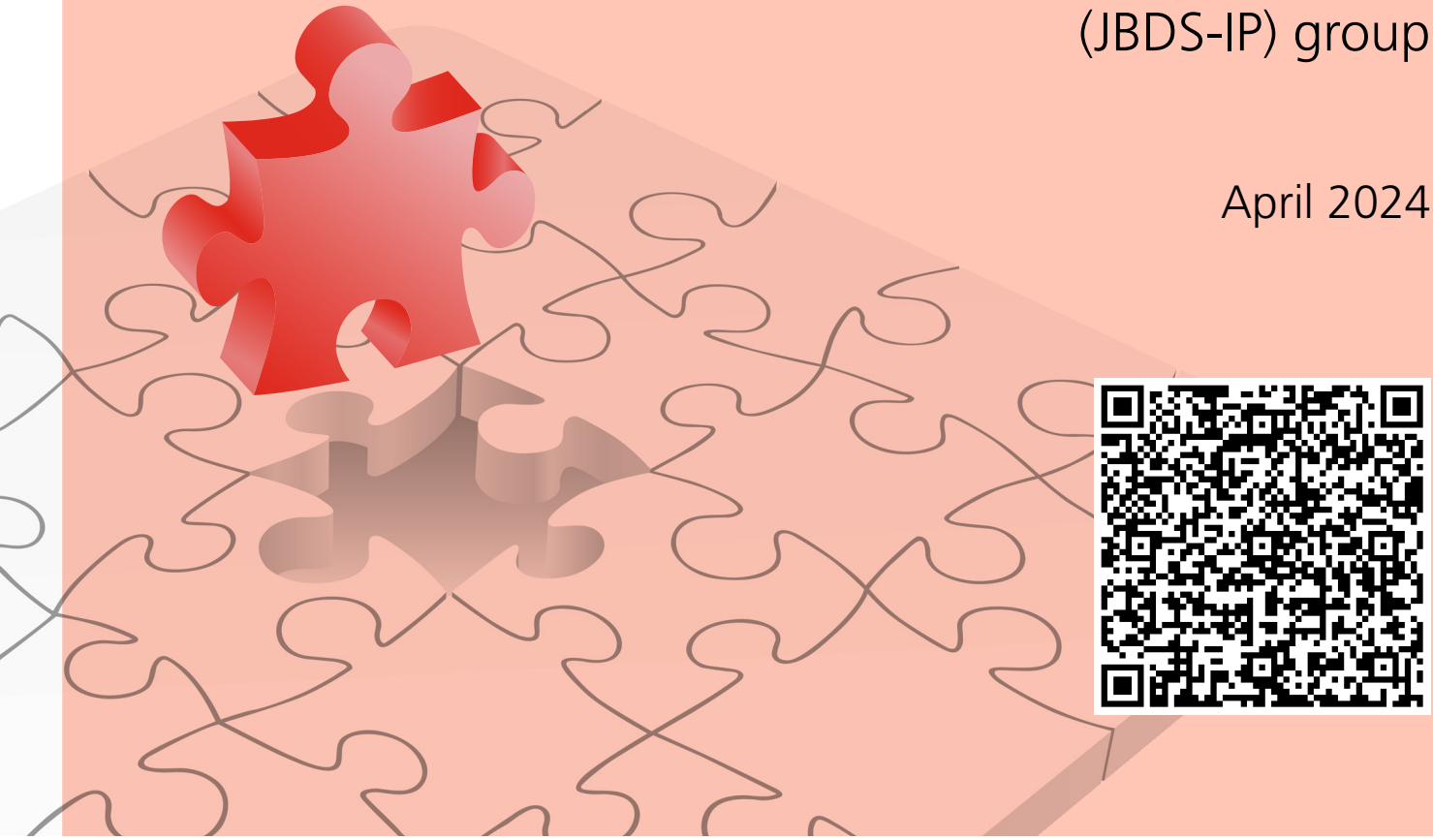
JBDS-IP Joint British Diabetes Societies for inpatient care

# Glycaemic management during enteral feeding for people with diabetes in hospital

A guideline from the Joint British Diabetes Societies for Inpatient Care (JBDS-IP) group

April 2024



Association of British Clinical Diabetologists

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## This document is coded JBDS 05 in the series of JBDS documents:

### Other JBDS documents:

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**These guidelines can also be accessed via the Diabetologists (ABCD) app (need ABCD membership to access the app)**

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## Statement for the JBDS-IP guidelines

JBDS guidelines have been developed to advise on the care process for people with diabetes currently under hospital care.

The guideline recommendations have been developed and reviewed by a multidisciplinary team led by the Joint British Diabetes Societies for Inpatient Care (JBDS-IP) group. People with diabetes have been involved in the development of the guidelines via stakeholder events organised by Diabetes UK.

It is intended that the guideline will be useful to clinicians and service commissioners in planning, organising and delivering high quality diabetes care. There remains, however, an individual responsibility of healthcare professionals to make decisions appropriate to the circumstance of the individual, informed by them and/or their guardian or carer and taking full account of their medical condition and treatment.

When implementing this guideline full account should be taken of the local context and in line with statutory obligations required of the organisation and individual. No part of the guideline should be interpreted in a way that would knowingly put staff, those with diabetes or anyone else at risk.

## Copyright statement



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# Contents

# Foreword

## Glycaemic management for people with diabetes admitted to hospital and receiving enteral nutrition

Enteral feeding is a commonly used tool to aid nutrition in hospitals. Adequate nutrition is essential to recovery. Managing glycaemic control in people with diabetes receiving enteral feed can be challenging. The largest group of people with diabetes using enteral nutrition are people admitted with stroke but this is also used for post-surgical management and, less frequently, for gastroenterological conditions.

The recent national survey has shown that there is currently considerable variability in the management of diabetes inpatients fed enterally (1). Variation in the inpatient management of hyperglycaemia and hypoglycaemia in people receiving enteral feeding may slow patient recovery and potentially result in further complications such as poor wound healing or super-added infection (2-10).

The aim of this document is to provide guidance to multidisciplinary teams – general physicians, surgeons, specialists, nursing staff, dietitians, and nutrition teams. It aims to provide pragmatic guidance for the inpatient management of people who have diabetes and who require a period of enteral feeding to improve patient outcomes and patient experience.

This document has been produced by the Joint British Diabetes Societies for Inpatient Care group (JBDS–IP) on behalf of Diabetes UK, the Association of British Clinical Diabetologists (ABCD), and the Diabetes Inpatient Specialist Nurse (DISN) UK Group.

This document is produced following a review of the available clinical evidence in this area, the results of a recent national survey, together with the input of a working group of clinical staff with expertise in diabetes and enteral feeding.

*Andrea K. Lake, Mark Green, Omar Mustafa, Daniel Flanagan, Ketan Dhatariya*

## Abbreviations

| | |
|---|---|
| CBG | capillary blood glucose |
| CSII | continuous subcutaneous insulin infusion |
| DISN | diabetes inpatient specialist nurse |
| DIT | diabetes inpatient team |
| DKA | diabetic ketoacidosis |
| FRIII | fixed rate intravenous insulin infusion |
| GLP-1 | glucagon like peptide-1 mimetics |
| HHS | hyperosmolar hyperglycaemic state |
| IV | intravenous |
| NGT | nasogastric tube |
| NPH | neutral protamine Hagedorn |
| NPSA | National Patient Safety Agency |
| PEG | percutaneous endoscopic gastrostomy |
| PEJ | Percutaneous endoscopic jejunostomy |
| PRN | Pro re nata ('when required') |
| PWD | Person/people with diabetes |
| T1DM | type 1 diabetes mellitus |
| T2DM | type 2 diabetes mellitus |
| VRIII | variable rate intravenous insulin infusion |

## Glossary

| | |
|---|---|
| Enteral feeding tube | A combined term for NGT, PEG and PEJ |
| Known insulin deficiency | Any person requiring basal insulin to avoid DKA |
| TDD | Total daily dose of insulin over 24 hours. Includes basal insulin requirements and feed related insulin requirements |
| TFD | Total feed dose is the total dose of insulin required to cover a prescribed feed |

## Summary of recommendations

(See figure 1 for a visual summary of the recommendations)

### Basics

- All people with diabetes receiving enteral feed should be reviewed by the diabetes specialist team, ideally in conjunction with the dietitian/ nutrition team prior to commencing the feed to determine a suitable feed/ treatment regimen
- As it is difficult to predict the individual response to insulin and feed, regular specialist review, frequent glucose testing and timely change to the regimen should be made if glucose targets are not being achieved
- Where out of hours feeding regimens are commenced, a locally agreed guideline, produced by the local dietetic/nutrition and diabetes team should be available to offer diabetes treatment advice

### Subcutaneous basal insulin (not for feed)

- People with type 1 diabetes (or other insulin deficient syndromes) should continue their subcutaneous basal insulin, or a suitable alternative, at all times – even if receiving additional insulin via the subcutaneous or intravenous route
- Basal insulin should not be omitted

### Target blood glucose and monitoring

- Target CBG 6-12 mmol/L during enteral feeding of people with diabetes
- Monitor capillary glucose pre-feed and then 4-6 hourly when the feed is running, when the feed is stopped, and at least 2 hourly during any feed break. Monitor hourly if the feed is unexpectedly switched off or the glucose levels are below the recommended target range
- If the individual is using continuous glucose monitoring before admission and is able to self-manage this may be used in addition to capillary glucose values to aid monitoring

### Therapies

- A number of possible insulin regimens may be used but the time action profile of the insulin should match the glycaemic effect of the feed used (and changed if not achieving target)
- Liquid metformin may be administered via an enteral feeding tube
- Crushing of oral tablet medications for administration via an enteral feeding tube is not recommended

## Hyperglycaemia/hypoglycaemia

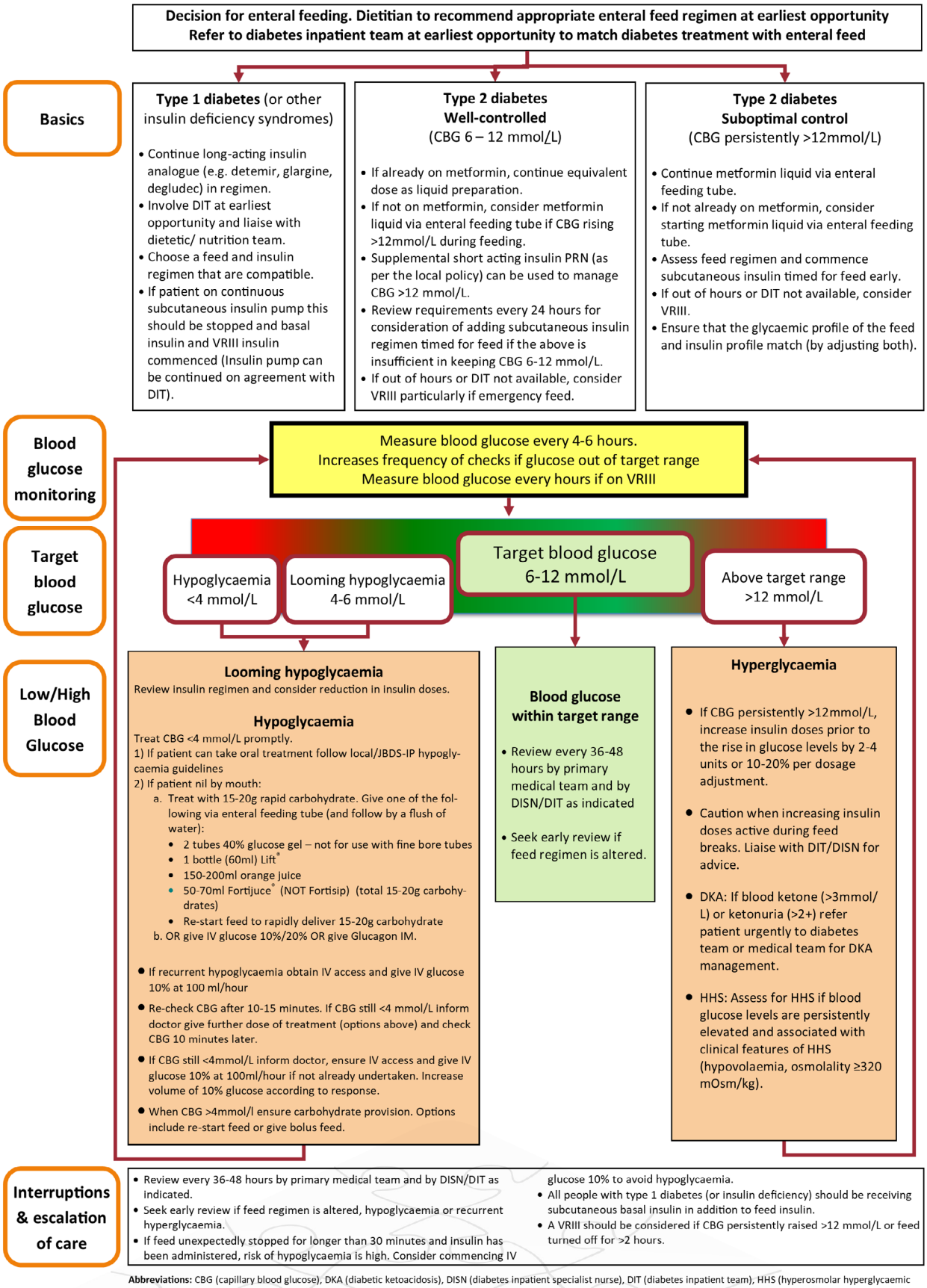
- If feed unexpectedly stopped for longer than 30 minutes and insulin has been administered, risk of hypoglycaemia is high
- If glucose levels are <4.0 mmol/L treat immediately as per local guidance or JBDS-IP hypoglycaemia guidelines
- Ensure hypoglycaemia treatment contains 15g rapid acting CHO and is given via an appropriate route
- Following hypoglycaemia resolution, consider the risk of recurrent hypoglycaemia and consider use of preventative carbohydrate (e.g. restart feed/ IV glucose/ oral carbohydrate where appropriate)
- If the glucose levels are below the recommended target range but above 3.9 mmol/L, consider offering an appropriate carbohydrate treatment equal to 15g carbohydrate to prevent hypoglycaemia
- If the glucose levels are above the target range test ketones in line with local guidance and consider using as required rapid acting insulin correction doses
- In people not receiving insulin with the feed, take caution in giving correction doses within 2 hours of the feed stopping
- n people receiving insulin alongside the feed take caution with any PRN insulin doses given both during the feed break and in the 4 hours before the feed ends

## Escalation of care

- Involve the DISN/DIT immediately in the event of hypoglycaemia or recurrent hyperglycaemia
- If the feed is stopped unexpectedly and feed related insulin has been given, inform doctors and increase glucose testing frequency
- Inform doctors. Consider actions to prevent hypoglycaemia and increase the glucose testing frequency

# Figure 1: Algorithm for the management of hyperglycaemia during enteral feeding of people with diabetes

## JBDS-IP algorithm for the management of blood glucose during enteral feeding




**Abbreviations:** CBG (capillary blood glucose), DKA (diabetic ketoacidosis), DISN (diabetes inpatient specialist nurse), DIT (diabetes inpatient team), HHS (hyperosmolar hyperglycaemic state), IV (intravenous), VRIII (variable rate intravenous insulin infusion)

JBDS-IP (Mar 2024)

# 1. Introduction

Poor glucose control in hospital is associated with adverse outcomes (2-10). Optimising glucose control in hospital has been shown to significantly improve outcomes (9-12). Hyperglycaemia is likely to be encountered if an individual with diabetes is to be fed via the enteral route. Extrapolating from this evidence, optimising glucose control for people with diabetes receiving enteral feed is likely to produce better outcomes. The opinion of this writing group is that controlling hyperglycaemia resulting from enteral feeding will benefit people with diabetes regardless of their presenting condition.

This guideline aims to concentrate solely on control of blood glucose during enteral feeding. Basic principles may be extrapolated, with the input of local diabetes teams, into other clinical situations such as parenteral feeding.

In hospitalised patients fed by the enteral route, the management of hyperglycaemia should be balanced against the risks of hypoglycaemia. Hypoglycaemia during the rest period between feeds, is a potentially life-threatening event, and close monitoring of the patient is recommended at all times. Thus, the focus in the management of hyperglycaemia should be the maintenance of blood glucose within an acceptable range whilst limiting the risk of hypoglycaemia. It is the recommendation of these guidelines that the diabetes inpatient team (DIT) be involved at the earliest opportunity to provide specialist guidance surrounding blood glucose control.

The case studies shown below are examples of poor outcomes experienced by people with diabetes during enteral feeding.

## Case study 1

Zeenat, 54 had been diagnosed with type 1 diabetes at the age of 5. She has had poor control for the last 10 years. She was admitted with a stroke and commenced enteral feeding, which was titrated up to the full rate over 48 hours. She was given a variable rate intravenous insulin infusion (VRIII) for the first 72 hours of her hospital admission, with hourly capillary glucose monitoring. Her basal insulin had been omitted.

The NGT was dislodged and removed, and the intravenous insulin infusion was stopped leaving her without insulin. The NGT was re-sited several hours later but nursing staff were unable to aspirate through the NGT, and a chest X-ray was ordered. There was a delay in getting the x-ray and a delay in it being reviewed. No blood glucose monitoring was carried out.

Staff checked the blood glucose before recommencing the feed and it was 27 mmol/L. An on-call doctor was called and capillary ketones and arterial blood gases were measured. These were consistent with diabetic ketoacidosis (DKA). She was subsequently transferred to the Intensive Care Unit for treatment.

## Case study 2

Elfyn, 82, had been diagnosed with type 2 diabetes at the age of 58 years. Prior to hospital admission he was prescribed glargine, metformin and gliclazide. He was admitted with a left hemiparesis, and a stroke was diagnosed in the medical assessment unit. An NGT was inserted and enteral feeding commenced. The feed was administered over an 18-hour period, with two doses of premixed insulin administered at the start and mid-point of feed.

The NGT became blocked two hours into the feed, and the feed infusion was stopped. The insulin was administered by the ward staff as "patients with diabetes must not miss insulin doses". At 10am the following morning the patient was found to be clammy and drowsy – capillary blood glucose was 1.9 mmol/L. This was a result of receiving feed specific insulin despite the feed being stopped.

# 2. Commencing enteral feeding in a person with diabetes or elevated blood glucose

People with diabetes should be referred to the DIT at the earliest opportunity, preferably prior to feed commencement.

Local guidelines should be adhered to for the setting up of syringe pumps, giving sets, intravenous access, skin bundles and intravenous insulin infusions.

## 2.1 Identifying people at higher risk of clinically significant glucose variability or harm when feed is being planned

Factors that may predict increased glucose variability during the feed:

- T1DM
- Known insulin deficiency (e.g. total pancreatectomy)
- High HbA1c
- High glucose variability prior to feeding
- Hypoglycaemia prior to feeding
- High NEWS score
- Patient at high risk for removing enteral feeding tubes

Actions for high-risk individuals:

- More frequent glucose monitoring - minimum 4 hourly
- Do not start the first feed late in the day or out of normal working hours
- Ensure that the DIT are involved with planning and commencement of feed and insulin
- Consider using multiple short feed initially to achieve early glucose control
- Consider if short term VRIII may be indicated in the first 24-48 hours to establish insulin requirements or optimise glucose control whilst awaiting DIT review and establishing the appropriate feeding regimen

## 2.2 Type 2 Diabetes

The largest group requiring enteral feed will be individuals with type 2 diabetes. Oral hypoglycaemic therapy may be adequate to control glucose, but the combination of insulin resistance associated with acute illness, risk of lactic acidosis or acute kidney injury may mean that their usual medication cannot be used. Metformin can be given as a liquid preparation, via an enteral feeding route. Tablets should not be crushed. If feeding is required urgently then insulin should be used as glucose lowering therapy at an early stage to avoid days of hyperglycaemia associated with oral medication titration. People with type 2 diabetes may have significant endogenous insulin production as well as clinically significant insulin resistance. Large doses of insulin may be required but conversely glucose variability may be less as they may still be making their own insulin. Matching the glucose load to pharmacological activity of the insulin chosen may be less important than for those with type 1 diabetes.

## 2.3 Type 1 Diabetes

Type 1 diabetes presents specific challenges with a higher risk of hypoglycaemia and ketosis. Careful monitoring is required acutely and in the early stages of feeding. The insulin absorption profile needs to match the rate of absorption of glucose from the gut. This may require a change in insulin regimen from that used before admission. As they are unlikely to have endogenous insulin production, a basal insulin will be required to avoid ketosis. Although a single feed with one break is the commonest feed regimen used, particular care is needed for this group to ensure that the insulin regimen chosen matches with absorbed carbohydrate and does not produce hypoglycaemia during the rest period. If a single feed is chosen, then careful monitoring of glucose is required with early review of glucose control to ensure that the regimen is successful.

## 2.4 Type 3c/Secondary diabetes

Following pancreatitis or other pancreatic damage, insulin production can vary considerably between individuals. Some will be entirely insulin deficient (treat as type 1) whereas others may have significant insulin reserve (treat as type 2). It may not be clear at the time of feeding which applies. Pancreatic exocrine insufficiency may also be present. This may influence the rate of carbohydrate absorption of the feed and influence overall glucose control.

# 3. Choice of feed regimen

Diabetes-specific feeds have been used in studies but there is no widespread clinical experience (13-16). Thus, until further evidence is available to demonstrate benefits of diabetes specific feeds over standard feed preparations, this guideline advises that people with diabetes receive the currently available standard feed preparations as recommended by the local dietitian or nutrition team.

There are few studies that compare these feeding regimens for improved glucose control or diabetes related outcomes (1, 15, 17, 18) however, a systematic review is being undertaken and this guideline will be updated based on the results. It is therefore not possible to provide strong recommendations for any specific feed regimen. Instead the feed regimen should be guided by the needs of the patient. Following a national audit in 2022 (1) we did identify the most commonly used feeding regimens for people with diabetes in hospital. There are potential benefits and challenges for each of the most commonly used regimens.

## 3.1 Single feed regimen

There is no clear evidence that any single feed regimen is advantageous for people with diabetes. The commonest feed regimen used in UK hospitals is a single long feed with a break. For example, 20-hour feed with 4-hour break. This is theoretically advantageous as it gives the gastrointestinal tract a period without feed (although some question the evidence for this). An advantage of this feed regimen is that ward teams are familiar with the routine of starting and maintaining the feed. This is often the first choice of feed regimen for people with diabetes. The disadvantage of this feed regimen is that it is difficult to match a 20 hour feed with a break to the glucose lowering effect of the commonly used insulins. This feed/ insulin regimen probably works best if individuals have some endogenous insulin production. Careful review at 36-48 hours should be performed to assess whether this feed regimen should be continued.

Another disadvantage of this feed regimen is it is at greater risk of unintentional disruptions. Common causes for disruption include:

- Showers/ washes
- Leaving the ward for procedures
- Accidental tube removal or blockage
- Feed stopped for administration of drugs

A further disadvantage is there is only a small break window, therefore if the feed is delayed for any reason, it can easily mean the shift away from the prescribed start/ stop times. Although not always problematic, if a person is on twice daily intermediate basal insulin alongside their feed a shift in the time of day could change their insulin sensitivity at the corresponding feed time.

## 3.2 Continuous 24-hours feed regimen

For people with diabetes (and in some units for people without diabetes) continuous 24-hours feed is used. This has the advantage of giving a continuous glycaemic load providing a more stable blood glucose which may be easier to match with the choice of insulin regimen. This regimen is more commonly used in high dependency and intensive care units as a high level of clinical supervision is required to ensure that there are no breaks in the feed. A number of centres use enhanced feed regimens where the rate of feed is increased to compensate for breaks in feeding. The glycaemic effect of this changing glucose load needs to be considered if a subcutaneous insulin regimen is chosen.

A disadvantage of a continuous feed regimen, like that of a single break feed, is that on a general medical or surgical ward, feeds are frequently interrupted. This may require intervention to prevent hypoglycaemia. On a busy ward this is often overlooked or delayed resulting in hypoglycaemia. If this regimen is chosen it is important that the ward team are aware of the risk and adequate safeguards are in place.

## 3.3 Multiple short feed regimen

A third option used in a number of centres are multiple short feeds (or bolus feeding) in a 24-hours period, For example, 3 feeds of 4 hours during 24 hours, 2 feeds of 6 hours duration or bolus feeds. This regimen may potentially provide a closer match with the pharmacodynamics of the available subcutaneous insulins. It requires more nursing time to administer this regimen. The timing of insulin administration is important. A mismatch in the timing of insulin and feed can increase the risk of hyper or hypoglycaemia.

In the acutely unwell patient, there are a number of variables that will influence the measured blood glucose. It is difficult therefore to predict the effect of a particular feed/ insulin combination. It is an important principle that glucose is checked frequently and at relevant times particularly when feed is being established. The DIT and dietetic/ nutrition team need to review glucose control at 36-48 hours and consider a change in regimen if the glucose range is not within 6-12 mmol/L. We recommend that the dietetic and diabetes team come to a joint decision about the feed/insulin combination. Feed rates are usually slowly titrated until the desired feed rate is achieved. Insulin doses need to match the increasing feed rate. It would be recommended that the carbohydrate content (total and per hour) is documented as part of the feed regimen review as this information can be used to inform insulin dosing.

**There are few studies that compare these three approaches. Early review to assess whether the chosen regimen is achieving glycaemic targets is important. Consideration should then be given to not just changing the insulin but also changing the feed regimen if required.**

# 4. Choice of agent to achieve glycaemic control

**Outline**

- Short term VRIII may be indicated in the first 24-48 hours to establish insulin requirements or optimise glucose control whilst awaiting DIT review and establishing the feeding regimen
- If capillary blood glucose persistently >12 mmol/L the treatment regimen should be reviewed and optimised promptly
- Metformin and insulin are the only two recommended treatment options to optimise glucose control during enteral feeding
- If not contraindicated, in patients already taking metformin this should be continued. Can be given as liquid preparation via the enteral feeding tube during feeding
- Avoid administering metformin during feed breaks
- Consider commencing the use of metformin in any patient with type 2 diabetes and persistent glucose >12 mmol/L as long as there are no contraindications
- If metformin is contraindicated or if the patient requires insulin prior to admission, then commence/ optimise subcutaneous insulin (see section 'insulin options')
- In those initially treated with metformin, if glucose levels continue to be >12 mmol/L commence an insulin regimen alongside metformin (see section 'insulin options')
- When not on VRIII, PRN rapid acting insulin can be used to correct glucose levels >12 mmol/L however, caution should be taken when given < 4 hours before a feed break (see section 'insulin options')
- Involve the patient and DIT at the earliest opportunity

The titration of enteral feed may take 3-4 days. While the use of a VRIII can be helpful in establishing insulin requirements, enteral feeding is often used for long periods. High dependency/ intensive care units may choose to continue with intravenous insulin as staffing levels allow closer monitoring. General wards should aim however to discontinue and commence a long term treatment regimen as soon as the clinical situation allows. The administration of liquid metformin and/or subcutaneous insulin will be effective, and more acceptable to patients.

# 5. Non insulin treatment

Metformin liquid administered via the enteral feeding tube should be continued where appropriate in any patient on metformin prior to admission, and may be considered for mild hyperglycaemia (e.g., capillary blood glucose up to 12 mmol/L) in people with well controlled type 2 diabetes, or as an adjunct in uncontrolled type 2 diabetes. PRN rapid acting insulin may be used alongside in accordance with local guidelines which the metformin is optimised. PRN insulin should be given with caution prior to or during a feed break.

The patients' usual oral hypoglycemics should not be administered unless they are eating sufficiently orally. Crushing oral hypoglycaemic medications, such as sulfonylureas, to manage hyperglycaemia during enteral feeding is not advised given the unpredictable absorption and difficulties in administration associated with this action, as well as the risk of tube blockage with crushed debris. However, once the enteral feed is stopped and the patient is able to swallow safely, the patient with type 2 diabetes may be able to return to oral pharmacotherapy to control hyperglycaemia. However, a dose review should take place prior to recommencing any diabetes therapy.

There is currently no data to support the use of glucagon-like peptide-1 mimetics (GLP-1), gliptins or SGLT2i in the management of hyperglycaemia during enteral feeding.

# 6. Insulin regimens

- People with known type 1 diabetes or known insulin deficiency (e.g. total pancreatectomy) must continue their subcutaneous basal insulin at all times
- The total feed dose is different to the total daily dose (TDD). The total daily dose is the total dose of insulin a patient requires over 24 hours and includes basal insulin requirements to meet their basic needs. The TFD is the insulin required to cover the enteral feed and contributes to the TDD
- The insulin regimen required will depend on the feed type and duration
- Consider the use of PRN rapid acting insulin to correct glucose levels >12 mmol/L however, given with caution prior to or during a feed break
- If no access to DIT refer to local guidelines for management of hyperglycaemia

A VRIII is reactive management to an elevated capillary glucose and much discussion in the literature is devoted to the effectiveness of a VRIII (19). Furthermore, there is little evidence to suggest that intravenous insulin dose can be used to predict an appropriate subcutaneous insulin dose, although strategies by consensus are available, see Appendix 2. Thus the use of subcutaneous insulin at the earliest opportunity to manage hyperglycaemia is desirable.

There are many options available when choosing an insulin regimen. It is important to note that a "one size fits all" approach is not possible in this situation. The patient has to be managed as an individual and the insulin chosen for its appropriateness with the feed regimen. Points to consider are:

- type of diabetes
- duration of feed
- frequency of rest periods
- most recent HbA1c
- age and weight
- previous total insulin doses or carbohydrate to insulin ratio if already taking insulin

It is important that whichever feed regimen is chosen the insulin regimen must attempt to match the glucose effect of the feed and vice versa. Both the feed regimen and insulin regimen can be adjusted. In some situations, it may be simpler to change the feed regimen to match the glucose lowering effect of the insulin rather than changing the insulin, however it is essential to ensure the patients nutritional needs are being met. Table 1 summarises the advantages and challenges of each feed regimen with suggested insulin regimens to match that feed.

**People with known type 1 diabetes or known insulin deficiency (e.g. total pancreatectomy)** should be reviewed by the DIT at the earliest opportunity and must continue their subcutaneous basal insulin at all times to avoid potentially life threatening DKA. If a patient with known type 1 diabetes or known insulin deficiency is nil by mouth and no enteral feed is prescribed or the feed is stopped for longer than two hours, a VRIII may be required if PRN rapid acting insulin is ineffective at correcting suboptimal glucose control, or the fasting state is deemed to be an increased risk for contributing to ketosis. Follow local VRIII protocols in order to avoid hypoglycaemia and achieve target glucose range 6-12 mmol/L. Continue basal insulin alongside VRIII. Bolus doses of soluble or rapid acting insulin may then be introduced and VRIII discontinued to manage carbohydrates consumed (oral or enteral).

**People admitted with continuous subcutaneous insulin infusion (CSII) devices** (likely type 1 diabetes) should be referred to the DIT for assessment and ongoing review. We recommend that where the trust can offer specialist pump advice for the patient and the patient is able to self manage their pump, it may be continued to meet basal insulin requirements and cover any oral carbohydrates consumed. If the patient is not fully competent and able to manage the insulin pump or there is no specialist pump support available then it should be discontinued, and a subcutaneous insulin injection regimen be commenced. Do not remove CSII until a replacement regimen has been commenced. While awaiting assessment VRIII can be used to replace CSII. Bolus doses of soluble or rapid acting insulin may then be introduced to manage carbohydrates consumed (oral or enteral).

**People with any type of diabetes, admitted to hospital on a basal insulin** should be reviewed by the DIT at the earliest opportunity. These patients should continue the basal insulin during enteral feeding. In patients with risk factors for hypoglycaemia you may wish to reduce the basal insulin dose by 20%. Bolus doses of soluble or rapid acting insulin may then be introduced to manage carbohydrates consumed (oral or enteral).

**People with any type of diabetes, admitted to hospital on a mixed insulin** should be reviewed by the DIT at the earliest opportunity. These patients should be commenced on basal insulin to mimic their usual basal insulin doses received from their usual mixed insulin regimen minus 20%. For example, if a patient is on 20 units of Humulin M3 (or Novomix 30) they receive 30% bolus insulin and 70% basal insulin, therefore they would require 11 units (14 units basal insulin - 20% = 11 units). Bolus doses of soluble or rapid acting insulin may then be introduced to manage carbohydrates consumed (oral or enteral).

**Insulin naive patients** should be reviewed by the DIT at the earliest opportunity. Short term VRIII may be indicated in the first 24-48 hours to establish insulin requirements or optimise glucose control whilst awaiting DIT review and establishing the feeding regimen. Alternatively a weight based calculation can be used, although there is no consensus regarding this. With all regimens the intravenous insulin infusion should not be discontinued for at least 30 to 60 minutes after the administration of the subcutaneous dose given in association with the feed.

Key considerations for commencing insulin in patients with diabetes receiving enteral feed:

- Involvement of the DIT - this is likely to be the most efficient way of initiating subcutaneous insulin
- Where available refer to local protocols for insulin initiation
- Where insulin requirements are unknown, estimation of the insulin requirement should take account of carbohydrate intake via the enteral feed, individual insulin sensitivity, weight and prior insulin use

## Commonly used insulin regimens:

- Pre-mixed biphasic (30/70) insulin administered at the start of the feed, with the option for a second dose at the midpoint of the feed if feed duration ≥ 16 hourly. Where two doses are required, you can start with either a 50/50 dose split or where glucose levels spike after start of the feed you can give 60% of the required total daily dose administered at start of the feed and 40% at the mid point dose. This is providing the feed rate is steady for the duration of the feed and these doses may need adjusting. Pre-mixed insulin is invaluable if the feed duration is shortening gradually, as the second dose can be reduced and the first can be increased, as hourly volume increases
- Intermediate basal insulin. This regimen requires a single administration of isophane (NPH) insulin at the start of the feed, with a further dose likely to be required at the midpoint of the feed if feed duration is ≥16 hours. Bolus short acting analogue or soluble insulin dose(s) may be added during the feed period (e.g., at the start and mid-point of the feed or at the start and then 6 hourly during the feed for soluble insulin and 4 hourly for analogue bolus insulin)
- Basal bolus insulin regimen already prescribed. The basal insulin should be administered at the same time each day. This may be at the usual administration time prior to admission, or when indicated to coincide with the start of a feed, if clinically appropriate. The rapid acting analogue insulin doses will need to be reviewed and can then be given at the start of the feed and 4 hourly thereafter, ensuring no feed related rapid acting insulin dose is given within the 4 hours of the feed ending. This is a benefit for patients with basal requirements who may experience disruption in their feed as the rapid acting insulin is of shorter duration and can be omitted if feed is interrupted
- Bolus insulin only is of particular use for bolus feeding. For bolus feeds given over 4-6 hours, a single dose of soluble human insulin, administered 20 minutes prior to the start of the bolus feed can be given. For bolus feeds given as a bolus or over < 4 hours an analogue insulin, administered 0-15 minutes prior to administration of the feed can be given to cover the carbohydrate content. This would not be used for any patient with basal insulin requirements
- Long-acting analogue insulin may be used alone. This regimen may be helpful if the individual is felt to have sufficient endogenous insulin and a continuous feed regimen is chosen
- If VRIII has been used prior to sc insulin this can be used to help calculate the dose of insulin required: consider both the total feed dose of insulin received minus 20% and the rate administered. Some people with diabetes have higher requirements at the start of the feed compared to later or may have lower insulin requirements for any part of the feed received overnight see appendix 2

As the feed rate and volume increases, the subcutaneous insulin dose will need to be titrated appropriately and considerations of total PRN insulin use should also be considered when titrating the insulin dose. Typical insulin titrations are by 10-20% however, some patients may require far larger dose titrations to achieve adequate glucose control – involve the DIT as early as possible in the care of these patients.

See Table 1 for further insulin options to aid a decision on which type of insulin regime may be most suitable for the patient.

## Table 1: Feed regimens matched with insulins

| Feed regimen | Advantages | Disadvantages | Commonly insulin regimens for people with Type 1 or insulin deficient diabetes | Commonly insulin regimens for people with type 2 diabetes or likely to have some endogenous insulin production |
|---|---|---|---|---|
| **Single feed with one break** (for example 20-hour feed with 4-hour break | A commonly used regimen.<br>The ward team will be familiar with using this regimen.<br>Interventions may be planned for when the feed is stopped. | Difficult to match insulin regimen with carbohydrate due to varying insulin sensitivity throughout the feed<br>Greater risk of unintentional disruptions<br>May be disruptive for patients due to overnight insulin requirements or interventions and prolonged periods of time attached to the feed. | **VRIII** may be used in the initial period of feeding to stabilise glucose and estimate insulin requirements while feeding regimen is established. With all regimens the intravenous insulin infusion should not be discontinued for at least 30 to 60 minutes after the administration of the subcutaneous dose given in association with the feed.<br>**Basal bolus insulin** continue usual **long-acting** insulin with either 4 hourly rapid acting analogue insulin doses from start of the feed or 6 hourly soluble quick acting insulin doses from start of the feed. No feed specific regular rapid acting insulin doses should be prescribed within 4 hours of the feed ending or 6 hours of the feed ending for quick acting soluble insulin. | **Intermediate basal insulin** administration of isophane (NPH) insulin at the start of the feed, with a further dose likely to be required at the midpoint of the feed if feed duration is ≥16 hours with either a 50/50 dose split or where glucose levels spike after start of the feed, consider 60% of the required total feed dose (TFD) administered at start of the feed and 40% at the mid point dose<br>**Pre-mixed biphasic (30/70) insulin** at start and halfway through feed if feed duration >16 hours. Where two doses required, take TFD and divide with either a 50/50 dose split or where glucose levels spike after start of the feed, consider 60% of the required total daily dose administered at start of the feed and 40% at the mid point dose |
| **Continuous 24-hours feed** | The glycaemic effect of the feed is more predictable (although the blood glucose may still vary due to insulin sensitivity over 24 hours). | Ward teams need to be aware of the risk of hypoglycaemia if the feed is stopped.<br>Can be difficult to adequately supervise if staffing numbers are low.<br>May be disruptive for patients or lead to overnight insulin requirements or interventions | **VRIII** may be used in the initial period of feeding to stabilise glucose and estimate insulin requirements while feeding regimen is established. With all regimens the intravenous insulin infusion should not be discontinued for at least 30 to 60 minutes after the administration of the subcutaneous dose given in association with the feed<br>**Basal bolus insulin** continue usual **long-acting** insulin with either 4 hourly rapid acting analogue insulin doses from start of the feed or 6 hourly soluble quick acting insulin doses from start of the feed. | **Long-acting analogue insulin** at the start of the feed<br>**Pre-mixed biphasic (30/70) insulin** at start and halfway through feed if >16 hours. Where two doses required, take TFD and divide with either a 50/50 dose split or where glucose levels spike after start of the feed, you can give 60% of the required total daily dose administered at start of the feed and 40% at the mid point dose |
| **Multiple short feeds**. (for example, 3 feeds of 4 hours) | A more flexible regimen where the feed rate can be adjusted to match the capillary glucose.<br>More closely matches the pattern of normal eating and may therefore better support patients self-administration and management. | The regimen requires more intervention by the ward team.<br>It is important that the timing of the insulin is matched with the feed times. | **Basal bolus insulin** Continue usual basal insulin with either 4 hourly rapid acting analogue insulin doses from start of the feed or 6 hourly soluble quick acting insulin doses from start of the feed. | **Bolus insulin only** For bolus feeds given over 4-6 hours, a single doses of soluble human insulin, administered 20 minutes prior to the start of the bolus feed can be given. For bolus feeds given as a bolus or over < 4 hours an analogue insulin, administered 0-15 minutes prior to administration of the feed can be given to cover the carbohydrate content. This would not be used for any patient with basal insulin requirements. |

## 6.1 Insulin administration for feed regimens involving a rest period

Careful consideration of the timing of insulin in relation to the rest period should be undertaken – insulin administered towards the end of the enteral feed may induce hypoglycaemia during the rest period. Some patients have tube feeds at night to allow activities or some oral intake during day, and the effects of exertion and bolus oral feeding will need to be factored into the insulin regimen. Other patients are fed during the day, and in these circumstances, the risk of nocturnal hypoglycaemia is high, particularly if medium or long-acting insulin products are administered. Insulin sensitivity in the day compared to night may also be a consideration if the prescribed feed timing is changed.

Many NHS organisations favour the use of human insulin (isophane) in the initial management of type 2 diabetes. However, long-acting basal insulin analogues (e.g., glargine, detemir) may be more safely used in non-hospitalised patients with type 1 diabetes, as the risk of hypoglycaemia with these agents may be reduced (20). A decision on substituting analogue for human insulin is likely to be best made by the DIT. All insulin regimens should be reviewed at least every 48 hours by the DIT. Where possible, the continuation and adaptation of the patient's usual insulin type is recommended.

## 6.2 Prescribing insulin for enteral feeding

Insulin safety remains paramount during periods of enteral feeding. It is important to ensure that prescriptions of insulin for enteral feeding include instructions for when to administer the insulin in relation to the enteral feed (at the start of the feed or X hours into feed). Insulin prescription should not simply state 'administer when the patient is receiving enteral feeding'. This is to avoid adverse events linked to insulin such as hypoglycaemia when feeds are withheld or stopped, but the insulin prescriptions remain active (on paper charts or electronic prescriptions).

PRN insulin for hyperglycaemia should follow local guidance and be the same brand as any rapid or quick acting insulin prescribed for administration during the feed, this is to allow for PRN correction doses to be added on to their feed related doses. If the patient is not on any bolus insulin doses then the insulin type should be in line with local guidelines. PRN insulin should be given with caution prior to or during a feed break.

People with known type 1 diabetes or known insulin deficiency should be reviewed by the DIT at the earliest opportunity and must continue their subcutaneous basal insulin at all times to avoid potentially life threatening DKA.

Where pancreatic exocrine insufficiency is also present ensure the correct digestive enzymes are prescribed. This may influence the rate of carbohydrate absorption of the feed and influence overall glucose control.

# 7. Managing a patient on the ward with an enteral feed

A discussion on the issues in relation to swallow, oral feeding and the insertion of an NGT is beyond the scope of this document.

A multidisciplinary approach to managing the patient with enteral feeding is advocated. It is advantageous to include the DIT to plan the diabetes treatment once the enteral feed protocol is recommended by the dietitian or the multidisciplinary feeding/nutrition team. Where out of hours or emergency feeding guidelines are in place, they should include what to do if the patient has diabetes or cross reference to a specific local guideline. Medical teams should be mindful of the refeeding syndrome in those patients in whom feeding is delayed – a description of the diagnosis and management of refeeding syndrome is also beyond the scope of this document.

A structured competency assessment should be in place for all staff in Acute Trusts who have contact with inpatients with diabetes. Competency is defined as a level of performance demonstrating the effective application of knowledge, skill, and judgement. A structured, skill-based competency assessment, should be developed for managing hypoglycaemia and DKA, managing insulin infusions, managing diabetes and parenteral nutrition, and in patients treated with steroids. These core competencies must be established not just for physicians and nurses but also for dietitians, midwives, healthcare assistants, allied healthcare professionals and pharmacists as the primary providers of patient care and education. For more detailes please refer to section 5 of the JBDS-IP 'Good inpatient service' guideline (21). The JBDS-IP has considered the composition of the DIT to support non-specialist teams in this paper (22).

Clinical staff need to have a good understanding of:
- Different types of diabetes and their associated risks
- Capillary glucose and ketone monitoring
- The definition of hyperglycaemia and hypoglycaemia
- The duration of action of different insulin products
- Knowledge of the circumstances in which the DIT should be consulted
- The ability to titrate and stop feed when required
- Managing hypoglycaemia in an appropriate and timely manner
- Recognising and managing hyperglycaemia, glycaemic excursions and variability linked to enteral feeding

Common causes of glycaemic disturbance during enteral feeding:
- The feed regimen is altered, planned or unplanned
- Diabetes treatment regimen not given as prescribed
- Enteral feeding tube displacement
- Oral feeding recommenced
- The patient's activity levels increase (e.g. with physiotherapy)
- Illness leading to changes in insulin resistance
- Alteration in medication use, e.g. addition of glucocorticoids or omission of oral hypoglycaemic agents

## 7.1 Considerations for the ward nurse

- Glucose monitoring should always take place at the start of the feed, end of the feed and during any feed breaks. Frequency of glucose testing whilst on the feed will depend of feed duration, type of diabetes and diabetes treatment, (see section 8)
- Ketone testing should be undertaken in line with local guidelines but patients at particular risk are those with type 1 diabetes and insulin deficiency
- Where possible, feeds should always be started at the prescribed time. This is because insulin sensitivity changes day to night, therefore if the feed is started at different time of day, the corresponding insulin dose may no longer be correct
- Where a feed has had to be started at a different time of day, especially if moved from day to night, increase glucose monitoring and be mindful of hypoglycaemia
- Always review the full prescription comments before administering any feed specific diabetes related medication to ensure it is being administered at the correct time associated to the feed
- If the feed is interrupted and any feed related insulin is still active there will be an increased risk of hypoglycaemia. Increase glucose monitoring and consider IV dextrose to replace the lost carbohydrate until the feed can be restarted
- Immobility and impaired movement and sensory disturbances increase the risk of foot/heel ulceration. Foot assessments should be undertaken and documented every shift. If heel ulceration occurs the foot team or diabetes inpatient team must be urgently contacted and local guidelines followed
- Where pancreatic exocrine insufficiency is also present ensure the correct digestive enzymes are prescribed. This may influence the rate of carbohydrate absorption of the feed and influence overall glucose control
- PRN insulin for hyperglycaemia should follow local guidance and be the same brand as any prescribed for administration during the feed, this is to allow for PRN correction doses to be added on to their feed related doses. If the patient is not on any bolus insulin doses then the insulin type should be in line with local guidelines
- PRN insulin should be given with caution prior to or during a feed break
- Ensure all members of the MDT, including the DIT are aware of planned changes to the feed regime before the changes are commenced
- As the clinical condition changes, nursing staff should inform the medical team and may need to refer back to the DIT to alter insulin doses, or transfer to oral hypoglycaemic agents

## 7.2 Considerations for the ward doctors/surgeons

- Ensure any feed related prescriptions clearly state the feed specific timing and route
- Ensure any feeds are prescribed with a start and stop time
- PRN insulin for hyperglycaemia should follow local guidance and be the same brand as any prescribed for administration during the feed, this is to allow for PRN correction doses to be added on to their feed related doses. If the patient is not on any bolus insulin doses then the insulin type should be in line with local guidelines
- PRN insulin should be given with caution prior to or during a feed break

- If a patient with known type 1 diabetes or known insulin deficiency and is nil by mouth and no enteral feed is prescribed or the feed is stopped for longer than two hours, a VRIII may be required if PRN rapid acting insulin is ineffective at correcting suboptimal glucose control, or the fasting state is deemed to be an increased risk for contributing to ketosis
- Where pancreatic exocrine insufficiency is also present ensure the correct digestive enzymes are prescribed. This may influence the rate of carbohydrate absorption of the feed and influence overall glucose control
- Ensure all members of the MDT, including the DIT are aware of planned changes to the feed regime before the changes are commenced
- Glucose review should be undertaken daily at each ward round and as the clinical condition changes the team may need to refer back to the DIT to alter insulin doses, or transfer to oral hypoglycaemic agents

## 7.3 Considerations for the ward dietitian

- Liaise with the DIT to discuss optimal feed duration (in order to more easily match glucose lowering therapy options)
- Consider the patients type of diabetes, expected duration of enteral feeding and glycaemic index of any recommended enteral feeding regimen recommended
- When deciding feed regimen and start times for people who require insulin treatment, avoidance of insulin doses overnight should be considered where possible
- Ensure any feeds are prescribed with a start and stop time
- Where pancreatic exocrine insufficiency is also present ensure the correct digestive enzymes are prescribed. This may influence the rate of carbohydrate absorption of the feed and influence overall glucose control
- Insulin doses need to match the increasing feed rate. It is recommended that the carbohydrate content (total and per hour) is documented as part of the feed regimen review as this information can be used to inform insulin dosing
- Ensure all members of the MDT, including the DIT are aware of planned changes to the feed regime before the changes are commenced
- Refer to the DIT as required

## 7.4 The role of the Diabetes Inpatient Team

The diabetes inpatient team should be available for:

- A comprehensive patient centred assessment of all aspects relating to a patients' diabetes management whilst on enteral feeding
- Formulating a diabetes management plan with the MDT and where appropriate, the patient and ensuring this is clearly documented and handed over
- Consultation in the event of hypoglycaemia and/or persistent hyperglycaemia.
- Education of staff in clinical areas involved in the management of patients who have diabetes receiving enteral feeding

# 8. Blood glucose testing

**Outline**

- Aim to keep glucose within target range 6-10 mmol/L, up to 12 mmol/L acceptable
- Patients with T1DM may require VRIII, with IV glucose if the feed is off/not prescribed, and the person is nil by mouth

This guideline may apply to all people with new or known hyperglycaemia and receiving enteral feeding with or without diabetes. Capillary blood glucose persistently >12 mmol/L should be treated following the advice given in sections 4 choice of agent to achieve glycaemic control, section 5 non-insulin options and section 6, insulin options.

## 8.1 Blood glucose targets

**Outline**

- Fasting/Pre-feed 6-10 mmol/L
- Feeding 6-12 mmol/L
- If capillary blood glucose <4 mmol/L or persistently>12 mmol/L on two consecutive occasions or evidence of ketonaemia/ketonuria then inform the DIT or on-call medical team

Evidence to support target ranges of blood glucose for inpatients with diabetes is weak, instead consensus to achieve safe glucose control, avoiding adverse glycaemic events has been widely adopted. (9, 23, 24). Data to support target glucose ranges for people with diabetes receiving enteral feed is weaker still (1). However, infection rates and other morbidity outcomes from inpatient hospital stay, increase with deteriorating glucose control. Similarly, patients experiencing hypoglycaemia in hospital experience lengthened hospital stay, and hypoglycaemia may have consequences in the acute and long term (11) . Patients with evolving cerebral damage may be particularly vulnerable to the neuroglycopaenic effects of hypoglycaemia. Thus intuitively, avoidance of excessive hyperglycaemia and hypoglycaemia should be aspirational in the management of all people with diabetes in hospital.

It is the opinion of this writing group that a target glucose range of 6-10 mmol/L with occasional readings up to 12 mmol/L considered acceptable is appropriate for the management of diabetes during enteral feeding in an attempt to limit the risk of adverse glycaemic events. These targets also align with other JBDS-IP recommended target ranges for people in diabetes during hospital admission.

If the capillary blood glucose is persistently >12 mmol/L (on two consecutive occasions), or in the event of a single episode of hypoglycaemia (capillary blood glucose <4 mmol/L), then a review should take place to identify causal factors and the diabetes management regimen should be reviewed. DISN or DIT may be contacted. Out of hours, the medical on-call team should be contacted. If these teams are unavailable see sections below in relation to hypoglycaemia and hyperglycaemia.

## 8.2 Frequency of bedside glucose monitoring

**Outline**

- Depends on whether feed is continuous, intermittent or bolus
- During continuous feeding monitor blood glucose pre-feed and then 4 hourly when patient receives rapid acting analogue subcutaneous insulin or 4-6 hourly when patient receives soluble insulin or basal only
- If intermittent feeding, monitor blood glucose pre-feed, and then 4 hourly when patient receives analogue subcutaneous insulin or 4-6 hourly when patient receives soluble insulin, at end of feed, 2 hours post feed and 4 hourly during prolonged intervals between feeds
- If bolus only feeds then monitor blood glucose pre-feed, 2 hours post feed and 4 hourly during prolonged intervals between feeds
- Beware of risk of hypoglycaemia during the fasted period between feeds or during feed interruptions
- Monitor blood glucose hourly if the person is receiving VRIII
- Beware of hypoglycaemia as cause of drowsiness in patients with stroke or other known neurological impairment

The frequency of bedside capillary blood glucose testing should be a clinical decision based on the stability of the patient. As a general rule, inpatients with diabetes should have a bedside capillary blood glucose checked 4-6 hourly. In the event of hypoglycaemia or recurrent hyperglycaemia, capillary blood glucose should be undertaken on a more frequent basis (e.g., every 15 minutes following treatment for hypoglycaemia) and then a minimum of 2 hourly until a review of the diabetes regimen has taken place in order to assess response to an intervention or to ensure return of glucose to the accepted range. **A capillary blood glucose should be checked prior to feed commencement and within 2 hours of feed discontinuation for all feed regimens**

It should be stressed that patients receiving enteral feed should not have their blood glucose checked only at the ward mealtimes. The care of people with diabetes receiving enteral feeding should be based on clinical need rather than that dictated by ward routine.

When the feed is stopped unexpectedly, and insulin has been or is being administered, healthcare practitioners should be acutely aware of the risk of hypoglycaemia. In this "fasted" state, we recommend the capillary blood glucose be checked hourly and a glucose infusion considered to replace missed carbohydrate intake.

# 9. Ketone monitoring

Patients with type 1 diabetes or significant insulin deficiency will be at increased risk of ketosis during a fasted state, acute illness or simply excess hyperglycaemia. Ketone monitoring should be undertaken in line with local guidance. Any result >0.6 mmol/L should be considered elevated, reviewed by the medical team and referred to the DIT if required.

In the presence of ketonaemia (>3 mmol/L) or ketonuria (>2+), consider a fixed rate intravenous insulin infusion (FRIII) to suppress ketone body formation as suggested in the JBDS-IP DKA guidelines (25), and refer the patient urgently to the diabetes inpatient team or if unavailable, the on-call medical team.

# 10. Actions to undertake if feed stopped unexpectedly

Whatever the reason for stopping the feed, it is necessary to remember that insulin may already have been administered and still be active. This will continue to drive blood glucose down. The patient should thus be monitored for signs of hypoglycaemia and the blood glucose level measured regularly.

- The capillary blood glucose should be checked hourly, and more frequently (up to every 15 minutes) if symptoms or signs of hypoglycaemia are present
- Consider the use of IV glucose to replace lost carbohydrate to prevent hypoglycaemia
- If the feed is stopped at an unplanned time and a feed related subcutaneous insulin dose is due, do not administer that insulin dose
- It is advised that the appropriate feed related insulin dose should be given when the feed is recommended, remembering this may be a different dose to the one missed
- Consult the DIT or on call medical team if unavailable, should the feed be withheld for a prolonged period

Patients with type 1 diabetes or sufficient insulin deficiency:

- Should always receive basal insulin, and this should never be omitted
- If the feed has been stopped for a prolonged period, consideration for the use of PRN rapid acting insulin or, if indicated, a VRIII may be required
- If the patient has received basal insulin, and the feed is off, then hourly monitoring of blood sugar will be required initially

# 11. Actions in the event of hyperglycaemia

Hyperglycaemia in hospitals confers poor outcomes in critical illness (2-4). For the purpose of these guidelines, hyperglycaemia is considered to be a capillary blood glucose level above 12 mmol/L. Where indicated ketone testing should be undertaken in line with local guidance.

In the presence of ketonaemia >0.6 mmol/L refer to local ketone testing and DKA policy

In the absence of ketonaemia, the use of PRN rapid acting insulin doses can be considered alongside a feed related insulin regimen to correct hyperglycaemia. Where used, the PRN insulin should be the same as any rapid or short acting insulin being used as part of the feed related insulin regimen and prescribed in line with local practice. Assessment for use of PRN insulin should be based on glucose readings taken at the recommended times in section 8.2. If glucose levels are taken outside of these times, caution in the use of PRN insulin should be taken and consideration of any active insulin already given. PRN insulin should be given with caution prior to or during a feed break

Alongside this, the optimisation of any prescribed subcutaneous insulin doses prior to a pattern of rise in the glucose levels, can usually be increased safely by 2 – 4 units (or 10-20%) incrementally until the target capillary glucose control is achieved. Some patients may require much larger insulin titrations – involve the DIT if hyperglycaemia persists despite titration of insulin doses.

# 12. Actions in event of hypoglycaemia

Any capillary blood glucose less than 4.0mmol/L should be treated in line with the local hypoglycaemia policy and the patients regularly prescribed diabetes treatment reviewed. In a patient who requires enteral feeding there may be specific risk factors for the development of hypoglycaemia – see table 2.

**Table 2 Specific risk factors for hypoglycaemia in people requiring enteral feeding**

| |
|---|
| • Feed stopped to give medication |
| • Feed stopped for physiotherapy/ procedure |
| • Vomiting |
| • Misplacement or removal of enteral feeding tube |
| • Insulin and oral medication not given at appropriate time for feed |
| • Reduced carbohydrate intake as feed volume reduced |
| • Alteration of type of feed, or timing of feed |
| • Change in time or duration of rest period |
| • Hypoglycaemia in the previous 24 hours |
| • Increased physical activity (e.g., during physiotherapy input) |
| • Use of steroids or other drugs affecting insulin resistance – titration, omission or cessation |

People with varying degrees of neurological injury or impairment may potentially mask the symptoms of hypoglycaemia – for instance confusion, drowsiness, odd behaviour, speech difficulty or un-coordination. In the event of hypoglycaemia, rapid action is indicated to correct the capillary blood glucose to above 4 mmol/L, and to maintain blood glucose at this level.

Table 3 indicates suggested actions to be undertaken in the event of hypoglycaemia in this patient group adapted from the national guidelines for the management of hypoglycaemia produced by the JBDS-IP (26).

**Table 3**

**Treatment of hypoglycaemia in those with impaired swallow and with an enteral feeding tube in situ.**

<table>
<tr><td colspan="2">1 -Blood glucose <4 mmol/L give one of the following treatments:<br>treat promptly</td></tr>
<tr><td>If patient has no IV access give ONE of the following via enteral feeding tube:<br>a. 2 tubes 40% glucose gel - not for use with fine bore enteral feeding tube<br>b. 1 bottle (60ml) Lift®<br>c. 150-200 ml orange juice<br>d. 50-70ml Fortijuce® or equivalent (NOT Fortisip) to give 15-20g carbohydrate<br>Follow these treatments by FLUSHING THE ENTERAL FEEDING TUBE WITH WATER.<br>Alternatively:<br>Give glucagon IM injection (providing no severe hepatic disease, prolonged starvation or repeated hypoglycaemia)</td><td>If severe or recurrent hypoglycaemia and patient has IV access give glucose 10% at 100ml/hour (and follow JBDS-IP hypoglycaemia guidelines).</td></tr>
<tr><td colspan="2">2 -After 10 - 15 minutes re-check capillary blood glucose.<br>• If capillary blood glucose level <4 mmol/L inform doctor, give another dose of treatment (see options above) then re-check blood glucose 10 minutes later.<br>• If blood glucose still <4 mmol/L alert a doctor, and if not already done so ensure IV access and start IV glucose 10% at 100ml/hour, increasing IV volume given if necessary, according to patient response.</td></tr>
<tr><td colspan="2">3 -When blood glucose level >4 mmol/L and the patient has recovered, give a long-acting carbohydrate. Some examples are<br>• Restart feed<br>• If bolus feeding, give additional bolus feed (read nutritional information and calculate amount required to give 15-20g carbohydrate)<br>• IV glucose 10% at 100ml/hr. Volume should be determined by clinical circumstances</td></tr>
<tr><td colspan="2">SAFETY NOTES:<br>• DO NOT OMIT BASAL INSULIN INJECTION IF DUE IN TYPE 1 DIABETES although dose alteration may be required. Review the insulin regimen and the insulin dose administered prior to the hypoglycaemic event<br>• Ensure at least 4 hourly capillary blood glucose monitoring continued for next 24 – 48 hours due to the increased risk of further hypoglycaemic episodes after any hypoglycaemic event</td></tr>
<tr><td colspan="2">4 - Document event in patients notes</td></tr>
</table>

# 13. Use of technology during enteral feeding

Use of continuous glucose monitoring: If previously used, the person with diabetes may wish to continue to use CGM glucose monitoring in hospital. They may potentially be of great benefit during enteral feeding but are not currently advised as they have not been extensively studied during acute illness and ward staff are unfamiliar with the technology. It should be explained to the person with diabetes that capillary glucose monitoring will still be required for the duration of feeding in addition to their sensor technology and used to adjust feed rates/ insulin doses. At the current time there is very little experience of the use of closed loop insulin pump and glucose sensor use during enteral feeding.

# 14. Self-management of diabetes and enteral feed.

In people for whom enteral feeding is an acute hospital based treatment, managing the complexity of glucose control during feed and acute illness may mean that self-management of diabetes could be difficult or inappropriate. However, this does not mean that a full explanation of why changes have been made should not be given to the individual with diabetes. If the feed however is likely to be longer term, the involvement of the patient in agreeing the feed and treatment regimen and early engagement with self-management within their capabilities is essential. For patients who are likely to be discharged on enteral feeding, self-management of the regimen should be considered when agreeing the regimen and training should not be left for the days prior to discharge unless for a clinical reason.

If the individual fulfils the requirements for self-administration of insulin for that institution, then they should be allowed to self-administer insulin if they are happy to and can follow the organisation's procedures. Further guidance on self management of diabetes whilst in hospital can be found in the JBDS-IP guidance 04 (27).

# 15. Stopping enteral feeding

There is often a transition time where oral intake improves prior to enteral feeding being discontinued. During this transition it can be expected that glucose management may have increased variability with the changing carbohydrate intake. In patients who did not require any diabetes related treatment prior to enteral feeding, unless a new diagnosis of diabetes has been made, all feed related diabetes treatment can be stopped when enteral feeding stops, however ongoing glucose testing should continue to ensure glucose levels return to normal parameters.

For patients on oral hypoglycaemic agents, these should be reviewed, adjusted as required and recommenced as the person's oral intake improves. Any feed related diabetes treatment should be stopped/ reduced when enteral feeding stops/ is reduced.

In some cases a person's ability to self manage their insulin regimen, their insulin requirements or oral intake may have changed considerably during the admission. The ward team needs to consider if the previous insulin regimen is appropriate and consult with the DIT if unsure.

# 16. Areas of uncertainty

**Outline**

- Limited evidence base for the best insulin regimen during enteral feeding
- Starting insulin doses, titration and other insulin related protocols
- Insulin dose adjustment according to carbohydrate content of feed
- Hypoglycaemia treatment concerns
- Use of CSII in management of enteral feeding
- Audit standards

It has not been possible to recommend with certainty a specific insulin regimen for a given enteral feeding regimen. Rather we presented the commonly used strategies identified through consensus and national audit (1). A systematic review is being undertaken and this guidance will be updated accordingly.

Some centres utilise a protocol whereby the dose of subcutaneous insulin is calculated according to patient characteristics and the carbohydrate content of the feed.
Other centres advocate commencing a VRIII to optimise glucose control and inform subcutaneous insulin doses. Although this is known practice (1), currently there is no published evidence base. We advise that this type of intervention is only undertaken with close supervision by a senior member of the DIT. Further experience with these insulin administration protocols may result in a review of this guideline in future years.

The administration of fizzy drinks via the enteral feeding tubes for hypoglycaemia treatment is controversial, as it can lead to damage to the lining of the feeding tube with repeated use and therefore has not been included in the recommendations made. However, anecdotally cola has been used to unblock enteral feeding tubes by nutrition teams.

Some dietitians advocate the administration of Glucogel via the enteral feeding tube in the event of hypoglycaemia, as this is generally available in the ward environment, and if followed by a flush, should be safe, and effective at elevating plasma glucose rapidly. There are, however, difficulties with drawing up Glucogel for administration, and thus other options for the acute management of hypoglycaemia in those nil by mouth should be explored. The preferred option of this writing group is the use of Lift (or equivalent) as this will deliver the required rapid acting carbohydrate and is a lower risk for tube blockage compared to some other treatments. All hypoglycaemia treatment given via an enteral feeding tube should be followed by adequate flush.

As the use of technology increases it can be expected that more people with diabetes using CSII technology will be in hospital and possibly receiving enteral feeding. Both evidence and experience in this area is limited and will be an ongoing consideration for this writing group as more information and guidance becomes available. For general recommendations please refer to the following JBDS-IP guidance:

- The use of variable rate intravenous insulin infusion (VRIII) in medical inpatients (19)
- Self-Management of Diabetes in Hospital (27)

There are currently no agreed research reporting or audit standards in this area. Such standards are vital to ensure work undertaken will provide a meaningful contribution to knowledge and clinical improvements. In Appendix 3, we provide recommended audit standards. A systematic review is being undertaken and this guidance will be updated accordingly with a recommendation for research related reporting standards.

# Appendix 1 - Practice points for insulin use during enteral feeding

## Key safety considerations:

- Basal insulin must be continued/ commenced in all patients with type 1 diabetes or those with known insulin deficiency
- All feed related insulin doses should include a feed specific instruction, such as: To be given at start of feed
- Any episodes of hypoglycaemia should be treated, and then trigger an insulin dose and timing review
- If feed stopped unexpectedly and feed related insulin has been given ensure glucose testing frequency increased and need for replacement carbohydrate source (e.g. IV dextrose, restart feed or oral intake) considered
- Any PRN insulin dose given prior to a feed break should be given with caution due to the increased risk of subsequent hypoglycaemia

## Insulin initiation:

- Once it is known that insulin will be required alongside enteral feeding, the total feed dose can be estimated using either VRIII use of weight/ carbohydrate based calculations
- There are no known standardised weight/ carbohydrate based calculations for initiating insulin alongside enteral feed. Therefore this should be undertaken by the diabetes inpatient team
- Appendix 2 details the process for initiating insulin based on VRIII use, however this should only be undertaken by the diabetes inpatient team or appropriately qualified and experienced doctors
- The insulin regimen will be guided by the enteral feeding regimen, see table 1
- Timing of insulin doses should also be considered, efforts to avoid frequent overnight insulin injections should be made where possible. This is especially important if the patient will be going home on enteral feeding

## Insulin prescribing:

- Ensure basal insulin is continued for all patients with type 1 diabetes or a known insulin deficiency and should be prescribed by time of day
- Ensure basal insulin is commenced for all patients with a new diagnosis of type 1 diabetes or insulin deficiency and prescribed by time of day
- If a feed specific basal insulin is used and the feed is going to be held or reduced, an insulin dose review and possible reduction may be needed
- If a feed specific basal insulin is used and the feed is unexpectedly held or stopped, IVI glucose may be needed to prevent hypoglycaemia for the duration of the insulin action or until the feed is restarted
- Additional feed specific insulin may be prescribed on top of normal basal insulin. This may be in the form of rapid, NPH or mixed insulin
- Ensure feed related insulin doses are prescribed against the time point of the feed, not for specific times of day e.g. To be given at the start of feed
- If applicable, ensure any PRN insulin prescribed is the same brand as any quick/ rapid acting insulin doses prescribed during the feed
- If no quick/ rapid acting insulin doses are prescribed during the feed then prescribe PRN insulin in line with local policy and include the comment: give with caution if to be given within 4 hours of the feed finishing
- Any episodes of hypoglycaemia should trigger an insulin dose and timing review
- When stopping VRIII, ensure any regular subcutaneous insulin (whether timed for feed or usual insulin regimen as per the individual case) is prescribed and given in line with local policy before the VRIII is stopped

## Insulin administration:

- Ensure you check all insulin prescriptions for feed related comments such as "Insulin timing in relation to feed: To be given at start of feed"
- Ensure any feed related instructions within an insulin prescription are followed
- Ensure patient's usual basal insulin is given at the prescribed time, when no other feed related instruction is present
- If the feed is stopped, do not give feed related insulin doses and raise this with the doctors or DIT to review if an insulin dose adjustment is required
- When a feed is recommenced, ensure the correct feed related insulin dose is given. This may not be the missed dose
- When stopping VRIII, ensure any regular subcutaneous insulin (whether timed for feed or usual insulin regimen as per the individual case) is prescribed and given in line with local policy before the VRIII is stopped

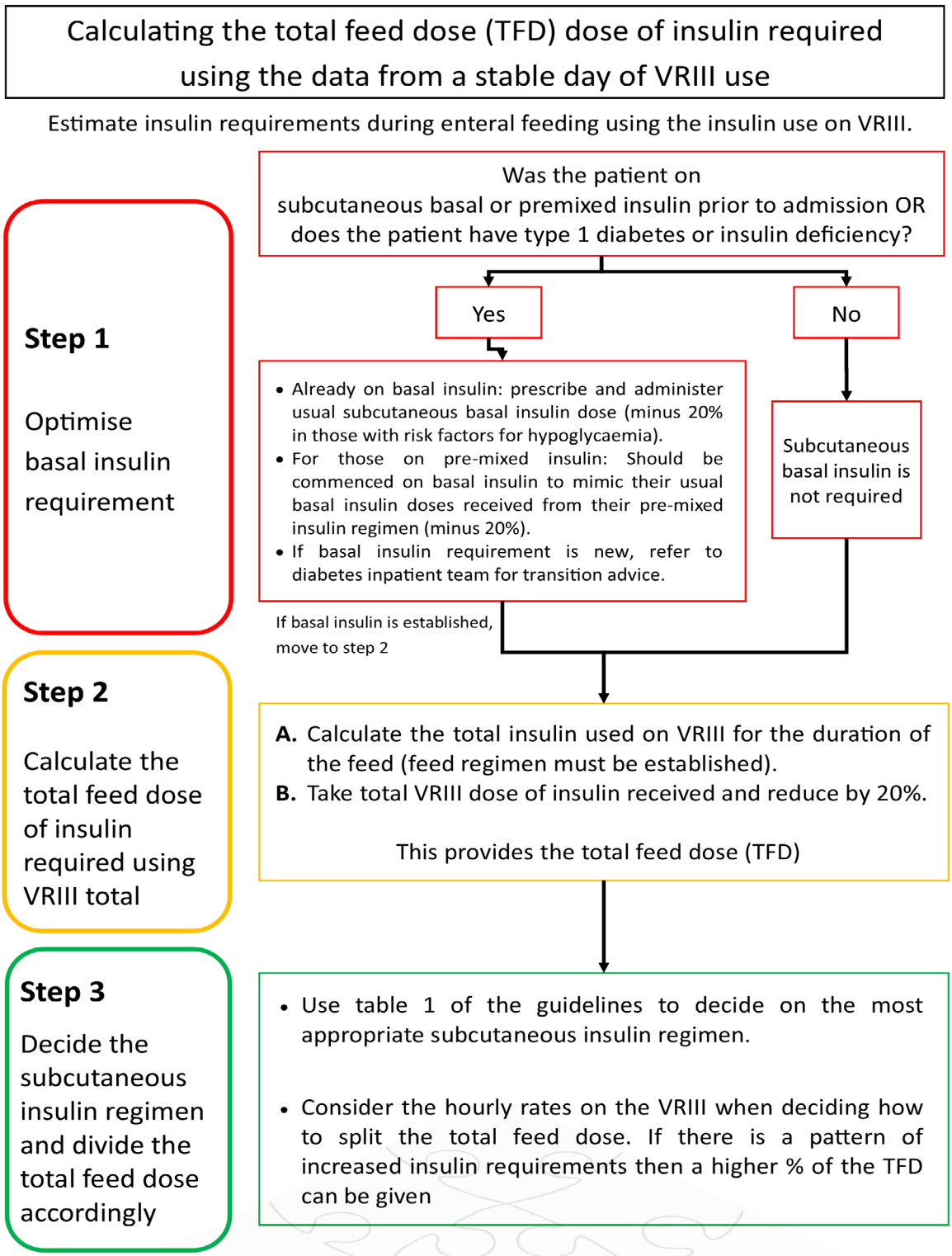
## Discontinuation of feed related insulin

- Do not discontinue basal insulin in any patient with type 1 or insulin deficiency. Risk of DKA
- When stopping enteral feeding, ensure the patients diabetes management regimen has been reviewed and prescribed in line with local policy before the enteral feed is stopped

## Discharge with a new insulin regimen and enteral feeding

- Diabetes inpatient team should commence new to insulin education as early in the admission as is appropriate
- Ensure diabetes related follow up is planned post discharge, in line with local practice
- Where a patient will be self managing their diabetes on discharge, aim to be self administering their medication during the admission
- Ensure feed and insulin timing are appropriate for home management i.e. avoiding insulin administration during sleep
- Ensure feed related education is done by the appropriate team in line with local practice

# Appendix 2 – Calculating the total feed dose (TFD) using the data from a stable day of VRIII use




Refer to the diabetes inpatient team if further individualisation of care is needed.

Abbreviations: TFD=Total Feed Dose, VRIII= Variable Rate Intravenous Insulin Regimen

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Insulin requirement during enteral feeding can be estimated using the insulin use on VRIII.

**Step 1 - Optimise basal insulin requirement**
**Step 2 - Calculate the total feed dose of insulin required using VRIII total**
**Step 3 - Decide the subcutaneous insulin regimen and divide the total feed dose accordingly**

**REMEMBER: If the patient has type 1 diabetes or was previously on basal insulin this should have been continued alongside the VRIII and will continue once stepped down off VRIII. Therefore, insulin dose calculated will be for the enteral feed only**

If the patient requires basal insulin and this has not yet been commenced, continue VRIII until a review by the DIT.

## Detailed guidance of each step:

1. **If applicable: Optimise basal insulin**

   On basal alongside VRIII: If insulin requirements go up during feed break or are > 1 unit/hour refer to DIT to review basal insulin requirements.

   If basal insulin is not prescribed but they were on it prior to admission: Reduce their usual basal dose by 20% (in patients with risk factors for hypoglycaemia) and commence this alongside VRIII. Step 2 can then be completed once VRIII rates with basal can be assessed.

   If the patient requires basal, but was not on this prior to admission: they should be referred to DIT for assessment and transition.

2. **Total Feed Dose (TFD) of insulin**

   The total feed dose is different to the total daily dose (TDD). The total daily dose is the total dose of insulin a patient requires over 24 hours and includes basal insulin requirements to meet their basic needs. The TFD is the insulin required to cover the enteral feed only and contributes to the TDD.

   Add up the total insulin dose used on the VRIII for the duration of the feed and take off 20%. This provides the total insulin requirement for during feed, known as the total feed dose (TFD).

3. **Decide the insulin regimen** (note, if basal bolus then the basal insulin should already be in place and optimised)

   How the insulin dose is prescribed will depend on the insulin regimen used, see table 1.

   **Bolus (for bolus element of basal bolus, or bolus only regimens)**

   TFD should be split as either 4 hourly rapid acting analogue insulin doses from start of the feed or 6 hourly soluble quick acting insulin doses from start of the feed. Note: a feed related dose should not be given within 4 hours of the feed ending for rapid analogue insulin and 6 hours of the feed ending for soluble quick acting insulin.

**Premixed (for patients not already on basal insulin)**

Premixed insulin should be given at start and halfway through feed, if feed duration >16 hours. Where two doses required, take TFD and divide with either a 50/50 dose split or where glucose levels spike after start of the feed, consider 60% of the required total daily dose administered at start of the feed and 40% at the mid point of the feed.

**Isophane only (for patients not already on basal insulin)**

Administration of isophane (NPH) insulin at the start of the feed, with a further dose likely to be required at the midpoint of the feed if feed duration is ≥16 hours. Prescribe the regimen as a 50/50 dose split of the TFD or where glucose levels spike after start of the feed, consider 60% of the required total feed dose (TFD) administered at start of the feed and 40% at the mid point dose

**Long acting analogue insulin only (for patients not already on basal insulin)**

The TFD should be given in one dose at the start of the feed.

With all regimens, the intravenous insulin infusion should not be discontinued for at least 30 to 60 minutes after the administration of the subcutaneous dose given in association with the feed.

**PRACTICE POINT:** Take note of the VRIII rates. If there is a pattern of higher insulin rates at certain points in the feed then this should be reflected in the prescribed insulin doses. For example, if insulin rates are higher in the first 4 hours of the feed and lower in the last 4 hours of the feed then the insulin doses should be proportionally bigger at start of the feed and lower for doses nearer the end of the feed.

## Example 1: Calculating basal bolus insulin dose for patient with Type 1/ insulin deficient diabetes receiving enteral feeding using VRIII

Type 1 diabetes. Currently on VRIII and 10 units BD Levemir
VRIII requirements during feed varied 1.5-3 units p/h = total 50 units received during feed
Carbohydrate content of feed = 184.5g
Intended infusion rate of enteral feed (ml/hr) = 75
Intended duration of feed (hr per day) = 20
Feed break from 2pm to 6pm

Step 1 - Continue usual Levemir

Step 2 - Total feed related insulin dose = 50 units - 20% = 40 units

Step 3 - Bolus regimen examples:

Analogue = Novorapid 8 units at start of feed and then 4, 8, 12 and 16 hours into feed

Soluble = Actrapid 13 units at start of feed and then 6 and 12 hours into feed

Rapid acting insulin dose per hour = 40 / 20 = 2 units per hour of feed

## Example 2: Calculating pre-mixed (biphasic) insulin dose for patient with non Type 1/ insulin deficient diabetes receiving enteral feeding using VRIII

Type 2 diabetes. Currently on VRIII and no basal insulin required

VRIII requirements during feed varied 1.5-3 units p/h = total 50 units received during feed

Carbohydrate content of feed = 184.5g

Intended infusion rate of enteral feed (ml/hr) = 75

Intended duration of feed (hr per day) = 20

Feed break from 2pm to 6pm

Step 1 - No regular basal insulin required

Step 2 - Total feed related insulin dose = 50 units - 20% = 40 units

Step 3 - Feed related Isophane insulin regimen example:
Insulatard = 24 units at start of feed and 16 units 10 hours into feed

Step 3 alternative - Feed related Mixed insulin regimen example:

Analogue = Novomix30  24 units at start of feed and 16 units 10 hours into feed

# Appendix 3 – Audit standards

## Process

1. Does the hospital have a protocol for the management of enteral feed with insulin with a review date?
2. Do the ward teams routinely access the protocol?
3. Is the protocol followed appropriately?
4. Do the diabetes team review all patients using enteral feed and insulin?

## Outcome

5. What feed regimens are used for people with diabetes?
6. What insulin regimens are used for people with diabetes with enteral feed?
7. Audit of glucose control during feed.
8. Audit of glucose control between feed.
9. Evidence of feed or insulin adjustment if control is suboptimal

## Safety

10. Audit of clinical incidents relating to enteral feed and insulin use.
11. Audit of hypoglycaemia during enteral feed and insulin use.
12. Audit of ketosis/ketoacidosis during enteral feed and insulin use.

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