وزارة الصحة
Ministry of Health

CLINICAL PRACTICE GUIDELINES

Neonatal/Pediatric Multi-Chamber Bag Parenteral Nutrition

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TITLE: Neonatal/Pediatric Multi-Chamber Bag Parenteral Nutrition

APPLIES TO: **Physicians, Pharmacist, And Nursing Staff in the Pediatric and Neonatal Setting**

1. STATEMENT OF PURPOSE

1.1 To provide essential information for healthcare professional involved in the provision and administration of Multi-Chamber Bag Parenteral Nutrition (MCB-PN) in neonates and pediatrics.

1.2 To improve the management of neonatal/pediatric patients requiring PN support including Home PN patients.

2. RELATED DOCUMENTS

2.1 **1431-201 CPP** High Alert Medication

2.2 **1431-290 CPP** Parental Nutrition

3. RELATED ACCREDITATION STANDARDS

3.1 **CBAHI 3rd edition:** MM.5, MM.27, & MM.32.6

3.2 **JCI standards 7th edition: MMU.5**

4. ABBREVIATIONS AND DEFINITIONS

4.1 PN: Parenteral Nutrition is the provision of nutrients via the intravenous route. PN is used for pediatrics and neonates who cannot receive their full nutritional requirements via enteral nutrition.

4.2 MCB-PN: Multi-chamber bag parenteral nutrition

4.3 EN: Enteral nutrition

4.4 GI: Gastrointestinal

4.5 PPN: Peripheral Parenteral Nutrition

4.6 CPN: Central Parenteral Nutrition

4.7 CVADs: Central venous catheter devices

4.8 AA: Amino acid

4.9 GIR: Glucose infusion rate

4.10 ILE: Intravenous lipid emulsion

4.11 EFAs: Essential fatty acids

4.12 NEC: Necrotizing enterocolitis

4.13 IUGR: Intrauterine growth restriction

4.14 ASPEN: American Society for Parenteral and Enteral Nutrition

4.15 TNAs: Total nutrition admixtures

4.16 CRBSI: Catheter-related bloodstream infection

4.17 SBS: Short bowel syndrome

4.18 EFAD: Essential fatty acid deficiency

5. GUIDELINES/ PROTOCOL/PATHWAY

5.1 Introduction

5.1.1 PN plays an essential role in the management of sick and growing preterm and term infants. Preterm infants are a particularly vulnerable population because they are born at a time, if they had remained in utero, of rapid intrauterine brain and body growth. The impact of early malnutrition can have long-lasting negative effects on central nervous system development and growth. The quality of PN and its early initiation are critical in providing the most adequate substrates for appropriate development. PN can be used as the sole source of nutrition support for pediatric patent who cannot be fed or as an adjunct to enteral feeding

5.1.2 Commercially available multi-chamber bag parenteral nutrition (MCB-PN) products have recently seen an increase in use due to reduced staff time required for its preparation and, in part, due to recent PN product shortages. ASPEN defines MCB-PN as standardized, commercially available parenteral nutrition (PN) formulations from a manufacturer. These products require fewer compounding steps before administration. The term "premixed" should be avoided as bag activation and additives are required.

5.1.3 MCB-PN Products come as 2-chamber or 3-chamber products

5.1.4 Advantages of using MCB-PN

5.1.4.1 Reduced risk of prescribing and compounding errors

5.1.4.2 Reduced infection rates

5.1.4.3 Cost advantage including reduced pharmacy time

5.1.4.4 Comparable nutrition efficacy

5.1.5 Disadvantages are:

5.1.5.1 Limited formulations thus not able to prescribe for all patients

5.1.5.2 Those with significant fluid or electrolyte imbalances, high gastrointestinal tract output, or require large amounts of amino acids or electrolytes may not be candidates

5.1.5.3 May require two systems of ordering PN, one for compounded and one for MCB-PN

5.1.5.4 Transitions of care may be confusing from a hospital MCB-PN to a home compounded PN

5.1.5.5 Not complete PN (still need activation and additives such as micronutrients)

5.2 Indications:

5.2.1 Absolute indications:

5.2.1.1 Functional immaturity, e.g., preterm infants <1.5 kg, to supplement advancing enteral nutrition

5.2.1.2 Intestinal failure, e.g. pseudo-obstruction, short bowel

5.2.1.3 Post-gastrointestinal surgery

5.2.1.4 Necrotising enterocolitis (NEC)

5.2.1.5 Congenital gastrointestinal defects, e.g. gastroschisis, intestinal atresia

5.2.1.6 Critically ill: initiate PN when EN is unable to meet energy requirements for energy expenditure and growth

5.2.2 Relative indications:

5.2.2.1 Preterm infants ≥32 weeks gestation or ≥1.5 kg who are not expected to receive adequate enteral intake (i.e., ≥75% of nutritional requirements) within approximately 3 - 5 days.

5.2.2.2 Term infants or children who are not expected to receive adequate enteral intake within 3 - 5 days.

5.2.2.3 Other indications in pediatric patients include: high output fistula, graft-vs-host disease, severe GI side effects of chemotherapy, when EN is contraindicated and the child is catabolic or in preparation for organ transplant in malnourished patients.

5.2.3 MCB-PN can be used in many patients who require PN. These products had limited utility in patients requiring higher amounts of protein and calories, but newer formulations have somewhat bridged this gap. MCB-PN had also some limited utility in patients with fluid and electrolyte abnormalities.

5.2.4 Time frame for initiating PN.

5.2.5 Very low birth weight infant (birth weight less than 1,500 g) or < 32 weeks: begin PN promptly in the first day of life (within the first **24 hours**).

5.2.6 Critically ill: initiate PN when EN is unable to meet energy requirements for energy expenditure and growth.

5.3 Energy requirements

Recommended Parenteral Energy Intake by ASPEN

	Age	Energy Goal (Kcal/kg)
Preterm	< 34 - 0/7 Week	90-111
Late Preterm	34-0/7 to 36-6/7 Week	100-110
Term	≥ 37-0/7 Week	90-108
Children	1 - 12yr	70-90
Adolescent	12 - 18yr	40-60

5.4 Fluid Requirement

5.4.1 Fluids Requirements in Neonates

Neonate	Initial Administration	Advancement	Goal
Preterm	80-100 ml/kg/day	10-20 ml/kg/day	150- 180 ml/kg/day
Term	50-70 ml/kg/day	10-20 ml/kg/day	120-140 ml/kg/day

5.4.2 Fluid Requirements in pediatric

Holliday- Segar Formula (Daily requirement)	**< 10 kg**	**100 ml/kg/day**
	11-20 Kg	**1000 ml + (50 ml x each kg > 10 kg) / day**
	> 20 Kg	**1500 ml + (20 ml x each kg > 20 kg) / day**
4 – 2 – 1 (Hourly Requirement)	**< 10 kg**	**4 ml/Kg/hr**
	11-20 Kg	**40 ml/hr + (2 ml/hr x each kg > 10 kg)**
	> 20 Kg	**60 ml/hr + (1 ml/hr x each kg > 20 kg)**

5.5 Constituents of Parenteral Nutrition: PN solutions contain some or all of the following constituents

5.5.1 Amino Acids (Protein / Nitrogen)

5.5.1.1 Proteins are the major structural and functional components of all cells in the body and are made up of chains of amino acids.

5.5.1.2 In the amino acid (AA) solutions currently used, each gram of AA contains approximately 4 kcals.

5.5.1.3 Pediatric and neonates are in high need for certain AAs (conditional essential), for this reason it is important to use an AA solution that is primarily designed for this patient group

5.5.2 Carbohydrate

5.5.2.1 Carbohydrate is the main source of energy in PN, it is recommended that approximately 60% of non-protein energy comes from carbohydrate.

5.5.2.2 Each gram of dextrose contains 3.4 kcal.

5.5.2.3 Glucose provision can be calculated as the glucose infusion rate (GIR), expressed as mg/kg/minute. GIR= (% of Dextrose X ml/kg/day)/144

5.5.2.4 Glucose intake of 10% on day 1 of postnatal life for both preterm and term infants is common practice.

5.5.3 Intravenous Lipid Emulsion (ILE)

5.5.3.1 ILEs are used in pediatric and neonatal PN as a non-carbohydrate source of energy, to provide a source of essential fatty acids (EFAs)

5.5.3.2 It is recommended that approximately 25-40% of non-protein energy comes from lipids in patients receiving PN as a sole source of nutrition.

5.5.3.3 The energy provided per gram of lipid in PN is approximately 10 kcal. only 20% ILE is recommended as it offers concentrated source of calories.

5.5.4 Electrolytes

5.5.4.1 The main electrolytes included in PN necessary for the maintenance of many cellular functions are: Sodium (Na), Potassium (K), Calcium (Ca), Magnesium (Mg), Phosphate (P).

5.5.4.2 Electrolytes may be given to maintain normal serum concentrations or to correct deficits.

5.5.4.3 Consider other sources of electrolytes such as intravenous fluids and medications when ordering PN.

5.5.4.4 Adequate calcium, phosphate, magnesium, together with vitamin D is essential for bone mineralization, to support linear growth and to protect against rickets fractures.

5.5.4.5 Electrolytes should be prescribed in the form of complete salts rather than individual ions to minimize the risk of dosing errors and ensure accurate preparation and administration

5.5.5 Calcium and Phosphate

5.5.5.1 The precipitation of calcium and phosphorus is a common interaction that is potentially life-threatening.

5.5.5.2 The risk of precipitate formation is greater with:

5.5.5.2.1 Increased solution temperature and pH

5.5.5.2.2 Higher concentrations of calcium and phosphorus

5.5.5.2.3 Lower concentrations of amino acids and dextrose

5.5.5.2.4 Use of the chloride salt of calcium

5.5.5.2.5 Improper mixing sequence when adding calcium and phosphorus salts.

5.5.5.2.6 The presence of other additives (including ILES)

5.5.5.3 Steps to minimize the risk of calcium and phosphate precipitation in PN admixtures include:

5.5.5.3.1 The use of calcium gluconate instead of calcium chloride because it is less reactive.

5.5.5.3.2 Use organic phosphate salt.

5.5.5.3.3 Adding phosphate salts early in the mixing sequence, adding calcium last or nearly last, and agitating the mixture throughout the admixture process to achieve homogeneity.

5.5.5.3.4 AA product specific solubility curves that are available from the manufacturer or primary literature should be consulted for calcium and phosphorous solubility.

5.5.6 Chloride and Acetate

5.5.6.1 Amount of chloride and acetate based on acid-base balance.

5.5.6.2 Because the addition of bicarbonate to acidic PN admixtures may result in the formation of carbon dioxide gas and insoluble calcium and magnesium carbonates, sodium bicarbonate used in PN admixtures is not recommended. Use of a bicarbonate precursor salt such as acetate usually is preferred.

5.5.6.3 Acetate is metabolized in the liver to produce bicarbonate on a 1:1 molar ratio.

5.5.6.4 Chloride in PN (as sodium chloride or potassium chloride) can be partly replaced by acetate (as sodium acetate or potassium acetate) to reduce metabolic acidosis and/or hyperchloremia

PN Electrolyte Daily Dosing (Per day)

	Preterm Neonates	**Infants/Children**
Sodium	2-5 mmol/kg	2-5 mmol/kg
Potassium	2-4 mmol/kg	2-4 mmol/kg
Calcium	1-2 mmol/kg	0.25-2 mmol/kg
Phosphorus	1-2 mmol/kg	0.5-2 mmol/kg
Magnesium	0.15-0.25 mmol/kg	0.15-0.25 mmol/kg
Acetate	As needed to maintain acid base-balance	
Chloride	As needed to maintain acid base-balance	

5.5.7 Trace Elements

5.5.7.1 Many trace elements are an important part of metalloenzymes and function as cofactors in a variety of regulatory metabolic pathways.

5.5.7.2 Injectable trace elements are available as single trace element solutions and as multiple trace element combinations.

5.5.7.3 Requirements for trace elements also vary on the basis of the patient's clinical condition.

5.5.7.4 Higher doses of supplemental zinc likely are necessary for patients with high-output ostomies or diarrhea because the Gl tract is the predominant excretion route for zinc.

5.5.7.5 Manganese and copper are excreted through the biliary tract, chromium, molybdenum, and selenium are excreted renally.

5.5.7.6 Multi-trace dosage may require alteration in patients with increased gastrointestinal or skin losses or with hepatic or renal dysfunction.

5.5.7.7 Additional zinc injectable solution in case of administration to preterm infants should be added to reach a total zinc parenteral intake of 400 mcg/kg/day

PN Trace Elements Daily Dosing (Per day)

Trace Element	Preterm Neonates	Term Neonates 3-10 kg	Children 10-40 kg	Adolescent >40 kg
Zinc	400 mcg/kg	250 mcg/kg	50 mcg/kg (max 5000 mcg/d)	2-5 mg
Copper	20 mcg/kg	20 mcg/kg	20 mcg/kg (max 500 mcg/d)	200-500 mcg
Manganese	1 mcg/kg	1 mcg/kg	1 mcg/kg (max 55 mcg/d)	40-100 mcg
Chromium	0.05-0.3 mcg/kg	0.2 mcg/kg	0.2 mcg/kg (max 5 mcg/d)	5-15 mcg
Selenium	2 mcg/kg	2 mcg/kg	2 mcg/kg (max 100 mcg/d)	40-60 cg

5.5.8 Vitamins

5.5.8.1 Both water-soluble and fat-soluble vitamins are added to PN.

5.5.8.2 Water-soluble vitamins are the B group of vitamins and vitamin C; and fat-soluble vitamins are vitamins A, D, E, and K.

5.6 Routes of PN administration

5.6.1 Peripheral route

5.6.1.1 Peripheral parenteral nutrition (PPN) is an option for mild to moderate stressed patients in whom adequate GI tract function is expected to return with 10-14 days.

5.6.1.2 Potential PPN candidates should not be fluid restricted or required large nutrient amounts.

5.6.1.3 Lower final concentration of dextrose (10-12.5%) Amino acid (2.5 %), and micronutrients (calcium concentration 1 mmol/100 ml) must be used for peripheral route administration.

5.6.1.4 The risk of phlebitis is greater with solution osmolarities greater than 1000 mOsmol/L for neonates and pediatrics.

5.6.1.5 It is possible to give PN with an osmolality around around 1100 mOsm/kg for up to 10 days via peripheral veins in neonates and around 1000 mOsm/kg in pediatric patients.

5.6.1.6 It is possible to give PN with an osmolality around 1100 mOsm/kg for up to 10 days via peripheral veins in neonates and around 1000 mOsm/kg in pediatric patients.

5.6.2 Central route

5.6.2.1 Central Parenteral Nutrition (CPN) is the preferred route for PN delivery and is used predominantly for patients who require PN for period of more than 7 to 14 days.

5.6.2.2 CPN is the preferred route for patients have large nutrient requirements, poor peripheral venous access, or fluctuating fluid requirements

5.6.2.3 Unlike peripheral veins, central veins have a higher blood flow, which quickly dilutes the hypertonic solution, PN with higher osmolarities than 900-1000 mOsmol/L can be used

5.6.3 Ordering and Prescribing Parenteral Nutrition

5.6.3.1 In all cases, the following should be included in PN prescription/order:

5.6.3.1.1 PN volume (ml/kg/day)

5.6.3.1.2 Infusion hours

5.6.3.1.3 Central/peripheral access

5.6.3.1.4 Working weight/dosing weight (kg)

5.6.3.1.5 Amino acid (g/kg/day)

5.6.3.1.6 Glucose (mg/kg/min) or (%)

5.6.3.1.7 Lipid (g/kg/day)

5.6.3.1.8 Electrolytes as salt (mmol/kg)

5.6.3.1.9 Water-soluble vitamins (ml/kg)

5.6.3.1.10 Fat-soluble vitamins (ml/kg)

5.6.3.1.11 Trace elements (ml/kg)

5.6.3.2 PN volume should be determined after subtracting all other patient's fluids from total fluid intake, up to 10% may be added as extra PN volume if needed.

5.6.3.3 PN prescriptions must be reviewed and verified by a PN pharmacist prior to transmitting to the PN compounding process

5.6.4 Dosing of Parenteral Nutrition

5.6.4.1 **Dosing:** The dosage depends on the patient's energy expenditure, clinical status, body weight, as well as additional energy or proteins provided orally/enterally; therefore, the bag size should be chosen accordingly.

5.6.4.2 **Appendix 2 Neonatal/Pediatric Products**

5.6.5 Preparation and other handling of MCB-PN

5.6.5.1 Identifies the correct product and volume to meet the PN order

5.6.5.2 Confirm the integrity of the bag and of the nonpermanent seals. Use only if the bag is not damaged; if the nonpermanent seals are intact; if the amino acid solution and the glucose solution are clear, colorless, or slightly yellow, and practically free of visible particles; and if the lipid emulsion is a homogeneous liquid with a milky appearance.

5.6.5.3 Ensure that the product is at room temperature when breaking the non-permanent seals.

5.6.5.4 Product-specific instructions for activating and mixing components in chambers should be followed.

5.6.5.5 It is preferable to dispense a MCB-PN bag volume that most closely approximates the daily volume required.

5.6.5.6 Use MCB-PN with electrolytes added by the manufacturer rather than those extemporaneously added as this is preferred when the electrolytes are appropriate for an individual patient.

5.6.6 Additives

5.6.6.1 Any additions (including vitamins) may be made into the reconstituted mixture. When making additions to formulations containing electrolytes, the amount of electrolytes already present in the bag should be considered.

5.6.6.2 When making additions, the final osmolarity of the mixture must be measured before administration via a peripheral vein.

5.6.6.3 Possible additions of commercially available trace element solutions and vitamins

5.6.6.4 Follow the manufacturer's recommendation for the maximum allowable electrolyte additives.

5.6.6.5 **To perform an addition:**

- Aseptic conditions must be observed.
- Prepare the injection site of the bag.
- Puncture the injection site and inject the additives using an injection needle or a reconstitution device.
- Mix content of the bag and the additives

5.7 Delivery and Storage of Parenteral Nutrition

5.7.1 **Storage of MCB-PN:** Use immediately after introduction of additives. If not used immediately, consult manufacturer's product-specific information on storage conditions.

5.7.2 All PN should be stored in a designated medication refrigerator 2 to 8°C.

5.7.3 The aqueous solution and lipid solution should be removed from the fridge in advance, approximately one hour prior to commencing the infusion. This allows it to come to a suitable temperature for infusion.

5.7.4 PN solutions (solution, and lines) should be protected from light to prevent peroxidation and degradation of light-sensitive vitamins.

5.8 Administration of Parenteral Nutrition by Nurse

5.8.1 Labeling Considerations for MCB-PN

5.8.1.1 PN label must match the PN order for both MCB-PN and compounded PN's.

5.8.1.2 Volume of bag with additives; if volume to be infused is different than total volume of bag, this should be noted on the label.

5.8.1.3 Complete name of MCB-PN product plus names and amounts of any additives should be listed on the label

5.8.1.4 Any extemporaneously added electrolytes shall be listed as the complete salt form.

5.8.2 Steps in the Administration Process with MCB-PN

5.8.2.1 PN solutions should be administered using volumetric pumps which are capable of accurately delivering low flow rates and have occlusive and air-in-line alarms to minimize infusion related complications.

5.8.2.2 Ensure 5 Rights of Medication Administration (Patient, Drug, Dose, Time, Route).

5.8.2.3 Only administer the product after the non-permanent seals between the two or three chambers have been opened and the contents of the two or three chambers have been mixed.

5.8.2.4 Ensure that the final activated 3CB emulsion for infusion does not show any evidence of phase separation or the final 2CB solution for infusion does not show any evidence of particles.

5.8.2.5 Patient Tolerance should be assessed (glucose control, accurate intake and output, body weight, vital signs).

5.8.2.6 Individual administering PN should assessed for complications related to PN therapy (extravasation, infection, hyperglycemia, altered labs).

5.8.2.7 Monitoring (weight, growth- to whether the patient is meeting goals of therapy).

5.8.2.8 Documentation of the infusion in the Electronic Health Record.

5.8.2.9 Use a 0.2-micron filter for aqueous PN solution and a 1.2-micron filter for lipid-containing PN.

5.8.3 Monitoring of Parenteral Nutrition

5.8.3.1 Monitoring is essential to assess tolerance of PN as well as nutritional adequacy to support growth. Special attention is required when PN is being increased or adjusted especially if the patient is clinically unstable, or if PN is to be provided long term.

5.8.3.2 Anthropometry should be checked regularly as a measure of growth.

5.8.3.3 Fluid balance, including input and output from all sources, must be monitored daily and provision of fluid and electrolytes adjusted as required.

5.8.4 Recommended Monitoring Parameter While Patient on PN

Parameter	Baseline	Initiation	Critically ill patient	Stable patient
Wight	Yes	Daily	Daily	2-3 X per week
Intake and output	Yes	Daily	Daily	Daily unless fluid status is assessed by physical exam
CBC with differential	Yes		Weekly	Weekly
INR, PT, PTT	Yes		Weekly	Weekly
Electrolytes: Na, K, Cl, CO2, Mg, Ca, Phosphorus, BUN, Cr	Yes	Daily X 3	Daily	1-2 X per week
Serum triglyceride	Yes	Day 1	Weekly	Weekly
Serum glucose	Yes	Daily X 3-4	Daily	1-2 X per week
Capillary glucose		As needed	Twice daily	As needed
ALT, AST, ALP, total bilirubin	Yes	Day 1	Weekly	Weekly
Nitrogen balance	As needed		As needed	As needed

5.9 Complication of Parenteral Nutrition

5.9.1 Infectious Complication

5.9.1.1 Infection is one of the most common and potentially fatal complications of CVADs

5.9.1.2 Effective prevention of catheter-related infections requires strict adherence to antiseptic techniques.

5.9.1.3 When Infection is suspected PN should be stopped and central blood cultures obtained, ideally a peripheral blood culture should be obtained at the same time.

5.9.1.4 CVAD should be removed if indicated.

5.9.1.5 Empirical antibiotic therapy for catheter related blood stream infection (CRBSI) should be started. The choice of antibiotics should be based on local antimicrobial guidelines.

5.9.1.6 Antibiotics should be changed to narrow spectrum once the infective organism has been identified.

5.9.1.7 The duration of antibiotics is guided by the identified organism.

5.9.2 Refeeding Syndrome

5.9.2.1 Refeeding syndrome is a potentially fatal complication observed in preterm infants with severe IUGR commencing PN after birth.

5.9.2.2 Refeeding syndrome is characterized by acute electrolyte imbalances, most notable hypophosphatemia, hypokalemia, hypomagnesaemia, and hypoglycemia.

5.9.2.3 To reduce risks of refeeding syndrome:

5.9.2.3.1 Initiate nutrition at a maximum of 40%–50% goal, but usually starting the glucose infusion rate around 4–6 mg/kg/min and advancing by 1–2 mg/kg/min daily as blood glucose levels allow until reach patient goal

5.9.2.3.2 Check serum potassium, magnesium, and phosphorus before initiation of nutrition.

5.9.2.3.3 Monitor every 12 hours for the first 3 days in high-risk patients. May be more frequent based on clinical picture and replace low electrolyte

5.9.2.3.4 Patients may be at risk of thiamine deficiency, therefore supplementation with thiamine and a multivitamin is essential.

5.9.2.3.5 Maintenance requirement of thiamine for PN: Premature neonates: 200 to 350 mcg/kg/day, term neonates, children and adolescents: 1.2 mg/day.

5.9.3 Metabolic Bone Disease

5.9.3.1 PN-related metabolic bone disease has been described in patients on long-term PN. It manifests with a decrease in bone mineral density, osteoporosis, pain, and fractures.

5.9.3.2 Regular measurements of urinary calcium, plasma calcium, phosphorus, alkaline phosphatase, parathyroid hormone, and vitamin D concentrations are advised.

5.9.3.3 Regular assessment of bone mineralization should be undertaken in children on long-term or home PN.

5.9.4 Hepatobiliary Complications

5.9.4.1 Patients requiring long-term PN are at high risk of developing PN- associated liver disease PNALD and in most cases it is moderate and reversible.

5.9.4.2 Risk factors include:

5.9.4.2.1 Absence of enteral nutrition

5.9.4.2.2 Short bowel syndrome (SBS) which may be associated with disruption of bile acid enterohepatic circulation, and bacterial overgrowth.

5.9.4.2.3 Recurrent septic episodes.

5.9.4.2.4 Excessive carbohydrate intake and/or continuous PN infusion leading to hyperinsulinism and subsequently to steatosis.

5.9.4.2.5 Prematurity

5.9.4.3 Prevention and treatment of cholestasis:

5.9.4.3.1 Introduce enteral nutrition as soon as possible, even if only minimal amount.

5.9.4.3.2 Consider decreasing lipid infusions if unexplained and sustained rise of conjugated bilirubin occurs (> 2 mg/dl).

5.9.4.3.3 Try to cycle PN as soon as clinically possible, may be poorly tolerated in acutely ill neonates).

5.9.4.3.4 Ursodeoxycholic acid (10-15 mg/kg/dose orally every 12 hours) might be indicated in patients with a continuous rise of transaminases, conjugated bilirubin and alkaline phosphatase.

6. Education

6.1 To ensure the safe, effective, and consistent use of Multi-Chamber Bag Parenteral Nutrition (MCB-PN), education and training of involved healthcare professionals is essential includes physicians, pharmacists, and nursing staff.

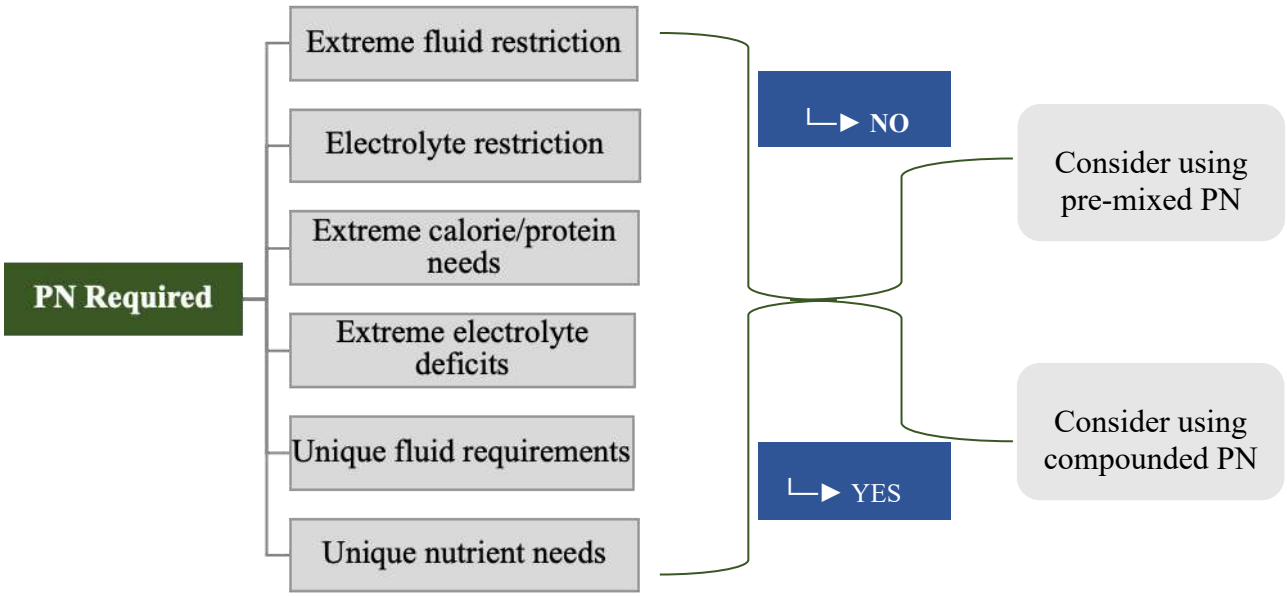
7. Activation bag

7.1 Activation must be performed in accordance with the manufacturer's specifications using aseptic technique, and the final product should be visually inspected for uniformity prior to administration.

8. APPENDICES

8.1 Appendix 2

Decision-Making Flowchart: Is the Patient a Candidate for MCB-PN?



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CLINICAL PRACTICE GUIDELINES

TITLE:

APPLIES TO: **Physicians, Pharmacist, And Nursing Staff ICU Department**

Disclaimer:
Author names included in this protocol are provided at the discretion and responsibility of the issuing department.
APPROVED BY:
Dr.Salim Alwi Baharoon

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Multi-Chamber Bag Parenteral Nutrition

Pediatric-Neonate Products

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Name	Volumes	Patient Group	Average Daily Requirements	Maximal Infusion Rate	Line
PERIPHERAL THREE CHAMBER PARENTERAL NUTRITION BAG WITH IV LIPIDS FISH BASED WITH MEDIUM CHAIN TRIGLYCERIDE AND OLIVE OIL SOYBEAN OIL	1448 ML	**Adult and Pediatric more than 2 years**	Adults 20-40 ml SmofKabiven Peripheral/kg bw/day Children (2-11 years) The dose up to 40 ml/kg bw/day should be regularly adjusted to the requirements of the pediatric patient that varies more than in adult patients.	- The infusion rate should not exceed 3.0 ml/kg/h - The maximum infusion rate for glucose is 0.25 g/kg/h for amino acids 0.1 g/kg/h and for lipids 0.15 g/kg/h. - The recommended infusion period is 14-24 hours.	PERIPHERAL and CENTRAL
CENTRAL THREE CHAMBER PARENTERAL NUTRITION BAG WITH ELECTROLYTES AND IV LIPIDS FISH BASED WITH MEDIUM CHAIN TRIGLYCERIDE AND OLIVE OIL SOYBEAN OIL	1970 ML	**Adult and Pediatric more than 2 years**	Adults 13-31 ml SmofKabiven/kg bw/day Children (2-11 years) The dose up to 35 ml/kg bw/day should be regularly adjusted to the requirements of the pediatric patient that varies more than in adult patients.		CENTRAL ONLY
CENTRAL THREE CHAMBER	300 ml G	**Preterm newborn**	For Activated 3CB (300 mL): 127.9	For 3CB: 6.4	**Central Only** If diluted according to

PARENTERAL NUTRITION BAG WITH ELECTROLYTES DEXTROSE IV LIPIDS OLIVE OIL AND SOYBEAN OIL FOR PEDIATRIC	13	**infants**	ml/kg/day For Activated 2CB (240 mL): 102.3 ml/kg/day - - Amino acid 4 g/kg/day - Glucose 17.1 g/kg/day Lipid 3.2 g/kg/day (3CB)	ml/kg/hr For 2CB: 5.1 ml/kg/hr - Amino acid 0.20 g/kg/hr - Glucose 0.85 g/kg/hr - Lipid 0.16 g/kg/hr (3CB)	the manufacturer's recommendation, it may be administered via a peripheral line. **Note:** For dilution guidelines, refer to the manufacturer's recommendations.
CENTRAL THREE CHAMBER PARENTERAL NUTRITION BAG WITH ELECTROLYTES DEXTROSE IV LIPIDS OLIVE OIL AND SOYBEAN OIL FOR PEDIATRIC	500 ml G16	**Term newborn infants and children up to 2 years**	For Activated 3CB (500 mL): 96.2 ml/kg/day - For Activated 2CB (376 mL): 72.3 ml/kg/day - Amino acid 2.5 g/kg/day - Glucose 14.9 g/kg/day Lipid 3 g/kg/day (3CB)	For 3CB: 5.5 For 2CB: 5.8 - Amino acid 0.14 g/kg/hr - Glucose 0.85 g/kg/hr - Lipid 0.17 g/kg/hr (3CB)	**Central Only** If diluted according to the manufacturer's recommendation, it may be administered via a peripheral line. **Note:** For dilution guidelines, refer to the manufacturer's recommendations.