1. Introduction

1.1 This document sets out the University Hospitals of Leicester (UHL) guidelines for managing adult inpatients with diabetes who are receiving enteral or parenteral nutrition (EN or PN).

1.2 EN and PN is commonly used in patients who are malnourished or at risk of malnutrition, and have an inadequate or unsafe oral intake (NICE, 2017).

1.3 This guideline was based on the JBDS 2012 guideline for the 'glycaemic management during the inpatient enteral feeding of stroke patients with diabetes' and guidelines produced by the 'Think Glucose' programme

1.4 This guideline should only be used out of hours. During working hours please refer to the Inpatient Diabetes Specialist Nurse (DSN) Team via ICE.

1.5 This guideline is also supported by the following appendices, which should be used in conjunction with the main document:

2. Guideline Standards and Procedures

This guideline applies to all healthcare professionals (HCP) looking after adult inpatients with diabetes.

2.1 Background

Patients with diabetes are more likely to be admitted to hospital than people without Diabetes. On average 1 in 5 hospital beds (21.6%) are occupied by a PWD (NaDIA report, 2017).

It is recognised that hyperglycaemia is common in acute critical illness, due to induced insulin resistance as a result of a hypermetabolic state (Egi et al., 2017). This can cause a person with diabetes experiencing avoidable complications, which may also lead to a longer length of stay and can be life threatening (Diabetes UK, 2019).

It is estimated that between 20-50% of patients admitted to hospital are malnourished or at risk of malnutrition (Kirkland, 2013). There are three categories of nutritional support for patients at risk of malnutrition: oral nutritional support, EN or PN. This guideline addresses the management of EN and PN for inpatients with diabetes.

2.2 Calculating initial insulin dose

See Appendix A for the 'Out of hours diabetes protocol for EN and PN'

Please note these protocols are designed for 20 hour EN or 24 hour PN feeds. If a patient is on a shorter EN or PN feeding regime, please refer to the Inpatient DSN team via ICE.

2.3 Adjusting insulin dose if feeding regime changes

If feeding regimen needs to be changed **and the Inpatient DSN team are not available:**

1. Calculate the % change in carbohydrate amount per day in the new regimen compared to the previous enteral or parenteral feeding regimen. The carbohydrate content of a set feed can be found documented in the feeding regime.
2. Change the dose of basal insulin and quick acting insulin at the equivalent percentage of the % change in carbohydrates/day from previous regimen.
3. Refer to the **Inpatient DSN team** via ICE as soon as possible.

For example:

Mr X has Type 2 Diabetes and is prescribed Humulin I twice daily: 20 units am, 6 units pm
He is on the following enteral feeding regime:

Day / Date	Product Name	Pump Rate (ml/hr)	Feed time (hours)	Rest period (hours)	Feed volume (ml)	Energy (kcal)	Protein (g)	CHO (g)	FOR WARD CLINICAL TEAM Suggested additional fluid to meet estimated needs
1	Nutrison Complete	50	20	4	1000	1000	40	123	Additional 1000ml as flushes
2	Nutrison Complete	75	20	4	1500	1500	60	185	Additional 500ml as flushes

1. The % difference in carbohydrate amount between day 1 and 2 is:
   (185 ÷ 123) x 100 = **150%**
2. Mr X's Humulin I dose needs to be increased by 150% for day 2 of his enteral feeding regime. This is calculated as follows:
   20 x 1.5 = **30 units am**
   6 x 1.5 = **9 units pm**
3. Mr X then needs to be referred to the **Inpatient DSN team** via ICE

2.4 If the feed stops

If feed stopped for longer than 2 hours and insulin has been administered, risk of hypoglycaemia is high. Consider commencing IV 10% glucose to avoid hypoglycaemia.

In someone with T1DM is not receiving basal insulin or on a VRIII, then a VRIII should be commenced if a feed is turned off for greater than 2 hours.

2.5 Treating hypoglycaemia

Hypoglycaemia should be confirmed using a capillary blood glucose (CBG) measurement of <4.0mmol/l, performed by staff trained in the procedure. Hypoglycaemia should be treated as per UHL hypoglycaemia protocol (*Trust ref: B41/2011).*

Treatment to be administered via enteral feed tube **(do not administer via the dedicated PN line):**

- Give 15-20g quick acting CHO:
  - 60ml Gluco juice®
  - 50-70ml Fortijuice® or Ensure Plus® juice
  - 3-4 heaped teaspoons sugar dissolved in water
- Check CBG every 15 minutes and repeat above up to 3 times if CBG remains <4.0mmol/l

- If CBG remains <4.0mmol/l after 45 minutes then consider iv glucose infusion
- When CBG >4.0mmol/l and patient recovered give long acting CHO:
    - restart feed
    - if bolus feeding give additional bolus – amount required to give 20g CHO
    - 10% IV glucose infusion 100ml/hr
- Do not omit usual insulin injection if due

Treatment to be administered intravenously:

A rapid supply of carbohydrate (sugar) should be provided as the initial treatment of hypoglycaemia in patients unable to take quick acting carbohydrate orally (patients who are unconscious or nil by mouth).

- In this situation a stat dose of iv glucose is usually given over 10-15 mins and the guideline recommends the use of 75ml 20% glucose given over 10-15mins(infusion rate of 300ml/hr **stopped after 15 mins**)
- If 20% glucose is not available then 10% glucose can be given: 150ml 10% glucose given over 10-15 mins (infusion rate 600ml/hr **stopped after 15mins**)

2.6 Treating hyperglycaemia

If CBG persistently >12 mmol/l - increase insulin doses by 2 - 4 units or (10-20%) per dosage adjustment.

Liaise with the **Inpatient DSN team** for advice

For more information please see the Hyperglycaemia in Adult Inpatients with Diabetes – including Decision Support Tool UHL Guideline (*Trust ref: B27/2019*)

3. Education and Training

All clinical staff working in any location within UHL would be expected to seek support from a senior peer or member of the diabetes team if they if they were presented with a patient on EN or PN with diabetes and they did not feel adequately trained to manage the situation.

To help raise awareness of the guideline, it will be highlited in the 'Inpatient Diabetes Training and Support' (ITS) newsletter.

Case studies and learning points relating to enteral or parenteral nutrition and diabetes, will be referenced alongside this guideline in the ITS newsletter.

4. Monitoring Compliance

What will be measured to monitor compliance	How will compliance be monitored	Monitoring Lead	Frequency	Reporting arrangements
Implementation of this guidance in appropriate areas	Case note reviews, datix incident reporting	Inpatient Lead Diabetes	Continuous	Report to the Diabetes Inpatient Safety Committee

5. Supporting References

Egi, M., Furushima, N., Makino, S. and Mizobuchi, S. (2017). Glycemic control in acute illness. *Korean Journal of Anesthesiology*, 70(6), p.591.

National Institution of Clinical Excellence (2017) *Nutrition support for adults: oral nutrition support, enteral tube feeding and parenteral nutrition.* [online] available from https://www.nice.org.uk/guidance/cg32 [04 July 2019]

Kirkland, L., Kashiwagi, D., Brantley, S., Scheurer, D., & Varkey, P. (2013). Nutrition in hospitalized patient. Journal of Hospital Medicine, 8(1): 52-58.

Diabetes UK (2018) *Making hospitals safe for people with diabetes.* [online] available from https://www.diabetes.org.uk/resources-s3/2018-12/Making%20Hospitals%20safe%20for%20people%20with%20diabetes_FINAL%20%28002%29.pdf?_ga=2.176721125.1543510932.1544000942-894481026.1539010454 [04 July 2019]

NHS Digital. 2017. *National Diabetes Inpatient Audit (NaDIA)*. [Online] Available at: https://digital.nhs.uk/data-and-information/publications/statistical/national-diabetes-inpatient-audit/national-diabetes-inpatient-audit-nadia-2017 [Accessed 25 July 2018]

Guideline for Commencing out of Hours Enteral Tube Feeding (Nasogastric) in Adult Inpatients (Trust ref: B55/2006)

Managing Parenteral Nutrition via a Central Venous Access Device in Adults Policy (Trust ref: B22/2015)

6. Key Words

Diabetes

Enteral nutrition

Parenteral nutrition

Out of hours

Insulin

Type 1 Diabetes

Type 2 Diabetes

Glucose

Ketone

CONTACT AND REVIEW DETAILS	
Guideline Lead (Name and Title) Kath Higgins	**Executive Lead:** **Medical Director**
Details of Changes made during review:	

Appendix A - Out of hours diabetes protocol for EN and PN

Target blood glucose level		
□ Target blood glucose: 4-7.8 mmol/L pre and post-meal. □ Check CBG every hour whilst on Variable Rate Intravenous Insulin Infusion (VRIII/Sliding scale)		
□ If CBG persistently elevated (>7 mmol/l) does patient already have diagnosis of diabetes? • If so – type 2 or type 1 diabetes? • If unsure refer to diabetes specialist team for clarification		
□ Measure CBG 4-6 hourly (hourly if VRIII in use). Target CBG levels: • Fasting/Pre-feed 5-8 mmol/l • Feeding 6-12 mmol/l		
□ Review insulin and medication on admission. • MDT decision to feed via enteral or parenteral nutrition - Dietitian to prescribe appropriate feed regimen for patient • Refer to diabetes specialist team at earliest opportunity		
Patient with type 1 diabetes	**Patient with well-controlled type 2 diabetes (CBG 6 – 12 mmol/l)**	**Patient with poorly controlled type 2 diabetes (CBG persistently >12)**
• As feeding starts, commence on Variable Rate Intravenous Insulin Infusion (VRIII) with normal saline *If patients require potassium supplementation, please prescribe intravenous (IV) normal saline with potassium or give through enteral feeding tube* • Continue long acting analogue insulin in regimen (eg, Lantus, Levemir, Toujeo, Tresiba). • Discontinue insulin regimen ONLY IF it is mixed insulin • Involve specialist diabetes team at earliest opportunity • If patient on continuous subcutaneous insulin pump this should be stopped and subcutaneous insulin commenced immediately. • Prescribe PRN drugs in case of hypoglycaemia (as per hypo protocol on EMEDS)	• Consider metformin liquid and administered via enteral feeding tube (if patient is being enterally fed) if CBG rising >12 mmol/l during feeding • Continue feed regimen • Review every 48 hours by specialist diabetes team or if feed regimen altered, hypoglycaemia or recurrent hyperglycaemia **NB patients with short bowel syndrome or for a high output stoma would benefit from an early introduction of insulin as metformin is unlikely to be absorbed orally or via enteral feeding tube.**	• As feeding starts, commence on VRIII with normal saline *If patients require potassium supplementation, please prescribe intravenous (IV) normal saline with potassium or give through enteral feeding tube* • Continue metformin if indicated using resuspended metformin liquid via enteral feeding tube (if patient is being enterally fed) **NB patients with short bowel syndrome or for a high output stoma would benefit from an early introduction of insulin as metformin is unlikely to be absorbed orally or via enteral feeding tube.**

Appendix A protocol continues overleaf

• Continue VRIII for at least 24 hours (including the 4 hour rest period for feeding if on 20-h feeding regimen) • On day 2, with VRIII still running, calculate and prescribe regular subcutaneous insulin doses and PRN quick acting insulin as below. **80% of Total Daily Insulin Dose (TDID) requirements as basal insulin. If before admission, patient was on basal insulin twice per day, then split the amount of basal insulin into two equivalent doses, otherwise prescribe once daily basal insulin** **10% of TDID as PRN quick acting insulin (NovoRapid/Humalog/Apidra) 6 hourly if glucose levels ≥18 mmol/l** • Stop VRIII at least 1 hour before administration of subcutaneous insulin.		• Prescribe PRN drugs in case of hypoglycaemia (as per hypo protocol on EMEDS) • Continue VRIII for at least 24 hours (including the 4 hour rest period for feeding if on 20-h feeding regimen) • On day 2, with VRIII still running, calculate and prescribe regular subcutaneous insulin doses and PRN Actrapid as below. **50% of Total Daily Insulin Dose (TDID) as Humulin I /Insulatard or Humulin M3 at start of feed** **30% of TDID as Humulin I/Insulatard or Humulin M3 at midpoint of the feed.** **10% of TDID as PRN quick acting insulin (NovoRapid/Humalog/Apidra) 6 hourly if glucose levels above 18 mmol/l.** • Stop VRIII at least 1 hour before administration of subcutaneous insulin.
• Treatment of hyperglycaemia - if CBG persistently >12 mmol/l - increase insulin doses by 2 - 4 units or (10-20%) per dosage adjustment. *See insulin dose titration decision support tool (Trust ref: B27/2019)* • Liaise with specialist diabetes team for advice.		
• If feed stopped for longer than 2 hours and insulin has been administered, risk of hypoglycaemia is high. Consider commencing IV 10% glucose to avoid hypoglycaemia. • In people with type 1 diabetes not receiving basal insulin a VRIII should be commenced if feed turned off for greater than 2 hours to avoid patient developing DKA due to omission of insulin • If ketonaemia (>3 mmol/l) or ketonuria (>2+) refer patient urgently to doctor or out-of hours medical team for review and FRIII/ VRIII and DKA management if required. *See the Management of Diabetic Ketoacidosis (DKA) in Adults guideline (Trust ref: B66/2011)*		
• Continue feed regimen. Review every 48 hours by specialist diabetes team or if feed regimen altered, hypoglycaemia or recurrent hyperglycaemia.		

Appendix B – Available insulins and guidelines for appropriate use

Type of insulin regimen	Name of insulin available	Advantages	Disadvantages	When to use
Pre-mixed human/ analogue insulin at start and mid point of feed	• Humulin M3®, Insuman Combo • NovoMix30, HumalogMix25 and HumalogMix50	• Required bd. • Moderately long-acting profile – 8-12 hours. • Fewer injections	• If feed stops insulin continues to work – risk of hypoglycaemia.	• For use in feeds that are 12 – 24 hours long. • Use 1 – 2 doses during feed, as required.
Intermediate- acting human insulin (Isophane) at start and mid-point of feed	• Insulatard, Humulin I or Insuman Basal	• Isophane has moderately long-acting profile – 8-12 hours. Cost effective insulin. • May only require one injection daily – but will require 2 in most cases.	• If feed stops insulin continues to work – risk of hypoglycaemia. • Peak of action at 8 hours – may cause hypoglycaemia. • May need extra soluble human insulin added earlier or later in feed.	• Use in feeds that are 12 – 24 hours long. • Use 1 – 2 doses during feed, as required.
Short-acting human insulin	• Soluble human - Actrapid, Humulin S, Insuman rapid	• Short-acting insulin added in is a flexible and cost-effective option	• Glucose-lowering effects of short-acting insulin alongside premixed or moderately long-acting insulin may be unpredictable.	• Single doses of short-acting insulin may be best used in the context of repeated bolus feeding. Give insulin dose 20 minutes before feed starts.
Rapid-acting insulin analogue	• Novorapid, Apidra, Humalog, Fiasp	• Rapid onset of action. • 3 – 4 hour period of action - flexible.	• Unlikely to be effective unless used alongside intermediate-acting or basal insulin. Rapid-acting analogues are costly.	• May be useful for patients with type 1 diabetes receiving bolus feeds.
Long-acting analogue Insulin od or bd	• Tresiba od, Toujeo od, Lantus® od, Abasaglar od, Levemir® od or bd	• Long-acting insulin works well to cover 20 – 24 hour feeds. • Useful for type 1 patients.	• Long-acting insulin more expensive. • Not appropriate for shorter bolus feeds as may cause hypoglycaemia. Also risk of hypoglycaemia in rest period or if feed interrupted for long periods.	• For use with patients requiring 16 – 24 hr feeds with hyperglycaemia not controlled with isophane or pre- mixed insulin, or in patients with type 1 diabetes.