

East of England Children & Young People's (CYP) Diabetes Network

Management of Children and Young people with Diabetes (Age >6months-18th birthday) Requiring Surgery and Other Procedures



- Surgeon/physician communicates with the diabetes team as soon as the decision to undertake the surgery/procedure is made
- Surgeon/physician fills in the pre-operative information sheet (appendix 3) and sends it to the diabetes team

- Tries to optimise pre-operative diabetes control
- Selects and completes the appropriate individualised care plan (page 2) and files in the hospital notes
- Provides appropriate information leaflet regarding pre-operative adjustment of insulin (appendix 4 or 5) to CYP/ parents

- Ward/Acute Area nurse goes through the admission check list (appendix 7) and files the individualised care plan in the front of the hospital notes
- Anaesthetist follows the individualised care plan in the theatre and during recovery
- Ward/Acute Area nurse continues to follow individualised care plan on CYP return to the ward
- At discharge the Ward/Acute Area nurse provides appendix 8 to CYP/parents and liaises with diabetes team.

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MANAGEMENT OF CHILDREN AND YOUNG PEOPLE WITH DIABETES REQUIRING SURGERY AND OTHER PROCEDURES

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REQUIRING SURGERY AND OTHER PROCEDURES

1. BACKGROUND

During surgery or other procedures under sedation or anaesthesia, the aim is to maintain near normal glycaemic control with optimal hydration and serum electrolytes, to avoid hypoglycaemia and prevent catabolism and ketoacidosis by ensuring optimum insulin delivery. This guideline is based on the International Society of Paediatric and Adolescent Diabetes (ISPAD) clinical practice consensus guidelines^{1, 2}. Modifications have been made in light of recently published (2014) document 'Management of adults with diabetes undergoing surgery and elective procedures'³ and from the evidence published in the anaesthetic literature⁴.

2. PURPOSE & SCOPE

This guideline is for use in children and young people with diabetes, over 6 months of age until the 18th birthday for patients admitted to hospital for surgery and procedures including sedation in the paediatric or adult wards/day services. To be available in all units within the East of England CYP Diabetes Network to ensure that quality of care is high and standardised.

3. DEFINITIONS

The definitions used below (1, 2 and 3) have been adopted from the recently published document 'Management of adults with diabetes undergoing surgery and elective procedures', (www.diabetes.org.uk).

3.1 Variable rate intravenous insulin infusion (VRIII): replaces the term '*Sliding Scale*' for an intravenous insulin infusion that is titrated to the patient's blood glucose page 12. VRIII is usually required during emergency surgery or for procedures requiring more than one missed meal e.g., breakfast and lunch. For safer administration of VRIII follow instruction on Appendix 1 (page 14).

3.2 Anticipated starvation period requiring more than one missed meal: If the peri-operative starvation period is likely to be long and is likely to involve more than one missed meal, or a period of pre-operative diet change to facilitate bowel prep or delay in resumption of normal intake post operatively. In these circumstances a VRII will most likely be required.

3.3 Anticipated starvation period requiring one missed meal: If the planned starvation period (*includes the total of pre-anaesthetic post-anaesthetic missed meals*) is short and generally less than 12 hours, the patient can be managed by modification of their usual subcutaneous insulin, thus avoiding a VRIII whenever possible. In practice this means that patients should be first on a morning or an afternoon list, and able to resume a normal oral intake after the procedure, so that they only miss either breakfast or lunch.

3.4 Anticipated starvation period not requiring a missed meal (delayed meal): CYP requiring anaesthesia/sedation for a maximum of 30 minutes and rapid recovery is anticipated (ideally early morning cases): these can be managed by delaying the morning dose of insulin or discontinuing an insulin pump until immediately after completion of the procedure.

4. GLYCAEMIC TARGETS FOR SURGERY

It has been shown that sub optimal glycaemic control in the peri-operative period has a significant impact on the risk of post-operative infection in adults^{5, 6, 7, 8, 9}. Enhanced catabolism stimulated by surgical trauma can lead to hyperglycaemia and even ketoacidosis^{10, 11}. There is a lack of quality evidence of peri-operative blood glucose and

outcome in CYP with diabetes undergoing surgery. The ISPAD clinical practice

consensus guidelines¹ suggest keeping capillary blood glucose (CBG) levels between 5 and 10mmol/L during surgical procedures in children. To minimise the risk of hypoglycaemia or hyperglycaemia, our consensus for this guideline is to aim for a CBG of 5-10mmol/L in the peri-operative period. However to minimise the risks of intervention, treatment is not necessary unless CBG is <5mmol/L or >14mmol/L.

5. GENERAL RECOMMENDATIONS

5.1 Planning

Careful planning and good communication between the surgeon or physician undertaking the procedure and the anaesthetists, diabetes team and the Ward/ Acute Area staff is essential for successful surgery and outcome, Appendix 2 (page 15).

- **Effective communication:** It is recommended that the surgeon or physician should communicate with the diabetes team as soon as the decision is made to undertake the surgery/procedure by filling in the pre-operative information sheet, Appendix 3 (page 16) and sending it to the CYP's diabetes team.
- **Role of the diabetes team:** The diabetes team should assess pre-operative diabetes control and should help the CYP to improve their diabetes control before surgery/procedure. Diabetes team selects and completes the appropriate individualised care plan (page 2) and files a copy in the notes. The diabetes team gives and explains the appropriate information leaflet regarding pre-operative adjustment of insulin, Appendix 4 (page 17) or Appendix 5 (page 18) to the parents/patient. 'Quick Guide' regarding adjustment of insulin before surgery is also provided in Appendix 6 (page 19).
- **Admission and discharge planning:** The Ward/Acute Area nurse responsible for the care of the CYP during the admission should go through the suggested check list before surgery, Appendix 7 (page 20). The anaesthetist follows the individualised care plan in the theatre and during recovery. The discharging nurse provides Appendix 8 (pg. 21), (*Advice for CYP with diabetes who are discharged following surgical procedure*) to the parents/CYP and liaises with the diabetes team regarding follow-up.

5.2 Commonly used insulin preparations

For commonly used insulin preparations see Appendix 9 (page 22).

5.3 Capillary blood glucose monitoring

The CBG should be monitored hourly as a minimum. In the young children (<3 years), those undergoing major surgery and in those where the CBG is <5mmol/L and the trend is decreasing it should be half hourly.

5.4 Hypoglycaemia

Hypoglycaemia is usually defined as CBG <4mmol/L. However for the purpose of this guideline the consensus of opinion is to treat any CBG < 5mmol/L as follows:

- Stop intravenous insulin if it is running and contact the duty doctor (recommence once CBG > 6mmol/L).
- If there is no IV access and the patient is conscious, give Glucogel (1 tube contains 10 gram of rapid acting glucose - < 8 years ½ tube and > 8 years 1 tube).
- If IV access is in situ give 2 ml/kg of 10% dextrose over 5 minutes. Repeat if required.
- If the CYP is unconscious and no IV access give IM Glucagon (<8yrs 0.5mg, >8yrs 1mg)
- Retest CBG after 15 minutes. If CBG 5-6mmol/L, monitor CBG half hourly. If the

trend is downward or the CYP is symptomatic consider treatment as above.

5.5 Hyperglycaemia

For the purpose of this guideline hyperglycaemia is defined as CBG >14mmol/L. A CBG <10mmol/L is desirable, but it is recognised that blood glucose often remains slightly elevated in the post-operative period secondary to the stress response to surgery. We therefore advocate treatment once the CBG is greater than 14mmol/L, as follows:

- Stop glucose infusion if running and contact the duty doctor (recommence if required, once CBG <10mmol/L).
- Give rapid acting insulin as per insulin sensitivity factor ([page 6](#)). If on insulin pump give correction bolus using pump bolus calculator. If after 2 hours CBG is still above 14mmol/L, check blood ketones and correct elevated blood glucose with rapid acting insulin.
- This CYP should be monitored carefully for the risk of developing diabetic ketoacidosis (DKA) and inform diabetes team.
- If on VRIII follow the instructions on the individualised care plan (page 12).

5.6 Parenteral maintenance fluids (PMF)

- The standard intravenous fluid to run alongside the VRIII is 5% dextrose in 0.9% saline with 0.15% KCl in a 500ml bag.
- **If a VRIII is not used, maintenance fluid should be administered according to the anaesthetist's normal practice.**
- Monitor electrolytes daily to avoid hyponatremia.
- The fluid infusion rate is calculated according to body weight using the Holiday- Segar nomogram¹³ (4ml/kg/hr for the 1st 10kg body weight, 2ml/kg/hr for the 2nd 10kg of weight, 1ml/kg/hr for the remaining weight). **This may be an overestimate of fluid requirements.**
- Should additional peri-operative fluids be required, boluses of fluids such as Hartmann's solution or any similar solution (according to the practice of the individual anaesthetist) can be co-administered if boluses of fluids are required.
- Further information is found in Appendix 10 (page 23).

5.7 Emergency surgery

- There is no opportunity for pre-admission planning in CYP 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. Start variable rate intravenous insulin infusion VRII and continue intravenous fluids containing dextrose, Appendix 10 (page 23).
- Check weight (if possible), serum electrolytes, capillary gases, and blood ketones before anaesthesia.
- If DKA is present, follow EOE CYPDN DKA ICP, based on British Society of Paediatric Endocrinology and Diabetes (BSPED) guidelines¹⁴ for management of DKA and delay surgery until circulating volume and deficits are corrected.

5.8 Insulin pump therapy/continuous subcutaneous insulin infusion (CSII)

- It is recommended that if possible CYP on CSII should continue on pumps during the surgery/procedure (as long as there is a health care professional present who is insulin pump proficient).
- For procedures requiring one missed meal, pump therapy should be continued and the CYP should remain on their basal rates (page 9).
- For procedures requiring very short anaesthesia (page 13), CSII can be discontinued up to a **maximum of 60 minutes** and CBG monitored before and after the procedure. This decision will be taken by the operating surgeon and the attending anaesthetist jointly and documented in the notes. **DO NOT** forget to recommence CSII IMMEDIATELY after the procedure (failure to do this is a critical incident).
- The anaesthetic team may choose to convert CSII to a VRIII during surgery to allow finer

control in the peri-operative period (or if there isn't a health care professional present who is pump proficient)

- If the CSII has been discontinued and replaced with VRIII, the CSII should be restarted once the CYP is ready to eat and VRIII should be **discontinued 60 minutes after the first mealtime bolus** has been given through the pump bolus calculator.

5.9 Safer administration of insulin

- Errors in the administration of insulin are very common. The wide range of insulin preparations and devices increases the risk of error. All staff involved in prescribing and administering insulin should have appropriate training and follow the national patient safety agency rapid response report on safer administration of insulin¹⁵.
- 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 50ml luer-lock intravenous syringes.
- When an intravenous insulin infusion is used, fluids containing dextrose should be infused continuously until the patient is eating and drinking.
- The first choice of fluids should be 5% dextrose in 0.9% saline with 0.15% KCl in a 500ml bag, Appendix 10 (page 23). If CBG drops below 5 to 6mmol/L despite adjustment in the VRIII then insulin infusion can be stopped temporarily but **only for 10-15 minutes**.
- A training programme should be in place in all trusts for all healthcare staff to provide the safe use of insulin.

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 14mmol/L. ISF can be calculated by using the rule of 100 (see example below). *The diabetes team should calculate ISF before surgery and write on the individualised care plan.*

Rule of 100:

Divide 100 by total daily dose (i.e. total basal + total bolus insulin)

e.g. if total daily dose is 50 units ($100 \div 50 = 2$). This means that 1 unit of rapid acting insulin (Humalog® or NovoRapid®), would drop CBG by 2mmol/L. (i.e. ISF = 2).

Aim to drop CBG to 10mmol/L. Example:

If CBG= 16, target CBG =10 and ISF=2 (Actual CBG – Target CBG) ÷ ISF

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

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.*

7.1 INDIVIDUALISED PERI-OPERATIVE CARE PLAN – ONE MISSED MEAL MANAGEMENT OF MULTIPLE DAILY INJECTIONS INSULIN REGIMEN

Usual type of rapid acting insulin:	CBG	Insulin dose Max 2hrly	<i>Addressograph</i> Surname: First Name: DOB: Hosp No: NHS No:
	14mmol/L to mmol/L	units	
Management of high blood glucose levels ISF: 1unit of rapid acting insulin will lower CBG by .....mmol/L Or use SMART meter	.....mmol/L to mmol/L	units	
Form filled in by (Name):	.....mmol/L to mmol/L	units	
Procedure:			

The Night before Surgery
CYP 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 ([Appendix 6](#))

On the Day of Surgery Write the plan here, ([Appendix 6](#))

Additional instructions:
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Caution: If CYP 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 – 09:00

Afternoon operation scheduled 13:00 – 14:00

<p>Meal: Nil by mouth (omit breakfast).</p> <p>Test CBG on getting up, before leaving home and on reaching hospital/ward.</p> <p>Manage CBG as below in the ward: If CBG is 5 – 6mmol/L and CYP asymptomatic, no treatment; if symptomatic, give Glucogel (< 8 years ½ and > 8years 1 tube). If CBG < 5mmol/L and cannula in place, give 2 ml/kg of 10% dextrose over 5 minutes; if no cannula inform anaesthetist and give glucogel as above. If CBG > 14mmol/L, give rapid acting insulin as per ISF above.</p> <p>Insulin: Withhold usual morning dose of rapid acting insulin. Administer the usual morning dose of basal insulin if taking split doses.</p> <p>Fluids: the decision will be taken by anaesthetist depending on procedure.</p>	<p>Meal: Allow breakfast but omit lunch.</p> <p>Test CBG on getting up, 2 hours after breakfast, before leaving home, then hourly.</p> <p>Manage CBG as below in the ward: If CBG is 5 – 6mmol/L and CYP asymptomatic, no treatment; if symptomatic, give Glucogel (< 8 years ½ and > 8years 1 tube). If CBG < 5mmol/L and cannula in place, give 2 ml/kg of 10% dextrose over 5 minutes; if no cannula inform anaesthetist and give glucogel as above. If CBG > 14mmol/L, give rapid acting insulin as per ISF above.</p> <p>Insulin: Give 100% of the usual morning dose of rapid acting insulin with breakfast.</p> <p>Fluids: the decision will be taken by anaesthetist depending on procedure.</p>
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Management in Theatre and in Recovery Room

CBG Monitoring: Test CBG at least hourly, target range (5 – 10mmol/L), intervention range (< 5 or > 14mmol/L).

IV Fluids: Maintenance fluid with 5% dextrose in 0.9% saline may be required if there is a trend towards a low CBG otherwise fluid should be administered according to the anaesthetist's normal practice. If CBG < 5mmol/L consider giving 2 ml/kg of 10% dextrose over 5 minutes. Fluid boluses should be with glucose free fluid such as Hartmann's solution as deemed necessary by the anaesthetist.

Additional instructions:
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Management in Ward

Measure CBG hourly and aim to keep it 5 – 10mmol/L. Maintenance fluid with 5% dextrose in 0.9 % saline may be required if there is a trend towards a low CBG till the CYP is well enough to tolerate orally. If hypoglycaemia or CBG > 14mmol/L manage as above. The evening dose of insulin is given as usual once the child has tolerated evening meal. If the child is fully recovered consider discharge.

7.2 INDIVIDUALISED PERI-OPERATIVE CARE PLAN – ONE MISSED MEAL MANAGEMENT OF TWICE/ THREE TIMES DAILY MIXED (BIPHASIC) INSULIN REGIMEN

Usual type of rapid acting insulin:	CBG	Insulin dose Max 2hrly	<i>Addressograph</i> Surname: First Name: DOB: Hosp No: NHS No:
	14mmol/L to mmol/L	units	
Management of high blood glucose levels ISF: 1 unit of rapid acting insulin will lower CBG by .....mmol/L Or use SMART meter	.....mmol/L to mmol/L	units	
Form filled in by (Name):	.....mmol/L to mmol/L	units	
Procedure:			

The Night before Surgery
Administer usual doses of insulin in the evening; test CBG at bed time

On the Day of Surgery

Morning operation scheduled 08:00 – 09:00

Afternoon operation scheduled 13:00 – 14:00

<p>Meal: Nil by mouth (omit breakfast).</p> <p>Test CBG on getting up, before leaving home and on reaching hospital/ward.</p> <p>Manage CBG as below in the ward: If CBG is 5 – 6mmol/L and CYP asymptomatic, no treatment; if symptomatic, give Glucogel (< 8 years ½ and > 8years 1 tube). If CBG < 5mmol/L and cannula in place, give 2 ml/kg of 10% dextrose over 5 minutes; if no cannula inform anaesthetist and give glucogel as above. If CBG > 14mmol/L, give rapid acting insulin as per ISF above.</p> <p>Insulin: Delay morning dose of insulin, give normal dose after the procedure with late breakfast</p> <p>Fluids: the decision will be taken by anaesthetist depending on procedure.</p>	<p>Meal: Allow breakfast but omit lunch.</p> <p>Test CBG on getting up, 2 hours after breakfast, before leaving home, then hourly.</p> <p>Manage CBG as below in the ward: If CBG is 5 – 6mmol/L and CYP asymptomatic, no treatment; if symptomatic, give Glucogel (< 8 years ½ and > 8years 1 tube). If CBG < 5mmol/L and cannula in place, give 2 ml/kg of 10% dextrose over 5 minutes; if no cannula inform anaesthetist and give glucogel as above. If CBG > 14mmol/L, give rapid acting insulin as per ISF above.</p> <p>Insulin: Give 50% of the usual morning dose of mixed (biphasic) insulin S/C.</p> <p>Fluids: the decision will be taken by anaesthetist depending on procedure.</p>
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Management in Theatre and in Recovery Room

CBG Monitoring: Test CBG at least hourly, target range (5 – 10mmol/L), intervention range (< 5 or > 14mmol/L).

IV Fluids: Maintenance fluid with 5% dextrose in 0.9% saline may be required if there is a trend towards a low CBG otherwise fluid should be administered according to the anaesthetist's normal practice. If CBG < 5mmol/L consider giving 2 ml/kg of 10% dextrose over 5 minutes. Fluid boluses should be with glucose free fluid such as Hartmann's solution as deemed necessary by the anaesthetist.

Additional instructions:
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Management in Ward

Measure CBG hourly and aim to keep it 5 – 10mmol/L. Maintenance fluid with 5% dextrose in 0.9 % saline may be required if there is a trend towards a low CBG till the child is well enough to tolerate orally. If hypoglycaemia or CBG > 14mmol/L manage as detailed above. The evening dose of insulin is given as usual once the CYP has tolerated evening meal. If the child is fully recovered consider discharge.

7.3 INDIVIDUALISED PERI-OPERATIVE CARE PLAN – ONE MISSED MEAL MANAGEMENT OF INSULIN PUMP THERAPY

<p>Procedure:</p> <p>Usual Insulin Dose:</p> <p>ISF: means one unit of rapid acting insulin would drop CBG bymmol/L OR use the CYP smart blood glucose meter.</p>		<p><i>Addressograph</i></p> <p>Surname: First Name: DOB: Hosp No: NHS No:</p>
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The Night before Surgery
Diabetes team to give and discuss (Appendix 5) of the guideline with parents

On the Day of Surgery
Secure the insulin infusion site to prevent dislodgement.
If the surgical / anaesthetic team not comfortable using insulin pumps then follow VRII, (page 12).

Morning operation scheduled 08:00 – 09:00	Afternoon operation scheduled 13:00 – 14:00
<p>Meal: Nil by mouth (omit breakfast).</p> <p>Test CBG on getting up, before leaving home and on reaching hospital/ward.</p> <p>Manage CBG as below in the ward: If CBG is 5 – 6mmol/L and CYP asymptomatic, no treatment; if symptomatic, give Glucogel (< 8 years ½ and > 8years 1 tube). If CBG < 5mmol/L and cannula in place, give IV dextrose 2 ml/kg 10%; if no cannula inform anaesthetist and give glucogel 10-20 grams. If CBG > 14mmol/L, give correction bolus using insulin pump bolus calculator.</p> <p>Insulin: Continue S/C insulin delivery via insulin pump at the usual basal rates.</p> <p>Fluids: the decision will be taken by anaesthetist depending on procedure.</p>	<p>Meal: Allow breakfast with 100% insulin bolus, but omit lunch.</p> <p>Test CBG on getting up, 2 hours after breakfast, before leaving home, then hourly.</p> <p>Manage CBG as below in the ward: If CBG is 5 – 6mmol/L and CYP asymptomatic, no treatment; if symptomatic, give Glucogel (< 8 years ½ and > 8years 1 tube). If CBG < 5mmol/L and cannula in place, give IV dextrose 2 ml/kg 10%; if no cannula inform anaesthetist and give glucogel 10-20 grams. If CBG > 14mmol/L, give correction bolus using insulin pump bolus calculator.</p> <p>Insulin: Continue S/C insulin delivery via insulin pump at the usual basal rates.</p> <p>Fluids: the decision will be taken by anaesthetist depending on procedure.</p>

Management in Theatre and in Recovery Room

CBG Monitoring: Test CBG at least hourly, target range (5 – 10mmol/L), intervention range (< 5 or > 14mmol/L).

IV Fluids: Maintenance fluid with 5% dextrose in 0.9% saline may be required if there is a trend towards a low CBG otherwise fluid should be administered according to the anaesthetist's normal practice. If CBG < 5mmol/L consider giving 2 ml/kg of 10% dextrose over 5 minutes. Fluid boluses should be with glucose free fluid such as Hartmann's solution as deemed necessary by the anaesthetist.

Additional instructions:
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Management in Ward

Measure CBG hourly and aim to keep it 5 – 10mmol/L. Maintenance fluid with 5% dextrose in 0.9% saline may be required if there is a trend towards a low CBG till the CYP is well enough to tolerate orally. If hypoglycaemia or CBG > 14mmol/L manage as above. The evening bolus of insulin is given as usual once the child has tolerated evening meal. If the CYP is fully recovered consider discharge.

7.4 INDIVIDUALISED PERI-OPERATIVE CARE PLAN – ONE MISSED MEAL MANAGEMENT OF TYPE 2 DIABETES

Usual type of rapid acting insulin:	CBG	Insulin dose Max 2hrly	<i>Addressograph</i> Surname: First Name: DOB: Hosp No: NHS No:
	14mmol/L to mmol/L	units	
Management of high blood glucose levels ISF: 1unit of rapid acting insulin will lower CBG by .....mmol/L Or use SMART meter	.....mmol/L to mmol/L	units	
	.....mmol/L to mmol/L	units	
Form filled in by (Name):	.....mmol/L to mmol/L	units	
Procedure:			

The Night before Surgery (delete as appropriate)

- If young person is on metformin stop 24 hours before the procedure.
- If young person is on Sulfonylureas or Thiazolidinediones stop for the day of surgery.
- If CYP is on insulin then for pre-operative insulin adjustment (Appendix 6) and write insulin doses here:

Additional instructions:

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On the Day of Surgery

For more than one missed meal use VR11, (page 12).

CYP on insulin and/or oral drugs

Meal: Nil by mouth (omit breakfast).

Test CBG on getting up, before leaving home and on reaching hospital/ward.

Manage CBG as below in the ward:

If CBG is **5 – 6**mmol/L and CYP asymptomatic, no treatment; if symptomatic, give Glucogel (< 8 years ½ and > 8years 1 tube).
If CBG < **5**mmol/L and cannula in place, give IV dextrose 2ml/kg 10%; if no cannula inform anaesthetist and give glucogel 10-20 grams.

If CBG > **14**mmol/L give rapid insulin as per ISF above.

Fluids: the decision will be taken by anaesthetist depending on procedure.

CYP on oral drugs only

Meal: Nil by mouth (omit breakfast).

Test CBG on getting up, 2 hour after breakfast, before leaving home, then hourly.

Manage CBG as below in the ward:

If CBG > **12**mmol/L use variable rate intravenous insulin infusion, VR11 (page 12).

Caution: If young person is on Metformin and less than 24 hours since the last dose for emergency surgery, it is essential to maintain hydration with IV fluids before and after surgery.

Fluids: the decision will be taken by anaesthetist depending on procedure.

Management in Theatre and in Recovery Room

CBG Monitoring: Test CBG at least hourly, target range (5 – 10mmol/L), intervention range (< 5 or >14 mmol/L).

IV Fluids: Maintenance fluid with 5% dextrose in 0.9% saline may be required if there is a trend towards a low CBG otherwise fluid should be administered according to the anaesthetist's normal practice. If CBG < 5mmol/L consider giving 2 ml/kg of 10% dextrose over 5 minutes. Fluid boluses should be with glucose free fluid such as Hartmann's solution as deemed necessary by the anaesthetist.

Additional instructions:

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Management in Ward

Measure CBG hourly and aim to keep it 5 – 10mmol/L. Maintenance fluid with 5% dextrose in 0.9 % saline may be required if there is a trend towards a low CBG till the CYP is well enough to tolerate orally. If hypoglycaemia or CBG > 14mmol/L manage as

above. The evening dose of oral hypoglycaemic agents is given as usual once the child has tolerated evening meal. If the CYP is fully recovered consider discharge.

7.5 INDIVIDUALISED PERI-OPERATIVE CARE PLAN – ONE MISSED MEAL MANAGEMENT FOR CYSTIC FIBROSIS RELATED DIABETES (CFRD)

Usual type of rapid acting insulin:	CBG	Insulin dose Max 2hrly	<i>Addressograph</i> Surname: First Name: DOB: Hosp No: NHS No:
	14mmol/L to mmol/L	units	
Management of high blood glucose levels ISF: 1unit of rapid acting insulin will lower CBG by .....mmol/L Or use SMART meter	.....mmol/L to mmol/L	units	
	.....mmol/L to mmol/L	units	
Form filled in by (Name):	.....mmol/L to mmol/L	units	
Procedure:			

The Night before Surgery

First determine the insulin regimen (Appendix 9) of the patient and advise accordingly as below (delete as appropriate)

- If CYP is on once daily evening basal insulin give half the dose in the evening before surgery.
- If CYP is on once daily morning basal insulin give the usual dose the day before surgery.
- If the CYP also takes rapid acting insulin with meals continue the usual dose the day before surgery.
- If CYP is on twice daily "Mixed Insulin", take usual dose the night before surgery.

Additional instructions:

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On the Day of Surgery

For more than one missed meal use VR11 (page 12).

Test CBG on getting up, before leaving home and on reaching hospital/ward.

Meal: Nil by mouth (miss the meal before surgery).

Insulin: For insulin adjustment see Appendix 6, write a plan here:

Additional instructions:

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Manage CBG as below in the ward:

- If CBG between **5 – 6mmol/L** and child asymptomatic, no treatment; if symptomatic, give Glucogel (< 8 years ½ and > 8years 1 tube)
- If CBG < 5mmol/L and cannula in place, give 2 ml/kg 10% dextrose IV injection over 5 minutes; if no cannula inform anaesthetist.
- If CBG > 14mmol/L, take rapid insulin as per ISF above.

Fluids: the decision will be taken by anaesthetist depending on procedure

Management in Theatre and in Recovery Room

CBG Monitoring: Test CBG at least hourly, target range (5 – 10mmol/L), intervention range (< 5 or > 14mmol/L).

IV Fluids: Maintenance fluid with 5% dextrose in 0.9 % saline may be required if there is a trend towards a low CBG otherwise fluid should be administered according to the anaesthetist's normal practice. If CBG < 5mmol/L consider giving 2 ml/kg of 10% dextrose over 5 minutes. Fluid boluses should be with glucose free fluid such as Hartmann's solution as deemed necessary by the anaesthetist.

Additional instructions:

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Management in Ward

Measure CBG hourly and aim to keep it 5 – 10mmol/L. Maintenance fluid with 5% dextrose in 0.9 % saline may be required if there is a trend towards a low CBG till the CYP is well enough to tolerate orally. If hypoglycaemia or CBG > 14mmol/L manage as above. The evening dose of oral hypoglycaemic agents is given as usual once the child has tolerated evening meal. If the CYP is fully recovered consider discharge.

7.6 MANAGEMENT OF SURGERY REQUIRING MORE THAN ONE MISSED MEAL VARIABLE RATE INTRAVENOUS INSULIN INFUSION (VRII)

Diabetes team to attach Appendix 1 and Appendix 10 with this individualised care plan **Planned surgery:** should be **First Case** on the morning list.

Procedure:	<i>Addressograph</i> Surname: First Name: DOB: Hosp No: NHS No:
Usual Insulin Dose:	

The Night before Surgery

Administer usual doses of insulin; (write the name and dose of insulin using Appendix 6):

Additional instructions:

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On the Day of Surgery

For planned surgery nil by mouth, omit breakfast and **Do Not Give** any S/C insulin in the morning.
For emergency surgery see page 5 of the guideline.

Administer insulin infusion and maintenance fluids on the morning of procedure

Add soluble insulin 50 units to 49.5ml 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 (page 6) Infusion rate is adjusted according to CBG. For safer administration of VRIII follow instructions on Appendix 1.

CBG (mmol/L)	Infusion rate	CBG (mmol/L)	Infusion rate
6 – 7.9	0.025 ml/kg/h (i.e. 0.025Units/kg/h)	12 – 14.9	0.075 ml/kg/h (i.e. 0.075Units/kg/h)
8 - 11.9	0.05 ml/kg/h (i.e. 0.5Units/kg/h)	> 15	0.1 ml/kg/h (i.e. 0.1Units/kg/h)

Monitor CBG half hourly: The aim of VRIII is to maintain CBG 6-12mmol/L. If CBG falls between **5** and **6**mmol/L despite adjustment in the VRIII as above, insulin infusion can be temporarily stopped for 10 to 15 minutes. If CBG is **<5**mmol/L give 2 ml/kg of 10% dextrose over 5 minutes. Retest CBG after 15 minutes to ensure that the level of blood glucose is safe, otherwise repeat 10% dextrose bolus as above.

Parenteral maintenance fluids: The standard intravenous fluid to run alongside the VRIII is 5% dextrose in 0.9 % saline with 0.15% KCl in a 500ml bag (Appendix 10). Monitor electrolytes daily to avoid hyponatraemia.
If CBG rises > **15**mmol/L, change to 0.9% sodium chloride with 0.15% KCl in 500ml bag.

Additional instructions:

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Management in Recovery Room

Continue to monitor CBG half to one hourly.
Continue parenteral maintenance fluids as above.

Management in Ward

Measure CBG hourly and continue parenteral maintenance fluids as above. Once CYP able to tolerate oral food give S/C insulin with meal. Discontinue insulin infusion **30 minutes** after the subcutaneous dose if using rapid acting or mixed (biphasic) insulin (Appendix 9). Discontinue insulin infusion **60 minutes** after recommencing insulin pump therapy, or s/c basal insulin (Appendix 9). The evening dose of bolus insulin is given as usual once the CYP has tolerated evening meal. If the CYP is fully recovered consider discharge.

7.7 INDIVIDUALISED PERI-OPERATIVE CARE PLAN MANAGEMENT OF PROCEDURES NOT

REQUIRING A MISSED MEAL Endoscopy / bronchoscopy / biopsy / insertion of long line / joint injection / lumbar puncture / dental extraction etc.

Usual type of rapid acting insulin:	CBG	Insulin dose Max 2hrly	<i>Addressograph</i> Surname: First Name: DOB: Hosp No: NHS No:
	14mmol/L to mmol/L	units	
Management of high blood glucose levels 1unit of rapid acting insulin will lower CBG by.....mmol/L Or use SMART meter	.....mmol/L to mmol/L	units	
	.....mmol/L to mmol/L	units	
Form filled in by (Name):	.....mmol/L to mmol/L	units	
Procedure:			

Pre-procedure Instructions

- Patient should follow the pre -procedure instruction provided by the team carrying out the procedure.
- Overnight admission may be required for younger patients or those with difficulties in maintaining adequate fluid intake during bowel preparation or bowel preparation requires more than one missed meal. In these cases use VR11 (see page 12).
- Test CBG on getting up, before leaving home and on reaching hospital/ward.

Additional instructions:

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Pre-procedure Adjustment of Insulin (delete as appropriate)

For CYP on insulin injections (Appendix 6) or for CYP on insulin pump therapy (Appendix 5), write a plan here:

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On the Day of Procedure

For insulin adjustment see (Appendix 6), write a plan here:

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- Continue CBG monitoring hourly before and after the procedure.
- Maintain CBG levels **5-10mmol/L**, intervention range **< 5 or > 14mmol/L**.
- If CBG **< 5mmol/L** infuse 5% dextrose in 0.9% saline at maintenance rate till the CYP is able to tolerate orally.

CYP requiring anaesthesia/sedation for a maximum of 30 minutes and rapid recovery is anticipated (ideally early morning cases): these can be managed by delaying the morning dose of insulin or discontinuing the insulin pump until immediately after completion of the procedure.

After the procedure, aim to keep CBG 5-10mmol/L.

If CBG > 14mmol/L: For CYP on insulin injections: Give rapid-acting insulin (Humalog® or NovoRapid®) subcutaneously (maximum 2 hourly) to correct capillary blood glucose > 14mmol/L using insulin sensitivity factor as above. For CYP on insulin pump: Give correction bolus using pump's bolus calculator (delete as appropriate).

If CBG < 5mmol/L and not tolerating orally, give 2 ml/kg of 10% dextrose over 5mins. Otherwise, if tolerating orally, give Glucogel (< 8 years ½ and > 8years 1 tube).

APPENDIX 1

SAFER ADMINISTRATION OF VARIABLE RATE INTRAVENOUS INSULIN INFUSION (VRIII)

VRIII

It is accepted that the use of a VRIII is a complicated procedure and errors during preparation and administration could be lethal. For safer administration of insulin see recommendations on page 6. The purpose of this section of the guideline is to clearly set out the procedures to ensure safe use of VRIII.

Aim:

The aim of the VRIII is to maintain the blood glucose level 6-10mmol/L. It is important that patients with diabetes have a constant level of insulin to prevent ketosis.

Indications:

VRIII is indicated for surgery requiring a starvation period more than one missed meal, emergency surgery in an ill child. If in DKA use BSPED DKA guideline¹⁴ (failure to do this is a critical incident).

Principles:

- When an intravenous insulin infusion is used, fluids containing dextrose (Appendix 10) should be infused continuously until the patient is eating and drinking.
- There is evidence that the risk of acute hyponatremia may be increased when using hypotonic parental maintenance fluid^{17, 18, 19} (i.e. < 0.9% saline) in hospitalised children. Compromise would be to administer 0.45% saline with 5% dextrose, carefully monitor electrolytes and change to 0.9% saline with 5% dextrose (Appendix 10) if plasma sodium concentration is falling.
- The initial insulin infusion rate is determined by the CBG (VRII page 12).
- The CBG should be monitored at least hourly.
- The rate of fluid must be set to deliver the hourly fluid requirements.
- **Preparation of VRIII:**
 - An insulin syringe must be used to measure and prepare insulin for an intravenous infusion. Add soluble insulin (Actrapid®) 50 units to 49.5ml sodium chloride 0.9%, making a solution of 1 unit insulin/ml.
 - The bed pole, on to which the fluid is hung, must always be present to allow safe transfers.
 - The mobile drip stand must always be present to promote stabilisation.
 - Delivery of the dextrose solution and the VRIII must be via a single cannula with appropriate one-way and anti-siphon valves.

50 ml leuer-lock Syringe

Insulin Syringe

50ml leuer lock Syringe



49.5ml Sodium Chloride 0.9% + 50 Units Actrapid Insulin = Final volume 50ml (1 unit of insulin / ml)

Transferring from VRIII to subcutaneous insulin:

- Restart the normal pre-surgical regimen. Be prepared to adjust the doses because the insulin requirement may change as a result of the surgery/procedure.
- Once the patient is able to tolerate food orally give S/C insulin. **Discontinue the insulin infusion 30 minutes** after the subcutaneous dose if using rapid acting, mixed (biphasic) insulin (Appendix 9) or 60minutes after recommencing insulin pump therapy. Discontinue the insulin infusion **60 minutes** after the subcutaneous dose if using basal insulin (Appendix 9).
- Consult the diabetes team if the CBG is outside the acceptable range (5-10mmol/L).

APPENDIX 2

PLANNING

Careful planning and good communication is essential for successful surgery and outcome.

- Surgeon/physician/pre-operative nurse communicates with the diabetes team as soon as the decision is made to undertake the surgery/procedure
- Surgeon/physician/pre-operative nurse fills in the pre-operative information sheet (**appendix 3**) and sends it to the patients diabetes team
- The diabetes team assesses pre-operative diabetes control and helps CYP to improve diabetes control before surgery/procedure.
- Diabetes team selects and completes the appropriate individualised care plan (ICP) according to the CYP insulin regime (page 2) and the pre-operative information provided by the surgeon/physician. The individualised care plan also depends on the type of procedure and whether patient would require missed meal (one or more than one) or not (page 2).
- The diabetes team files the ICP in the CYP hospital notes.
- Diabetes team gives and explains appropriate information leaflet regarding pre-operative adjustment of insulin (Appendix 4 or 5) to CYP/patient. 'Quick Guide' regarding adjustment of insulin before surgery is also provided in Appendix 6.
- Diabetes team should instruct parents to bring their own insulin to hospital so that the CYP can be restarted on their usual insulin as soon as possible.
- Diabetes team also instruct CYP/parents to bring their blood glucose monitoring equipment and hypoglycaemia treatment.
- The ICP to be used by anaesthetist, paediatricians, physicians, surgeons and nurses to guide diabetes management pre-, intra- and post-operatively.
- Diabetes team to be contacted for advice during the perioperative period.
- Surgical team discusses with anaesthetist to schedule surgery as 'FIRST CASE' on a surgical list.
- The Ward/Acute Area nurse responsible for the care of the child goes through the suggested check list before surgery (Appendix 7) and file the individualised care plan in the front of the notes.
- Anaesthetist follows the individualised care plan in the theatre and during recovery.
- The Ward/Acute area nurse continues to follow individualised care plan on CYP return to the ward.
- The CYP can be discharged once able to tolerate food orally and the observations are stable for at least 4 hours after the procedure.
- CYP can be discharged if CBG falls between 5 and 14mmol/L.
- If CBG is more than 14mmol/L give rapid acting insulin as per insulin sensitivity factor (page 6). If on insulin pump give correction bolus using pump bolus calculator. Repeat CBG after 2 hours. If it is still above 14mmol/L, check blood ketones and correct elevated blood glucose with rapid acting insulin. This CYP should be monitored carefully for the risk of developing diabetic ketoacidosis (DKA) and inform diabetes team.
- Make sure CBG > 5mmol/L, with no downward trend.
- The Ward/Acute Area nurse provides Appendix 8 (advice for CYP with diabetes who are discharged following surgical procedure) to patients/parents.
- The Ward/Acute Area nurse to inform the diabetes team regarding discharge.

APPENDIX 3

Pre-operative Notification Form: For children over 6 months and for patients under the care of paediatrician/diabetes physician and admitted to hospital for surgery and procedures in the Ward/Acute Areas

Name of the procedure:

Is CYP required to fast longer than usual pre-op, 6hrs for food or milk & 2hrs for clear fluid (water or squash): **YES/NO**

If **YES**, please give details of pre-op fasting instructions:

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Expected duration of peri-operative starvation (please tick the appropriate box):

• **Anticipated short starvation period requiring one missed meal:** The planned starvation period (*includes the total of pre-anaesthetic and post-anaesthetic missed meals*) is short and generally less than 12 hours. In practice this means that CYP should be first on a morning or an afternoon list, and able to resume a normal oral intake

after the procedure/surgery, so that they only miss either breakfast or lunch.

• **Anticipated starvation period requiring more than one missed meal:** The peri-operative starvation period is likely to involve more than one missed meal, e.g., breakfast and lunch, or a period of pre-operative diet

change to facilitate bowel prep or delay in resumption of normal intake post-operatively.

• **Anticipated starvation period not requiring a missed meal (delayed meal):** CYP requiring anaesthesia/sedation for a maximum of 30 minutes and rapid recovery is anticipated (ideally early morning cases).

- **Is bowel prep required: YES / NO**
- **Is a low residue food diet required pre-op: YES / NO**
- **Expected duration of procedure:hoursminutes.**
- **Is child expected to resume normal oral intake immediately post-op: YES / NO**

If NO, please give details of expected delays or restrictions (e.g. clear fluids for 4hr).

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Consultant Surgeon/Physician in charge of admission:

Consultant Paediatrician/Adult Physician (Diabetes):.....

Key worker (Paediatric/Adult Diabetes Specialist Nurse):

Anaesthetist (if known):

Form filled in by (Name):

Signature:

Date:

Please send this form to the CYP diabetes team by post or email and file one copy in CYP's hospital notes.

APPENDIX 4

Pre-operative advice for Child/Young Person/ with type 1 diabetes on insulin injections

Diabetes team should provide and explain this sheet to the parents/CYP

(For procedures requiring one missed meal)

The day before surgery/procedure

- Administer usual dose of insulin.
- Reduce the preceding evening's basal insulin only up to 20% if there is a pattern of low capillary blood glucose values in the preceding 3-4 mornings. Otherwise continue your basal insulin as normal
- Check your 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 your blood glucose before leaving home. If the glucose level is less than 4mmol/L take glucogel 10 to 20 grams by mouth and check the glucose level again in 15 minutes.
- If the surgery is in the **morning** then omit breakfast and do not give any mixed or rapid acting insulin.
- If you take basal insulin in the morning (Lantus[®] /Glargine or Levemir[®] / Detemir /Degludec) and the surgery is also planned in the **morning** then omit breakfast and give the usual dose of basal insulin at the usual time,
- If the surgery is in the **afternoon** then you may be allowed to take light breakfast. Take an appropriate dose of rapid acting insulin (Humalog[®] or NovoRapid[®] or Apidra[®]). If you are on Mixed insulin take half the usual dose at breakfast. If your child takes basal insulin in the morning (Lantus[®] /Glargine or Levemir[®] / Detemir) give usual dose at breakfast.
- On admission your blood glucose will be checked again.
- You may need intravenous fluids with glucose to prevent hypoglycaemia.
- **Please bring your own insulin to hospital. This is important.**

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

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APPENDIX 5

Pre-operative advice for Children/Young people on insulin pump therapy

Diabetes team should provide and explain this sheet to the parents/child

The day before surgery/procedure

- Administer the 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 reservoir, cannula and infusion set in the afternoon before surgery, but no later than tea time.
- Bring additional pump supplies with you to the hospital
- Check capillary blood glucose before bedtime to make sure the 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 the battery of the pump is at least half charged.
- Make sure the 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).

Your anaesthetist may decide it appropriate to discontinue the pump therapy prior to surgery. They will explain this to you on the day if necessary along with alternative treatment options. Please ask your diabetes team for further information or discuss this with the anaesthetist during the pre-operative assessment visit.

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APPENDIX 6

Adjustment of insulin before surgery – ‘Quick guide’

INSULIN REGIMEN	DAY BEFORE PROCEDURE	DAY OF SURGERY	
		MORNING LIST	AFTERNOON LIST
<p>MDI insulin regimen</p> <p>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/day.</p>	Continue usual dose	<p>Withhold usual morning dose of rapid acting insulin.</p> <p>Basal insulin advice as above.</p> <p><i>If patient takes basal insulin both in the morning and in the evening consider reducing the morning basal insulin dose.</i></p>	<p>Take usual morning rapid acting insulin with breakfast.</p> <p>Omit lunch time dose.</p> <p>Basal insulin as usual.</p> <p><i>If patient takes basal insulin both in the morning and in the evening consider reducing the morning basal insulin dose.</i></p>
<p>Twice Daily</p> <p>Mixed insulin NovoMix 30[®], Humulin M3[®], Humalog Mix 25[®], Humalog Mix 50[®] Insuman[®] Comb 25, Insuman[®] Comb 50.</p>	Continue usual dose	<p>When patient arrives in the Ward</p> <p>Delay morning dose of insulin, give normal dose after the procedure with late breakfast.</p> <p>Take usual insulin dose with evening meal.</p>	<p>When patient arrives in the ward</p> <p>Check that 50% of usual dose was given in the morning.</p> <p>Allow child to eat light breakfast.</p> <p>Take usual insulin dose with evening meal.</p>
<p>Once daily (evening) Basal insulin Lantus[®]/Glargine Levemir[®]/Detemir Tresiba /Degludec</p>	Continue usual dose	<p>Continue usual dose.</p> <p>Consider reducing dose up to 20% if there is a pattern of low CBG in the morning.</p>	Continue usual dose
<p>Once daily (morning) Basal insulin Lantus[®]/Glargine Levemir[®]/Detemir Tresiba/Degludec</p>	Continue usual dose	<p>Check that the usual dose has been taken in the morning</p> <p>Check CBG at admission.</p> <p>Follow flow sheet for further management.</p>	<p>Check that the usual dose has been taken in the morning</p> <p>Check CBG at admission.</p> <p>Follow flow sheet for further management.</p>

APPENDIX 7

Check list for the Ward/Acute Area nurse responsible for the care of the CYP with diabetes undergoing surgery / procedure

On the day of surgery/procedure

- Check capillary blood glucose at admission.
- Request appropriate team to clerk the CYP.
- Follow instructions on the individualised care plan and attach this on the front of the notes.
- Inform diabetes team regarding admission.
- Make sure hospital identification label is attached on the individualised care plan.
- For a CYP requiring variable intravenous insulin infusion (VRIII), **Do Not Give** morning dose of mixed or rapid acting subcutaneous insulin. VRIII must be commenced within an hour of the missed insulin dose.
- Check with CYP if they have brought their own insulin. If not request from pharmacy.
- For safe preparation and administration of intravenous insulin see instructions on (pages 6 & 14).
- For safer administration of intravenous insulin (VRIII) see instructions on Appendix 1
- For CYP on insulin pumps make sure parents/patient has followed the check list provided by the diabetes team (Appendix 5).
- Make sure Glucogel is available to treat hypoglycaemia (page 4). Some advice is provided on the individualised care plan; alternatively follow trust guidelines for the management of hypoglycaemia in CYP.

APPENDIX 8

Advice for CYP with diabetes that are discharged following a surgical procedure

Insulin and blood glucose monitoring

- Continue your insulin and other medication as usual or as advised in the discharged letter
- You may need to check your blood glucose more frequently especially if you are unwell or being sick
 - Your blood glucose may be higher than usual. This is not a concern if you are feeling well and blood ketones are not raised.
- You may need extra doses of rapid acting insulin to correct blood glucose levels above the target range

When should I call my diabetes team?

- **Continuous** diarrhoea, vomiting or fever
- **Unable to keep food** down for 4 hours or more
- **High blood glucose** (14mmol/L or above), despite extra rapid acting insulin
- **Blood Ketones** above 1.5mmol/L and rising despite extra insulin

Contact member of your diabetes team during normal working hours, Tel:

Outside normal working hours contact the "Out of Hours" diabetes service, Tel:

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Sick day rules

Follow the sick day rules provided by your diabetes team. The general principles are:

Never stop taking your insulin,

Check your blood glucose every 2 hours

Check for blood ketone every 2 hourly, if do not have blood ketone meter, check urine ketones

Drink water/sugar free fluids every hour

Eat as normal as you can. If you cannot eat or have reduced appetite, replace solid food during illness, with sugary fluids or semi solids e.g., milk, ice cream, fruit juice etc.

APPENDIX 9

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[®])
Insulin degludec (Tresiba)

Biphasic Insulins (Mixed insulin)

NovoMix 30[®]
Humulin M3[®]
Humalog Mix 25[®]
Humalog Mix 50[®]
Insuman Comb 25[®]
Insuman Comb 50[®]

Biphasic insulins 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:

CYP on this regimen receive one injection of the Mixed (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 Mixed (biphasic) insulin at breakfast, lunch and with tea. Such patients can also be managed using flow chart for twice daily mix insulin regimen.

Twice Daily Free Mix Insulin Regimen:

Rarely CYP 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 mixed insulin regimen.

Three Injections a Day Insulin Regimen:

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

MDI Insulin Regimen:

CYP on MDI 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.

APPENDIX 10

Parenteral Maintenance Fluids (PMF)

Choice of intravenous fluid

- These recommendations are modified from the results of a recently conducted randomised control trial¹² and from ISPAD clinical practice consensus guidelines¹. Hospital acquired hyponatraemia is common, and children undergoing surgery are at particular risk^{17. 18. 19}. It is recognised that hyponatraemia is associated with severe neurological morbidity^{20. 21. 22}. Those in favor of isotonic PMF argue that it supports the role of sodium during illness by maintaining plasma tonicity, whereas hypotonic PMF results in excess electrolyte free water (EFW) in patients with an already impaired ability to excrete EFW²³. Those who favour hypotonic PMF argue that hyponatraemia results from excessive PMF volume (as opposed to type of PMF) and there are risks with isotonic PMF, such as hyperchloremic metabolic acidosis^{24. 25}.
- Our consensus for this guideline is that the standard intravenous fluid to run alongside the VRIII is 5% dextrose in 0.9% saline with 10mmol/500ml KCl. Monitor electrolytes daily to avoid hyponatremia. The fluid infusion rate is calculated according to body weight using the Holiday-Segar nomogram¹³ (4ml/kg/hr for the 1st 10kg body weight, 2ml/kg/hr for the 2nd 10kg of weight, 1ml/kg/hr for the remaining weight).

Availability of pre-made 5% dextrose in 0.9% saline with 0.15% KCl / 500ml bags

- 5% dextrose in 0.9% saline with 0.15% KCl and without KCl in a 500ml bag is available
- The potassium containing fluid is quite expensive but this outweighs the risk of having to add potassium in some hospital settings. Some units allow addition of potassium in the fluid.
- All units would need to make their own arrangements regarding the availability of these fluids.

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The guideline would be reviewed every three years, and comments are welcomed on the

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