

## **1. Introduction and Who Guideline applies to**

This guideline is for the use of a variable rate intravenous insulin infusion (VRIII) in:

- adult inpatients with diabetes/hyperglycaemia, who require intravenous administration of insulin to keep their blood glucose within the recommended target range during an acute illness or a period of starvation.

This guideline applies to all adult inpatients with diabetes and to all healthcare professionals who are responsible for the clinical management and/or care of these patients. This guideline is applicable across adult services with the exception of the labour ward.

This document is designed to guide non specialist teams in the appropriate and safe use of a VRIII.

### **This guideline is not suitable for use in certain situations:**

- Management of diabetic ketoacidosis
- Management of hyperosmolar hyperglycaemic state
- Management of patients with diabetes who are fasted or undergoing surgical procedures

### **For these specific situations follow the relevant UHL guidance**

#### **Abbreviations used in this guideline**

Variable rate intravenous insulin infusion (VRIII)

Capillary blood glucose (CBG)

Diabetic Ketoacidosis (DKA)

Hyperosmolar Hyperglycaemic State (HHS)

Total Parenteral Nutrition (TPN)

Continuous Subcutaneous Insulin Infusion (CSII)

Total Daily Dose (TDD)

Sodium Chloride (NaCl)

Potassium Chloride (KCl)

## **2. Guideline Standards and Procedures**

The majority of hospitalised medical patients with diabetes can be managed without a VRIII. Aim to avoid intravenous insulin if the patient is eating and drinking normally and remains

well. For patients who are eating and drinking refer to Hyperglycaemia Decision support tool, Insulin Dose titration decision support tool and consult with the diabetes specialist team for advice.

### **Indications for VRIII**

Hyperglycaemia in:

Patients with known diabetes or with newly diagnosed diabetes or hospital related hyperglycaemia (fasting glucose >7mmol/l or random glucose >11mmol/l) unable to take oral fluid/food and for whom adjustment of their own insulin regime is not possible.

- Vomiting (exclude DKA and HHS)
- Nil by mouth and will miss more than one meal
- Severe or acute illness with need to achieve good glycaemic control e.g. sepsis
- When indicated following Hyperglycaemia Decision support tool

### **Practical aspects of setting up a VRIII (see Appendix 1)**

This stand-alone appendix covers how to set up a VRIII.

### **Suggested insulin infusion rates**

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

Three insulin rates are recommended in Table 1 below.

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

These rates are starting points only and the prescribing doctor must be prepared to adapt the insulin infusion rate for the individual patient depending on the blood glucose response. Note: on initiating VRIII it may take 3 - 6 hours for CBG to fall into target range. Insulin scale adjustment should be considered if CBG is not in target within 6 hours of commencing a VRIII or change of scale unless there is clear evidence of steady improvement. Advice should be sought from the diabetes team if target range cannot be achieved and maintained. If CBG readings are out of target ensure:

- Cannula is patent
- Infusion equipment is working appropriately
- Substrate infusion is running at correct rate.

If all above criteria are met and CBG is not within target range see advice below:

If CBG remains above target (> 12mmol/l and not falling on 2 or more consecutive readings) then:

- Increase the insulin infusion rate to the next scale

- If already on increased rate then prescribe a customised scale and seek advice from diabetes team

If CBG is consistently too “tight” (between 4 – 6mmol/l on 2 or more consecutive readings) then:

- Consider reducing to a lower insulin infusion scale
- If reduced rate already in use increase substrate to 10% glucose
- Prescribe a customised insulin infusion rate and seek advice from diabetes team. Consider if VRIII is actually required for this patient

Caution in patients with acute coronary syndrome (ACS) or stroke who have worse outcomes if hypoglycaemic. Do not allow CBG to drop below 6 mmol/l.

**Table 1. Suggested scales for insulin infusion rate**

Glucose (mmol/l)	Insulin infusion rate (ml/hr)				
	Start on standard infusion rate unless otherwise indicated				
	Reduced rate for insulin sensitive patients eg, <24 units per day	Standard rate (first choice in most patients)	Increased rate (for insulin resistant patients eg, > 100 units per day)	Customised scale	Customised scale
<b>N.B. if a patient is on basal subcutaneous insulin – continue this alongside the VRIII</b>					
<4.0	0*	0*	0*		
4.1 – 8.0	0.5	1	2		
8.1 – 12.0	1	2	4		
12.1 – 16.0	2	4	6		
16.1 – 20.0	3	5	7		
20.1 – 24.0	4	6	8		
>24.1	6	8	10		

\*treat hypoglycaemia and once CBG >4.0mmol/l restart iv insulin within 20 minutes. The half-life of insulin is very short and restarting the VRIII promptly minimises the risk of ketosis. Consider if patient requires reduced rate insulin infusion or increase in substrate infusion to 10% dextrose

Hypoglycaemia during VRIII should be treated according to Hypoglycaemia guidance. NOTE: if patients are nil by mouth they will require treatment with intravenous glucose according to guidance.

### Maintaining safety during use of a VRIII

Essential requirements for the safe use of VRIII:

- Hourly monitoring of CBG – to be carried out by a Registered nurse or Registered Nursing Associate only. The Registered Nursing Associate cannot change the dose

so must escalate this to the supporting Registered Nurse. HCAs must not perform CBGs on patients who are on VRIII

- Regular review of insulin infusion rate to achieve target CBG range
- At least daily review of the need for VRIII
- At least daily review of patient including fluid status
- Daily urea and electrolytes

### **Measurements of capillary blood ketones**

Type 1 diabetes – patients with type 1 diabetes who are unwell or have persistent hyperglycaemia in hospital should have blood ketones checked. If found to be in DKA change treatment to DKA protocol.

Type 2 diabetes – patients with type 2 diabetes can develop ketosis if acutely unwell particularly if treated with the class of drug SGLT-2 inhibitors. Check ketones in patients with type 2 diabetes who present acutely unwell.

HCAs should not perform capillary blood ketone tests

### **Choice of concurrent fluids**

Aim of fluid infusion:

- Avoid hypoglycaemia by providing substrate at a steady rate for the insulin infusion
- Maintain fluid balance and electrolytes in the normal range

Always take into account the underlying medical condition, and need for supplements when determining choice of fluids and infusion rate.

Changing of substrate fluid according to CBG values (eg, switching from dextrose containing fluid to normal saline or vice versa) is not recommended as it leads to highly variable CBG readings. If the CBG is above target range, this should be corrected by altering the rate of insulin infusion.

### **Factors to consider when considering fluid and rate of infusion**

Fluid status

- Patients who are vomiting, pyrexial or dehydrated may need additional fluid usually in the form of 0.9% NaCl. This can be run alongside the glucose infusion.

Risk of fluid overload

- In patients with heart failure or severe renal or hepatic impairment it may be necessary to use 10% glucose to meet the substrate requirements and avoid fluid overload. Fluids containing 0.9% NaCl should be avoided in these patients.
- Frail elderly patients are at high risk of fluid overload. We recommend around 2 litres per 24hrs for this group of patients (25-30ml/kg/24hrs).

Electrolyte replacement

Daily monitoring of electrolytes is required to enable fluid selection to take into account potassium and sodium requirements

- Patients on a VRIII for more than 24 hours are likely to need fluid containing sodium chloride to avoid hyponatraemia
- Fluids containing KCl should be selected to maintain serum potassium in the 3.5-5.0 range.
- The combination of glucose and insulin can lead to life threatening hypokalaemia

#### Recommended fluid choice

National guidance recommends (depending on the potassium requirement): 0.45% NaCl with 5% glucose and 0.15%KCl (20 mmol/L)

or 0.45% NaCl with 5% glucose with 0.3% KCl (40 mmol/L)

However, these fluids are not widely available and acceptable alternatives are:

5% glucose with 20 mmol/L or 40 mmol/L KCl

Or

0.18% NaCl with 4% glucose with 0.15% KCl (20 mmol/L)

Or

0.18 % NaCl with 4% glucose with 0.3% KCl (40 mmol/L).

**Table 2. summary of fluid recommendations for UHL in view of availability of fluid substrate**

Patient group	Fluid recommendation
No concern of fluid overload	<p><b>First choice:</b></p> <p>0.18% NaCl with 4% glucose with 0.3% KCl with 20 or 40 mmol/L at 125 ml/hr if serum K is 3.5-5.5 mmol/L</p> <p><b>Second choice:</b></p> <p>5% glucose with 20 or 40 mmol/L KCl at 125 ml/hr if serum K is 3.5-5.5 mmol/L</p>
	<p><b>Aim to keep K 4.0 - 5.0 mmol/L</b></p> <p>If serum K &gt;5.5 no additional K but reassess serum K regularly</p> <p>If serum K &lt;3.5 senior review as extra potassium needs to be given</p>
Concern of fluid overload	<p>Consider whether VRIII is essential or whether a subcutaneous insulin regime can be used</p> <p>Use fluid rate of 83 ml/hr or less for frail</p>

	<p>elderly or consider 10% glucose as substrate at 42 ml/hr to reduce volume further if required</p> <p>If hypoglycaemia occurs on VRIII treat hypoglycaemia and reduce VRIII scale to 'insulin sensitive' regime</p> <p>Do not infuse insulin without substrate unless in HDU/ITU setting</p>
Hyponatraemia or serum sodium falls by >3mmol/l in 24hrs	<p>Consider whether VRIII is essential or whether a subcutaneous insulin regime can be used</p> <p>If available use a mixed solution with higher sodium content such as 0.9%</p> <p>0.9% NaCl with 5% glucose and 0.3% KCl depending on potassium requirement (this fluid is not widely available and so in UHL use following option)</p> <p>OR</p> <p>Add 0.9% NaCl 42 ml/hr to run alongside glucose infusion, provided fluid overload is not a concern.</p>
Hepatic or renal failure	<p>Use 'insulin sensitive' VRIII scale as these patients may have an increased risk of hypoglycaemia</p> <p>Seek specialist advice from nephrology/hepatology team regarding fluid management</p>

### 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 Hyperglycaemia Decision support tool and seek advice from the diabetes team.

Refer patient to the diabetes team if the patient had type 1 diabetes, had suboptimal diabetes control prior to the VRIII or has newly diagnosed diabetes

### Management of other diabetes treatment during VRIII

### Withhold usual diabetes treatment during VRIII

Most patients will have their usual diabetes medication completely withheld whilst they are on a VRIII including oral and injectable hypoglycaemic drugs as well as most forms of insulin. The exception is long acting analogue or isophane basal insulin, which should be continued (see below).

### **Continue basal long-acting analogues\* or isophane basal insulin\*\* in patients usually taking multiple daily injections of insulin.**

\*Detemir (Levemir®), \*Glargine (Lantus®, Abasaglar®, Toujeo®),\* Degludec (Tresiba®), \*\* Insulatard®\*\* Insuman Basal® or\*\* Humulin I®

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.

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

Most patients will restart their usual diabetes treatment following a VRIII (see Appendix 2 for detailed guidance on transferring patients back to their usual diabetes medication). 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 has type 1 diabetes
- 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, that they are confident to self-inject prior to discharge, and that follow-up support is available from appropriately trained professionals.

### **Special circumstances**

#### **Total parenteral nutrition (TPN)**

Although detailed advice regarding total parenteral nutrition is beyond the scope of this guideline it is widely recognised that although TPN improves the nutritional status of critically ill patients, it is associated with the short term complication of hyperglycaemia

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#### **Monitoring**

- 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 the blood glucose is elevated a VRIII will be required, in which case CBG should be monitored hourly. As for all patients receiving a VRIII, these patients will require daily venous blood glucose and urea and electrolytes. In addition other biochemical tests, e.g. micronutrients etc. may be needed. Consult your local nutrition and diabetes teams.

## Delivery

- Intravenous Insulin must always be infused with a substrate; therefore if TPN is delivered via a multi lumen central line, the insulin must also be infused via its own dedicated central line lumen.
- If the TPN is to be delivered via a PICC line, it may be necessary to consider a double lumen PICC line.

## Cautions

If the TPN is stopped for any reason this will put the patient at risk of hypoglycaemia. In this situation the VRIII should be discontinued and blood glucose monitored hourly until the TPN can be reinstated or other steps taken to avoid hypoglycaemia. If hypoglycaemia develops – treat according to JBDS guideline ‘The hospital management of hypoglycaemia in adults with diabetes mellitus’. (<https://abcd.care/joint-british-diabetes-societies-jbds-inpatient-care-group>).

Patients on long acting insulin e.g. Detemir (Levemir®), Glargine (Lantus®, Abasaglar®, Toujeo®). Degludec

(Tresiba®), or intermediate acting insulins such as Insulatard®, Insuman Basal® or Humulin I® should continue these in addition to the VRIII.

## Stepping down from a VRIII in patients on Total Parenteral Nutrition

Once glycaemic control is obtained patients should be stepped down to subcutaneous insulin as soon as possible. The regime chosen should reflect the fact the caloric intake will be a continuous infusion over 24 hours rather than, for instance, as 3 meals a day. The usual regimens of basal bolus or twice daily premixed insulin will not be suitable. In this special circumstance twice daily isophane insulin is recommended.

Once glycaemic control has been obtained on an intravenous infusion:

- Calculate the total daily dose of insulin used over 24 hours on TPN and prescribe as isophane insulin e.g. Humulin I or Insulatard
- Give 50% of the total daily dose at the start of the feed and 50% 12 hours later
- Contact your local diabetes team for further advice

## Patients on Continuous Subcutaneous Insulin Infusions (CSII) also known as Insulin Pumps

CSII is not recommended in situations where self-management is unsafe as in the following:

- Acute illness preventing self-management
- Diabetic Ketoacidosis (DKA)

Major surgery involving a general anaesthetic

- Patients with reduced conscious level or confusion



If a VRIII is required, this should be commenced prior to removing the CSII infusion set from subcutaneous site. Once removed, the subcutaneous pump should be stored in a safe and secure place.

- ALWAYS commence VRIII before disconnecting CSII pump, since if the CSII pump is discontinued without an alternative provision of insulin, diabetic ketoacidosis is likely to develop within a short space of time because there is no reservoir of long-acting insulin.
  - Once patient is well enough to self-manage recommence CSII and stop VRIII (as per stepdown guidance)
  - Prior to resuming CSII, fill a new reservoir and re-site cannula
- Recommence CSII prior to a meal to allow a bolus to be given with the meal

- Discontinue the VRIII 30 minutes later

Check the BG 2 hours after the initial meal time bolus. If the BG is >14, pump manufacturer’s hyperglycaemia guidelines should be followed. A correction should be given via the pump and glucose checked again 1 hour later. If glucose has risen or no improvement is seen, the cannula should be re-sited and the patient should be checked for ketones. This is to establish that the cannula is patent as the cannula may bend/kink on insertion, preventing 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 regimen by the diabetes team.

### **3. Education and Training**

We recommend that all healthcare professionals who prescribe, handle, prepare or administer insulin undertake all either face to face training on the safe use of insulin or undertake the relevant e-learning module available via HELM.

### **4. Monitoring Compliance**

<b>What will be measured to monitor compliance</b>	<b>How will compliance be monitored</b>	<b>Monitoring Lead</b>	<b>Frequency</b>	<b>Reporting arrangements</b>
Adherence to guidance	Review of clinical cases	HA/KH	Continual	Via Datix and Diabetes inpatient Safety committee

### **5. Supporting References (maximum of 3)**

Variable rate insulin infusion (VRII) for medical inpatients with diabetes. Joint British Diabetes Societies Oct 2014.

## **6. Key Words**

Variable rate intravenous insulin infusion, diabetes, fluids

<b>CONTACT AND REVIEW DETAILS</b>	
<b>Guideline Lead (Name and Title)</b> Dr Kath Higgins Clinical lead for Inpatient Diabetes care	<b>Executive Lead</b> Mr Andrew Furlong, Medical Director
<b>Details of Changes made during review:</b> None – new guideline	

## Appendix 1 – Setting up a variable rate intravenous insulin infusion

Two registered nurses must check and prepare the VRIII and every time the rate of infusion is changed.

- INSULIN MUST BE DRAWN UP USING AN INSULIN SYRINGE. NO OTHER SYRINGE TO 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/1ml
- 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

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 Aspart® (Novorapid), Humulin S® and Insulin Lispro® (Humalog) can also be used as an alternative and have a licence for intravenous use. However these are more expensive alternatives.

In areas in which iv insulin is used frequently prefilled / pre-prepared insulin syringes are available but require the department to have adequate fridge storage space. These are supplied by pharmacy.

## Appendix 2: Safe discontinuation of VRIII

### General principles

- Review diabetes treatments in all patients admitted with unstable blood sugars, and refer to diabetes in-patient team
- Do not discontinue the VRIII until 30 minutes after usual diabetes treatment has been restarted, and the patient is able to eat and drink
- Check the CBG one hour after discontinuing VRIII and at least four times for first 24 hours after VRIII has been discontinued, to ensure that there is no rebound hyperglycaemia i.e. pre-meal and pre-bed

### Restarting Oral and Injectable Hypoglycemic Agents

Recommence 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 sugars, and refer to the in-patient diabetes team.

**Table 3 restarting therapy in patients with type 2 diabetes**

	Diet alone	Oral hypoglycaemic therapy	GLP-1 mimetics (injectable)
Good Control (HbA1c<59 mmol/mol or 7.5%)	Discontinue VRIII when the patient is stable	Restart usual diabetes treatment when a meal is due Do not stop VRIII until at least 30 minutes after treatment has been given and the patient has eaten Some patients may also be on basal insulin (see Table 6 for additional advice)	Most patients will be taking additional OHG treatments, which should be restarted when a meal is due 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
Suboptimal control (HbA1c>59 mmol/mol or 7.5%)	In addition to above, discuss with local diabetes in-patient team Patient may need additional hypoglycaemic therapy depending on individualised goals		

Monitor blood glucose	CBG 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 hyper- or hypoglycaemia i.e. pre-meal and pre-bed
Considerations	Dose of insulin secretagogues e.g. sulphonylureas or glinides may need to be reduced if food intake is likely to be limited Metformin should only be recommenced when eGFR is >30 ml/min/1.73 m <sup>3</sup> Review GLP1 and DDP4 inhibitors if patient was admitted with suspected pancreatitis Review glitazone therapy if patient was admitted with heart failure, has macular oedema or has been admitted with a lower limb fracture following a fall Review dapagliflozin therapy if patient was admitted with urogenital infection

### Restarting insulin for patients previously on subcutaneous insulin

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 background insulin (either long acting analogue or isophane) has been given before the VRIII is withdrawn<sup>75</sup>. 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 (see Table 6 for detailed advice). 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 > 59 mmol/mol (7.5%), and refer to the diabetes in-patient team.

**Table 4. Guidance for restarting insulin in patients according to previous regimes**

	Good Control (HbA1c <59 mmol/ mol or 7.5%)	Sub-optimal Control	Monitoring blood glucose
<b>Basal Insulin</b>	Restart usual dose of insulin when it is due (usually with either breakfast or evening meal). Do not stop VRIII until at least 30-60 minutes after insulin has been given and patient has eaten If it is necessary to stop VRIII but the basal insulin is not due for several hours, give half the usual	In addition, discuss with local diabetes in-patient team.	CBG should be checked one hour after discontinuing VRIII and at least four-

	dose of basal insulin. This will provide background insulin until the usual dose can be recommenced	Insulin regime may need adjusting	hourly for the next 24 hours, to ensure that there is no rebound hyper- or hypo- glycaemia
<b>Once or Twice Daily Mixed Insulin</b>	Restart usual dose of insulin together with a meal (either breakfast or evening meal). Do not stop VRIII until at least 30-60 minutes after insulin has been given and the patient has eaten If it is necessary to stop VRIII at lunchtime, give half the usual breakfast dose of mixed insulin. This will provide essential background insulin until the usual dose can be recommenced		
<b>Multiple daily insulin injections (MDI or basal bolus)</b>	Restart usual diabetes treatment together with a meal Basal insulin will usually have been continued. Restart bolus dose of insulin together with the next meal. Do not stop VRIII until at least 30-60 minutes after bolus insulin has been given and the patient has eaten If basal insulin has been stopped, background insulin must be restarted prior to stopping VRIII Ideally, continue the VRIII until basal insulin is given and a meal is due, and stop at least 30-60 minutes after basal and bolus insulin is restarted If it is necessary to stop the VRIII, but the basal insulin is not due for several hours, give half the usual daily dose of basal insulin, along with a meal and bolus insulin. This will provide essential background insulin until the usual dose can be recommenced		
<b>Insulin Pump (CSII)</b>	Restart usual basal rate via CSII Do not stop VRIII until at least 30 minutes after insulin has been recommenced via CSII Give bolus insulin according to patient's usual regime. It is not usually necessary to wait until a mealtime to switch back to CSII therapy Avoid restarting CSII at bedtime		

### Calculating subcutaneous insulin dose in insulin-naïve patients, or where insulin regime needs altering because of sub-optimal control

**It is important that patients starting insulin receive education and support in selfmanagement 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 (either weight-based calculation or calculation based on insulin requirements during **stable** phase of the VRII). There is no evidence on which to base a recommendation. The following guidance is based on calculating the dose based on insulin requirement and is a suggestions only to allow staff to safely initiate subcutaneous insulin

in order that discontinuation of VRIL is not delayed when appropriate – patients also require referral to the diabetes team for review.

### Calculating estimated insulin dose from insulin requirements during the VRIL

An estimate of the daily insulin requirement can be estimated from the last 6 hours of the VRIL as follows:

Divide the total dose of insulin administered in last 6 hours of the VRIL by 6 to calculate average hourly dose of insulin. Multiply this by 20 (not 24, to reduce risk of hypoglycaemia) to estimate the patient’s total daily insulin requirement. A further correction may be needed in some patients, depending on individual insulin sensitivity, previous degree of glycaemic control and severity of intercurrent illness.

#### Worked example using method B:

Total dose of insulin administered in last 6 hours (6 times hourly rate)	12 units
Divide by 6 to calculate hourly dose	$12 \div 6 = 2$ units
Multiply by 20 (not 24 to reduce risk of hypoglycaemia) to estimate <b>total daily insulin requirement TDD</b>	$2 \times 20 = \mathbf{40}$ units
Basal bolus insulin regime (MDI)* Give half of TDD requirement as basal insulin and divide the remainder by three for bolus doses with each meal	Basal dose: $40 \div 2 = \mathbf{20}$ units Bolus dose: $20 \div 3 = \mathbf{7}$ units with each meal
Twice-daily pre-mixed insulin regime* Give 60% of TDD with breakfast and 40% with evening meal	Breakfast dose: $60\% = \mathbf{24}$ units Evening Meal: $40\% = \mathbf{16}$ units

### 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 VRIL 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