Doncaster and Bassetlaw Teaching Hospitals
NHS Foundation Trust

Variable Rate Intravenous Insulin Infusion Guidelines for Adults

This is a new procedural document, please read in full.

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Amendment Form

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Version 1	27 May 2021	• No previous guidelines • This is a new procedural document, please read in full	Shivani Dewan Sue Robson Fahad Arshad Terri Sharp

Contents

Page No.

1 INTRODUCTION

Approximately 29% of hospital in-patients have a secondary diagnosis of diabetes, of which 70% are admitted as medical emergencies. There is evidence from both medical and surgical settings to indicate that if the blood glucose is not controlled, the outcomes measured by mortality, morbidity or length of stay are worse, resulting in hyperglycaemia and even diabetic ketoacidosis.

Variable Rate Intravenous Insulin infusion (VRIII), formerly known as sliding scale has been used for decades to achieve normo glycaemia in hospitals. It is a very useful tool when used in the right context and has been shown to improve outcomes.

2 PURPOSE

In an acute setting, the options for controlling blood glucose are limited. On some occasions it may be possible to achieve good glycaemic control using subcutaneous insulin but this requires a degree of expertise and if the diabetes team are not available for advice, the method of choice for an unwell or fasting patient is VRIII.

This guideline is designed for acutely unwell patients, including those with a pre-existing diagnosis of diabetes and those who present with hyperglycaemia for the first time. The guidelines are intended for use by any healthcare professionals who manage patients with diabetes on hospital wards. It aims to be a practical guide for when and how to use an intravenous insulin infusion and how to transition patients to other glucose lowering medication after stabilisation.

Until advances in technology produce a system that can automatically adjust the insulin infusion rate in response to changes in the blood glucose, the safe and effective use of VRIII will depend on close monitoring and decision making by health care professionals. The emphasis throughout the guideline is on **safe** use of a VRIII only when clinically indicated**. It should be used for a short duration period as possible, with plans for a safe and effective step-down to other agents as soon as the clinical situation allows. Referral to the diabetes team as soon as possible after admission is required since individual patient's needs must be assessed and appropriate action taken to ensure the VRIII is used safely.**

3 DUTIES AND RESPONSIBILITIES

This guideline is designed for all hospital staff looking after patients on VRIII. All nurses must work within the Nursing and Midwifery Council (NMC) professional code of conduct and work within their own competencies.

Diabetes In-patient team

- Implementation of this policy and all National recommendations made regarding diabetes and using VRIII
- Ensure education and training of all appropriate Trust staff.
- Responsibilities to ensure all patients with diabetes receive an equitable and high-quality service.
- To be alerted to all patients with diabetes who are identified using the infusion.

Escalate any incidents regarding diabetes management to the relevant clinical governance groups.

Consultant Diabetologist and Consultant Anaesthetist, Lead Nurse and Specialist Nurses
Act as a clinical expert in diabetes management for intravenous (IV) insulin infusion. Provide education and training to all staff. Also refer to 'Diabetes team' for support in provision of care.

Head of Nursing
Support the Nurse in provision of care for patients with diabetes needing VRIII.

Matrons and Ward Managers
To promote safe standards of diabetes care on all wards as appropriate.
Ward Managers to release staff when required, in order to participate in education and training.

All staff directly involved in caring for patients who require VRIII
All staff to attend/undertake relevant training to provide safe effective care when dealing with patients using VRIII. To ensure all diabetic patients are referred to the Diabetes Specialist Nurse Team so that they can offer the patient and staff full support and guidance.

The education team will facilitate what training is being given and how long will it take?

3.1 Definition of a Variable Rate intravenous insulin infusion

Intravenous insulin infusion of a variable rate according to regular capillary blood glucose measurements with the aim of controlling serum glucose levels within a specified range. The VRIII is usually accompanied by an infusion of fluid containing glucose to prevent insulin-induced hypoglycaemia.

3.2 Use of VRIII in Hospital

The National Diabetes in-patient Audit has yielded some important findings relating to the real-world use of VRIII.

- Inappropriate use: 6.5% of patients treated unnecessarily.
- Inappropriate duration of use.
- Inadequate monitoring.

3.3 Summary of evidence

Hyperglycaemia in hospital is associated with worse outcomes. Target blood glucose levels have not been established in trials but there is consensus for a range between 6-10mmol/l. This range should avoid the risks associated with both hyperglycaemia and hypoglycaemia. However, this would be acceptable for a patient with type 1 diabetes with evidence of blood ketones. Patients with type 2 diabetes may not require the infusion with blood glucose of this level. All considerations should be based on individual circumstances. A realistic accepted range would be between 6-12mmol/l.

3.4 Patients Lacking Capacity

Sometimes it will be necessary to provide care and treatment to patients who lack the capacity to make decisions related to the content of this policy. In these instances staff must treat the patient in accordance with the Mental Capacity Act 2005 (MCA 2005).

- A person lacking capacity should not be treated in a manner which can be seen as discriminatory.
- Any act done for, or any decision made on behalf of a patient who lacks capacity must be done, or made, in the persons Best Interest.
- Further information can be found in the MCA policy, and the Code of Practice, both available on the Extranet.

There is no single definition of Best Interest. Best Interest is *determined on an individual basis. All factors relevant to the decision must be taken into account, family and friends should be consulted, and the decision should be in the Best interest of the individual. Please see S5 of the MCA code of practice for further information.*

4 MAIN RECOMMENDATIONS

- **Contact the Diabetes team for advice** if there is doubt about the best way to manage hyperglycaemia or if blood glucose readings are not responding to treatment.
- Continue patient's usual basal subcutaneous insulin whilst on VRIII and stop rapid acting Or mixed insulins.
- Review VRIII to ensure correct rate of infusion is achieving target glucose levels
- The on-going need for the VRIII.
- Safety measures are continually in place
- Hypoglycaemia is treated promptly and adequately following trust guidelines and the infusion is re-started once blood glucose is above 4mmol/l to prevent rebound hyperglycaemia and possible ketosis in type 1 patients.

4.1 Indications for Use

- Patients with known diabetes or with hospital related hyperglycaemia unable to take oral fluid/food and for whom adjustments of their own insulin regime is not possible.
- Vomiting (**exclude DKA**). Nil by mouth and will miss more than one meal, for example surgery (**refer to pre and post op guidelines**).
- Severe illness and the need to achieve good glycaemic control e.g. sepsis.
- **Consult the diabetes team** who may be able to adjust the patient's own insulin regime.

4.2 Advantages of VRIII

- Target driven glucose control for the specified indications, with the potential to improve clinical outcomes.
- Avoidance of metabolic decompensation.

Patients with known diabetes or with hospital related hyperglycaemia unable to take oral/fluid/food and form whom adjustments of their own insulin regimes not possible. (examples below):

- Vomiting (**exclude DKA**), NBM and will miss more than 1 meal.
- Severe illness with the need to achieve good glycaemic control. e. g: Sepsis
- Special circumstances *Acute coronary syndrome (follow trust guidelines). Total Parental Nutrition (TPN) Enteral feeding, steroid use in pregnancy.

4.3 Disadvantages of VRIII

- Frequent CBG (continuous capillary blood glucose monitoring) and intravenous infusion is intrusive for patients.
- Difficult to manage if the patient is eating (use with caution in this circumstance)
- If target blood glucose is not achieved, it requires a review of prescription for rate of insulin infusion.
- May prolong length of stay if used inappropriately.
- Potential risks of VRIII hyper and hypoglycaemia due to inappropriate insulin infusion rates or adequate monitoring.
- Rebound hyperglycaemia and possible ketoacidosis if intravenous access is lost or VRIII is stopped inappropriately.
- Fluid overload.
- Hypokalaemia and/or hyponatraemia.
- Infection related to intravenous line.

Most acutely unwell medical patients can be managed without a VRIII. Avoid intravenous insulin if the patient is eating and drinking normally.

4.4 Setting Up the Infusion

Two registered nurses must check and prepare the VRIII and every time the rate of infusion is changed. The trust now has pre- prepared syringes for VRIII. The following advice applies if a pre-prepared syringe is unavailable.
Insulin must be drawn up using an insulin syringe. NO OTHER SYRINGE SHOULD BE USED.

- Draw up 50 units of prescribed Human Actrapid insulin and add to 49.5 ml of 0.9% sodium chloride in a 50 ml luer lock syringe. Mix thoroughly; this will provide a concentration of 1 unit/- 1 ml.
- Complete the drug additive label in full signed by 2 registered nurses and placed on the syringe barrel; not obscuring the numerical scale.
- Prime through an appropriate giving set with a non-return valve.
- Set up an intravenous insulin syringe-driver pump.
- Discard any unused insulin solution after 24 hours.

Intravenous fluid must be administered using a volumetric infusion pump Delivery of the substrate solution and the VRIII must be via a single cannula or two lumens of a central line with appropriate one way and anti - siphon valves

First Choice Fluids

- 5% Dextrose with 20/40mmol/l KCL at 125ml/hr if serum k is 3.5-5.5mmol/l

DBTH does not have Dextrose/Saline with KCL, therefore first choice should be 5% Dextrose with 20/40mmol/l KCL.

Second Choice Fluids

- 0.45% NaCL and 4% Dextrose with 0.3KCL (/20/40mmol/l) at 125ml/hr if serum K is 3.5-5,5mmol/l **Not yet available**

Set the concurrent fluid replacement rate to deliver the hourly fluid requirements of the individual patient as prescribed which must take into account their individual circumstances. The rate must not be altered thereafter without senior advice. Insulin should not be administered without substrate unless done in a critical care setting and upon senior advice. Insulin must be infused at a variable rate aiming for a glucose of 6-10 mmol/L (acceptable range 4-12 mmol/L). Continue the substrate solution and VRIII until the patient is eating and drinking and back on their usual glucose lowering medications.

Although Human Actrapid is the most commonly used insulin in VRIII, insulin Novorapid, Humulin S, Apidra, Humalog and Fiasp - can also be used as an alternative and have a licence for intravenous use.

Suggested scales for infusion rate and Glucose (See Appendix 1)

Start on standard rate unless otherwise indicated (renal impairment, heart failure and elderly patients)**. If a patient is on basal subcutaneous insulin – continue this along- side the VRIII.**

Patients can have different degrees of insulin sensitivity and insulin resistance related to weight, concurrent illness and medication (particularly steroids). These circumstances may require a change in the rate of the insulin infusion depending on the blood glucose response to the initial rate.

Three insulin rates are recommended

- Reduced rate for patients thought to be insulin sensitive
- Standard rate for most patients
- Increased rate for patients likely to be insulin resistant

4.5 Duration of VRIII

- The aim should be to convert back to standard (oral or subcutaneous) medication as soon as patients are able to eat and drink, provided the VRIII can be discontinued safely.
- Avoid recommencing a VRIII if the patient becomes hyperglycaemic when the VRIII is withdrawn. **Consult the diabetes team.**
- **Consult the diabetes team** if the patient had suboptimal diabetes control prior to the VRIII or has newly diagnosed diabetes.

4.6 Management of Other Diabetes Medications During VRIII

- Most patients will have their usual diabetes medication completely withheld whilst they are on a VRIII including oral and injectable hypoglycaemic drugs such as GLP1s and most forms of insulin. The exception is long acting analogue or isophane (basal insulin) which should be continued.
- **Continue basal long-acting analogues or isophane insulin in patients usually taking multiple daily injections of insulin (MDI or basal-bolus insulin therapy).** This may help control blood glucose during the VRIII and will avoid rebound hyperglycaemia once the patient's usual diabetes treatment is restarted. **This can help reduce the overall length of stay.**

4.7 Transferring from A VRIII to Subcutaneous Insulin

Transferring from a VRIII to subcutaneous insulin and/or oral treatment

Most patients will restart their usual diabetes treatment following a VRIII.

Consult the diabetes team in the following circumstances for additional advice on ongoing management:

- Diabetes control was sub-optimal prior to admission (recent pre-admission HbA1c >58 mmol/mol [7.5%]).
- The patient can no longer manage their previous regime.
- The patient cannot recall their previous insulin regime.
- Contraindications to previous therapy or new medical conditions have arisen
- Insulin commenced on this admission.

It is important that patients receive education and support in self-management of diabetes, which they are confident to self-inject prior to discharge, and the follow-up support is available from appropriately trained professionals.

- Patients must have recovered from the precipitating illness/condition and be eating and drinking. Blood glucose targets must be achieved on the VRIII for insulin treated patients.
- **Long- acting insulin should always be continued.** If it has not been given and/or the patient is insulin naive, a long-acting insulin should be given either as a mixed or part of a basal bolus regime prior to stopping the VRIII.
- VRIII should only be discontinued 30 minutes to 1 hour after subcutaneous insulin has been given. This should ideally be at a meal time. Avoid stopping the VRIII at bed time where there is fewer observing staff.
- For insulin naïve patients the insulin dose can be calculated on a weight basis or by calculating the insulin requirements over the last few hours on VRIII. **(see Appendix 4)** If blood glucose levels rise after VRIII is discontinued, **DO NOT**, restart the infusion straight away. **Contact the Diabetes team for advice.**

For non-insulin treated patients

- Give normal treatment prior to discontinuing VRIII, at least 30 minutes before
- Consult the Diabetes team for detailed guidance, if control prior to admission was suboptimal.

4.8 Safe Use of Insulin

Errors in insulin prescribing are very common and insulin is one of the 5 highest risk medications in the in-patient environment. The wide range of insulin preparations and administration devices increase the potential for error and it is essential that staffs are trained in the safe use of insulin. Dose errors can occur, such as where insulin is incorrectly prescribed, and management errors can cause harm through over-or under-dosing with insulin causing abnormal blood glucose **(refer to E learning on Safe Use of Insulin)**.

The National Patient Safety Agency (NPSA) has made recommendations to promote the safe use of insulin and the Department of Health has added death or severe harm as a result of insulin maladministration to the list of 'Never Events' that are monitored by the NHS. It is important that health care professionals follow this guidance and refer to local protocols to ensure safe prescribing is maintained. We recommend that all healthcare professionals caring for patients with diabetes undertake all the relevant modules within the diabetes suite of e-learning.

4.9 Total Parenteral Nutrition

The detailed advice regarding total parenteral nutrition (TPN) is beyond the scope of this guide line (**refer to dietitian**). It is widely recognised that although TPN improves the nutritional status of critically ill patient, it is associated with the short-term complication of hyperglycaemia.

- All patients receiving TPN should have their blood glucose levels checked at least twice in 24 hours, but the frequency of monitoring should be increased if hyperglycaemia develops, or if the patient has pre-existing diabetes. Achieving optimum glycaemic control can reduce morbidity and mortality in patients receiving TPN.
- TPN provides essential glucose and electrolytes required in a 24-hour period. However, if the patient is fluid deplete, it may be necessary for additional fluids to be infused.
- If blood glucose levels are elevated VRIII will be required, in which case blood glucose should be monitored hourly. As for patients receiving a VRIII, these patients will require daily venous bloods for glucose, urea and electrolyte. In addition, other biochemical tests such as micronutrients may be required (**Consult dietitian and diabetes team for advice**).
- If infusing TPN along-side intravenous insulin with a substrate solution, each should have their own dedicated central line lumen.
- If the TPN is to be delivered via a peripherally inserted central catheter line (PICC), it may be necessary to consider a double lumen PICC line.

Cautions:
If the TPN is stopped this may put the patient at risk of hypoglycaemia. In this situation the VRIII should be discontinued and blood glucose monitored more frequent until the TPN is reinstated or other steps taken to avoid hypoglycaemia. If hypoglycaemia develops, treat according to trust guidelines. Patients on long or intermediate acting insulin should continue these in addition to the VRIII. Once glycaemic control is obtained, patients should be stepped down to subcutaneous insulin as soon as possible. **Contact the Diabetes team for advice.**

Patients already established on long- acting insulin e.g. Levemir, Lantus, Tresiba, Toujeo, Semglee and Abasaglar should be continued on the VRIII. Also, intermediate acting insulins such as Insulatard, Insuman or Humulin I, should be continued, these in addition to the VRIII. Once glycaemic control is obtained patients should be stepped down to subcutaneous insulin as soon as possible at an appropriate meal time.

5 CONTINUOUS SUBCUTANEOUS INSULIN INFUSIONS (CSII)

Continuous subcutaneous insulin infusions (CSII), also known as insulin pumps. CSII are not recommended in situations where self-management is unsafe.

- Acute illness
- Diabetic Ketoacidosis
- Major surgery involving a general anaesthetic
- Reduced conscious level or confusion

The Diabetes team should be involved with all patients on CSII to give individual advice.

If a VRIII is required for pump patients, **ALWAYS** commence the VRIII before disconnecting the CSII pump. If the pump is disconnected without an alternative provision of insulin, diabetic ketoacidosis is likely to develop within a short space of time because there is no reserve of long-acting insulin.

In most patients their previous subcutaneous insulin should be restarted via the CSII. Continue the VRIII for at least 30-60 minutes after the restart of the CSII to avoid rebound hyperglycaemia. It is not always necessary to wait until meal time to switch back to CSII. Avoid restarting CSII at bed time because of the risk of rebound hyperglycaemia overnight. The CSII should not be recommenced until the patient is capable of management as they are usually very knowledgeable about their device. Check blood glucose 2 hours after the initial meal time bolus. If blood glucose is >14mmol/l, pump manufacturer's hyperglycaemia guidelines should be followed. A correction should be given via the pump and glucose checked again 1 hour later. If blood glucose has risen or there is no improvement is seen, the cannula should be re-sited and the patients should be checked for ketones. This is to establish that the cannula is patent as the cannula may bend/kink on insertion and prevent insulin infusion.

- Patients who are no longer able to self- manage e.g. patients who have had a stroke, should be converted to an appropriate insulin regime **by the diabetes team.** Calculating subcutaneous insulin dose in insulin-naïve patients, or where an insulin regime needs altering because of sub-optimal control. It is important that patients starting insulin receive education and support in self-administer prior to discharge, and that follow-up support is available from the appropriately trained professionals.

6 TRAINING/ SUPPORT

Staff Education
The trust training needs analysis (diabetes) will identify individual needs to staff. Diabetes and Endocrinology can be contacted at any time for support.

6.1 Contact Numbers

DRI
Diabetes Specialist nurses 01302 642611
Bleeps 1333 and 1388

Bassetlaw Hospital
Diabetes Specialist nurses 01909 572647 and 01909 572648
Bleep 3477

7 MONITORING COMPLIANCE WITH THE PROCEDURAL DOCUMENT

What is being Monitored	Who will carry out the Monitoring	How often	How Reviewed/ Where Reported to
All diabetes patients admitted to hospital	Datix incidents	Incidents filled in whenever there is a breach in the guidelines	Every Datix incident actioned appropriately
Patients with diabetes who have been referred to the diabetes team for advice and support	The inpatient diabetes team	Annually	Audit referrals to be reviewed by the lead for diabetes. To be discussed at the diabetes network meetings
Regular audit	Diabetes team	Annually	Discuss in appropriate departmental Clinical governance meetings

8 EQUALITY IMPACT ASSESSMENT

The Trust aims to design and implement services, policies and measures that meet the diverse needs of our service, population and workforce, ensuring that none are disadvantaged over others. Our objectives and responsibilities relating to equality and diversity are outlined within our equality schemes. When considering the needs and assessing the impact of a procedural document any discriminatory factors must be identified.

An Equality Impact Assessment (EIA) has been conducted on this procedural document in line with the principles of the Equality Analysis Policy (CORP/EMP 27) and the Fair Treatment For All Policy (CORP/EMP 4).

The purpose of the EIA is to minimise and if possible remove any disproportionate impact on employees on the grounds of race, sex, disability, age, sexual orientation or religious belief. No detriment was identified.

9 ASSOCIATED TRUST PROCEDURAL DOCUMENTS

- In Hospital Management of Hypoglycaemia in Adults with Diabetes Mellitus - PAT/T 49
- Adult Diabetes Ketoacidosis treatment and monitoring chart WPR39420 Aug 2013
- Peri-Operative Management of Diabetes in Adults – PAT/T 70
- Fair treatment for All Policy – CORP/EMP 4
- Equality Analysis Policy – CORP/EMP 27

- Mental Capacity Act 2005 Policy and Procedure, including Deprivation of Liberty Safeguards (DoLS) – PAT/PA 19
- Privacy and Dignity Policy – PAT/PA 28.

10 ABBREVIATIONS

VRIII – Variable rate intravenous insulin infusion
CBG – Capillary blood glucose
DKA – Diabetes Ketoacidosis
BG – blood glucose
IV – Intravenous infusion
SCII – Subcutaneous insulin infusion
TPN – Total Parenteral nutrition
GLP1 – Glucose lowering proton inhibiter
MDI – Multiple daily injections
NPSA – National Patient Safety Association

11 DATA PROTECTION

Any personal data processing associated with this policy will be carried out under 'Current data protection legislation' as in the Data Protection Act 2018 and the UK General Data Protection Regulation (GDPR) 2021.

For further information on data processing carried out by the trust, please refer to our Privacy Notices and other information which you can find on the trust website:
https://www.dbth.nhs.uk/about-us/our-publications/information-governance/

12 REFERENCES

JBDS-IP. Joint British Diabetes Societies for In-patient care. The Use of Variable Rate Intravenous insulin infusion in hospital

Department of Constitutional Affairs Mental Capacity Act (2005): Code of Practice, 2007
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/497253/Mental-capacity-act-code-of-practice.pdf

APPENDIX 1 – A GUIDE TO VRIII

AFFIX PATIENT STICKER HERE				
	Dosing Rates (see guide below)			
Rates	Standard Rate	Reduced Rate	Increased Rate	Customised Rate
	Start standard unless indicated	for use in insulin sensitive patients (needing <24 units/day)	for use in insulin resistant patients (needing >100units/day)	For use to bespoke rate
CBG levels (mmol/l)	Infusion Rates (unit/hr = ml/hr)			
<4	Stop VRIII. Administer 100ml iv 20% glucose or 200ml iv 10% glucose. Restart when CBG>4mmol/l but at reduced rate			
	0	0	0	
4.1-8	1	0.5	2	
8.1-12	2	1	4	
12.1-16	4	2	6	
16.1-20.0	5	3	7	
20.1-24.0	6	4	8	
>24.1	8	6	10	
Signed/dated				
Print Name				

ENTRY CRITERIA	RATE GUIDE
1. NBM>1 missed meal 2. Type 1 diabetes with recurrent vomiting (exclude DKA) 3. Type 1 or 2 diabetes + severe illness with need to achieve good glycaemic control i.e. sepsis **Special circumstance:** ACS,stroke, TPN/enteral feeding/steroids and pregnancy, follow local guidelines and seek advice from the diabetes team Try to avoid using in patients who can eat and drink **Limit use to <24 hours where possible**	Standard Rate: most patients will start here Reduced Rate: Use this rate for insulin sensitive patients (i.e. needing <24 units/day), or when CBG persistently 4-6mmol/l or dropping too fast Increased Rate: Use this for patients who require more insulin (i.e. steroids, those on >100 units of insulin prior to admission, those not achieving target on standard rate) Customised Rate: use this bespoke rate depending on co-morbidities, if the patient is not achieving targets with these algorithms, contact the diabetes team

Avoid hypoglycaemia (CBG < 4 mmol/L)Target CBG level 6-10mmol/L (4-12mmol/l acceptable)										
Drug (approved name) tick	Dose	Volume	Route	Prescribe and Sign name	Prescriber Print name	Date	SYRINGE PREPARATION			
Human actrapid ☐ Humulin ☐	50 units	Made up to 50ml with NaCl 0.9% (1 unit per ml)	iv				Prepared and administer by	Date	Start Time	Stop Time

INTRAVENOUS SUBSTRATE FLUID PRESCRIPTION (caution with patients at risk of fluid overload)
First Line- 5% Dextrose with 20 mmol/L or 40 mmol/L KCl
Second line- 0.18% NaCl with 5% glucose with 0.15% KCl (20/40 mmol/L) OR 0.18% NaCl with 4% glucose with 0.3% KCl 20/(40 mmol/L). (**Not widely available in the trust**)
Caution in those with eGFR<20mls/min- may need less K
You must take into account with patient's individual's circumstances in terms of fluid requirement (below are some suggestions and not substitute a thorough clinical assessment)

1. **Dehydrated patient**: Additional fluid required usually in the form of Normal saline 0.9%. This can run alongside glucose infusion
2. **Frail elderly patient at risk of fluid overload**: Reduce infusion fluid rate to 83ml/hr i.e. 2 litres per 24 hours
3. **Patients with severe heart of renal failure:** May not be able to tolerate standard volumes of fluid. It may be necessary to use 10% glucose instead. This should be prescribed as 500 mls of 10% glucose with 20 mmol/L

Date	Intravenous fluid and rate	Potassium see (K) guide	Alternative rate	Prescriber's signature	Nurses signature

Prescription of intravenous management of hypoglycaemia									
Date	Time	Preparation	Volume	Route	Duration	Prescriber's signature	Print name	Given by	Time given

Potassium (K) guide	
If K is >5.5mmol/l-no K is to be added to the infusion fluid If K is 3.5-5.5mmol/l-use (20/40mmol/l)Potassium chloride If K is <3.5mmol/l-senior review needed as extra K needs to be given Check U+Es on admission and at least once daily **Nb: Check potassium levels when prescribing substrate fluids**	Patients with T1DM on insulin pumps should be referred to the Diabetes team

EXIT CRITERIA

Stop VRIII when patient is able to eat and drink without nausea or vomiting/ bio chemistry within normal range. This should take place when the next meal-related subcutaneous insulin dose is due. Maintain IV insulin infusion for 30 mins after re-starting original insulin regime – IV insulin has a 5 minute 1/2-life

Please contact diabetes team:

-If you are unable to achieve targets

-If your patient requires VRIII for > 24 hours

-If diabetes control was suboptimal before admission (i.e. recent HBA1c>59mmol/mol)

Ensure no contraindications to restarting 'usual medication'

- Dose of insulin may need to be reduced if food intake is likely to be less than normal
- Dose of insulin secretagogues may need to be reduced if food intake is likely to be limited
- Metformin should only be recommenced when eGFR is >30ml/min. Reduce the dose to 500mg bd if the eGFR is <45ml/min
- Review the GLP-1 and DPP4-inhibitors if the patient was admitted with suspected pancreatitis.
- Review glitazone therapy if the patient was admitted with heart failure or lower limb fracture or has known macular oedema.
- Review SGLT2 inhibitor therapy if the patient was admitted with a urogenital infection

Intravenous Insulin, CBG and Ketones Monitoring Record Sheet									
GUIDE: Only use for patients on VRIII (use different chart for patients on subcutaneous insulin) Make sure patient's hands are clean Check CBG hourly Check capillary blood ketone levels if CBG>20mmol/l If DKA or HHS follow DKA/HHS protocol							Addressograph Label		
Date	Time	CBG	Blood ketones	Hourly infusion rate (units/ml)	Volume left in syringe(ml)	Volume infused in one hour (ml)	Total volume infused (ml)	Signatures	Key notes

APPENDIX 2 – A GUIDE TO SETTING UP A SYRINGE DRIVER PUMP FOR VRIII

Two registered nurses must check and prepare the VRIII
Use a pre- prepared syringe of Normal Saline and Actrapid insulin wherever possible.

INSULIN MUST BE DRAWN UP FROM AN INSULIN SYRINGE
Draw up 50 units of prescribed Human Actrapid insulin and add 49.5ml of 0.9% Sodium Chloride in a 50 ml luer lock syringe and mix thoroughly. Complete the drug additive label in full and signed by 2 registered nurses and place on the barrel of the syringe.

Set up the intravenous insulin syringe driver pump.

Discard any unused insulin solution after 24 hours.

Intravenous fluid must be administered using a Volumetric infusion pump at hourly rate as prescribed.

Delivery of each solution must be through a single cannula.

Do not administer insulin without substrate unless in a critical care setting.

In an attempt to increase safety, some hospital trusts use pre-filled/pre-prepared insulin syringes. (These are available with-in the trust)

APPENDIX 3 – SAFE DISCONTINUATION OF VRIII

Discontinuing VRIII
Review diabetes treatments in all patients admitted with unstable blood glucose and refer to in-patient diabetes team.

Do not discontinue VRIII until 30 minutes after usual diabetes treatment has been restarted and the patient is able to eat and drink.

Check capillary blood glucose 1 hour after discontinuing VRIII and at least four times for the first 24 hours to ensure there is no rebound hyperglycaemia.

Only restart oral and injectable hypoglycaemic agents once the patient is able to eat and drink.

Ensure that no contra-indications to the previous hypoglycaemic therapy have arisen.

Review diabetes treatment in all patients admitted with unstable blood glucose.

Refer to the in-patient diabetes team.

APPENDIX 4 - INSULIN – NAIVE PATIENTS CALCULATIONS

Method A: Weight based calculation
Calculate total daily dose requirements (TDD)
Adults- frail elderly, CKD stage 4 or 5, severe hepatic failure or new type 1 Total daily insulin dose = 0.3xbody weight in kg. All other adults patients: Total daily insulin dose = 0.5 x body weight in Kg.

Example:
Patient with CKD 4 or 5 weighs 100kg – TDD=0.3x body weight. Give half calculated dose as long-acting insulin and divide the remainder as bolus dose with food.
Twice daily mixed insulin- give 60% of TDD with breakfast and 40% with evening meal

100 kg 0.3x100=30 units basal dose: 30÷2=15 units bolus dose: 15÷3=5 units with each meal.
Mixed insulin: Breakfast dose: 60%=18 units evening meal 40% = 12 units.

Method B
Calculate from insulin requirements from the VRIII from the last 6 hours; calculate the average hourly dose of insulin. Multiply this by 20 to estimate the TDD. A further correction may be required in some patients depending on insulin sensitivity.

Total insulin dose in last 6 hours (6x hourly rate). Divide by 6 to calculate hourly dose, multiply by 20. To estimate TDD basal bolus regime, give half as basal insulin and divide the remainder by three for bolus doses with each meal. Twice daily mixed insulin regime – Give 60% of TDD with breakfast and 40% with evening meal.

Example: 12 units 12÷6 =2 units x 20=40 units bolus dose: 20÷3=7 units with each meal
Mixed insulin: Breakfast dose: 60% = 24 units evening meal 40% = 16 units.

APPENDIX 5 – CONSIDERATIONS ORAL THERAPY IN PATIENTS WITH TYPE 2

- Diet – Discontinue VRIII when the patient is stable.
- Oral – Restart oral treatment when a meal is due, do not stop VRIII until 30 minutes after treatment has been given and the patient has eaten. Some patients may also be on long-acting insulin (refer to table).
- GLP-1 mimetics should be recommenced at the usual dose and time.
- Do not stop VRIII until at least 30 minutes after treatment has been given and the patient has eaten.
- Dose of Sulphonylureas or SGLT 2, may need reducing if food intake is less. Metformin should only be restarted if eGFR is >30ml/min. Review GLP-1 and DPP4 inhibitors if suspected pancreatitis. Review Glitazones if patient has heart failure, oedema or lower limb fracture following a fall. Review SGLT2 if admitted with urogenital infection.
- Blood glucose should be checked 1 hour after discontinuing VRIII and at least 4 times for the next 24 hours to ensure no rebound hypoglycaemia.

Please refer to the diabetes team for advice

APPENDIX 6 – CONSIDERATIONS FOR INSULIN THERAPY

Insulin Therapy

Convert to subcutaneous insulin when the patient is able to eat and drink and has managed at least one meal.

Ideally the transfer should take place at a mealtime, usually breakfast or lunch. Ensure that the meal time insulin has been given before the VRIII is withdrawn.

The VRIII should be continued until at least 30 minutes after the administration of a subcutaneous dose of insulin. This is to avoid rebound hyperglycaemia. Most patients will restart their normal regime.

The pre-admission dose of insulin may need to be reduced if food intake is likely to be limited or the patient was admitted with low blood sugars.

Review diabetes treatment in all patients admitted with unstable blood glucose or HbA1c > 58 mmol/mol (7.5%), and refer to the diabetes in-patient team.

It is important that patients starting insulin receive education and support in self-management of diabetes, that they are confident to self-inject prior to discharge, and that follow-up support is available from appropriately trained professionals If the insulin dose is uncertain because the patient is new to insulin or has previously had poor control there are two possible ways of calculating the starting dose. There is no evidence on which to base a recommendation.

Advice should be sought from local protocols and the diabetes team

APPENDIX 7 - PATIENTS ON SUB-CUT CONTINUOUS INSULIN INFUSION

Patients on continuous subcutaneous insulin infusion (CSII, insulin pump)

- The inpatient diabetes team should be involved with all patients on a CSII, to give individual advice
- In most patients, the previous basal subcutaneous insulin regime should be restarted via the CSII. Continue the VRIII for at least 30 minutes after CSII is restarted to avoid rebound hyperglycaemia
- It is not always necessary to wait until a mealtime to switch back to CSII. Avoid restarting CSII at bedtime because of the risk of rebound hyperglycaemia overnight
- The CSII should not be recommenced until the patient is capable of managing it. Consult the patient about their pump management as patients are usually very knowledgeable about their device.

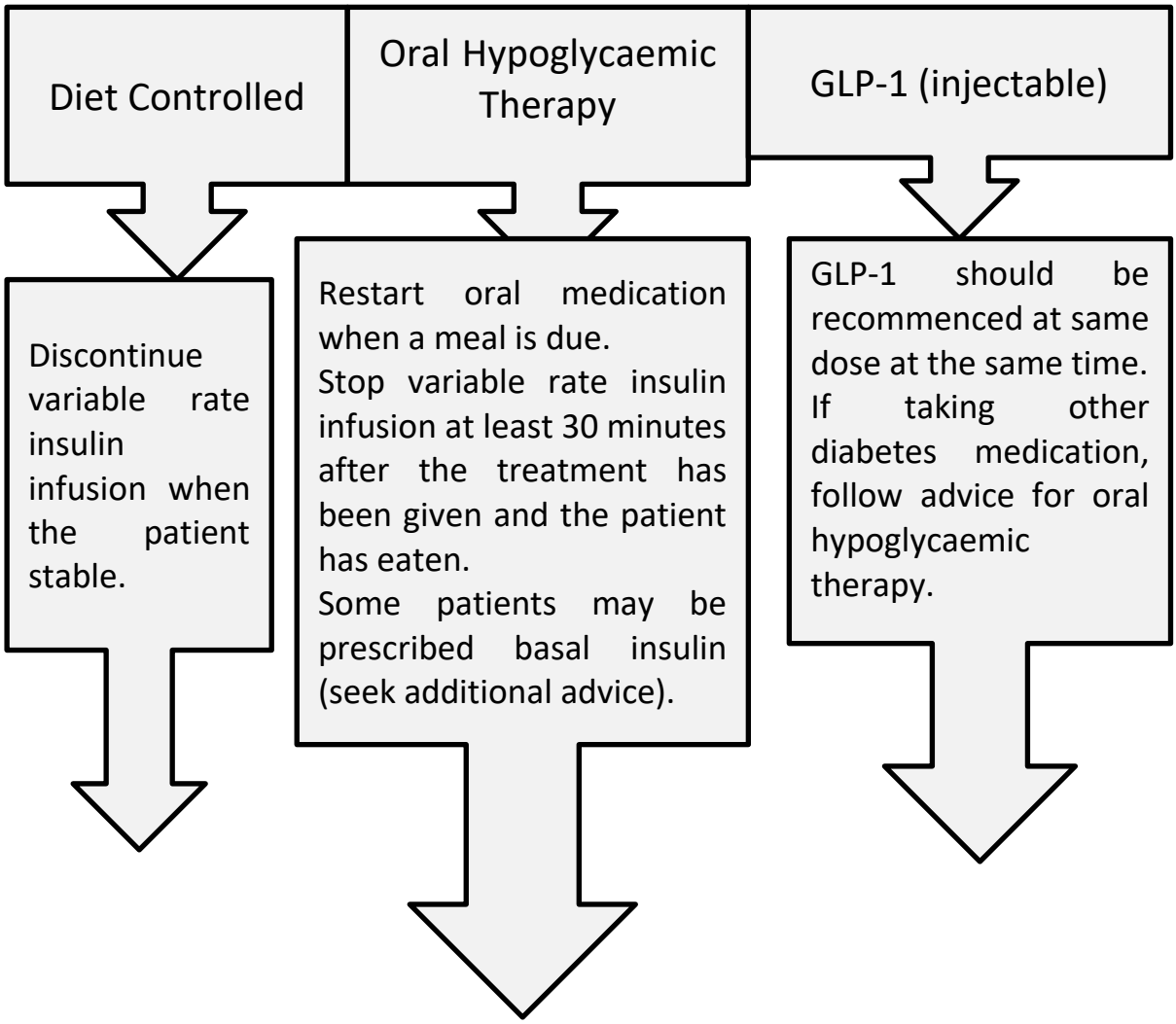
APPENDIX 8 – HYPERGLYCAEMIA POST VRIII

Hyperglycaemia post VRIII

Blood glucose should be checked one hour after discontinuing VRIII and at least four times for the next 24 hours to ensure that there is no rebound hyperglycaemia i.e. pre-meal and pre-bed.

- **DO NOT recommence the VRIII if hyperglycaemia recurs unless the patient is clinically unwell.**
- Ensure that VRIII was discontinued appropriately with usual medication recommenced. Risk of rebound hyperglycaemia and possible ketoacidosis if intravenous access is lost unexpectedly or VRIII is stopped inappropriately.
- If patient was previously on a long-acting insulin ensure this was continued with no gap in administration during VRIII. If the long-acting insulin was omitted in error this must be restarted before the VRIII is discontinued. If the basal insulin is not due for several hours, give half the usual dose of long-acting insulin along with a meal time insulin. This will provide essential background insulin until the usual dose can be recommenced.
- Be aware that diabetes control may have been suboptimal control prior to admission. Check HbA1c and consider adjusting usual medication. Seek advice from the diabetes team for optimisation of their diabetes medication and ongoing management.
- **Type 1 Diabetes**: blood glucose greater than 12.0 mmol/L with blood ketones less than 3.0 mmol/L or urine ketones no more than 2+, give subcutaneous rapid acting analogue insulin. Assume that 1 unit will drop blood glucose by 3 mmol/L **BUT** wherever possible take advice from the patient about the amount of insulin normally required to correct high blood glucose. Recheck the blood glucose 1 hour later to ensure it is falling. Consider increasing the dose if the response is inadequate. Recheck the blood glucose after 1 hour. If it is not falling, consider re-introducing VRIII**.**
- **Type 2 diabetes:** give 0.1 units/kg of subcutaneous rapid acting analogue Insulin and recheck blood glucose 1 hour later to ensure it is falling. Repeat the subcutaneous insulin in at least 2 hours if the blood glucose is still above 12.0 mmol/L. In this situation the insulin dose selected should take into account the response to the initial dose. Repeat the blood glucose after another hour. If it is not falling consider re-introducing VRIII. (rapid acting analogue insulin e.g. Novorapid, Humalog, Apidra, Humalog and Fiasp)
- VRIII is not indicated for treatment of hypoglycaemia. Should hypoglycaemia occur following discontinuation of VRIII follow trust guidelines for treatment of hypoglycaemia**(Refer to PAT/T49 In Hospital management of Hypoglycaemia in Adults with Diabetes Mellitus**). Establish cause of hypo, consider adjusting usual medication especially if patient's dietary intake is reduced from pre-admission Patients with severe (less than 3.9 mmol/L) or recurrent hypoglycaemia **must be referred to the diabetes team**

APPENDIX 9 – ORAL THERAPY FLOW CHART QUICK GUIDE



- Capillary blood glucose should be checked 1 hour after discontinuing variable rate insulin infusion.
- Capillary blood glucose should be checked at least pre-meal and bedtime for the next 24 hours, to ensure there is no rebound hyper- or hypoglycaemia.

Consider:

- Insulin secretagogues (sulphonylureas/glinides) may need reducing if food intake likely to be limited.
- Metformin should only be recommenced when eGFR>30ml/min/1.73m or creatinine <150.
- Review GLP-1(e.g.Liraglutide,Semaglutide) and DDP4(e.g.Sitagliptin), if patient was admitted with suspected pancreatitis.
- Review glitazone, if patient was admitted with heart failure, has macular oedema or lower limb fracture after a fall.
- Review SGLT-2 inhibitors (e.g. Dapagliflozin, Canagliflozin, Empagliflozin). If patient admitted with uro-genital infection or **diabetic ketoacidosis**

APPENDIX 10 – INSULIN THERAPY FLOW CHART QUICK GUIDANCE

Insulin Pump (CSII)

Restart usual basal rate via CSII.
Do not stop VRIII until at least 30 minutes after insulin commenced via CSII.
Give bolus insulin according to usual regime. It is not necessary to wait for a mealtime to switch back.
Avoid restarting CSII at bedtime.

Multiple Daily Injections (MDI or Basal Bolus)

Give dose of sub cut insulin with meal. VRIII should continue for 30-60 minutes then stop. Long-acting insulin is generally given AM/PM. If the long-acting insulin has been missed and the VRIII is to discontinue, administer 50% of the usual dose of insulin while on VRIII and the other 50% at the normal prescribed time. Wait at least 2 hours before the VRIII is stopped, this will provide essential background cover.

Once or Twice Daily Mixed Insulin

Restart usual dose of insulin with a meal (breakfast or evening meal) Do not stop VRIII for at least 30-60 minutes after insulin given and meal eaten.
If it is necessary to discontinue the VRIII at lunch time give 50% of the breakfast dose. Wait at least 2 hours before the VRIII is stopped, this will provide essential background insulin until usual dose of insulin is recommenced.

Long-acting Insulin

Restart usual dose when it is due. Do not stop VRIII until at least 30-60 minutes after insulin given. If necessary to discontinue the VRIII and the basal insulin is not due for several hours, give 50% of the usual dose of long-acting insulin with a meal. Wait at least 2 hours before the VRIII is stopped, this will provide essential background cover.
Give the other 50% of long-acting insulin at the normal prescribed time

Considerations and Recommendations

Blood glucose levels should be monitored one hour after discontinuation of VRII and at least pre-meal and at night for the next 24 hours, to ensure that there is no rebound hyperglycaemia or hypoglycaemia.
In addition discuss with local diabetes inpatient team. Insulin regime may need adjusting.

APPENDIX 11 - EQUALITY IMPACT ASSESSMENT PART 1 INITIAL SCREENING

Service/Function/Policy/Project/ Strategy	Division/Executive Directorate and Department	Assessor (s)	New or Existing Service or Policy?	Date of Assessment
Variable Rate Intravenous Insulin Infusion Guidelines for Adults – PAT/T 76 v.1	Department of Diabetes and Endocrinology. Speciality Services	Shivani Dewan/Annette Johnson/Sue Robson	New Policy	20th March 2021

1) Who is responsible for this policy? Name of Division/Directorate: Division of Medicine

2) Describe the purpose of the service / function / policy / project/ strategy? Who is it intended to benefit? What are the intended outcomes? Treatment of patients on a variable rate insulin infusion in hospital

3) Are there any associated objectives? Legislation, targets national expectation, standards: To improve patient experience/avoid harm

4) What factors contribute or detract from achieving intended outcomes? – Guidance and education

5) Does the policy have an impact in terms of age, race, disability, gender, gender reassignment, sexual orientation, marriage/civil partnership, maternity/pregnancy and religion/belief? Details: [see Equality Impact Assessment Guidance] – No

- **If yes, please describe current or planned activities to address the impact** [e.g. Monitoring, consultation] -

6) Is there any scope for new measures which would promote equality? [any actions to be taken] -

7) Are any of the following groups adversely affected by the policy? No

Protected Characteristics	Affected?	Impact
a) Age	No	
b) Disability	No	
c) Gender	No	
d) Gender Reassignment	No	
e) Marriage/Civil Partnership	No	
f) Maternity/Pregnancy	No	
g) Race	No	
h) Religion/Belief	No	
i) Sexual Orientation	No	

8) Provide the Equality Rating of the service / function /policy / project / strategy – tick (✓) outcome box

Outcome 1 ✓	Outcome 2	Outcome 3	Outcome 4

Date for next review: May 2024

Checked by: Sue Robson **Date: 20th March 2021**