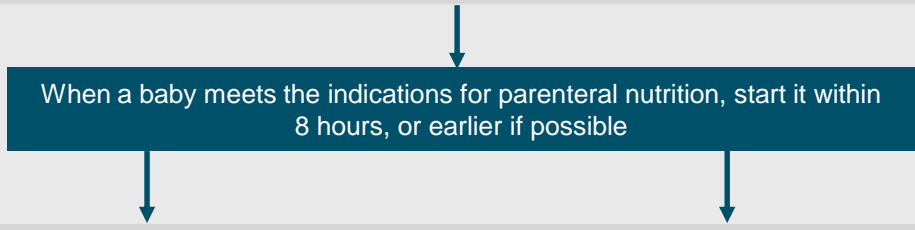


**For newborn babies start NPN in**

- Preterm babies born before 31 weeks
- Preterm babies born at or after 31 weeks if adequate progress is not made with enteral feeding in the first 72 hours after birth
- Preterm and term babies who are unlikely to establish adequate enteral feeding, for example, if they have a congenital gut disorder, critical illness (e.g. sepsis) or a major cardiac disorder

**For babies who have previously established some enteral feeds start NPN in**

- Preterm babies whose enteral feeds are stopped for >24 hours and adequate enteral feeding is unlikely to restart within a further 48 hours (for example, because of suspected necrotising enterocolitis or a critical illness such as sepsis)
- Term babies if the feeds are stopped for more than 48 hours and the baby is unlikely to restart adequate enteral feeding within a further 48 hours (for example, because of a critical illness such as sepsis or a surgical gut disorder)



**Venous access**

- Use a central venous catheter to give neonatal parenteral nutrition.
- Only use peripheral venous access to give neonatal parenteral nutrition if:
  - it would avoid delay in starting parenteral nutrition
  - short-term parenteral nutrition is anticipated, for example less than 3 days
  - it would avoid interruptions in giving parenteral nutrition or
  - central venous access is impractical, for example, if there is poor venous access
- Only consider surgically inserting a central venous catheter if:
  - non-surgical insertion is not possible or
  - long-term parenteral nutrition is anticipated, for example, in short bowel syndrome

**Protection from light**

- Protect the neonatal parenteral nutrition bag from light during administration and storage.
- Consider protecting syringe and infusion set of both aqueous and lipid parenteral nutrition solutions from light during administration.

- Standardised neonatal parenteral nutrition ('standardised bags') should be formulated in concentrated solutions to help ensure that the nutritive element of intravenous fluids is included within the total fluid allowance.

## Constituents of neonatal parenteral nutrition

### For preterm babies give

- **Energy** 40–60 kcal/kg/day
- **Glucose**
  - within 1<sup>st</sup> 4 days after birth 6–9 g/kg/day
  - >4 days after birth 9-16 g/kg/day
- **Amino acids**
  - within 1<sup>st</sup> 4 days after birth 1.5–2 g/kg/day
  - >4 days after birth 3-4 g/kg/day
- **Lipids/lipid emulsions**
  - within 1<sup>st</sup> 4 days after birth 1–2 g/kg/day
  - >4 days after birth 2.5-3 g/kg/day
- **Calcium**
  - within 1<sup>st</sup> 48 hrs after birth 0.8 -1 mmol/kg/d
  - >48 hrs after birth 1.5-2 mmol/kg/d
- **Phosphate**
  - within 1<sup>st</sup> 48 hrs after birth 1 mmol/kg/d
  - >48 hrs after birth 2 mmol/kg/d

### For term babies give

- **Energy** 40–60 kcal/kg/day
- **Glucose**
  - within 1<sup>st</sup> 4 days after birth 6–9 g/kg/day
  - >4 days after birth 9-16 g/kg/day
- **Amino acids**
  - within 1<sup>st</sup> 4 days after birth 1–2 g/kg/day
  - >4 days after birth 2.5-3 g/kg/day
- **Lipids/lipid emulsions**
  - within 1<sup>st</sup> 4 days after birth 1–2 g/kg/day
  - >4 days after birth 2.5-3 g/kg/day
- **Calcium**
  - within 1<sup>st</sup> 48 hrs after birth 0.8 -1 mmol/kg/d
  - >48 hrs after birth 1.5-2 mmol/kg/d
- **Phosphate**
  - within 1<sup>st</sup> 48 hrs after birth 1 mmol/kg/d
  - >48 hrs after birth 2 mmol/kg/d

- **Iron** Do not give intravenous parenteral iron supplements to preterm or term babies <28 days. For preterm babies 28 days or older, monitor for iron deficiency, and treat if necessary.
- **Acetate** Only consider acetate for preterm and term babies if hyperchloraemia occurs despite other methods to reduce chloride intake.

## Other constituents of neonatal parenteral nutrition

- **Vitamins** Daily, when starting or as soon as possible after starting parenteral nutrition
- **Electrolytes** Sodium and potassium to maintain standard daily requirements
- **Magnesium** Give magnesium
- **Trace elements** Daily, when starting or as soon as possible after starting parenteral nutrition

### Ratios of: non-nitrogen energy to nitrogen, and carbohydrates to lipids

- When giving neonatal parenteral nutrition for preterm or term babies:
  - use a non-nitrogen energy to nitrogen ratio range of 20 to 30 kcal of non-nitrogen energy per gram of amino acids (this equates to 30 to 40 kcal of total energy per gram of amino acid)
  - use a non-nitrogen energy that is made up of 60% to 75% carbohydrates and 25% to 40% lipids



### For preterm & term babies gradually increase over, for example, 4 days

- **Energy** to 75-120 kcal/kg/day
- **Glucose** to 9–16 g/kg/day
- **Amino acids** to 3-4 g/kg/day (preterm) or 2.5-3 g/kg/day (term)
- **Lipid/lipid emulsions:** increase in daily increments of 0.5–1 g/kg/day to at least 3 g/kg/day, but not exceeding 4 g/kg/day. (For preterm and term babies with parenteral nutrition associated liver disease, consider giving fish oil containing lipid emulsions)
- **Calcium:** ↑ to a maintenance dose of 1.5-2 mmol/kg/day after 48 hours
- **Phosphate:** ↑ to a maintenance dose of 2 mmol/kg/day after 48 hours



### Standardised NPN Bags

- When starting neonatal parenteral nutrition for preterm or term babies, use a standardised parenteral nutrition formulation ('standardised bag')
- Continue with a standardised bag unless an individualised parenteral nutrition formulation is indicated, for example, if the baby:
  - has complex disorders associated with a fluid and electrolyte imbalance
  - has renal failure

## Monitoring

- When taking blood samples to monitor neonatal parenteral nutrition:
  - collect the minimum blood volume needed for the tests, and liaise with the local clinical laboratory to retrieve as much information as possible from the sample **and**
  - coordinate the timing of blood tests to minimise the number of blood samples needed

### Minimum requirements for frequency of blood monitoring

Constituent	Starting	Maintenance	Increased frequency
Glucose	1-2 hours after 1 <sup>st</sup> starting parenteral nutrition	1-2 hours after each change of parenteral nutrition bag (usually every 24-48 hours)	<ul style="list-style-type: none"> <li>• If baby has previously had hypoglycaemia or hyperglycaemia</li> <li>• Dosage has been changed</li> <li>• Clinical reasons for concern, for example, sepsis or seizures</li> </ul>
Blood pH, potassium, chloride, and calcium	Daily when starting and increasing parenteral nutrition	Twice weekly after reaching a maintenance parenteral nutrition	<ul style="list-style-type: none"> <li>• If baby has previously had levels of these components outside the normal range</li> <li>• Dosages have been changed</li> <li>• Clinical reasons for concern, for example, sepsis or seizures</li> </ul>
Serum triglycerides	Daily while increasing the intravenous lipid dosage	Weekly after reaching maintenance intravenous lipid dosage	<ul style="list-style-type: none"> <li>• If level &gt;2.8 mmol/litre</li> <li>• Clinical reasons for concern, for example, critically ill babies or if a blood sample is lipaemic</li> </ul>
Serum or plasma phosphate	Daily while increasing intravenous phosphate dosage	Weekly after reaching maintenance intravenous phosphate dosage	<ul style="list-style-type: none"> <li>• If level has been abnormal</li> <li>• Clinical reasons for concern, for example, metabolic bone disease</li> <li>• Born &lt;32 weeks</li> </ul>
Iron status	Measure ferritin, iron and transferrin saturation if preterm baby on parenteral nutrition for >28 days		
Liver function	Weekly	If clinical concerns or previous abnormal liver function	



### When weaning babies from NPN, as their enteral feeds increase

- For extremely preterm babies born before 28 weeks:
  - consider stopping parenteral nutrition within 24 hours of reaching an enteral feed volume of 140 to 150 ml/kg/day
- For preterm babies born at or after 28 weeks:
  - consider stopping parenteral nutrition within 24 hours of reaching an enteral feed volume of 120 to 140 ml/kg/day
- For babies who have complex needs or who have had surgery, decisions should be made on a case-by-case basis, depending on the baby's overall clinical condition, taking into account factors such as tolerance of enteral feeds, venous access and stoma losses



When deciding when to stop parenteral nutrition, take into account the following

- Enteral feed tolerance
- Total nutritional intake
- Nutritional composition of enteral feeds
- Total fluid intake
- The remaining prescribed parenteral nutrition volume
- The need to maintain nutritional intake while minimising the risk of line sepsis
- The individual baby's particular circumstances, for example, a baby with complex needs (e.g. short bowel syndrome, increased stoma losses or slow growth may need longer term parenteral nutrition)