

Position paper

Addressing the nutritional emergency of preterm birth – Optimal practice in neonatal parenteral nutrition



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1. Introduction

A preterm infant is an infant born before 37 completed weeks of pregnancy.¹

Adequate nutritional intake – especially during the first 1000 days of life – is essential for promoting growth and a healthy immune response, as well as long-term metabolic, cognitive and neuro-developmental health.²⁻⁷ For most preterm infants, especially those born before 28 completed weeks of gestation, interruption of nutrition supplied from the mother via the umbilical cord results in significant nutritional challenges in the early days and weeks of life.

Own mother's breast milk is ideally adapted to the term infant's nutritional needs, but for preterm infants, and those born at term with significant gut abnormalities or who are unwell, milk feeding may not be possible. Parenteral nutrition is a method that delivers nutrients directly to the bloodstream and thus bypasses the digestive tract. For infants born preterm, who take time to establish enteral intake, parenteral nutrition provides an alternative method of nutrient intake and is widely considered an integral component of care. Parenteral nutrition is also an important tool when treating infants with a congenital or acquired gut disorder including necrotising enterocolitis (NEC).⁸ When enteral feeding is not possible, parenteral nutrition is vital for adequate growth and development and can be life-saving, although there are associated risks and it may result in untoward effects.^{6,8} Whilst the short-term benefits of providing preterm infants with parenteral nutrition are widely accepted, there are still limited data on the long-term outcomes of infants who received parenteral nutrition.

Several studies have shown that intake recommendations in Europe are frequently not achieved; additionally, there is uncertainty as to when to start parenteral nutrition, and there are regular challenges with prescribing and compounding of parenteral solutions.⁹⁻¹¹ Other challenges to the administration of parenteral nutrition are transcription, or validation errors, the mix up of different products, errors at the infusion site, catheter misplacement or extravasation of parenteral nutrition, catheter-related septicaemia, metabolic disturbances and more.

An updated version of the ESPGHAN/ESPEN/ESPR/CSPEN guideline was published in 2018.¹² Continuous education focusing on parenteral nutrition practice is needed, and greater efforts are required to disseminate and implement international guidelines on a national level.

With the aim of supporting the implementation of this revised guideline into daily practice across Europe, an expert panel from several countries and disciplines (neonatologists, paediatricians, hospital pharmacists, nutrition experts, and parent representatives) came together to develop this position

paper that highlights the importance of parenteral nutrition as a life-saving treatment for preterm and ill infants as well as the need for standardisation of parenteral nutrition. The position paper is intended to serve as a supplement to, and a driving force for the development and implementation of guidelines on a national level based on the newly revised *Guidelines on Paediatric Parenteral Nutrition of the European Society of Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN), the European Society for Clinical Nutrition and Metabolism (ESPEN), the European Society of Paediatric Research (ESPR), and the Chinese Society of Parenteral and Enteral Nutrition (CSPEN)*.¹²

This position paper primarily targets policy makers and hospital administrators, but can also be used as a tool by parent representatives and healthcare professionals to convince decision-making bodies to support delivery of appropriate, high-quality parenteral nutrition.

2. Glossary

Preterm baby	A baby born before 37 completed weeks of pregnancy.
Very preterm baby	A baby born between 28 and <32 weeks of pregnancy.
Extremely preterm baby	A baby born before 28 weeks of pregnancy.
Parenteral nutrition	Administration of nutrition through the veins directly into the bloodstream, bypassing the digestive tract.
Enteral nutrition	Administration of nutrition via the gut, either sucked by the infant or given through a feeding tube inserted through the nose or the mouth into the stomach or small intestine.
Standard parenteral nutrition	Parenteral nutrition solution with a set ratio of the different nutritional components designed to meet the nutritional needs of most patients of the same age and maturity, produced either hospital based or commercially. ¹³
Individual parenteral nutrition	Individually tailored parenteral nutrition formulation, adapted to the individual patient's nutritional needs. ¹³
Multi-chamber parenteral nutrition solution (two or three chamber bag)	A licensed standard parenteral nutrition solution in which the different nutritional components are separated from each other.
Five Rights of Medication Administration, 5R	One of the recommendations to reduce medication errors and harm is to use the "five rights": the right patient, the right drug, the right dose, the right route, and the right time.



3. Background

3.1. Different types of nutrition in preterm or ill infants

In order to support normal growth and body physiology, the human body needs an adequate intake of all macro- and micronutrients (glucose, protein, fats, vitamins, minerals, and trace elements). Besides short-term adverse effects on growth and immunity, undernutrition in the perinatal period can also have negative long-term effects on health and cognitive development. On the other hand, overnutrition may also have short- and long-term adverse effects, including increased risk for hyperglycaemia (too high blood sugar), infections and the development of the metabolic syndrome (increased risk of heart disease, diabetes, etc.) later in life.^{2,14-17} Thus, investment during this period of life in appropriate nutrition (be it enteral or parenteral nutrition depending on the infant's needs) is likely to improve both short- and long-term outcomes.

There are different types and administration routes of nutrition, especially for preterm or ill infants:

Enteral nutrition



Breastfeeding/providing mother's own milk is the best and first choice for every infant and should be started immediately after birth. The composition of breast milk is ideally adapted to the needs of the growing term born infant. For the preterm infants with the smallest gestational age, breast milk alone may not provide enough nutrients for optimal growth, especially protein and phosphate, making fortification of breast milk necessary.



When mother's own milk is not available, **quality-controlled donor milk** (with or without fortifier) should be used. If this is not available, preterm formula is an alternative option.¹⁹⁻²¹



Tube feeding is indicated when an infant has at least a partially functioning digestive tract, but oral feedings do not meet the infant's needs or are not yet possible, e.g. due to sucking or swallowing difficulties. When tube feeding is required, (fortified) mother's own milk, (fortified) donor milk, or formula is given to the infant through a feeding tube, which is inserted through the infant's nose or mouth and goes into the infant's stomach or small intestine.^{14,18}



Sufficient sucking-swallowing coordination can be expected from the 34th week of gestation, so **oral feedings** can be established. The process may last many weeks and infants can be supported by initiating sucking and swallowing.

Parenteral nutrition



Infants who cannot be fed adequately by mouth or through a feeding tube (enterally) require **parenteral nutrition**, which is a feeding method that bypasses the digestive tract by delivering nutrients directly to the bloodstream. This method is similar to the feeding of unborn infants via the umbilical cord. A sterile solution containing essential nutrients is given to the infant as an infusion into a vein.^{6,8}

Parenteral nutrition is often used as a bridge until enteral feedings are established. Most infants born before 30 weeks, and many born before 32 weeks of gestation (very or extreme preterm infants) require at least some parenteral nutrition during the first days or sometimes even weeks of life until full enteral feeding is tolerated.² Total parenteral nutrition is also the only way to provide nutrients to infants with congenital or acquired gastrointestinal malfunction (e.g. necrotising enterocolitis) or if the infant is severely ill (e.g. sepsis, on ventilation, post-surgery).

Even when parenteral nutrition is indicated, efforts should be made to provide at least minimal enteral nutrition from the first day of life^{6,8}, as it is beneficial for gut priming (encouragement of development of the gastrointestinal system). Once milk is being tolerated in reasonable volumes, parenteral nutrition may continue to be supplied to achieve full nutritional requirements (partial parenteral nutrition).⁸



3.2. Benefits and risks of parenteral nutrition

In some infants, parenteral nutrition is the only way to provide the necessary nutrients for days or weeks. As parenteral nutrition is not a “natural” way of feeding but an invasive procedure, it also carries potential risks. Therefore, it is important to only use parenteral nutrition when indicated and to always strive to support enteral nutrition if possible.^{6,8,13} Regular monitoring of growth, signs of infections and biomarkers of nutrition (e.g. fluid and electrolyte balance) should be performed in all infants, especially in those who receive additional nutritional support, in order to minimise risks associated with parenteral nutrition or other means of nutrition.



Benefits of parenteral nutrition:

- Prevents nutritional compromise after delivery when nutrition via the placenta is abruptly stopped
- Necessary treatment when the administration of enteral feeding cannot meet the infant’s nutritional needs
- Can be life-saving for preterm infants with immature digestive system and for critically ill infants
- Is regularly used as a ‘bridge’ to establish enteral feedings
- Enhances growth



Risks of parenteral nutrition:

- Bloodstream infections (sepsis)
- Complications of the venous line placement, including venous thrombosis
- Side effects of intravenous cannula e.g. skin infections or damage
- Deficiency or excess of certain nutrients
- Parenteral nutrition associated liver disease
- Vascular damage
- Inflammatory reaction
- Metabolic disturbances like hyperglycaemia (high blood sugar), hyperuricaemia and metabolic acidosis
- Electrolyte disturbances (deficiencies and excesses)
- Miscalculations and errors in prescribing, manufacture, supply, or administration of parenteral nutrition
- Incompatibilities of different nutritional components



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Parenteral nutrition is life-saving in premature infants, and has the potential to significantly improve long-term brain outcomes. However, parenteral nutrition use is complex and requires established systems to ensure safe and appropriate delivery. Without safe systems, parenteral nutrition has the potential to result in serious harm, including death.

3.3. Standardised and individualised parenteral nutrition

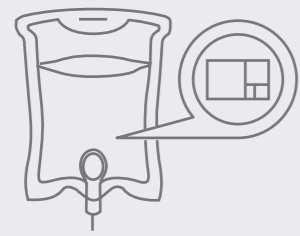
Parenteral nutrition can be provided as individualised or standardised formulation (either produced at the hospital pharmacy or purchased commercially); for most preterm babies standardised solutions will be adequate. The cost-effectiveness of both types depends on the local setting and resources, including the availability of a hospital pharmacy and the infrastructure for prescribing (computerised order entry system), transcription (conversion of prescription to volumes of additives in pharmacy), compounding parenteral nutrition (e.g. clean rooms, laminar air flow, materials like bags, modern infusion pumps with accurate flow control, lines with light protection, filters, regular supply of parenteral nutrition), dispensing (e.g. validated cold chain transports and storage possibilities), administration (e.g. filters), staff expertise (e.g. compatibility knowledge, regular training), error mitigation work and sufficient manpower (e.g. doctors, nurses, pharmacists).

Standardised parenteral nutrition solutions are generally preferred over individualised parenteral nutrition solutions as they safely meet the needs of the majority of infants.¹³ However, in cases where the nutritional requirements cannot be met by the available range of standard parenteral nutrition solutions, individualised parenteral nutrition should be used, e.g. in very ill and metabolically unstable infants with specific nutritional needs.¹³



Besides clinical complications inherent to intravenous parenteral nutrition therapy, each step in the process of providing parenteral nutrition – from prescribing, order verification and review, compounding, labelling and dispensing, to administration – carries risks.²² Unfortunately at present, errors are not uniformly tracked or sometimes even go unnoticed, e.g. due to a lack of prescription reviews. Furthermore, not all hospitals that provide parenteral nutrition have precautions in place to prevent errors.²² Prescription processing software tools that have proven to reduce errors and improve patient safety are therefore recommended.²³⁻²⁷

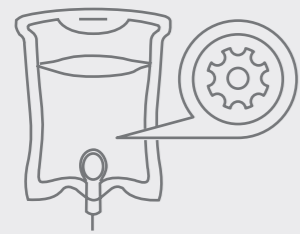
Advantages of standardised parenteral nutrition solutions: ^{6,13,28,29}



set ratio

- Readily available in the NICU and can be used as soon as needed (although some may still require the addition of vitamins etc.)
- Provides an adequate amount of macro- and micronutrients for the majority of infants
- Stability and sterility of the final product is tested and quality assured, and compatibility with frequently used admixtures is tested
- Fewer prescription and administration errors
- Cost benefits compared to individualised parenteral nutrition (depending on the local setting)

Advantages of individualised parenteral nutrition solutions: ^{6,13,30}



individual ratio

- Optimally adapted to an individual infant's needs
- Potentially higher chance of giving optimal nutrition to an infant with more complex needs (e.g. long-term parenteral nutrition, or specific disorders such as metabolic, liver or renal disease, electrolyte loss in stoma)
- More individualised approach to nutrition

4. Implementation of parenteral nutrition

Although a number of guidance documents exist, they are not always implemented into daily practice.⁹ With this position paper the expert panel aimed to create a tool that supports the implementation of the recently revised ESPGHAN/ESPEN/ESPR/CSPEN guidelines on paediatric parenteral nutrition.¹² Of particular importance is standardisation of procedures related to the prescription, preparation, administration, and monitoring of parenteral nutrition.

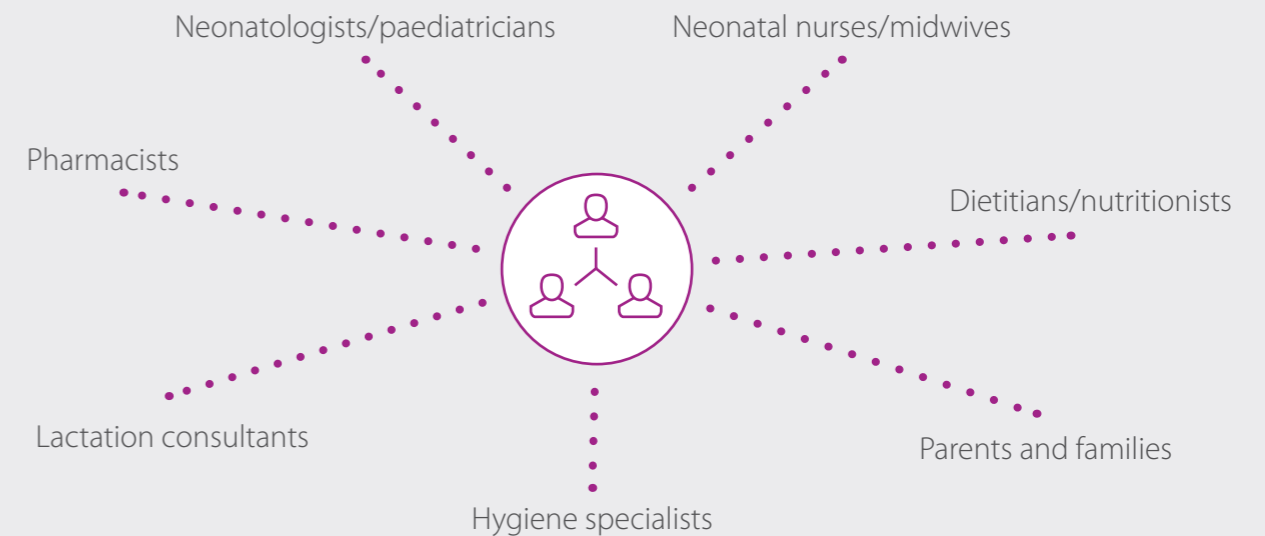
4.1. Multidisciplinary nutrition support team

Care and treatment of extremely preterm and ill infants in general is extremely challenging. Studies have shown that appropriate staff training and the involvement of a multidisciplinary nutrition team are associated with improved assessment of requirements and monitoring of nutritional status, and thus improved nutrition outcomes, as well as fewer cases of catheter related sepsis.³¹⁻³⁶ At present, only a few hospitals have a multidisciplinary nutrition support team in place for parenteral and enteral nutrition, which may lead to inadequate monitoring of nutritional care.⁶

Parents and families are partners in care and therefore need to be informed and educated about the nutritional status of their infant. Where appropriate, they also need to be involved in the decision-making process.

Regular reviews, audits, and discussions to evaluate monitoring, quality control, adverse events, and complex cases are needed to ensure high-quality nutritional care.

A multidisciplinary nutrition support team should include, but is not limited to: ^{31,35}





Tasks of the team include, but are not limited to:

- ✓ Identifying infants who require nutritional support
- ✓ Analysing the nutritional needs for each individual infant
- ✓ Promoting, calculating and coordinating optimum nutritional care
- ✓ Preparing parenteral nutrition
- ✓ Administration of parenteral nutrition
- ✓ Documentation and recordings of actual intake of parenteral nutrition/enteral nutrition vs. prescribed amount
- ✓ Screening for nutritional risks
- ✓ Reducing harm associated with inappropriate use of parenteral nutrition
- ✓ Establishing and promoting enteral nutrition
- ✓ Controlling and documenting of parenteral and enteral nutrition
- ✓ Monitoring growth
- ✓ Educating staff and providing continuous training
- ✓ Developing unit guidelines and protocols
- ✓ Promoting research
- ✓ Informing parents
- ✓ Encouraging mothers to produce breast milk, supporting mothers and monitoring breast milk output
- ✓ Auditing the practices associated with parenteral and enteral nutrition

4.2. Overall nutritional care plan

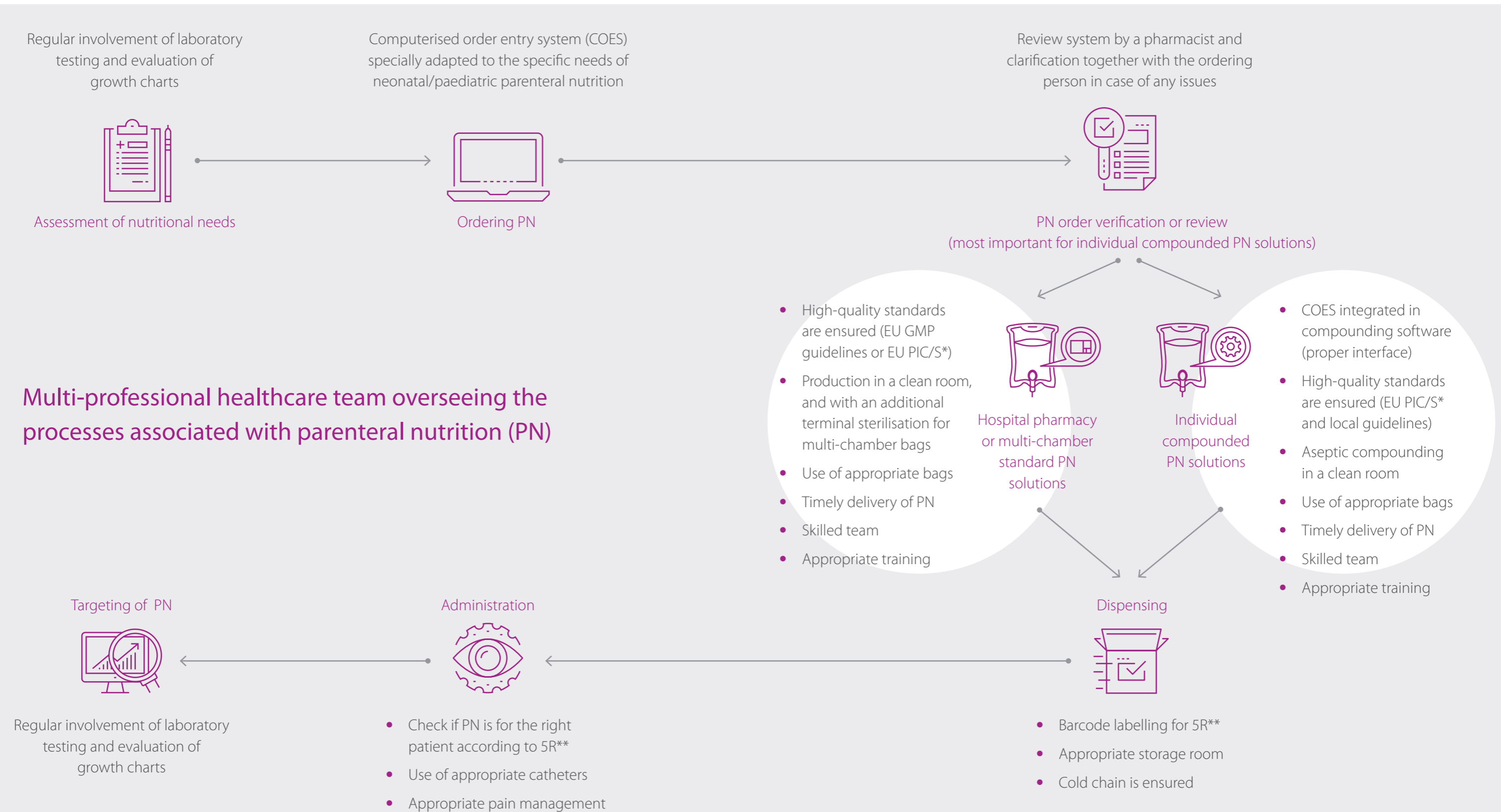
Whereas very preterm infants all need parenteral nutrition for at least a short period of time after birth to facilitate survival and optimal outcome, larger and more mature infants have greater nutritional reserves and therefore the immediate commencement of parenteral nutrition may be considered less 'time' critical.¹² However, for all infants who require specialised nutritional support, an overall nutritional care plan needs to be developed on an individual basis taking into account potential risks and benefits associated with parenteral nutrition (e.g. catheter-associated sepsis), if possible developed with the support of a multidisciplinary nutrition support team.³¹⁻³⁴

The overall goal of such a plan is to avoid under- and overnutrition in infants who cannot be fed orally. The plan should include an early introduction and stepwise increase in enteral nutrition where tolerated, close monitoring of weight gain and overall growth (especially noting the importance of head circumference and length growth) as well as the clinical status of the infant and expected duration of parenteral nutrition. Units should have defined nutrition protocols including short- and long-term goals regarding growth and nutritional progress (see 4.6.). The transition from parenteral nutrition to full enteral nutrition and breastfeeding later on is an important part of this plan, and standard protocols may serve as tools to improve the implementation, even though individual adaptations might be necessary according to each infants' personal development. It is recommended that mothers receive professional support by a lactation specialist or a midwife to stimulate and maintain breast milk flow during the time their infants are receiving parenteral nutrition. In this way, mother's own milk can be provided as soon as the infant is ready. Good support for breastfeeding is important for long-term breastfeeding success.¹² Preparing the infant for breastfeeding is also supported by appropriate mouth care³⁷ and the encouragement of sucking and swallowing.



4.3. Resources and infrastructure

In order to ensure high quality of parenteral nutrition in daily practice, certain infrastructure and resources should be provided.



*PIC/S: Pharmaceutical Inspection Co-operation Scheme

**"Five rights": the right patient, the right drug, the right dose, the right route, and the right time

Figure 1: Overview of the infrastructure and resources that need to be provided in order to guarantee high-quality parenteral nutrition in preterm infants.

4.3.1. Cost efficiency



In order to ensure safe administration of parenteral nutrition, hospitals need to invest in education and training of all staff and the provision of appropriate facilities. Staff need to develop and agree on consistent unit protocols. The expert panel recognises that provision of these resources and infrastructure to ensure high-quality parenteral nutrition in the neonatal unit is relatively expensive.³⁸ However, an optimal nutritional status during the early days and weeks of life will have a positive impact on the child throughout the life course. Even small improvements in outcomes due to improved nutritional status during the early days and weeks of life, might thus have a large impact on the personal burden for the children, the caregivers, and the public, making the investment in parenteral nutrition “cost-effective”.³⁹

Certain measures can be taken to maximise cost efficiency:

- Standardisation is one of the steps that can help to reduce costs, as processing and compounding times, material costs, costs for laboratory testing, and inventory-holding costs decrease^{40,41}
- Standardised parenteral nutrition solutions also help to reduce the number of bags for single nutrients, number of syringes and lines in stock
- Consolidation of production and collective purchasing of materials using tenders
- Reduction of the proportion of individually prescribed parenteral nutrition that may increase risks, especially where staff expertise may be more limited

4.3.2. Appropriate staff training and expertise of staff



It is essential that the importance of nutrition, including basic knowledge on parenteral nutrition, is a key component of all healthcare professionals’ curricula.

Professionals who are involved in the process of ordering, checking the prescriptions, preparing, and administering parenteral nutrition must all be trained on indications, complications, compositional variations, and administration. All professionals involved in any procedure related to parenteral nutrition must receive appropriate interdisciplinary training depending on the tasks they undertake. Before they can practise any parenteral nutrition related activity, they should have demonstrated their competencies.^{42,43}

By including parenteral nutrition in continuous and interdisciplinary education of all relevant healthcare professionals, up-to-date evidence-based practice can be incorporated into daily practice.

Knowledge and competencies that staff need to have and be trained for:

Please note that the processes vary from country to country within Europe, e.g. in some countries the prescriber needs to be a neonatologist, in other countries it is a pharmacist making the prescription. The below mentioned knowledge and competencies are therefore not necessarily restricted to the professional categories mentioned here, but more so to the persons fulfilling the respective tasks.



Prescriber:

Assessment and monitoring of nutritional status in preterm infants, parenteral and enteral nutrient requirements, including the common situation where the patient receives a combination of parenteral and enteral nutrition, indications for and use of parenteral nutrition including different lipid and amino acid solutions and micronutrients, fluid management, knowledge of the prescribing software (COES), monitoring, including management of common electrolyte imbalances, delivery of parenteral nutrition using central or peripheral intravenous devices, risk awareness of inserting central catheters, locally approved guidelines for day-to-day management of complications, e.g. metabolic complications, compatibility of co-infused drugs and solutions.



Pharmacist/person compounding the parenteral nutrition:

Knowledge of the prescribing software (COES), preparation of parenteral nutrition solutions, compatibility of ingredients with additives and co-infusion of other commonly used medications (e.g. inotropes), costs, dosing, stability, nutrition guidelines, preparation/production guidelines, clean-room management, knowledge of commercially available products (including multi-chamber parenteral nutrition solutions), logistics and storage, use of medical products (e.g. in-line filters, lines, bags, etc.), ability to assess individual infants’ requirements/likelihood of establishing enteral feeding, quality control, ordering, hygiene practices.



Attending healthcare professionals responsible for application of parenteral nutrition:

Knowledge of correct placement and management of parenteral nutrition lines and risk of complications (infection, thrombosis, osmolarity, flow-rate, etc.), costs, compatibility with concomitant infusions, hygiene practices, understanding of neonatal nutrition and normal growth, ability to assess individual infants’ requirements/likelihood of establishing enteral feeding.



Nurse:

Hygiene practices, aseptic management of lines, medical pumps/equipment, general nutritional principles, signs/symptoms of catheter misplacement/blockage, checking of parenteral nutrition bag labels/correct patient identification, ‘hang time’, appropriate use of filters for aqueous and lipid solutions, documentation of amount of nutrition given (rate and timing).



4.4. Quality assessment and risk management

The aim to minimise harm while maximise quality is the guiding principle of quality improvement and risk management, which applies to parenteral nutrition as well. Regular audits of parenteral nutrition should document the processes associated with parenteral nutrition (see page 14/15) as well as the development and infant medical conditions that are highly connected to parenteral nutrition, such as growth, infection-related sepsis and thrombosis. Regular internal (e.g. comparisons over time within one unit) and external benchmarking (e.g. between units, and even between countries) are recommended to ensure continuous improvement. At the same time, a blame-free error-reporting culture is necessary for the documentation of adverse events associated with parenteral nutrition, in order to avoid making the same mistakes in the future.

The Critical Incident Reporting System (CIRS)⁴⁴ is a tool that is used to collect mistakes and near misses systematically with the aim of developing strategies to prevent recurring errors. With CIRS, the reporting of errors may result in improvement of care rather than in sanctions. Due to the fact that not only severe incidences, but also mild mistakes and near misses are analysed, the overall occurrence of all mistakes (including severe incidences) can be reduced.

Briefing in a minute (BIM)

An example from Newcastle Hospital how to share important information within a team



BIM is a concept on how to give ward staff regular updates on any changes in routine procedures or important incidents that have occurred. Typically, this happens during hand-over and includes 3-4 very brief items that can be reported in 1-2 minutes. These short briefings are then repeated at every handover for about 1 week (so each team member may hear it 2-3 times). BIMs can be adapted to staff roles, i.e. the 'nursing' and 'medical' BIM may include similar or different items. The topics to be included are selected by senior management (nurses and doctors), are regularly updated and delivered using simple messages that fit on one page of a laminated sheet.

Please note that BIMs are not designed to deliver complex information which requires separate education/training meetings.

4.5. Information for parents

The information that parents of infants in the neonatal intensive care unit receive, should cover the topic of nutrition. If the infant needs parenteral nutrition, parents should be informed in detail about its indications, benefits, risks, administration routes, composition in general and time line. Other forms of nutrition, including breastfeeding, donor milk use and fortification should be addressed and mothers supported in maintaining lactation by expression. Information should be given in writing, and should be comprehensive and understandable for parents. The EFCNI factsheet on "Parenteral nutrition for very preterm and ill babies", for example, can be shared with parents as it provides important and up-to-date knowledge on nutritional support for these patient groups and is easy to understand for persons without a medical background. (Please see www.efcni.org/activities/downloads)

Parents should be informed and always have access to information about all processes associated with parenteral nutrition. For example, a nurse may show them a multi-chamber bag with nutritional solutions and explain the different colours as well as the insertion site. Additionally, parents should be educated on how their presence can support the infant during the painful procedure of inserting the cannula. It is very important that the information parents receive is coordinated between individual healthcare professionals, but also between hospitals in case of transferral to another unit, as inconsistencies in information create parental insecurity.

Information about the duration and type of parenteral nutrition (standardised or individualised) as well as the type of venous access the infant had, should be documented in the medical record and summarised in the discharge letter.

Livia Nagy Bonnard

Parent Organisation Melletted a helyem Egyesület (Right(s) beside you), Hungary



For parents it is very important to receive written information on parenteral nutrition in addition to being verbally informed by healthcare professionals. This allows them to learn more about the treatment whenever they feel like it.



4.6. Development and implementation of local guidelines based on best available evidence

The implementation of local guidelines based on best available evidence and international consensus guidelines minimises differences in practice between staff in neonatal units, and represents an important step in standardising procedures. This also helps to ensure similar treatment in different hospitals or wards, in case an infant is transferred, which is known to be extremely important for parents.

The local guidelines should include the different types of nutrition for preterm and ill infants, the use and monitoring of central venous catheters and intravenous lines as well as fluid balance, the set-up of a multidisciplinary nutrition support team, the development of a nutritional care plan for every infant, staff training and expertise, sharing information with parents whose infants receive parenteral nutrition, as well as the promotion of a blame-free error-reporting culture. Algorithms for the transition from parenteral feeding to enteral feeding (e.g. how to adjust parenteral feeding if there is a change in enteral feeding) are also to be included in the unit protocol.

Such feeding guidelines may result in several benefits: faster transition to full enteral feeding, reduced need for parenteral nutrition, reduced risk of acquiring sepsis, necrotising enterocolitis (NEC) and chronic lung disease, and improved short-term growth.^{45–50}

These local guidelines need to be reviewed every two to three years by representatives of every discipline within the multidisciplinary nutritional support team.



5. Conclusion and Call to Action

In 2018, the new *Guidelines on Paediatric Parenteral Nutrition of the European Society of Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN), the European Society for Clinical Nutrition and Metabolism (ESPEN), the European Society of Paediatric Research (ESPR), and the Chinese Society of Parenteral and Enteral Nutrition (CSPEN)*¹² were released and should be implemented now all around Europe. This position paper shall serve as a starting point and driving force to push the implementation of these European guidelines on a national and local level.

Parenteral nutrition is a life-saving feeding method in infants who cannot be fed enterally, which is extremely common in very preterm infants, or infants with a congenital or acquired gut disorder. Parenteral nutrition does however carry certain risks, especially if it is not performed according to evidence-based guidelines.

We therefore call on all stakeholders involved in parenteral nutrition to:

- Implement the *Guidelines on Paediatric Parenteral Nutrition of the European Society of Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN), the European Society for Clinical Nutrition and Metabolism (ESPEN), the European Society of Paediatric Research (ESPR), and the Chinese Society of Parenteral and Enteral Nutrition (CSPEN)*¹² into daily practice by translating them to national and hospital level guidelines
- Develop and implement a warning system for the early detection of errors and adaptation of processes
- Develop and implement an evidence-based computerised order entry system according to current guidelines with appropriate interfaces with the compounding units in hospitals adapted to the special needs of neonatal parenteral nutrition
- Increase research into optimal formulations and the long-term outcomes of infants treated with parenteral nutrition
- Develop and implement a benchmarking system to measure and compare the use of parenteral nutrition
- Implement antenatal preparatory conversations with mothers at high risk of having a preterm birth and include information about parenteral nutrition as well as counselling on breast milk expression in these conversations
- Provide accurate and reliable information to parents and families on parenteral nutrition



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The European Foundation for the Care of Newborn Infants (EFCNI) is the first pan-European organisation and network to represent the interests of preterm and newborn infants and their families. It brings together parents, healthcare experts from different disciplines, and scientists with the common goal of improving long-term health of preterm and newborn children. EFCNI's vision is to ensure the best start in life for every baby.

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