East of England Neonatal ODN

(Hosted by Cambridge University Hospitals)

Clinical Guideline: Neonatal Insulin Infusion Guideline

Authors: Nigel Gooding

For use in: EoE Neonatal Units

Used by:

Key Words: insulin, hyperglycaemia

Date of Ratification: September 2026

Review due: September 2029

Registration No: NEO-ODN-2026-20

Approved by:

Neonatal Clinical Oversight Group	
ODN Director	

Ratified by ODN Board:

Date of meeting	

East of England Neonatal ODN
(Hosted by Cambridge University Hospitals)

Neonatal Insulin Infusion
Executive summary of guideline

Recommendation (section of guideline)	Guidance
Patient review before commencing insulin for hyperglycaemia **(section 2)**	Before initiating an insulin infusion, review the following to see if changes to these may eliminate the need for insulin. • **Review the glucose content of intravenous fluids.** • **Assess the diluents used for intravenous infusions to reduce glucose load.** • **Consider transient physiological causes e.g. surgery.** • **Review concomitant medications e.g. corticosteroids** Glucose Infusion Rate (GIR) can be calculated as follows **GIR (mg/kg/min)** = Rate of glucose (mL/hr) x % glucose / Weight (kg) x 6
Management of hyperglycaemia **(section 3)**	Follow local guidelines, or the flowchart in Section 3. Start the hyperglycaemia management pathway if any of the following occur: • Any blood glucose ≥ 20 mmol/L • Persistent blood glucose ≥ 15 mmol/L • Persistent blood glucose ≥ 10 mmol/L with glycosuria **Step 1:** Identify and treat underlying causes **Step 2:** Reduce glucose intake **Step 3:** Start insulin therapy ***If blood glucose is controlled:*** • Gradually wean insulin as blood glucose falls • Avoid hypoglycaemia • Wean insulin more rapidly once blood glucose is <12 mmol/L ***If blood glucose is not controlled:*** • Reduce glucose concentration further (including in Parenteral Nutrition)
Preparing Insulin Infusions **(section 4)**	• Refer to East of England regional IV monograph for insulin (hyperglycaemia) • Preparation should be undertaken by appropriately trained staff (when possible QIS nurses) • Insulin should ALWAYS be drawn up using an insulin syringe • As insulin can adsorb onto plastic infusion equipment, the giving set should be primed with at least 20mL of insulin infusion solution, before being connected to the patient. • Do not administer insulin infusion via a filter.

Recommendation (section of guideline)	Guidance
Administration of insulin infusions **(section 5)**	• Always administer as a continuous infusion using a syringe pump. • Ensure the IV line is clearly labelled. • A typical starting dose is 0.05 units/kg/hour. • The sliding scale dose adjustment is to be used once insulin has been commenced. • The initial infusion rate and any subsequent rate changes must be independently checked by 2 registered healthcare professionals. • Assess blood glucose level 1 hour after initiating insulin infusion and then every 2 – 3 hours until blood glucose begins to decline. • After each insulin rate change, assess blood glucose level 1 hour after changing the insulin infusion rate and then every 2 – 3 hours until blood glucose begins to decline. • Change insulin infusion syringes every 24 hours.
Monitoring **(section 6.1; 6.3)**	• Blood glucose: Monitoring may be required every 1-2 hours when glucose levels are unstable, reducing to every 4 hours once glycaemic control is achieved. • Routine observations include ○Heart rate, respiratory rate, O_2 saturation (hourly) ○Blood pressure / temperature (4-6 hourly • Urinalysis (at least 12 hourly) • Monitor for hypokalaemia caused by insulin.
Recognition of hypoglycaemia **(section 6.2)**	All infants receiving insulin are at risk of hypoglycaemia (blood glucose of ≤2.6mmol/L). Clinical features of hypoglycaemia may include: • Irritability, jitteriness or tremors, seizures, hypotonia, lethargy, poor feeding, apnoea, temperature instability, sweating, tachycardia, cyanosis Severe or prolonged hypoglycaemia can result in significant neurological injury and long-term neurodevelopmental impairment. • Following prescribing guidelines carefully • Adjustments to insulin infusion rates should be discussed between appropriate medical and nursing staff.

<table>
<tr><th>Recommendation (section of guideline)</th><th>Guidance</th></tr>
<tr><td>Adjusting insulin doses

(section 7)</td><td>Insulin infusion rates are usually adjusted in 2 ways
Use of a sliding scale. Follow local guidance if available.
Use of continuous glucose monitoring and associated algorithm
However, there may also be clinical circumstances where the insulin rate needs to be adjusted<table><tr><th colspan="2">Clinical indications for altering insulin infusion rate</th></tr><tr><th>Action to insulin</th><th>Clinical situation where change required</th></tr><tr><td>Increase insulin dose rate</td><td>Blood glucose rising
Blood glucose elevated and unresponsive despite insulin infusion ongoing</td></tr><tr><td>No change to insulin dose rate</td><td>If insulin rate has only recently be changed
If blood glucose has stabilised and insulin is still required.</td></tr><tr><td>Reduce insulin dose rate</td><td>Blood glucose level falling rapidly
Blood glucose level nearer to ‘normal’ i.e. 7 – 9mmol/L, when a chance of overshooting and going too low.</td></tr><tr><td>Stop insulin</td><td>Blood glucose <7 mmol/L
Blood glucose falling exceptionally fast and may overshoot and become hypoglycaemic.</td></tr></table></td></tr>
<tr><td>Discontinuing insulin infusions

(section 8)</td><td>Recheck blood glucose level 2 – 4 hours after discontinuing insulin infusion. (May need to check earlier if blood glucose level had been falling rapidly before stopping insulin infusion.
If insulin was administered via a dedicated PVL, do not flush the line or use for any other purpose after the infusion has been stopped and remove.</td></tr>
<tr><td>Training

(section 10)</td><td>All staff involved with prescribing, preparing and/or administering insulin and neonatal pharmacists should complete the national e-learning package every 3 years.</td></tr>
<tr><td>Audit and incident reporting

(section 11)</td><td>Regular audits of insulin handling, storage, prescribing and administration must be undertaken
All incidents and near misses relating to insulin are reported using local incident reporting systems.</td></tr>
</table>

Neonatal Insulin Infusion Prescribing, Administration and Monitoring Guideline

1. Introduction

Insulin is a hormone produced by the beta cells of the pancreas. It plays a vital role in regulating blood glucose levels by promoting the uptake of glucose into muscle and adipose (fat) tissue and by reducing the release of glucose from the liver. In healthy individuals, insulin is secreted in two primary patterns. The first is basal insulin, a continuous low-level secretion that manages the steady release of glucose from the liver between meals and overnight. The second is bolus (meal-time) insulin, which is released in response to rising blood glucose levels following the consumption of food and drinks.

In both adults and children, insulin is most commonly used to treat diabetes mellitus, a lifelong condition characterised by elevated blood glucose levels. There are two main types of diabetes. Type 1 diabetes occurs when the body's immune system destroys the insulin-producing beta cells of the pancreas, resulting in little or no insulin production. Type 2 diabetes develops when the body either does not produce sufficient insulin or becomes resistant to its effects.

Diabetes is extremely rare in neonates. However, insulin infusions may occasionally be required to manage hyperglycaemia in this population. By lowering blood glucose concentrations, insulin therapy can help reduce the risk of metabolic disturbances and prevent the development of complications associated with persistent hyperglycaemia.

Hyperglycaemia in neonates can occur through a number of different mechanisms, including:

- **Iatrogenic causes** – most commonly due to excessive intravenous glucose administration during the first few days of life, particularly in very low birth weight infants (<1.5 kg).

- **Physiological stress** – conditions such as surgery, hypoxia, respiratory distress syndrome, and sepsis (especially fungal sepsis) can stimulate hepatic glucose production, resulting in elevated blood glucose levels.

- **Immature insulin production in preterm infants** – premature infants have a reduced capacity to secrete insulin, which impairs glucose utilisation and promotes hepatic glucose output.
  In addition, many preterm infants are growth restricted and may have experienced intermittent or chronic hypoxia, leading to increased catecholamine release that further inhibits insulin secretion.

- **Limited enteral nutrition** – delayed initiation or slow progression of enteral feeding is common in very preterm infants. This can reduce the production of gut-derived incretin hormones, which normally enhance insulin secretion and contribute to glucose regulation.

- **High intravenous lipid intake** – administration of large amounts of intravenous lipids may alter gluconeogenic pathways and contribute to the development of hyperglycaemia.

- **Nutritional factors and glucose intolerance** – over the longer term, the nutritional intake of preterm infants has often been skewed towards carbohydrates and lipids rather than protein. This can promote fat accumulation and impair glucose utilisation, contributing to persistent hyperglycaemia even after full enteral feeding has been established during the neonatal intensive care unit (NICU) stay.

As insulin is broken down by enzymes within the gastrointestinal tract, it cannot be administered orally and must be given by injection. While the subcutaneous route is appropriate for most clinical situations, intravenous administration of soluble insulin is the preferred method for treating hyperglycaemia in neonates.

Short-acting preparations, which include soluble insulin and rapid-acting insulin analogues, are most suitable for managing neonatal hyperglycaemia because of their rapid onset and short duration of action, allowing closer control of blood glucose levels.

Soluble insulin is used for neonatal insulin infusions because its formulation allows it to be administered intravenously. When given by subcutaneous injection, soluble insulin typically begins to act within 30–60 minutes, reaches peak activity after 1–4 hours, and has a duration of action of up to 9 hours. In contrast, when administered intravenously, it has an almost immediate onset of action and a very short half-life of only a few minutes, enabling rapid dose adjustment in response to changes in blood glucose concentrations.

The insulin used for continuous infusion within neonatal units is human soluble insulin. In the UK, this preparation is available under the brand name Actrapid®.

2. Patient review before commencing insulin

Before initiating an insulin infusion for the management of neonatal hyperglycaemia, several simple interventions should be considered, as these measures may reduce blood glucose concentrations to an acceptable level and eliminate the need for insulin therapy. The following options should be discussed with the medical team where appropriate:

- **Review the glucose content of intravenous fluids.** Reducing the glucose concentration of maintenance fluids may help improve glycaemic control. This could involve changing from 10% glucose to 5% glucose, switching parenteral nutrition (PN) formulation to a lower-glucose PN regimen.

- **Assess the diluents used for intravenous infusions.** Some medications may be prepared in glucose-containing solutions, contributing significantly to overall glucose intake. For example, intravenous morphine prepared in 10% glucose may be suitable for dilution in 5% glucose, 0.45% sodium chloride, 0.9% sodium chloride, depending on clinical circumstances. In infants receiving multiple infusions, modifying infusion diluents can substantially reduce the glucose load.

- **Consider transient physiological causes.** Hyperglycaemia may occur in response to acute physiological stress, such as following surgery. In these situations, blood glucose concentrations may improve spontaneously as the stress response resolves. Repeating a blood glucose measurement after 1–2 hours may demonstrate that the hyperglycaemia is temporary and does not require intervention.

- **Review concomitant medications.** Certain medicines, particularly corticosteroids such as dexamethasone and hydrocortisone, are known to increase blood glucose concentrations. In infants receiving these agents, it may be clinically appropriate to tolerate a higher blood glucose threshold before initiating treatment, for example allowing levels to exceed 12 mmol/L rather than 10 mmol/L, depending on the overall clinical assessment.

When considering whether it is appropriate to adjust the glucose concentration of a neonate's intravenous fluids, the medical team will often calculate the Glucose Infusion Rate (GIR). This calculation estimates the amount of glucose being delivered to the infant and is expressed as milligrams of glucose per kilogram of body weight per minute (mg/kg/min).

For term infants, a typical glucose infusion rate is generally between 4 and 6 mg/kg/min. In preterm infants, glucose requirements vary according to postnatal age and clinical condition. It is common practice to commence glucose administration at approximately 4–8 mg/kg/min, with gradual increases over the first week of life to achieve a target infusion rate of around 11 mg/kg/min between days 4 and 8.

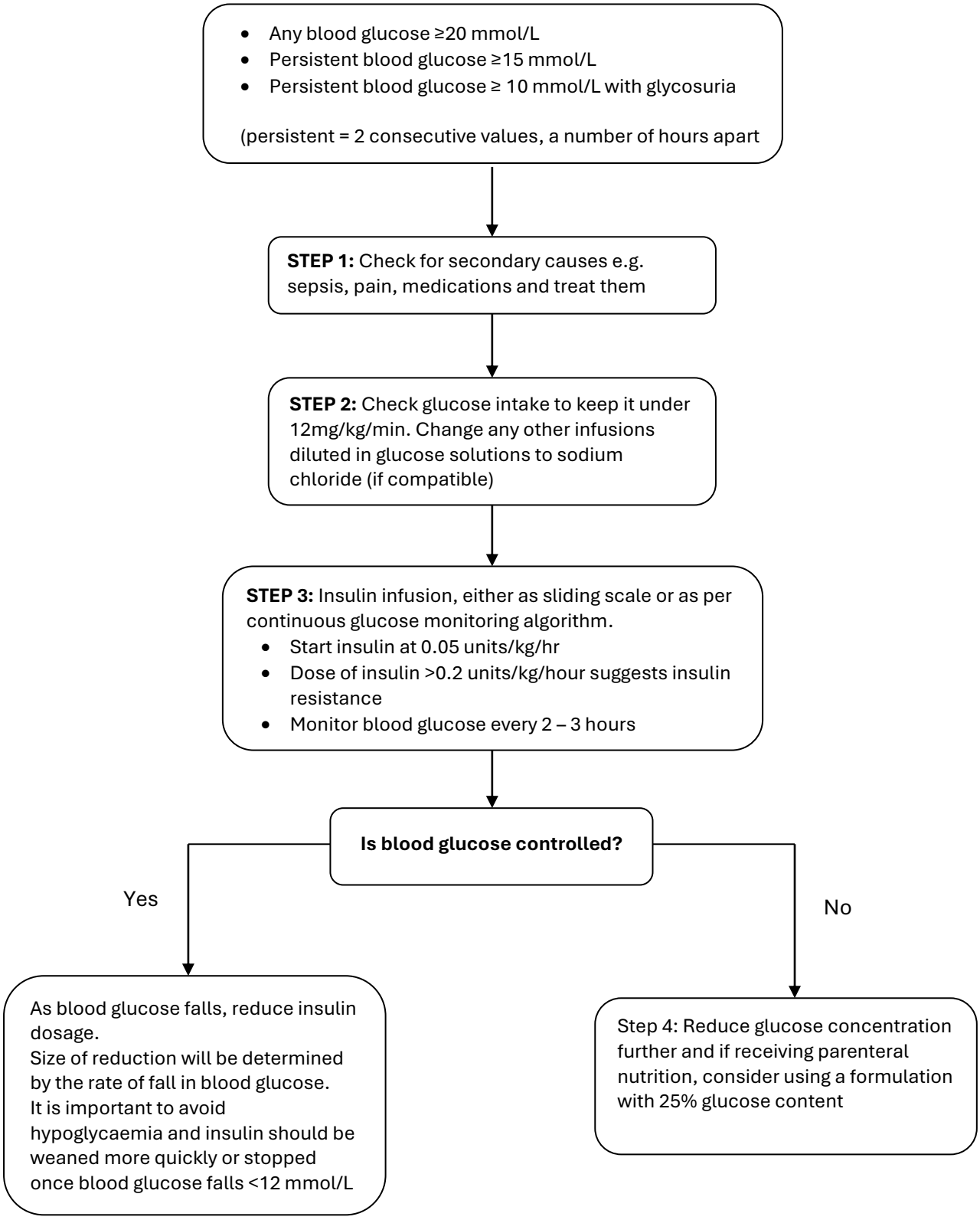
Calculating the GIR helps clinicians assess whether excessive glucose administration may be contributing to hyperglycaemia and aids decision-making when adjusting intravenous fluids, parenteral nutrition regimens, or other sources of glucose intake.

GIR can be calculated as follows

$$\textbf{GIR (mg/kg/min)} = \frac{\text{Rate of glucose (mL/hr)} \times \text{\% glucose}}{\text{Weight (kg)} \times 6}$$

3. Management of hyperglycaemia in neonates

Neonatal units will have local guidance around management of hyperglycaemia ***which should be followed.*** The flowchart below gives an example of how hyperglycaemia could be managed.



4. Preparation and storage of Insulin

Practice must be in line with recommendations from GIRFT-guide-to-safe-insulin-use-in-neonatal-services. Trusts must include local details of how they store insulin and control access, within their own Trust medication storage policies.

Refer to East of England neonatal monographs for either preparation of insulin infusion as a standard concentration of insulin or as a weight based concentration.

Insulin solutions should only be prepared by appropriately trained staff. Wherever possible, preparation should involve an experienced Qualified in Specialty (QIS) neonatal nurse who has previous experience preparing insulin infusions.

Soluble insulin should be stored in accordance with the manufacturer's recommendations. Key principles include:

- Insulin should always be stored as per local policy and in line with GIRFT recommendations.
- Keep the vial in its original outer carton to protect it from light.
- Ideally store at 2–8°C in a refrigerator, and always below 25°C.
- Once opened, insulin may be used for up to 6 weeks. Staff should record the date of opening on the vial.
- If removed from refrigeration, insulin remains stable provided the ambient temperature does not exceed 25°C.
- Clear insulin does not require mixing or agitation before use.
- Do not use the product if the solution is not clear, colourless, and aqueous in appearance.
- Insulin that has been frozen **must** be discarded. Care should be taken to ensure vials do not come into contact with the back wall of the refrigerator, where freezing may occur, as this can denature the insulin.
- Undiluted insulin should **not** be stored in plastic syringes. It should be diluted immediately after being drawn up, as contact with plastic may cause the solution to become hazy. If haziness develops, both the solution and syringe should be discarded and replaced with freshly prepared insulin.

Practice varies between neonatal units regarding the route of insulin administration, including whether insulin is infused through a dedicated intravenous line or alongside maintenance fluids. Staff should follow local protocols while recognising that alternative approaches may be used elsewhere, each with its own benefits and risks.

Some units administer insulin via a dedicated intravenous line. This approach avoids the need to flush or bolus the insulin infusion, which is important because neonates can be highly sensitive to even small changes in insulin dose. Using a separate line reduces the risk of unintended dose fluctuations caused by administering other medications or infusions through the same access. However, if the infant's energy supply is interrupted—for example, due to loss of venous access or failure of maintenance fluid delivery—the insulin infusion may continue uninterrupted, increasing the risk of hypoglycaemia.

- Once in the blood stream, insulin has a half-life of 5-6 minutes, so where possible the baby should have spare IV access. This is so that if one IV access stops working the infusion can be transferred rapidly to another cannula. However the insulin will continue to have some

effect on the cells for some hours, so loss of intravenous access is not an emergency situation.

Some neonatal units administer insulin alongside an energy source, such as parenteral nutrition (PN) or a glucose infusion. This approach ensures that if intravenous access is lost, both the insulin and energy supply are interrupted simultaneously, reducing the risk of the infant receiving one without the other. However, administering insulin in this way may result in fluctuations in insulin delivery if maintenance fluid rates are adjusted or if other medications are given through the same line.

Insulin should **always** be drawn up using an insulin syringe. These syringes are calibrated in insulin units rather than millilitres and must correspond to the insulin concentration being used. In the UK, standard human insulin is supplied as U100 insulin (100 units/mL); therefore, U100 insulin syringes should be used and should be the only insulin syringes routinely available within the clinical area.

Insulin can adsorb to plastic infusion equipment, resulting in reduced insulin concentrations being delivered to the patient. To minimise this effect, the delivery tubing of the giving set must be primed with at least 20mL of diluted insulin solution before being attached to the baby. It is extremely important that any replacement set is fully primed to minimise possible destabilisation of glucose control. Avoid administration of insulin infusion via a filter as these may retain insulin and reduce the amount delivered to the infant.

Insulin infusions may be prepared as per the East of England neonatal monographs using a range of compatible diluents, including 5% glucose, 10% glucose, 0.45% sodium chloride, or 0.9% sodium chloride.

Insulin infusion rates are prescribed and administered in units per kilogram per hour (units/kg/hour). When prescribing on paper the work ‘UNIT’ must always be used and not ‘U’ or ‘iU’.

5. Administration of insulin infusions

Intravenous insulin has a rapid onset of action and a short half-life. Consequently, it must be administered as a continuous infusion to maintain a consistent therapeutic effect.

Insulin infusions should always be delivered using a syringe pump to ensure precise and continuous administration.

A typical starting dose is 0.05 units/kg/hour, although prescribing should always follow local guidelines and individual patient requirements.

The initial infusion setup and any subsequent rate adjustments must be independently checked by two registered healthcare professionals. Both practitioners should document the check by signing the administration record or prescription chart in accordance with local policy.

Insulin infusions are generally administered in addition to the infant’s prescribed daily fluid allowance. This is because the infusion volume is usually very small and the infusion rate may need frequent adjustment in response to changes in blood glucose levels.

When a peripheral venous line (PVL) is used, line patency should be confirmed by flushing before the insulin infusion is started, as the line should not be flushed once insulin administration has commenced.

The infusion should be started at the prescribed rate, with blood glucose reassessed approximately one hour after initiation.

If insulin is administered through a PVL, the line should not be flushed or used for the administration of bolus medications during the infusion, as this may result in inadvertent delivery of an insulin bolus. Similarly, the line should not be reused immediately after the insulin infusion has been discontinued, as residual insulin may remain within the cannula hub and tubing. To minimise the risk of accidental use, the line should be clearly labelled as being used, or previously used, for insulin administration.

When insulin is administered alongside other infusions, the administration set should be clearly labelled close to the infant to reduce the risk of accidental disconnection, clamping, or interruption of the insulin infusion.

Insulin infusion syringes should be replaced every 24 hours in accordance with local policy.

Given the short half-life of insulin, replacement infusions should be prepared and ready before the current syringe is exhausted to avoid interruptions in insulin delivery.

If either the insulin infusion or the accompanying glucose infusion becomes disconnected, both the infusion solution and administration set should be replaced with newly prepared equipment and solutions.

If the intravenous line used for insulin administration becomes blocked or loses patency, blood glucose levels may rise because insulin is no longer being delivered rather than because the infant requires an increased dose. In such circumstances, the insulin infusion rate should not be increased until line patency has been restored, and insulin has been delivered at the prescribed rate for at least 1.5–2 hours.

6. Ongoing care and monitoring

6.1 Monitoring

Blood glucose levels should be monitored regularly throughout insulin therapy. The frequency of monitoring may be influenced by the stability of the infant's blood glucose levels and the condition of their skin. Monitoring may be required every 1–2 hours when glucose levels are unstable, reducing to at least every 4 hours once satisfactory glycaemic control has been achieved.

Routine observations should generally be recorded hourly and include:

- Heart rate
- Respiratory rate
- Oxygen saturation

Blood pressure and temperature should also be monitored regularly, typically every 4–6 hours.

Urinalysis should be performed at least every 12 hours to assess for glycosuria (glucose in the urine). Monitoring urinary glucose can provide a useful indication of the degree of glycaemic control and the effectiveness of treatment.

However, the presence or absence of glucose in the urine should not be used in isolation to guide insulin therapy. Decisions regarding the initiation, adjustment, or discontinuation of an insulin infusion should be based primarily on blood glucose measurements and the infant's overall clinical condition.

6.2 Prevention and Recognition of Hypoglycaemia

All infants receiving insulin therapy are at risk of hypoglycaemia. This may occur if blood glucose levels fall more rapidly than anticipated or if an error occurs during preparation or administration of the insulin infusion.

Although definitions vary between neonatal units, hypoglycaemia is generally considered to be a blood glucose concentration of 2.6 mmol/L or less.

Clinical features of hypoglycaemia in neonates may include:

- Irritability
- Jitteriness or tremors
- Seizures
- Hypotonia
- Lethargy
- Poor feeding
- Apnoea
- Temperature instability
- Sweating
- Tachycardia
- Cyanosis

Severe or prolonged neonatal hypoglycaemia can result in significant neurological injury and may lead to long-term neurodevelopmental impairment.

To minimise the risk of hypoglycaemia, staff caring for infants receiving insulin must adhere closely to monitoring and prescribing protocols. Blood glucose measurements should be performed at the prescribed intervals without delay. Decisions regarding insulin dose adjustments should be discussed with an appropriate medical or nursing colleague to ensure a shared understanding of the proposed change. All infusion rate adjustments should be independently checked by a second registered practitioner and documented in accordance with local policy.

6.3 Monitoring for Hypokalaemia

Infants receiving insulin infusions are also at risk of hypokalaemia, as insulin promotes the movement of potassium from the extracellular space into cells, reducing circulating potassium concentrations.

Hypokalaemia is a potentially serious complication and should be monitored carefully. Serum potassium concentrations should usually be measured at least daily, with a target concentration maintained within the normal reference range of 3.5–5.0 mmol/L, unless otherwise clinically indicated.

7. Adjusting doses of insulin infusion

7.1 Sliding Scale (Variable Rate) Insulin infusions

Local guidance around adjusting doses for sliding infusions must be followed if available.

Examples of sliding scale guidance is shown below

7.1.1 Sliding scale advice when using fixed concentrations of insulin

The following sliding scale is a recommendation but may need adjusting to suit individual requirements. Remember to recheck blood glucose regularly and frequently. If the blood glucose remains >10mmol/l, consider revising the sliding scale to give more insulin for higher blood glucose values.

Blood glucose	Rate of infusion of solution using 0.1 unit/mL concentration	Rate of infusion of solution using 0.5 unit/mL concentration	Rate of infusion of solution using 1 unit/mL concentration
>20 mmol/l	3 ml/kg/hr (0.3 unit/kg/hr)	0.6 ml/kg/hr (0.3 unit/kg/hr)	0.3 ml/kg/hr (0.3 unit/kg/hr)
18-20 mmol/l	2.5 ml/kg/hr (0.25 unit/kg/hr)	0.5 ml/kg/hr (0.25 unit/kg/hr)	0.25 ml/kg/hr (0.25 unit/kg/hr)
16-18mmol/l	2 ml/kg/hr (0.2 unit/kg/hr)	0.4 ml/kg/hr (0.2 unit/kg/hr)	0.2 ml/kg/hr (0.2 unit/kg/hr)
14-16 mmol/l	1.5 ml/kg/hr (0.15 unit/kg/hr)	0.3 ml/kg/hr (0.15 unit/kg/hr)	0.15 ml/kg/hr (0.15 unit/kg/hr)
10-14mmol/l	1 ml/kg/hr (0.1 unit/kg/hr)	0.2 ml/kg/hr (0.1 unit/kg/hr)	0.1 ml/kg/hr (0.1 unit/kg/hr)
7-10 mmol/l	0.5 ml/kg/hr (0.05 unit/kg/hr)	0.1 ml/kg/hr (0.05 unit/kg/hr)	0.05 ml/kg/hr (0.05 unit/kg/hr)
<7 mmol/l	Stop insulin infusion	Stop insulin infusion	Stop insulin infusion

7.1.2 Sliding scale advice when using weight based concentration of insulin infusion

The following sliding scale is based on an insulin infusion prepared with 25 units**/kg** of soluble insulin in a final volume of 50mL. It is a recommendation, but may need adjusting to suit individual requirements.

Blood glucose	Rate of infusion of solution prepared as stated above.
>20 mmol/l	0.6ml/hr (0.3unit/kg/hr)
18-20 mmol/l	0.5ml/hr (0.25unit/kg/hr)
16-18mmol/l	0.4ml/hr (0.2unit/kg/hr)
14-16 mmol/l	0.3ml/hr (0.15unit/kg/hr)
10-14mmol/l	0.2ml/hr (0.1unit/kg/hr)
7-10 mmol/l	0.1ml/hr (0.05unit/kg/hr)
<7 mmol/l	Stop insulin infusion

7.2 Continuous Glucose monitoring

Blood glucose monitoring is a routine component of neonatal intensive care but is currently reliant on intermittent blood sampling via a central arterial line or heel-prick testing. Consequently, there are extended periods during which glucose levels are not assessed. While glucose instability is often temporary in many infants, some experience persistent dysglycaemia that requires prolonged monitoring. Management of these infants frequently involves adjustments to dextrose-containing intravenous fluids and insulin therapy. In such cases, the use of continuous glucose monitoring (CGM) should be considered to support glucose surveillance and optimise management.

A CGM sensor is inserted into the subcutaneous tissue, where it measures interstitial glucose concentrations continuously. The availability of real-time glucose data enables clinicians to identify glycaemic trends and promptly detect episodes of hypo- and hyperglycaemia. This allows treatment to be tailored more accurately to the infant's individual metabolic needs while reducing exposure to the procedural pain and distress associated with repeated heel-prick blood sampling.

Multiple research studies and randomised controlled trials have demonstrated the accuracy, safety, and clinical utility of CGM use in neonates. Apart from the brief discomfort associated with sensor insertion, CGM devices are generally well tolerated, including in very low birth weight infants. Reported local complications are uncommon and are typically minor.

Although CGM provides valuable information on glucose trends over time, it does not completely eliminate the need for confirmation of blood glucose levels using conventional blood-based monitoring methods. This guideline describes the indications, insertion procedure, and use of CGM within the NICU as an adjunctive tool for the monitoring and management of infants at risk of dysglycaemia.

Continuous glucose monitoring (CGM) should be used alongside the CGM algorithm to guide insulin infusion titration and optimise glucose control. For infants with a CGM in place, insulin should continue to be prescribed at the same concentration. However, the prescription should clearly state that insulin dose adjustments are to be made using the CGM guideline. A printed copy of the guideline should be kept at the cot side to support clinical decision-making and facilitate reference by staff.
If sensor glucose (SG) levels are falling rapidly, a blood glucose (BG) measurement should be obtained, as changes in interstitial glucose may lag behind those in blood glucose. However, BG values obtained during periods of rapidly changing glucose concentrations should **not** be used for sensor calibration. Calibration should instead be performed using a BG measurement taken when glucose levels are relatively stable.

Continuous Glucose Monitoring Algorithm for adjustment of insulin doses

Sensor Glucose mmol/L	↓ Falling Blood Glucose ↓	↔ Stable Blood Glucose ↔	↑ Rising Blood Glucose ↑
<2.6	**Check Blood Glucose** Stop any insulin and check all lines Consider increasing baseline glucose infusion or give a glucose bolus	**Check Blood Glucose** Stop any insulin and check all lines Consider increasing baseline glucose infusion or give a glucose bolus	**Check Blood Glucose** Review infusions and check lines Consider baseline glucose infusion
2.6 – 4.0	**Check Blood Glucose** Stop any insulin and check all lines Consider increasing baseline glucose infusion rate	**Check Blood Glucose** Stop any insulin and check all lines	**Observe the rate of rise** Review infusions and check lines
Target Range 4.0 – 8.0	**IN TARGET** If the rate of fall means you will be <4.0mmol/L within 1 hour, consider reducing or stopping insulin or increasing glucose infusion rate	**IN TARGET**	**IN TARGET**
8.0 – 10.0	**Observe the rate of fall** Consider ***reducing*** insulin infusion rate by 25% if already running and rapid rate of glucose fall	Start insulin at 0.05 units/kg/hour or if insulin already running consider ***increasing the*** insulin infusion rate by 50%	Start insulin at 0.05 units/kg/hour or if insulin already running consider ***increasing the*** insulin infusion rate by 50%
10.0 – 15.0	**Observe the rate of fall** Consider ***increasing*** the insulin infusion rate by 25%	Start insulin at 0.05 units/kg/hour or if insulin already running ***increase*** the insulin infusion rate by 50%	Start insulin at 0.05 units/kg/hour or if insulin already running ***increase*** the insulin infusion rate by 50%
>15	**Observe the rate of fall** Consider ***increasing*** the insulin infusion rate by 50%	Start insulin at 0.05 units/kg/hour **or** consider ***increasing*** the insulin infusion rate by 100% (i.e. double) **Always check infusion lines if there is little or no response to an intervention**	Start insulin at 0.05 units/kg/hour **or** consider ***increasing*** the insulin infusion rate by 100% (i.e. double) **Always check infusion lines if there is little or no response to an intervention**
CRITICAL **CONCERN** **IN TARGET**	Please remember continuous glucose sensor readings are provided to support clinical management They provide additional information on trends in glucose levels which should be used to guide the need for more blood glucose measurements. Capillary / venous blood glucose levels are more accurate. **Always check infusion lines if there is little or no response to an intervention**		

7.3 Clinical indications for altering insulin infusion rate

The insulin administration algorithm should be used as the primary guide for clinical practice. However, there may be circumstances where it is appropriate to adapt the guideline following discussion with the medical team. This may be necessary when an infant's blood glucose levels are highly variable, not responding as expected to treatment, or when there is a significant change in the infant's clinical condition or management, such as problems with intravenous access or line function. In these situations, clinical judgement should be applied alongside the algorithm. The table below highlights key principles to support healthcare professionals in making informed decisions regarding insulin management.

Clinical indications for altering insulin infusion rate	
Action to insulin	**Clinical situation where change required**
Increase insulin dose rate	• Blood glucose rising • Blood glucose elevated and unresponsive despite insulin infusion ongoing
No change to insulin dose rate	• If insulin rate has only recently be changed • If blood glucose has stabilised and insulin is still required.
Reduce insulin dose rate	• Blood glucose level falling rapidly • Blood glucose level nearer to 'normal' i.e. 7 – 9mmol/L, when a chance of overshooting and going too low.
Stop insulin	• Blood glucose <7 mmol/L • Blood glucose falling exceptionally fast and may overshoot and become hypoglycaemic.

Carefully monitor the insulin infusion site, particularly when insulin is being administered through a dedicated peripheral venous line (PVL). Because insulin is delivered in very small volumes, signs of infiltration or extravasation may not become apparent until several hours after the PVL has ceased to function effectively.

Ensure familiarity with the locally agreed target blood glucose range and associated management protocols, especially if these have recently been revised or updated.

Maintain uninterrupted intravenous maintenance fluids and/or enteral feeding throughout the insulin infusion whenever possible. Any sudden interruption or reduction in the infant's energy supply can substantially increase the risk of hypoglycaemia.

8. Discontinuing insulin infusions

Recheck the blood glucose level 2–4 hours after discontinuing the insulin infusion to assess the ongoing glycaemic response. If blood glucose levels had been falling rapidly prior to stopping insulin, an earlier measurement may be required to ensure that hypoglycaemia does not develop.

If insulin was administered via a dedicated peripheral venous line (PVL), the line should not be flushed or used for any other purpose after the infusion has been stopped. The PVL should be clearly labelled as an insulin line to ensure that staff on subsequent shifts are aware that it is reserved exclusively for insulin administration.

In exceptional circumstances where urgent intravenous access is required and no alternative access is available, the insulin PVL may be used following discussion and agreement with the medical team. In this situation, the T-piece and extension tubing should be removed, and only the cannula should be flushed at the point where it enters the skin. This approach minimises the volume of residual insulin that could be inadvertently administered to approximately 0.1–0.2 mL. Such use should be restricted to situations where no other option exists, and a blood glucose measurement should be performed within one hour of flushing the line.

9. Parents

Keep parents regularly informed about their baby's condition, including the latest clinical findings, any current concerns, and the ongoing plan of care.

10. Training

All staff involved with prescribing, preparing and/or administering insulin, and pharmacists covering neonatal units should complete the national e-learning package https://nhspaediatric.safeprescriber.org/login every 3 years. The training module is called 'Insulin use in neonatal care' and is found within the 'General Therapeutics' category.

Staff are responsible, in partnership with their employer, for maintaining and updating their knowledge and competencies relating to hyperglycaemia management and insulin infusion administration. As well as the national e-learning package, this may also include, familiarisation with local guidelines, and attendance at study days, conferences, seminars, or webinars relevant to neonatal practice.

The administration of insulin infusions is often regarded by neonatal nursing staff as a high-risk and infrequently encountered aspect of care. Staff should therefore be familiar with the sources of support available, particularly in situations where insulin therapy may be required unexpectedly. These sources may include:

- Senior nursing colleagues
- Unit or network nursing guidelines and standard operating procedures (SOPs)
- Medical hyperglycaemia management guidelines
- The unit pharmacist or on-call pharmacist
- Local policies and clinical guidelines
- Specialist advice from the network Neonatal Intensive Care Units

As a matter of best practice, at least one (and ideally both) of the nurses preparing an insulin infusion should be an experienced neonatal nurse who hold the Qualified in Speciality (QIS) qualification.

11. Audit and review of reported incidents

11.1 Audit

Audit is an essential component of quality assurance for the handling, storage, prescribing and administration of insulin infusions. It helps evaluate the standard of care provided, identify opportunities for improvement, and inform staff development.

Following completion of an audit, there should be clear evidence that findings have been acted upon and that appropriate improvements have been implemented.

11.2 Incident reporting

It is important that incidents and near misses relating to insulin are reported using local incident reporting systems. Any reported incidents and near misses should be reviewed promptly

References

Beardsall, K. (2019). Real time continuous glucose monitoring in neonatal intensive care. Early Human Development. doi: 10.1016/j.earlhumdev.2019.104844.

Beardsall, K., Thomson, L., Elleri, D., Dunger, D.B. and Hovorka, R. (2019). Feasibility of automated insulin delivery guided by continuous glucose monitoring in preterm infants. Archives of Disease in Childhood Fetal and Neonatal Edition, Volume 105 (3), pp. 279-284. doi: 10.1136/archdischild-2019-316871

Beardsall, K., Thomson, L., Guy, C., van Weissenbruch, M., Iglesias, I., Muthukumar, P., Somisetty, S., Bond, S., Petrou, P. and Dunger, D. (2018) Protocol of a randomised controlled trial of real-time continuous glucose monitoring in neonatal intensive care 'REACT'. BMJ Open. doi: 10.1136/bmjopen-2017-020816.

Beardsall K, Vanhaesebrouck S, Ogilvy-Stuart AL, Vanhole C, Palmer CR, Ong K, et al. Prevalence and determinants of hyperglycaemia in very low birth weight infants: cohort analyses of the NIRTURE study. J Pediatr. 2010;157(5):715-9.e1-3.

GIRFT-guide-to-safe-insulin-use-in-neonatal-services January 2026

Newby.B and Holmes.D (2017) Effect of tubing flush or preconditioning on available insulin concentration for IV infusion: A pilot project. CJHP, Vol 70, No 4, pp320-21.

Ng SM, May JE, Emmerson AJ. Continuous insulin infusion in hyperglycaemic extremely-low-birthweight neonates. Biol Neonate. 2005;87(4):269-72.

Ogilvy-Stuart AL, Beardsall K. Management of hyperglycaemia in the preterm infant. Arch Dis Child Fetal Neonatal Ed. 2010;95(2):F126-31.

Shah, R., McKinlay, C. and Harding, J. (2018). Neonatal hypoglycemia: continuous glucose monitoring. Current Opinion in Pediatrics, Volume 30 (2), pp. 204-208. doi: 10.1097/MOP.0000000000000592.

Thames Valley & Wessex ODN. Insulin infusion guideline March 2022

Thompson.C.D et al (2012) The effect of tubing dwell time on insulin adsorption during intravenous insulin infusions. Diabetes technology and therapeutics. Vol 14, No 10, pp912-916.

West of Scotland Neonatal Guideline. Hyperglycaemia in the Neonate May 2026

East of England Neonatal ODN
(Hosted by Cambridge University Hospitals)

Exceptional Circumstances Form

Form to be completed in the **exceptional** circumstances that the Trust is not able to follow ODN approved guidelines.

Details of person completing the form:	
Title:	Organisation:
First name:	Email contact address:
Surname:	Telephone contact number:
Title of document to be excepted from:	
Rationale why Trust is unable to adhere to the document:	
Signature of speciality Clinical Lead: Date:	Signature of Trust Nursing / Medical Director: Date:
Hard Copy Received by ODN (date and sign):	Date acknowledgement receipt sent out:

Please email form to: kelly.hart5@nhs.net requesting receipt.

Send hard signed copy to:

Kelly Hart
EOE ODN Office Manager
Box 402
Rosie Hospital
Robinson Way
Cambridge University Hospital
Hills Road
Cambridge CB2 0SW