern** of low blood glucose in the preceding 3 to 4 mornings
- Change the infusion set in the afternoon before surgery, but no later than tea time
- Check blood glucose before bed time to make sure new infusion set insertion is working and take appropriate action. If in doubt contact your diabetes team or out of hours diabetes advice service
- Make sure battery of the pump is at least half full
- Make sure date and time on the pump is correct
- Check all the pump settings (basal rates, carbohydrate ratios, target blood glucose, insulin active time/insulin on board and insulin sensitivity factor)

If the anaesthetist or the ward nurses are not comfortable using the insulin pump during surgery, your child will be managed using intravenous insulin infusion. Please ask your diabetes team for further information or discuss this with the anaesthetist during pre-operative assessment visit

Appendix 6:

Check list for ward nurse responsible for the care of the child

On the day of surgery/procedure

Check list for ward nurse responsible for the care of the child with diabetes undergoing surgery/procedure

- Check capillary blood glucose (CBG) at admission
- Request appropriate team to clerk the patient
- Insist for early cannulation
- Inform paediatric diabetes team regarding admission
- Clarify with the operating surgeon if the surgery is minor or major. Clarify with anaesthetist whether the surgery/procedure will require very short anaesthesia/sedation (**see page 5**)
- Make sure the appropriate flow chart 1-8 (see page 2) is attached at the front of the notes
- Write child's name and DOB on the flow chart
- For child requiring variable intravenous insulin infusion (VRIII) e.g. major surgery, **Do Not Give** morning dose of S/C insulin (**use flow chart 5**)
- Commence intravenous fluids as suggested on the flow chart
- Monitor CBG hourly
- Check with patient if they have brought their own insulin. If not request pharmacy
- Make sure 10% dextrose 0.45% saline is available in the theatre, if not send this with the child. **To prepare 500ml 10% dextrose 0.45% saline - withdraw 50 ml fluid from a 500 ml bag of 5% dextrose 0.45% saline and add 50 ml of 50% glucose.**
- For safe preparation and administration of intravenous insulin (**see page 4 & 5**)
- For children on insulin pumps make sure parents/patient has followed the check list provided by the diabetes team (**see appendix 5**)
- Make sure Glucogel, Lucozade or alternative sugary drink is available to treat hypoglycaemia (CBG < 4mmol/L). Some advice is provided on the flow chart, alternatively follow trust guidelines for the management of hypoglycaemia in children

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