

# NATIONAL GUIDELINE ON PARENTERAL NUTRITION 2025-2026



# **National Guideline on Parenteral Nutrition 2025 - 2026**

**Developed by  
Sri Lanka Medical Nutrition Association (SLMNA) &  
Sri Lanka College of Nutrition Physicians (SLCNP)**

**In collaboration with  
College of Anesthesiologists and Intensivists of Sri Lanka  
Ceylon College of Critical Care Specialists  
Sri Lanka College of Surgeons**

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## List of Contributors

- Dr. Nalinda Herath - Consultant Nutrition Physician, National Hospital of Sri Lanka
- Dr. J.R. Tennakoon Jayaweera - Consultant Nutrition Physician, Colombo South Teaching Hospital
- Dr. Shalika Kurukulaarachchi - Consultant Nutrition Physician, National Hospital of Sri Lanka
- Dr. Sajitha Mallawaarachchi - Consultant Nutrition Physician, National Cancer Institute Maharagama
- Dr. Pearl Mallawaarachchi - Consultant Nutrition Physician, Lady Ridgeway Hospital for Children
- Dr. T. Wickramasekara - Consultant Nutrition Physician, Medical Research Institute
- Dr. M.P. Gamage - Consultant Nutrition Physician, Nutrition Division-Ministry of Health
- Dr. Gowri Samarasekara - Consultant Nutrition Physician, Colombo North Teaching Hospital
- Dr. Greata Pigera - Consultant Nutrition Physician, District General Hospital Kegalle
- Dr. Kausala Sitharamparapillai – Consultant Nutrition Physician, Lecturer, Teaching Hospital Jaffna.
- Dr. Ishan Gamage - Consultant Intensivist, Teaching Hospital Anuradhapura
- Dr. Isuru Upanishad – Consultant Gastroenterological Surgeon, National Hospital of Sri Lanka
- Dr. Vishaka Kaluarachchi - Consultant Nutrition Physician, District General Hospital Monaragala
- Dr. Evone Jayaweera - Consultant Nutrition Physician, National Hospital Kandy
- Dr. Sajitha Jayasekara - Consultant Nutrition Physician, Teaching Hospital Kurunegala
- Dr. Dhammika Rathnayake - Consultant Nutrition Physician, District General Hospital Chilaw
- Dr. Upeka Samarawickrama - Consultant Nutrition Physician, District General Hospital Matara
- Dr. Wasana Marasinghe - Consultant Nutrition Physician, Teaching Hospital Badulla
- Dr. Rajitha Gunawardhana - Consultant Nutrition Physician, National Hospital Galle
- Dr. Thakshila Uduwavithana - Consultant Nutrition Physician, District General Hospital Negambo
- Dr. Lasith Uyanege - Consultant Nutrition Physician, Teaching Hospital Peradeniya
- Dr. Sugath Peiris - Consultant Nutrition Physician, National Institute for Infectious Diseases
- Dr. Dineshya Liyanapathiranage Consultant Nutrition Physician, De Soysa Maternity Hospital
- Dr. Himali Dharmaweera – Consultant Nutrition Physician, Navy General Hospital Colombo
- Dr. Anushka Wickramarathna- Consultant Nutrition Physician, Teaching Hospital Kuliyaipitiya
- Dr. Udara Abeywarne - Acting Consultant Nutrition Physician, District General Hospital Trincomalee

Dr. D.S. Diminguarachchi - Acting Consultant Nutrition Physician, Castle Street Hospital for Women

Dr. Ruksha Shammuganathan - Acting Consultant Nutrition Physician

Dr. K.C.D. Karunarathna - Acting Consultant Nutrition Physician, Base Hospital Homagama

Dr. Channa Ilangasinghe - Acting Consultant Nutrition Physician, District Base Hospital, Teldeniya

Dr. R.A.D. Sagali Nayanjana Rupasinghe - Acting Consultant Nutrition Physician, Colombo East Base Hospital.

Dr. S. N. Liyanage - Senior Registrar in Clinical Nutrition, National Hospital of Sri Lanka

Dr. W.A. Kasunika Senanayake - Senior Registrar in Clinical Nutrition, National Hospital of Sri Lanka

Dr. U.D. Hiripitiya - Senior Registrar in Clinical Nutrition, Colombo South Teaching Hospital

Dr. M.S.M. Fernando - Senior Registrar in Clinical Nutrition, Colombo South Teaching Hospital

Dr. I.R. Weerakkody - Senior Registrar in Clinical Nutrition, National Hospital of Sri Lanka

Dr. R.K.C. Roopasinghe - Senior Registrar in Clinical Nutrition, National Hospital of Sri Lanka

Dr. Kosala Piyanandana - Senior Registrar in Clinical Nutrition, National Hospital of Sri Lanka

Dr. R.M.A.P. Rathnayake - Senior Registrar in Clinical Nutrition, National Hospital Kandy

**Cover page design & other contributions**

Dr. H.R.L. Maddumabandara - Lecturer, Department of Biochemistry, Faculty of Medicine, University of Peradeniya

Dr. D.S.B. Wijesundera - Medical Officer in Nutrition, National Hospital of Sri Lanka

Dr. N.C. Liyanage - Medical Officer in Nutrition, Colombo South Teaching Hospital

**Expert opinion**

Dr. Anoma Perera – Senior Consultant Anesthetist, The College of Anaesthesiologists and Intensivists of Sri Lanka

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## List of Abbreviations

<b>Abbreviation</b>	<b>Definition</b>
AKI	Acute Kidney Injury
BIA	Bioelectrical Impedance Analysis
BMI	Body Mass Index
CHO	Carbohydrates
CIF	Chronic Intestinal Failure
CKD	Chronic Kidney Disease
COPD	Chronic Obstructive Pulmonary Disease
CNP	Consultant Nutrition Physician
CRBSI	Catheter Related Blood Stream Infections
CRP	C-reactive protein
CVADs	Central Venous Access Devices
CVC	Central Venous Catheter
DRM	Disease-related malnutrition
EN	Enteral Nutrition
ESPEN	European Society of Parenteral and Enteral Nutrition
FA	Fatty Acids
FBC	Full Blood Count
GLIM	Global Leadership Initiative on Malnutrition
GRV	Gastric Residual Volume
GVHD	Graft Versus Host Disease
HPN	Home Parenteral Nutrition
ICU	Intensive Care Unit
IV	Intravenous
LCT	Long Chain Triglycerides
LFT	Liver Function Tests
MCT	Medium Chain Triglycerides
MNA -SF	Mini Nutritional Assessment Short-Form
MNT	Medical Nutrition Therapy
MUAC	Mid Upper Arm Circumference
MUST	Malnutrition Universal Screening Tool
NCP	Nutrition Care Process
NICE	National Institute for Health and Care Excellence
NRS 2002	Nutritional Risk Screening 2002
NST	Nutrition Support Team
ONS	Oral Nutrition Supplements
PG-SGA	Patient-Generated Subjective Global Assessment
PICC	Peripherally Inserted Central Catheter
PN	Parenteral Nutrition
PNALD	Parenteral Nutrition Associated Liver Disease
PUFA	Polyunsaturated Fatty Acids
RF-HNPT	Royal Free Hospital Nutrition Prioritizing Tool
RFS	Refeeding Syndrome
SLCNP	Sri Lanka College of Nutrition Physicians
SLMNA	Sri Lanka Medical Nutrition Association
SPN	Supplementary Parenteral Nutrition
TG	Triglycerides
TPN	Total Parenteral Nutrition

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## Background

Disease-related malnutrition (DRM) is a type of malnutrition caused by an existing illness. DRM is classified into two types: those linked to inflammation and those are not<sup>2</sup>. Although DRM in hospitalized patients was first identified in 1974, it continues to be a major health problem in high to low-income countries. 40-70% of hospital patients worldwide either suffer from malnutrition or are at risk of it<sup>2,9</sup>. Malnutrition can worsen disease outcomes, leading to more complications, higher death rates, longer hospital stays, and increased chances of readmission. Identifying DRM early can improve patient recovery and reduce healthcare costs, making nutrition screening an essential part of patient care.

Medical nutrition therapy (MNT) offers a range of options to overcome malnutrition. MNT is a term that encompasses oral nutritional supplements (ONS), enteral nutrition (EN) and parenteral nutrition (PN). Parenteral nutrition (PN) is indicated when a patient is unable to meet their nutritional requirements via oral or tube (enteral) feeding alone due to poorly-functioning, leaking or inaccessible gut.

Although parenteral nutrition (PN) is increasingly employed in tertiary care settings across Sri Lanka, its implementation remains inconsistent and is often guided by individual clinician experience rather than standardized national protocols. This lack of uniformity introduces significant risks. Furthermore, access to trained nutrition support teams and standardized PN formulations remains inconsistent across healthcare institutions underscoring the urgent need for implementation of National guidelines to ensure safe, equitable, and evidence-based practice.

Recognizing this need the Sri Lanka College of Nutrition Physicians (SLCNP) and the Sri Lanka Medical Nutrition Association (SLMNA) took the challenge to initiate and develop this National Guideline to establish uniform, evidence-based standards for adult parenteral nutrition practice in Sri Lanka, with the collaboration of relevant stake holders. The guideline intends to support clinicians, pharmacists, and nurses involved in the delivery of PN, ensuring that patients receive safe, effective, and individualized nutrition care based on current scientific evidence and local feasibility.

The **Objectives** of the guideline are to:

1. Provide evidence-based recommendations for the safe and appropriate use of PN in adult patients.
2. Standardize assessment, indication, formulation, and monitoring practices.
3. Minimize PN-related complications through adherence to best practices and multidisciplinary care.
4. Enhance the capacity of healthcare professionals through guidance, training, and standardized protocols.
5. Improve overall patient outcomes and optimize resource utilization in hospital nutrition support services.

This guideline provides a concise and comprehensive summary of parenteral nutrition.

## Scope

### **Population covered:**

This guideline applies to all adult patients (> 18 years) who require parenteral nutrition due to an inability to meet their nutritional requirements via the oral or enteral route. It includes individuals with acute or chronic medical, surgical, oncological, or critical illnesses in whom PN is indicated as part of comprehensive nutritional support.

### **Settings:**

This guideline is intended for use in secondary and tertiary care hospitals across Sri Lanka where PN is administered under appropriate medical supervision. It applies to all relevant inpatient clinical settings involved in the care of adults requiring PN, including critical care and specialized medical and surgical services. It may also support step-down, intermediate care, and rehabilitation units in the continuation or transition of PN therapy initiated in acute hospital settings.

### **Interventions and outcomes considered:**

This guideline provides evidence-based recommendations covering the following components of PN practice:

- Nutritional screening and comprehensive nutritional assessment
- Indications and contraindications for PN
- Timing of PN initiation
- Selection of the appropriate route and vascular access device
- Prescription, formulation, and administration of PN
- Monitoring of clinical, biochemical, and metabolic parameters
- Prevention and management of complications
- Criteria and process for discontinuation of PN
- Referral pathways and multidisciplinary coordination for safe PN delivery

The expected outcomes of implementing this guideline include:

- Safe and effective delivery of PN
- Prevention and early detection of metabolic and catheter-related complications, with improvement in patients' nutritional status
- Reduction in hospital-related morbidity and mortality, length of hospital stay, readmission rates, and overall healthcare costs
- Establishment of standardized national practice in PN management across healthcare settings in Sri Lanka

**Exclusions:**

This guideline does not cover:

1. Patients <18 years
2. Oral or enteral nutrition protocols, except where relevant for transition from or to PN.
3. Home parenteral nutrition (HPN) beyond basic recommendations, as this requires separate operational guidance. Emergency intravenous fluid therapy unrelated to nutritional support.
4. Micronutrient supplementation guidelines outside the context of PN formulations.

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# Chapter 1

## Process – Nutrition care process (NCP)

Provides a systematic and evidence-based approach to delivering high quality nutrition care. It comprises four distinct yet interrelated steps. Four separate yet connected steps make up the NCP.

The flow chart below elaborates the nutrition care process in detail.

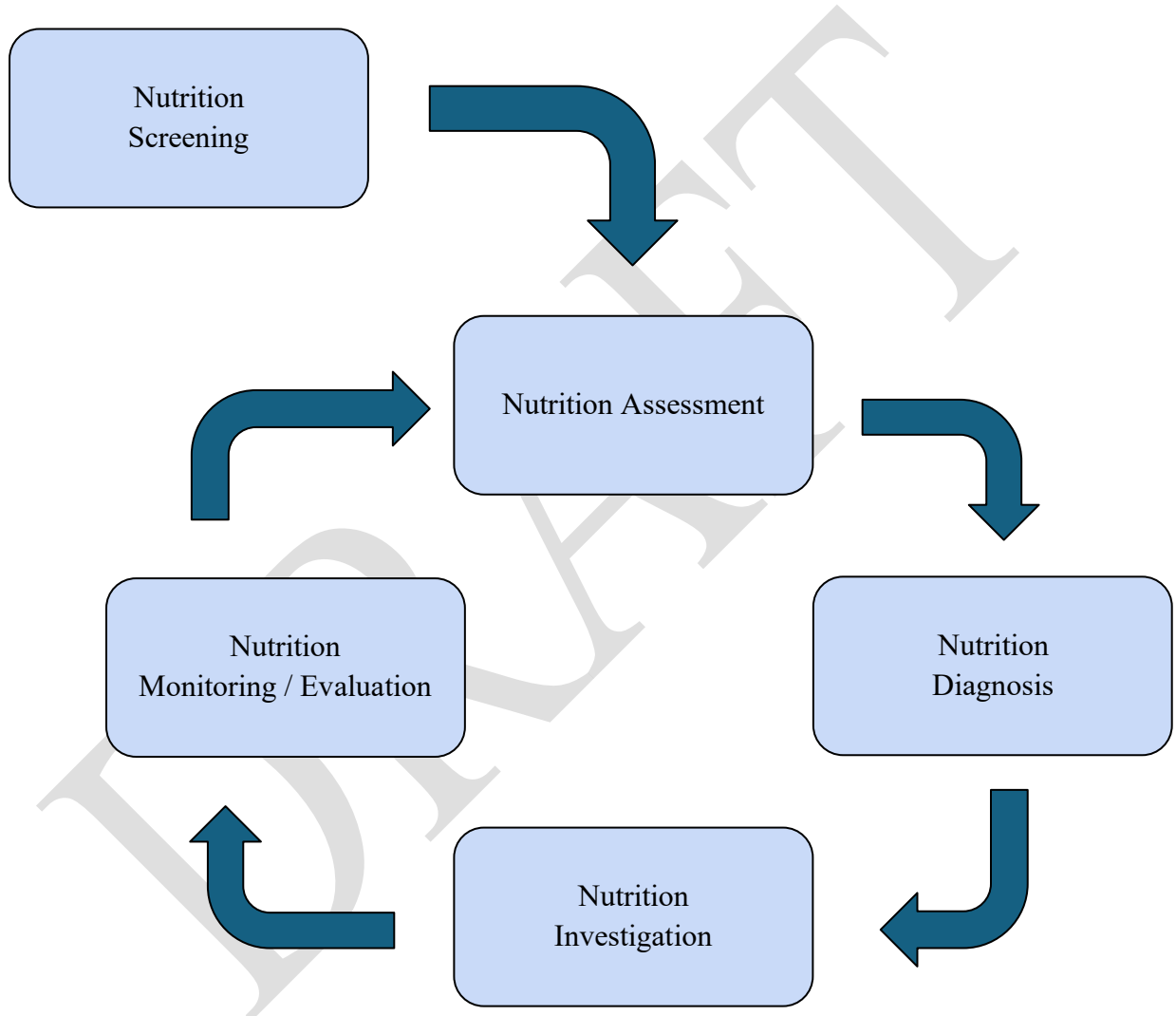


Figure 1: Nutrition care process

## Nutrition Screening

A simple and rapid process used to identify individuals who may be malnourished or at risk of malnutrition and to determine whether they require a comprehensive nutrition assessment and appropriate intervention. There are simple anthropometric measures and several nutrition screening tools used for nutritional screening. BMI and mid upper arm circumference (MUAC) can use as abed side anthropometric measures to screen nutritional status. Local validation of global tools is under process, with efforts to develop culturally specific instruments for better accuracy in diverse Sri Lankan population.

$$\text{BMI} = \frac{\text{Weight (in kilograms)}}{\text{Height}^2 \text{ (in meters)}}$$

MUAC is a simple, quick measurement of the circumference of the upper arm. A measurement of the circumference of the middle of the upper arm, between the shoulder and elbow is taken using a non-stretchable tape.

It is recommended that a nutrition screening be conducted within 24 hours of hospital admission. Common global nutrition screening tools include,

Malnutrition Universal Screening Tool (MUST) – (Annexure 1)	<ul style="list-style-type: none"> <li>• Five-step screening tool designed to identify whether an adult is obese, malnourished, or at risk of undernutrition.</li> <li>• Management guidelines provided with the tool can be used to develop a care plan.</li> <li>• It is intended for use across community, hospital, and other care settings and can be utilized by all caregivers.</li> </ul>
Nutrition Risk Screening (NRS) 2002 - (Annexure 2)	<ul style="list-style-type: none"> <li>• Used in hospital settings to identify patients at risk of malnutrition</li> </ul>
Mini Nutritional Assessment – Short Form (MNA-SF) - (Annexure 3)	<ul style="list-style-type: none"> <li>• Simple and quick screening tool designed to identify elderly individuals who are at risk of malnutrition or already malnourished</li> </ul>
Royal Free Hospital Nutrition Prioritizing Tool (RFHNPT) - (Annexure 4)	<ul style="list-style-type: none"> <li>• Used to assess the risk of malnutrition in patients with liver disease</li> </ul>
Renal i-Nut - (Annexure 5)	<ul style="list-style-type: none"> <li>• To identify the risk of malnutrition in patients with chronic kidney disease (CKD), those undergoing dialysis or with advanced kidney disease</li> </ul>
Patient-Generated Subjective Global Assessment (PG-SGA) - (Annexure 6)	<ul style="list-style-type: none"> <li>• Developed for cancer patients</li> <li>• Includes a patient questionnaire addressing symptoms, weight loss, and dietary intake, along with a clinician’s evaluation of physical examination findings and functional status.</li> </ul>

Table 1: Nutrition Screening Tools

## Nutritional Assessment

Is a structured and comprehensive process involving the collection and analysis of patient data, including medical history, nutrition-focused physical examination, and relevant investigations. Its purpose is to identify nutrition-related concerns that may require intervention. This should be performed by a qualified Nutrition Support Team (NST) before initiating PN.

The initiation of PN must be based on a thorough, multidisciplinary evaluation to confirm its indication, ensure patient safety, and tailor the therapy to individual clinical needs.

### **A. Anthropometric Assessment and Body Composition**

Physical measurements height, weight, BMI, waist-to-hip ratio, MUAC, skinfold thickness, and calf circumference evaluate nutritional status and body composition. Body composition assessment helps determine fat mass, fat-free mass, muscle mass, and bone mineral content, expressed as percentages according to the model used. Bioelectrical impedance analysis (BIA) may be employed as a non-invasive, cost-effective method for estimating body composition when clinically feasible.

Some parameters like MUAC and skinfold thickness could be inaccurate in critically ill patients due to oedema formation.

In addition, the assessment should include:

1. Nutritional history - appetite changes, recent weight loss, number of days without adequate oral or enteral feeding, diarrhoea/ vomiting
2. Risk of refeeding syndrome, particularly in malnourished or chronically undernourished patients.
3. Functional status and mobility, including muscle strength and activity limitations.

Assessment is limited in ICU patients due to sedation/paralysis.

### **B. Biochemical Assessment**

Biochemical investigations are essential to identify existing imbalances and to guide PN formulation. Baseline laboratory investigations should include:

1. Glycemic status (Capillary Blood Glucose/ Random Blood Glucose/ Fasting Blood Glucose)
2. Full Blood Count (FBC)
3. Markers of inflammation and disease severity [e.g. C-Reactive Protein (CRP)]
4. Renal profile: urea, creatinine, electrolytes (sodium, potassium)
5. Liver function tests (LFTs)
6. Bone profile (including calcium, magnesium, phosphate)
7. Plasma protein levels: transthyretin (prealbumin), transferrin (if indicated)
8. Micronutrient profile: zinc, iron, vitamins (as clinically indicated)

These parameters should be interpreted in the context of disease state, hydration status, and organ function.

### **C. Clinical Assessment**

Clinical assessment provides a comprehensive understanding of the patient's overall condition and tolerance to PN. It includes:

1. Assessment of disease-related catabolic stress, including tissue trauma, infection, sepsis, or postoperative state, which may increase protein and energy requirements.
2. Evaluation of comorbid conditions such as renal or hepatic disease, chronic obstructive pulmonary disease (COPD), or cardiac dysfunction, which may alter nutrient, electrolyte, and fluid requirements.
3. Review of post-surgical gastrointestinal anatomy, including the integrity of anastomoses, presence of fistulae or intra-abdominal collections, and assessment of residual bowel length (pre-stoma and total bowel length).
4. Detailed medication review, with particular attention to drugs affecting metabolism, gastrointestinal function, and nutrient absorption or utilization.
5. Identification of clinical features suggestive of nutritional compromise, including unintentional weight loss, poor appetite, gastrointestinal symptoms (nausea, vomiting, diarrhea, steatorrhea), and nutrient losses through wounds, fistulae, or drains.
6. Measurement and monitoring of temperature, pulse rate, blood pressure, and blood glucose levels to assess metabolic stability and feeding tolerance.
7. Assessment of ventilatory status in critically ill patients, as the level of respiratory support influences energy expenditure, fluid management, and enteral feeding strategy.
8. Clinical evaluation of muscle strength and functional capacity, including the patient's ability to handle and administer tube feeds independently, where appropriate.
9. Assessment of psychological well-being and cognitive function, as these factors influence understanding, acceptance, adherence, and long-term compliance with enteral nutrition therapy

### **D. Dietary Assessment**

This will identify recent intake patterns and nutrient adequacy including.

- 24-hour dietary recalls, food frequency questionnaires, or food diaries
- Estimation of caloric and protein intake compared with requirements
- Documentation of days without sufficient oral or enteral feeding

### **E. Environmental and Functional Assessment**

It is very important to consider factors influencing nutrition and PN implementation, such as:

1. Infrastructure - suitable to support aseptic practices
2. Workforce - appropriate medical and nursing capacity
3. Supplies - requirement of PN for estimated duration and its composition

## Diagnosis – GLIM

An international consensus on the core standards for diagnosing and assessing the severity of adult malnutrition. It was developed as a diagnostic framework to facilitate global comparisons of the prevalence, management, and outcomes of malnutrition.

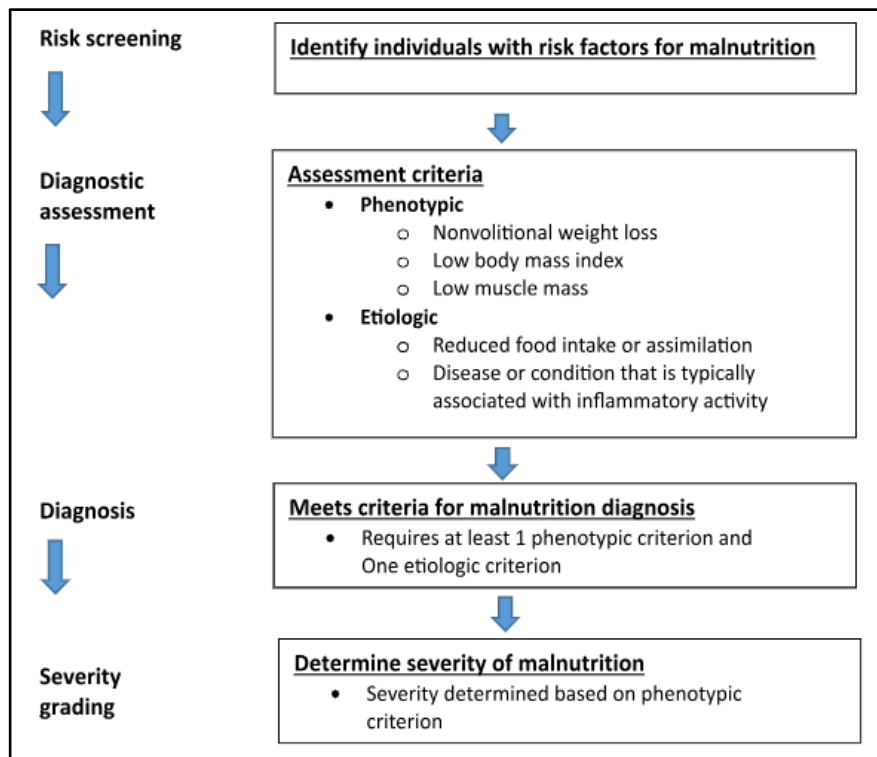


Figure 2: GLIM diagnostic scheme for screening, diagnostic assessment and grading of malnutrition<sup>3,6</sup>

Malnutrition diagnosis using GLIM requires at least one phenotypic criterion and one etiologic criterion. Severity grading is completed using only the phenotypic criteria (Annexure 7).

## Chapter 2

### Implementation of Medical Nutrition therapy

Once the assessment is done medical nutrition therapy can be initiated in following steps.

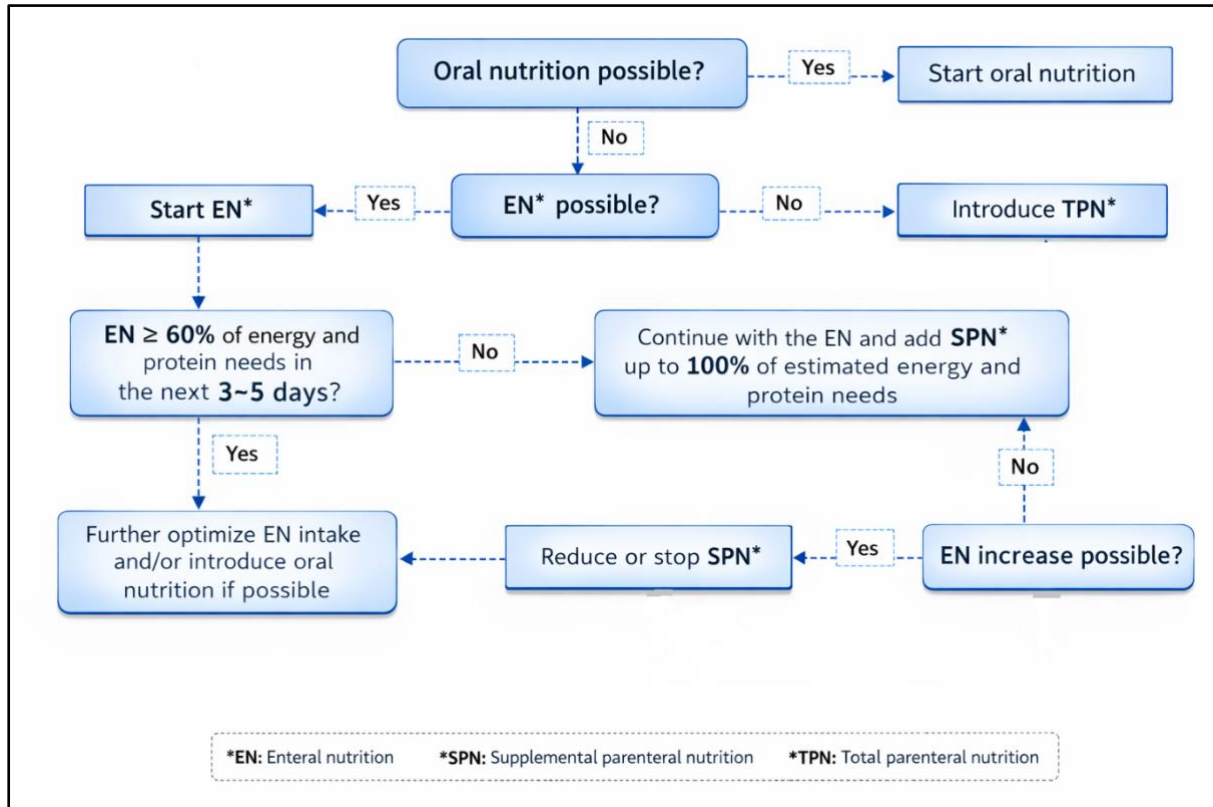


Figure 3: Initiation of medical nutrition therapy

## Chapter 3

### Parenteral Nutrition

Parenteral nutrition (PN) refers to the provision of nutrition directly into the venous circulation, bypassing the gut. Nutrients are provided bio available form to be utilized by different tissues.

#### Indications of Parenteral nutrition:

- Impaired absorption or loss of nutrients
  - High output fistula (>500mL/24h)
  - Short bowel syndrome
  - High-output stoma (>1.5L/24h)
- GI intolerance

Intractable vomiting, abdominal distention, complaints of discomfort, high gastric residual volume (GRV), diarrhea, reduced passage of flatus and stool, or abnormal abdominal radiographs. (GRV  $\geq$  500 mL is considered high.)

- Mechanical bowel obstruction
- Inability to obtain and maintain enteral access
- Severe dysmotility (prolonged ileus, pseudo-obstruction)
- GI tract leak (acute perforation, anastomotic leak)
- Severe enteropathy with malabsorption or high-volume diarrhoea
  - Radiation enteropathy
  - Graft versus host disease (GVHD)
  - Severe infectious enteritis
- Small bowel ischemia

#### Absolute Contraindications of Parenteral nutrition:

- When gastrointestinal tract is fully functional and accessible with adequate absorption of macro and micronutrients.

#### Relative Contraindications

- When PN is likely to be needed for less than 5 days in patients without severe malnutrition.
- Lack of appropriate venous access.

- Acute severe Pancreatitis – Enteral feeding should be trialed and given to maximal tolerance if no other indication for PN is present.
- High serum cholesterol/triglyceride concentrations - may require lipid free PN.
- Cases when the risks of PN exceed the benefits.
- In patients with a prognosis that does not justify aggressive nutrition support.
- Haemodynamically unstable conditions (e.g. severe traumatic conditions, acute shock, uncontrollable diabetes mellitus, severe metabolic acidosis) are strong relative contraindications.
- Known hypersensitivity to peanuts, egg, soybean or fish proteins, olive, fish or soybean.

Renal and hepatic failure are not absolute contraindications but they both require careful attention regarding the use of amino acids and lipids.

### When to start Parenteral nutrition

#### 1) Well-nourished patients

Short periods of starvation or minimal nutrient intake are generally tolerated without significant adverse physiological effects. Therefore, PN is not routinely recommended during this period.

PN should be considered if inadequate oral or enteral intake has lasted, or is expected to last, more than 4-7 days, after careful clinical assessment.

#### 2) Malnourished patients

Re-establishment of nutrient intake may have beneficial effects within a few days, and therefore nutrition support should not be delayed.

1. PN should be implemented within 3-7 days in case of contraindications to oral and EN.
2. Early, gradually advanced PN should be considered when enteral nutrition is contraindicated in severely malnourished patients, instead withholding Nutrition.
3. Supplementary PN can be given when EN is not adequate.

### How to decide the route of Parenteral nutrition:

The route of the parenteral nutrition depends on the following factors,

1. Patient factors: Clinical condition, Current physical and mental status, Availability of venous access
2. Recommended prescription: Volume, Composition, Energy, Osmolality, Duration of PN

Following figure may elaborate, how to decide the route of parenteral nutrition.

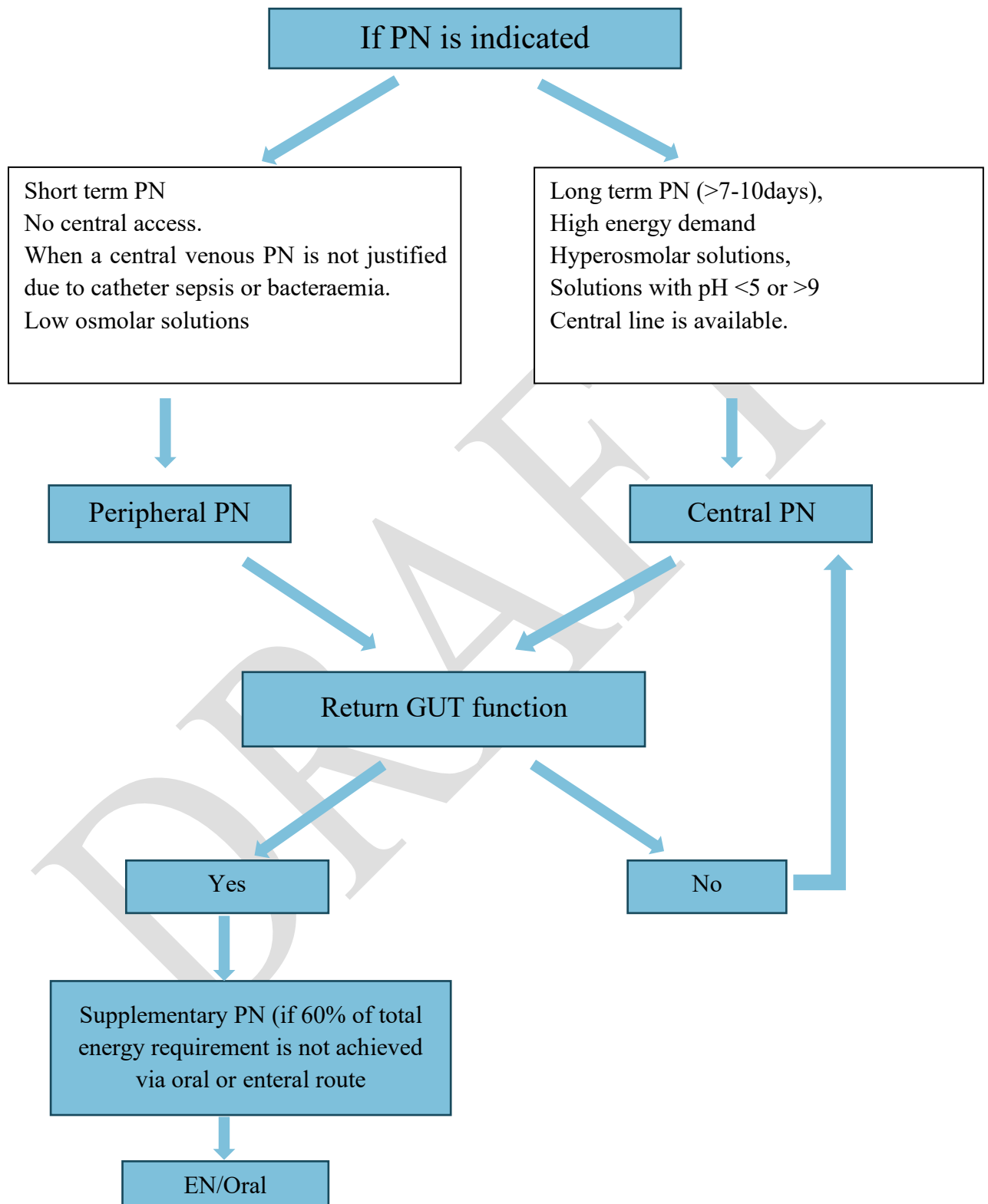


Figure 4: How to decide the route of parenteral nutrition

## Parenteral nutrition access devices

Parenteral nutrition may be administered via central venous access devices (CVADs), peripheral venous catheters, or, in selected long-term cases, arteriovenous fistulae. The choice of access device should be individualized, based on the expected duration of PN, osmolality of the solution, patient comorbidities, and risk of complications.

### **Central Venous Access**

Central venous access is preferred for hyperosmolar PN solutions and when PN is expected to be required for more than 7–10 days. The tip of the CVAD should be placed at the level of the right atrial-superior vena cava junction.

Preferred routes:

- Subclavian vein – generally preferred for PN administration due to lower infection rates when technically feasible.
- Internal jugular vein – acceptable alternative, particularly in patients with contraindications to subclavian access.

Right-sided access is preferred over left-sided access to reduce the risk of venous thrombosis and catheter malposition.

### **Peripheral Venous Access**

Peripheral venous catheters may be used for short-term PN with low-osmolality formulations, when central access is not available or not appropriate. Close monitoring is required due to the increased risk of phlebitis and extravasation.

Special Considerations for PN Access

- Use a dedicated lumen exclusively for PN administration whenever possible.
- Single-lumen CVADs are preferred, as multi-lumen catheters are associated with a higher risk of catheter-related bloodstream infections (CRBSI).
- Avoid femoral venous access for PN due to the significantly increased risk of infection and thrombosis.
- In patients with coagulopathy, the internal jugular vein is preferred over the subclavian vein to reduce the risk of bleeding complications.
- Strict aseptic techniques must be used during catheter insertion, handling, and maintenance.
- Catheter choice and insertion site should be reviewed by the NST in collaboration with the primary clinical team.

## Chapter 4

### Substrates for parenteral nutrition.

#### Carbohydrates

- It should cover 50-60% of total energy during artificial nutrition.
- Glucose (dextrose) is the only carbohydrate used in PN.
- Rate of glucose infusion should not exceed the maximal rate of glucose oxidation 4-5 mg/kg/min (corresponds to 0.25 - 0.3 g/kg/h) in an adult.
- Intravenous (IV) glucose is available in concentration from 5%, up to 50% in Sri Lanka. (10%, 25% and 50% are the most popular).

#### Amino acids

- Requirement depends on the clinical condition of the patient.
- Needs for protein substrate must be fully covered during PN.
- Standard amino acid solutions always contain all essential amino acids, and the amount of non-essential varies depending on the admixture.
- Amino acids solutions are available from different manufacturers in stock admixtures with concentration from 3% up to 20%.
- The maximum infusion rate of amino acids up to 0.1 g/kg/hour.

#### Lipids

- Should cover 20-40% of energy requirements.
- Intravenous lipid emulsions [Long Chain Triglycerides (LCT), Medium Chain Triglycerides (MCT) or mixed emulsions] can be administered safely at a rate of 0.7 g/kg up to 1.5 g/kg over 12-24 h in ICU patients.
- When Triglyceride (TG) concentrations reach a threshold of 2.0-3.5 mmol/l or 190-260 mg/dl, rate of the lipid emulsion should be reduced and when TG concentration rise above 4-5 mmol/l or 350-450 mg/dl, their use is contraindicated.
- SMOF (Soy/MCT/Olive/Fish Oil) lipid is now the first choice due to liver protective effects and anti-inflammatory effect. (Annexure 8)
- IV Lipid emulsions - 10%-20% available for parenteral nutrition.

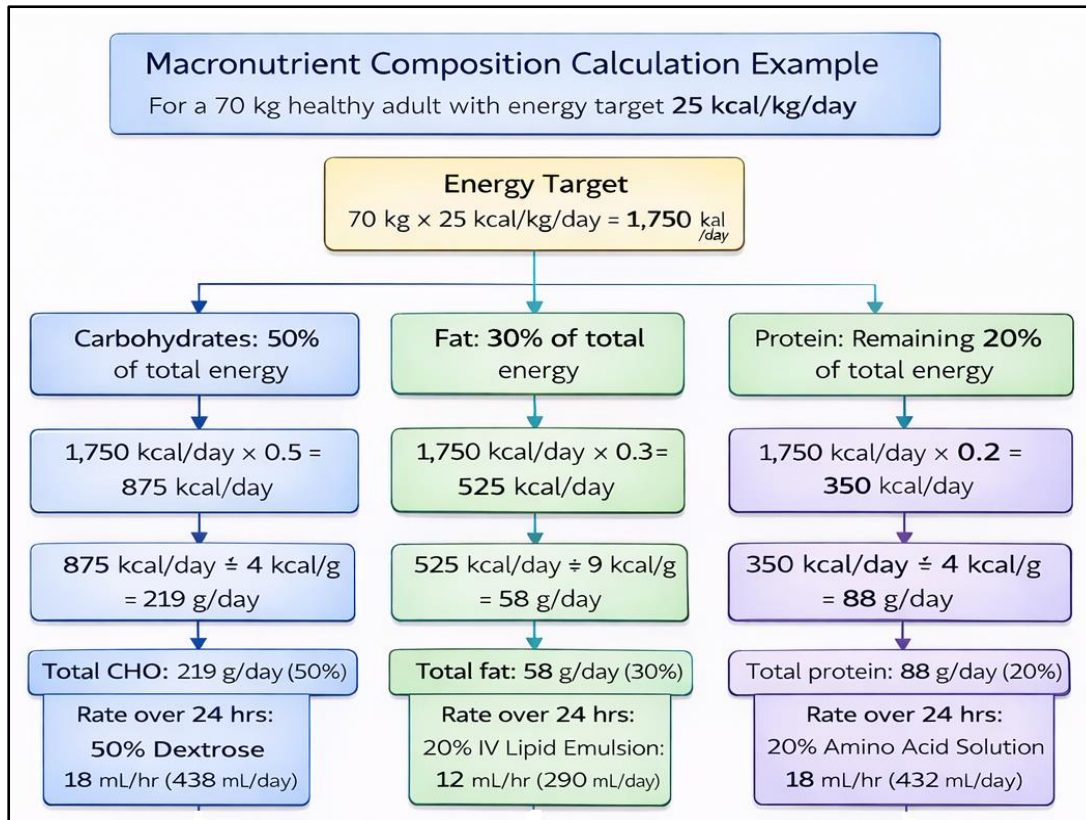


Figure 5: Example for macronutrient composition calculation

## Micronutrients

Micronutrients are an essential component of PN and should be included since initiation of PN. Vitamin–mineral admixtures are currently not available in Sri Lanka.

### Vitamins

4 essential fat-soluble vitamins A, D, E and K, B vitamins and vitamin C

### Minerals

Zinc, chromium, copper, selenium and manganese should be included. Currently IV preparations are not available.

## Water and Electrolytes

### Electrolytes

Daily electrolyte requirement should always be replaced in PN.

The average electrolyte requirements per day for an adult is provided below (ref - Clinical nutrition guideline on Nutritional management of critically ill patients 2021-Sri Lanka). This can vary depending on the clinical situation and should be modified accordingly.

1. Phosphate: 0.3 -0.6 mmol/kg/day
2. Potassium: 1-2 mmol/kg/day
3. Magnesium: 0.1 mmol/kg/day
4. Sodium: 1-2 mmol/kg/day
5. Calcium: 0.25-0.4 mmol/kg/day

In multichambered bags electrolytes are already included at standard doses in solution (amino acid chamber). If single substrates are used electrolytes should be replaced separately.

### Fluid requirement

Fluid requirements must be individualized using goal-directed fluid therapy principles. A general guide in stable adults is 25–30 mL/kg/day (up to 30–35 mL/kg/day if increased insensible losses).

Fluid prescription must be adjusted according to:

- Hemodynamic status
- Renal function (AKI/CKD/dialysis)
- Cardiac function
- Liver disease/ascites
- Mechanical ventilation
- Fever
- Presence of edema or third spacing
- Ongoing measurable losses (e.g., high-output stoma, NG drainage, fistulae, diarrhea, drains)

The total daily fluid allowance must include:

- PN volume
- Maintenance IV fluids
- Drug infusions and diluents
- Blood products
- Enteral/oral intake
- Electrolyte replacement solutions

PN should be prescribed within the available daily fluid quota, not in addition to it. In fluid-restricted patients (e.g., cardiac failure, renal failure, ARDS, positive fluid balance):

- Use concentrated PN formulations
- Reduce PN volume while maintaining nutrient targets where possible

Daily reassessment of fluid balance is mandatory. PN prescription should be adjusted promptly to prevent fluid overload or dehydration.

## Chapter 5

### Complications of PN

#### 1. Infections

##### 1.1. Local Infections

##### 1.2. Invasive Infection (CRBSI) - (Annexure 10)

1.2.1. Endoluminal Colonization is a type of invasive infection. It can occur in following conditions,

- Colonization of Catheter hub
- Broken or leaking line due to poor connection
- Contaminated admixtures
- Multiuse lines (blood, drug)

1.2.2. Extraluminal Contamination is the other type of invasive infection. Which occurs when,

- Migration of microorganisms along the catheter (from cutaneous exit site.)
- Direct contamination during catheter insertion (3<sup>rd</sup> day surgical fever)
- Hematogenous seeding

#### 2. Technical/mechanical Complications

##### 2.1. Peripheral PN

Thrombophlebitis (3-31%) and catheter blockage

##### 2.2. Central PN

##### 2.2.1. Early Complications

- Insertion Failure
- Misplacement
- Hematoma / abscess formation
- Thrombo-embolism
- Cardiac tamponade

##### 2.2.2. Late Complications

Catheter Blockage

#### 3. Metabolic complications

- Refeeding Syndrome - (Annexure 9)
- Azotemia
- Hyperglycemia/ Hypoglycemia
- Hypertriglyceridemia
- Hepato-biliary complication (liver steatosis / cholestasis)
- Parenteral Nutrition associated Liver Disease (PNALD)
- Metabolic Bone Disease

## Chapter 6

### Monitoring

Monitoring is a key factor in safe and effective delivery of PN. The main goals of monitoring are:

- Preventing complications
- Verifying nutritional efficacy
- Verifying clinical efficacy

To achieve these goals, clinical, nutritional, functional and laboratory indices should be used.

#### 1. Clinical parameters

- Temperature, pulse rate, respiration, blood pressure
- Edema, dehydration, sepsis and wound healing
- Catheter sites should be inspected at regular intervals for signs of inflammation or infection.

All central venous catheter (CVC) records should include details such as the insertion date, removal date, the reason for removal, and the results of the catheter tip culture, along with documentation of whether sepsis was present.

#### 2. Nutrition Indices

- Body weight
- MUAC
- Hand grip dynamometry
- Micronutrient status

#### 3. Investigations

- Serum electrolytes – Daily in initial period
- Calcium, phosphate, magnesium
- Blood glucose at least twice daily.
- Triglyceride and cholesterol – weekly

Parameter – PRN	Base Line	Daily	Thrice a Week	Weekly
Weight	√	√	When stable	
Mid Upper Arm Circumference (MUAC)	√			√
Glucose	√	Initially	√	
Electrolytes	√	Initially	√	
PO <sub>4</sub> <sup>3-</sup> /Mg <sup>2+</sup> /Ca <sup>2+</sup>	√	Initially		√
Renal Functions	√		Initially	√
Triglycerides	√			√
Total Bilirubin/ LFT	√		Initially	√
Albumin	√			√
FBC	√	Initially		√

Table 2: Clinical monitoring guide of patients on parenteral nutrition

## Chapter 7

### Discontinuation of parenteral nutrition

- Weaning off
  - Withhold PN when the patient can tolerate oral or enteral feeding that meets at least 60-75% of their nutritional requirements.
  - The decision to discontinue parenteral nutrition should be based on a comprehensive evaluation of the patient's nutritional status, feeding history, and tolerance to enteral nutrition.
  - Care must be taken to avoid overfeeding during the transition from parenteral to enteral nutrition.
  - PN should not be stopped until enteral feeding has been initiated and adequately tolerated to meet a substantial portion of the patient's nutritional requirements.
  - Premature withdrawal of PN may result in nutrient deficits.
  
- Unexpected interruption of Parenteral Nutrition

If PN must be stopped unexpectedly, the patient should immediately receive appropriate IV fluids to maintain hydration and electrolyte balance until PN can be safely resumed.

Unplanned interruption of PN may occur due to several reasons, including:

  - Loss of central or peripheral venous access (e.g. catheter occlusion, dislodgement, or mechanical failure)
  - Catheter-related bloodstream infection (CRBSI) or suspicion of line sepsis
  - Line blockage or leakage
  - Metabolic complications, such as severe hyperglycemia, electrolyte imbalance, or fluid overload
  - Hemodynamic instability or acute deterioration in clinical status
  - Technical or logistic issues, such as PN bag contamination, formulation error, or equipment malfunction
  - Planned invasive procedures or imaging requiring interruption of PN infusion

## Referral procedure

PN is the most complex modality of nutritional support, which is why its effectiveness and safety of application depend on multiple factors. Consultation, with an experienced multidisciplinary NST may reduce complications and may decrease inappropriate use of PN. Individualized PN plans should only be started by NST led by Consultant Nutrition Physician (CNP). The referral of a patient that identified as nutritionally at risk should be made within 24 hours.

When PN is started, indication should be clearly mentioned.

### Nutrition support team

1. Consultant Nutrition Physician – Head of the team
2. Senior Registrar in Clinical Nutrition
3. Registrar in Clinical Nutrition
4. Medical officer in Nutrition
5. Nursing officer
6. Pharmacist
7. Other supportive teams

### Role of the MNT

1. Nutrition assessment of the ward referral and all Intensive Care Unit (ICU) patients.
2. Deciding the best route of nutrition in consultation with primary medical/surgical team and ICU team (in case of ICU) patients.
3. Liaise with Medical/Surgical/ICU team regarding the total volume.
4. Determining the nutritional requirements. (Energy and protein).
5. Determining the correct type of PN.
6. Determining the correct rate of infusion.
7. Determining the correct duration of infusion.
8. Daily review to see the tolerance and metabolic changes.
9. Ordering relevant investigations with the relevant team members.
10. Correction of micronutrient deficiencies.

### Role of the medical/surgical team

1. Nutrition screening
2. Referral of patients with nutrition concerns to Medical nutrition team
3. Liaise with Medical nutrition team, anesthesia team, microbiology team, biochemistry team and pharmacy
4. Monitoring for features of re feeding syndrome and other metabolic derangements
5. Correction of electrolyte abnormalities
6. Informing the Medical nutrition team if line sepsis or metabolic derangement is detected

### Role of the ICU team

1. Liaise with Medical nutrition team, surgical/ medical team, microbiology team, biochemistry team and pharmacy
2. Monitoring for features of re-feeding syndrome, other metabolic derangements and line sepsis
3. Correction of electrolyte abnormalities
4. Withhold PN infusion and inform the Medical nutrition team if line sepsis or metabolic derangement is detected

DRAFT

## Home Parenteral Nutrition (HPN)

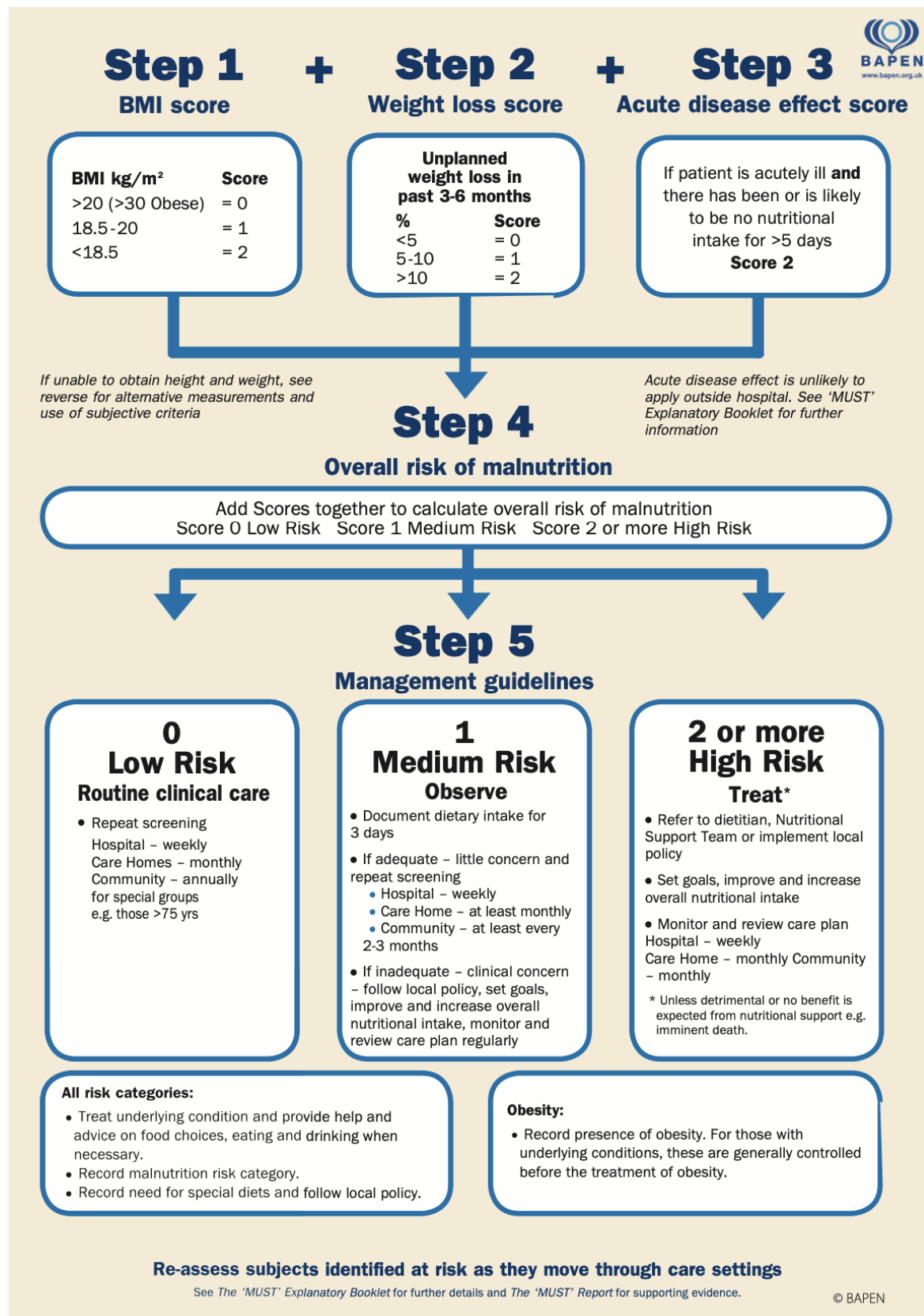
Home Parenteral Nutrition should be administered to those patients unable to meet their nutritional requirements via the oral and/or enteral route and who can be safely managed outside of the hospital.

HPN can be identified in following situations.

- (i) HPN as primary life-saving therapy for a patient with chronic intestinal failure (CIF) due to benign disease.
  - (ii) HPN for CIF due to malignant diseases, often transiently occurring during curative treatments.
  - (iii) HPN included in a program of palliative care for incurable malignant disease, to avoid death from malnutrition.
  - (iv) HPN used to prevent or treat malnutrition in patients with a functioning intestine who decline other types of medical nutrition ('no-CIF scenario').
- CIF is the chronic “reduction of gut function below the minimum necessary for the absorption of macronutrients and/or water and electrolytes, such that intravenous supplementation is required to maintain health and/or growth”, in metabolically stable patients. CIF can be due to either benign or malignant disease and may be reversible or irreversible
  - For a safe HPN program,
    - the patient and/or the patient's legal representative have to give fully informed consent to the treatment proposed.
    - The patient has to be sufficiently metabolically stable outside the acute hospital setting.
    - The patient's home environment has to be adequate to safely deliver the therapy proposed.
    - The patient and/or the caregiver has to be able to understand and perform the required procedures for the safe administration of therapy.
  - At the moment HPN is not available in Sri Lanka

# Annexes

## Annexure 1: MUST



## Annexure 2: NRS 2002

		Yes	No
1	Is BMI <20.5?		
2	Has the patient lost weight within the last 3 months?		
3	Has the patient had a reduced dietary intake in the last week?		
4	Is the patient severely ill ? (e.g. in intensive therapy)		

**Yes:** If the answer is 'Yes' to any question, the screening in Table 2 is performed.  
**No:** If the answer is 'No' to all questions, the patient is re-screened at weekly intervals. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.

Impaired nutritional status		Severity of disease (≈ increase in requirements)	
Absent <b>Score 0</b>	Normal nutritional status	Absent <b>Score 0</b>	Normal nutritional requirements
Mild <b>Score 1</b>	Wt loss > 5% in 3 mths or Food intake below 50–75% of normal requirement in preceding week	Mild <b>Score 1</b>	Hip fracture* Chronic patients, in particular with acute complications: cirrhosis*, COPD*, <i>Chronic hemodialysis, diabetes, oncology</i>
Moderate <b>Score 2</b>	Wt loss > 5% in 2 mths or BMI 18.5 – 20.5 + impaired general condition or Food intake 25–60% of normal requirement in preceding week	Moderate <b>Score 2</b>	Major abdominal surgery* Stroke* <i>Severe pneumonia, hematologic malignancy</i>
Severe <b>Score 3</b>	Wt loss > 5% in 1 mth (>15% in 3 mths) or BMI < 18.5 + impaired general condition or Food intake 0-25% of normal requirement in preceding week in preceding week.	Severe <b>Score 3</b>	Head injury* Bone marrow transplantation* <i>Intensive care patients (APACHE&gt;10).</i>
Score:	+	Score:	= Total score
Age	if ≥ 70 years: add 1 to total score above		= age-adjusted total score
<b>Score ≥ 3:</b> the patient is nutritionally at-risk and a nutritional care plan is initiated <b>Score &lt; 3:</b> weekly rescreening of the patient. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.			

NRS-2002 is based on an interpretation of available randomized clinical trials. An asterisk (\*) indicates that a trial directly supports the categorization of patients with that diagnosis. Diagnoses shown in italics are based on the prototypes given below. Nutritional risk is defined by the present nutritional status and risk of impairment of present status, due to increased requirements caused by stress metabolism of the clinical condition.

A nutritional care plan is indicated in all patients who are (1) severely undernourished (score=3), or (2) severely ill (score=3), or (3) moderately undernourished + mildly ill (score 2 +1), or (4) mildly undernourished + moderately ill (score 1 + 2).

### Prototypes for Severity of Disease

Score=1: a patient with chronic disease, admitted to hospital due to complications. The patient is weak, but out of bed regularly. Protein requirement is increased, but can be covered by oral diet or supplements in most cases.

Score=2: a patient confined to bed due to illness, e.g. following major abdominal surgery. Protein requirement is substantially increased, but can be covered, although artificial feeding is required in many cases.

Score=3: a patient in intensive care with assisted ventilation etc. Protein requirement is increased, and cannot be covered, even by artificial feeding. Protein breakdown and nitrogen loss can be significantly attenuated.

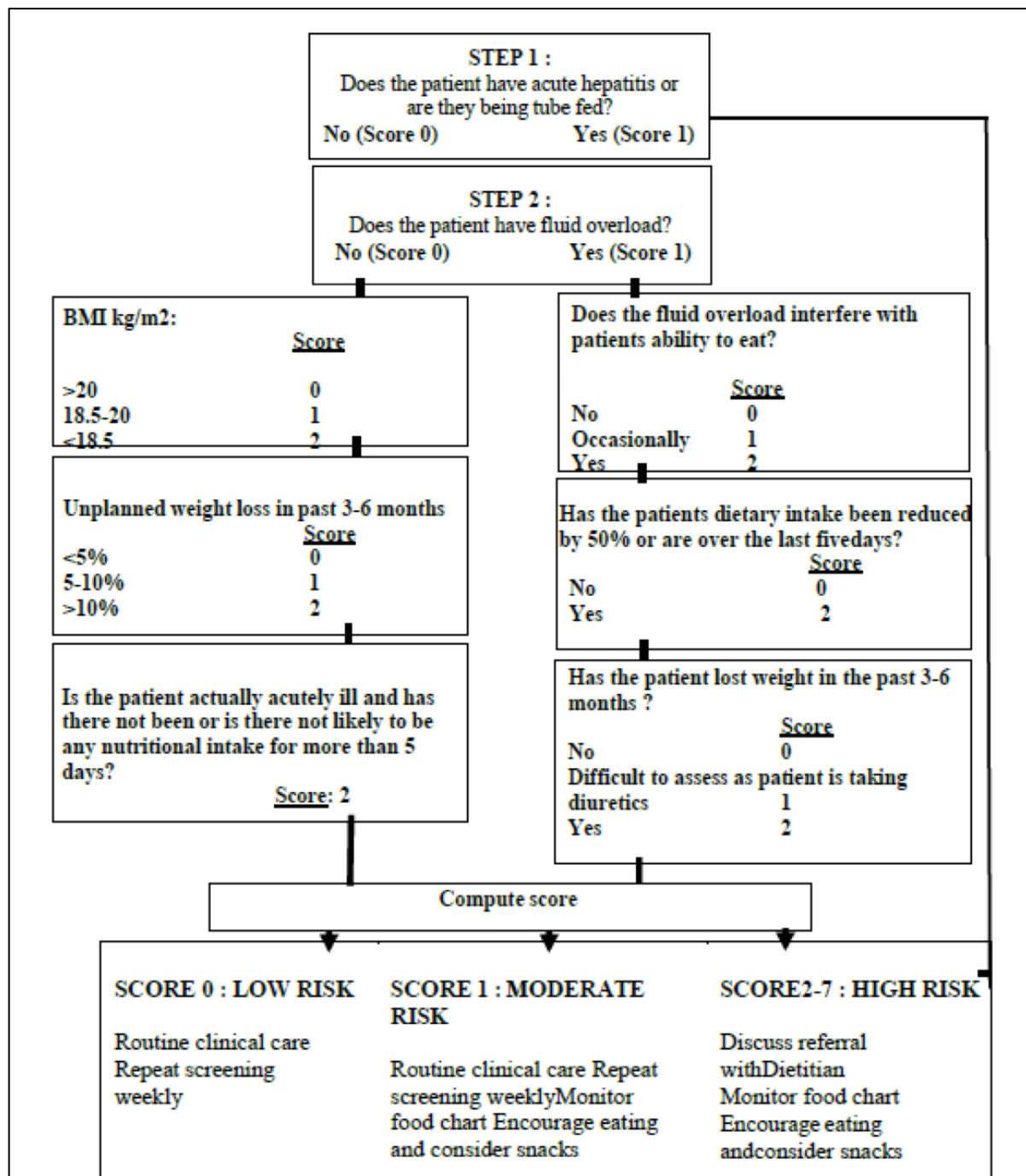
## Annexure 3: MNA SF

Last name:	<input type="text"/>	First name:	<input type="text"/>
Sex:	<input type="text"/>	Age:	<input type="text"/>
Weight, kg:	<input type="text"/>	Height, cm:	<input type="text"/>
Date:	<input type="text"/>		

Complete the screen by filling in the boxes with the appropriate numbers. Total the numbers for the final screening score.

Screening	
<b>A Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?</b> 0 = severe decrease in food intake 1 = moderate decrease in food intake 2 = no decrease in food intake	<input type="checkbox"/>
<b>B Weight loss during the last 3 months</b> 0 = weight loss greater than 3 kg (6.6 lbs) 1 = does not know 2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs) 3 = no weight loss	<input type="checkbox"/>
<b>C Mobility</b> 0 = bed or chair bound 1 = able to get out of bed / chair but does not go out 2 = goes out	<input type="checkbox"/>
<b>D Has suffered psychological stress or acute disease in the past 3 months?</b> 0 = yes      2 = no	<input type="checkbox"/>
<b>E Neuropsychological problems</b> 0 = severe dementia or depression 1 = mild dementia 2 = no psychological problems	<input type="checkbox"/>
<b>F1 Body Mass Index (BMI) (weight in kg) / (height in m)<sup>2</sup></b> <input type="checkbox"/> 0 = BMI less than 19 1 = BMI 19 to less than 21 2 = BMI 21 to less than 23 3 = BMI 23 or greater	<input type="checkbox"/>
IF BMI IS NOT AVAILABLE, REPLACE QUESTION F1 WITH QUESTION F2. DO NOT ANSWER QUESTION F2 IF QUESTION F1 IS ALREADY COMPLETED.	
<b>F2 Calf circumference (CC) in cm</b> 0 = CC less than 31 3 = CC 31 or greater	<input type="checkbox"/>
<b>Screening score</b> (max. 14 points)	<input type="checkbox"/> <input type="checkbox"/>
<b>12-14 points:</b> <input type="checkbox"/> Normal nutritional status	<input type="button" value="Save"/>
<b>8-11 points:</b> <input type="checkbox"/> At risk of malnutrition	<input type="button" value="Print"/>
<b>0-7 points:</b> <input type="checkbox"/> Malnourished	<input type="button" value="Reset"/>

Annexure 4: Royal Free Hospital Nutrition Prioritizing Tool (RFHNPT)



## Annexure 5: Renal i-Nut

<b>Information to record</b>
1. Admission weight (kg)
2. AND 'dry weight' i.e. most recent post dialysis or edema-free weight target (dialysis patients) OR reported usual weight (non-dialysis patients)
3. Height (m)
4. Body Mass Index (kg/m <sup>2</sup> ) using the lowest of the two weights documented

<b>Admission screening questions</b>	<b>Scoring system</b>
1 Has the patient unintentionally lost weight from their target OR usual weight?	No = 0, Yes = 1
2 Does the patient look malnourished OR have a BMI 20kg/m <sup>2</sup> or less?	No = 0, Yes = 1
3 Is the patient already on nutritional supplements?	No = 0, Yes = 1
4 Compared to usual, how is the patient's food intake?	better/similar = 0, worse = 1
5 Compared to usual, how is the patient's appetite?	better/similar = 0, worse = 1

<b>Total score</b>	<b>Action Plan</b>
0	Continue screening weekly
1	Monitor patient at risk (Local monitoring and nurse intervention protocols stated)
2 or more	Refer to dietitian (Local referral procedures stated)

# Annexure 6: Patient-Generated Subjective Global Assessment (PG-SGA)



## Scored Patient-Generated Subjective Global Assessment (PG-SGA)

History: Boxes 1 - 4 are designed to be completed by the patient.  
[Boxes 1-4 are referred to as the PG-SGA Short Form (SF)]

**1. Weight (See Worksheet 1)**

In summary of my current and recent weight:

I currently weigh about \_\_\_\_\_ kg  
I am about \_\_\_\_\_ cm tall

One month ago I weighed about \_\_\_\_\_ kg  
Six months ago I weighed about \_\_\_\_\_ kg

During the past two weeks my weight has:

decreased (1)  not changed (0)  increased (0)

**Box 1**

**Patient Identification Information**

**2. Food intake:** As compared to my normal intake, I would rate my food intake during the past month as

unchanged (0)  
 more than usual (0)  
 less than usual (1)

I am now taking

normal food but less than normal amount (1)  
 little solid food (2)  
 only liquids (3)  
 only nutritional supplements (3)  
 very little of anything (4)  
 only tube feedings or only nutrition by vein (0) **Box 2**

**3. Symptoms:** I have had the following problems that have kept me from eating enough during the past two weeks (check all that apply)

no problems eating (0)

no appetite, just did not feel like eating (3)  vomiting (3)  
 nausea (1)  diarrhea (3)  
 constipation (1)  dry mouth (1)  
 mouth sores (2)  smells bother me (1)  
 things taste funny or have no taste (1)  feel full quickly (1)  
 problems swallowing (2)  fatigue (1)  
 pain; where? (3) \_\_\_\_\_  
 other (1)\*\* \_\_\_\_\_

\*\*Examples: depression, money, or dental problems **Box 3**

**4. Activities and Function:**

Over the past month, I would generally rate my activity as:

normal with no limitations (0)  
 not my normal self, but able to be up and about with fairly normal activities (1)  
 not feeling up to most things, but in bed or chair less than half the day (2)  
 able to do little activity and spend most of the day in bed or chair (3)  
 pretty much bed ridden, rarely out of bed (3)

**Box 4**

The remainder of this form is to be completed by your doctor, nurse, dietitian, or therapist. Thank you.

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**Additive Score of Boxes 1-4**  A

## Scored Patient-Generated Subjective Global Assessment (PG-SGA)

**Worksheet 1 – Scoring Weight Loss**

To determine score, use 1-month weight data if available. Use 6-month data only if there is no 1-month weight data. Use points below to score weight change and add one extra point if patient has lost weight during the past 2 weeks. Enter total point score in Box 1 of PG-SGA.

Weight loss in 1 month	Points	Weight loss in 6 months
10% or greater	4	20% or greater
5-9.9%	3	10- 19.9%
3-4.9%	2	6- 9.9%
2-2.9%	1	2- 5.9%
0-1.9%	0	0- 1.9%

**Numerical score from Worksheet 1**

**Additive Score of Boxes 1-4 (See Side 1)**  A

**5. Worksheet 2 – Disease and its relation to nutritional requirements:**

Score is derived by adding 1 point for each of the following conditions:

Cancer  Presence of decubitus, open wound or fistula  
 AIDS  Presence of trauma  
 Pulmonary or cardiac cachexia  Age greater than 65  
 Chronic renal insufficiency

Other relevant diagnoses (specify) \_\_\_\_\_

Primary disease staging (circle if known or appropriate) I II III IV Other **Numerical score from Worksheet 2**  B

**6. Worksheet 3 – Metabolic Demand**

Score for metabolic stress is determined by a number of variables known to increase protein & caloric needs. Note: Score fever intensity or duration, whichever is greater. The score is additive so that a patient who has a fever of 38.8 °C (3 points) for < 72 hrs (1 point) and who is on 10 mg of prednisone chronically (2 points) would have an additive score for this section of 5 points.

Stress	none (0)	low (1)	moderate (2)	high (3)
Fever	no fever	> 37.2 and < 38.3	≥ 38.3 and < 38.8	≥ 38.8 °C
Fever duration	no fever	< 72 hours	72 hours	> 72 hours
Corticosteroids	no corticosteroids	low dose (< 10 mg prednisone equivalents/day)	moderate dose (≥ 10 and < 30 mg prednisone equivalents/day)	high dose (≥ 30 mg prednisone equivalents/day)

**Numerical score from Worksheet 3**  C

**7. Worksheet 4 – Physical Exam**

Exam includes a subjective evaluation of 3 aspects of body composition: fat, muscle, & fluid. Since this is subjective, each aspect of the exam is rated for degree. Muscle deficit/loss impacts point score more than fat deficit/loss. Definition of categories: 0 = no abnormality, 1+ = mild, 2+ = moderate, 3+ = severe. Rating in these categories is not additive but are used to clinically assess the degree of deficit (or presence of excess fluid).

Muscle Status	0	1+	2+	3+
temples (temporalis muscle)				
clavicles (pectoralis & deltoids)				
shoulders (deltoids)				
interosseous muscles				
scapula (latissimus dorsi, trapezius, deltoids)				
thigh (quadriceps)				
calf (gastrocnemius)				
<b>Global muscle status rating</b>	<b>0</b>	<b>1+</b>	<b>2+</b>	<b>3+</b>

Fat Stores	0	1+	2+	3+
orbital fat pads				
triceps skin fold				
fat overlying lower ribs				
<b>Global fat deficit rating</b>	<b>0</b>	<b>1+</b>	<b>2+</b>	<b>3+</b>

Fluid status	0	1+	2+	3+
ankle edema				
sacral edema				
ascites				
<b>Global fluid status rating</b>	<b>0</b>	<b>1+</b>	<b>2+</b>	<b>3+</b>

Point score for the physical exam is determined by the overall subjective rating of the total body deficit. No deficit score = 0 points  
Mild deficit score = 1 point  
Moderate deficit score = 2 points  
Severe deficit score = 3 points

**Numerical Score for Worksheet 4**  D

**Total PG-SGA Score (Total numerical score of A+B+C+D)**

Clinician Signature \_\_\_\_\_ RD RN PA MD DO Other \_\_\_\_\_ Date \_\_\_\_\_ **Global PG-SGA Category Rating (Stage A, Stage B or Stage C)**

**Worksheet 5 – PG-SGA Global Assessment Categories**

Category	Stage A	Stage B	Stage C
Weight	Well-nourished	Moderate/suspected malnutrition	Severely malnourished
Nutrient intake	No weight loss	≤ 5% loss in 1 month (≤ 10% in 6 months)	> 5% loss in 1 month (> 10% in 6 months)
Nutrition Impact	OR recent non-fluid wt gain	OR Progressive weight loss	OR Progressive weight loss
Symptoms (NIS)	No deficit OR Significant recent improvement	Definite decrease in intake	Severe deficit in intake
Functioning	OR significant recent improvement allowing adequate intake	Presence of NIS (Box 3 of PG-SGA)	Presence of NIS (Box 3 of PG-SGA)
Physical Exam	No deficit OR Significant recent improvement	Moderate functional deficit	Severe functional deficit
	Deficit but with recent clinical improvement	Evidence of mild to moderate loss of muscle mass &/or muscle tone on palpation &/or loss of SQ fat	Obvious signs of malnutrition (e.g., severe loss muscle, fat, possible edema)

**Nutritional Triage Recommendations:** Additive score is used to define specific nutritional interventions including patient & family education, symptom management including pharmacologic intervention, and appropriate nutrient intervention (food, nutritional supplements, enteral, or parenteral triage).

First line nutrition intervention includes optimal symptom management.

**Triage based on PG-SGA point score**

0-1 No intervention required at this time. Re-assessment on routine and regular basis during treatment.  
2-3 Patient & family education by dietitian, nurse, or other clinician with pharmacologic intervention as indicated by symptom survey (Box 3) and lab values as appropriate.  
4-8 Requires intervention by dietitian, in conjunction with nurse or physician as indicated by symptoms (Box 3).  
≥ 9 Indicates a critical need for improved symptom management and/or nutrient intervention options.

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email: [faithottervmdphd@gmail.com](mailto:faithottervmdphd@gmail.com) or [info@pt-global.org](mailto:info@pt-global.org)

## Annexure 7: GLIM criteria

	PHENOTYPE CRITERIA			ETIOLOGY CRITERIA	
	Weight loss (%)	Body mass index (kg/m <sup>2</sup> )	Muscle mass <sup>a</sup>	Food intake, malabsorption or GI symptoms	Disease burden/inflammation
STAGE 1/ MODERATE MALNUTRITION (REQUIRES 1 PHENOTYPIC AND 1 ETIOLOGIC CRITERION)	5 - 10% within the past 6 mo, or 10-20% beyond 6 mo	<20 if <70 yr, <22 if ≥70 yr Asia: <18.5 if <70 yr, <20 if ≥70 yr	Mild to moderate deficit (per validated assessment methods - see below)	Any reduction of intake below ER for >2 weeks, or moderate malabsorption symptoms <sup>b</sup>	Acute disease/injury <sup>d</sup> ,  or chronic disease related
STAGE 2/ SEVERE MALNUTRITION (REQUIRES 1 PHENOTYPIC AND 1 ETIOLOGIC CRITERION)	>10% within the past 6 mo, or >20% beyond 6 mo	<18.5 if <70 yr, <20 if ≥70 yr Asia: TBD	Severe deficit (per validated assessment methods - see below)	50% intake of ER for >1 week, or severe malabsorption/GI symptoms <sup>c</sup>	Acute disease/injury,  or chronic disease related

GI = gastro-intestinal, ER = energy requirements, yr = year, mo = month.

<sup>a</sup> For example, fat-free mass index (FFMI, kg/m<sup>2</sup>) by dual-energy absorptiometry or corresponding standards using other body composition methods like bioelectrical impedance analysis (BIA), CT or MRI. When not available or by regional preference, physical exam or standard anthropometric measures like mid-arm muscle or calf circumferences may be used. Thresholds for reduced muscle mass need to be adapted to race (Asia). Functional assessments like hand-grip strength may be used as a supportive measure.

<sup>b</sup> Gastrointestinal symptoms of moderate degree - dysphagia, nausea, vomiting, diarrhoea, constipation, or abdominal pain.

<sup>c</sup> Gastrointestinal symptoms of severe degree - dysphagia, nausea, vomiting, diarrhoea, constipation, or abdominal pain.

<sup>d</sup> Acute disease/injury-related with severe inflammation. For example, major infection, burns, trauma or closed head injury.

<sup>e</sup> Chronic disease-related with chronic or recurrent mild to moderate inflammation. For example, malignant disease, chronic obstructive pulmonary disease, congestive heart failure, chronic renal disease, or any disease with chronic or recurrent Inflammation. CRP may be used as a supportive laboratory measure.

## Annexure 8 – Development Phases of PN delivery container system and Evolution of lipid emulsions

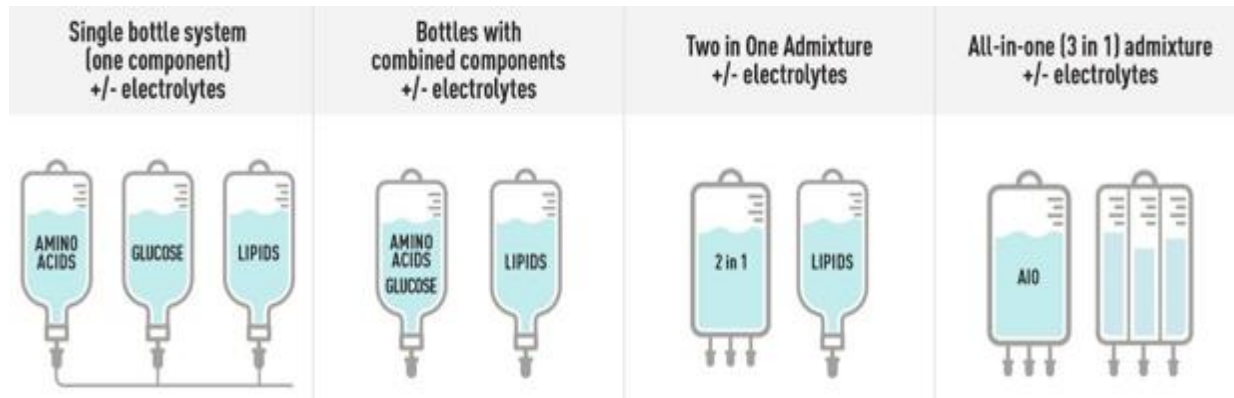


Figure 6: Parenteral nutrition delivery container systems

### **Multi bottle system/single component preparations**

- Amino acids, glucose and fat emulsions are administered in parallel or in sequence using multiple bottles. Minerals and vitamins are given separately with separate bottles.

### **Combined systems**

- “All in One” hospital mixtures /Compounding system
- Amino acids, glucose, and lipids are combined in a single infusate along with electrolytes, vitamins and trace elements as required. Designed for immediate intravenous administration with no mixing or admixing required before administration.
- Not available in Sri Lanka.

### **Industrial Parenteral nutrition Admixtures: Multi-chamber Bag**

1. Two chamber bags – glucose and amino acids
2. Three chamber bags – lipids, amino acids and glucose

Additional nutrients, electrolytes, vitamins and trace elements may be added to selected compartments according to defined aseptic admixing procedures which respect compatibility.

Component	Typical range per bag	Purpose/Notes
Total Fluid Volume	1000 – 2500ml (adjusted to clinical need)	Tailored to fluid status, renal/cardiac function, and ongoing losses
Glucose (Carbohydrate)	300 – 1000 kcal	Main carbohydrate source for energy
Amino acids (Nitrogen)	4 – 16 g nitrogen	Supports protein synthesis and nitrogen balance
Lipids (Fat)	300 – 800 kcal	May consist of a SMOF 20% formulation, which includes soybean oil (30%), MCT (30%), olive oil (25%), and fish oil (15%), or alternatively a 20% medium- and long-chain triglyceride emulsion, depending on availability

Table 3: Typical composition of a standard PN bag

	Multi bottle system	Combined system
Advantages	<ol style="list-style-type: none"> <li>1. Easy to overcome compatibility issues/minimize or avoid precipitation secondary to chemical interactions.</li> <li>2. A tailor-made nutrition regime can be delivered</li> </ol>	<ol style="list-style-type: none"> <li>1. Easy and safe to handle</li> <li>2. Fewer line manipulations</li> <li>3. Low risk of infections</li> </ol>
Disadvantages	<ol style="list-style-type: none"> <li>1. Burdensome procedure requiring multiple manipulations which need three pumps.</li> <li>2. High risk of microbial contamination.</li> </ol>	<ol style="list-style-type: none"> <li>1. Compatibility issues</li> <li>2. Not tailor-made</li> </ol>

Table 4: Comparison of multi bottle system and combined system

1 <sup>st</sup> Generation	2 <sup>nd</sup> Generation	3 <sup>rd</sup> Generation
Conventional lipid emulsions <ol style="list-style-type: none"> <li>1. LCT* (soybean)</li> <li>2. LCT (soy/safflower)</li> </ol>	Reduced amount of PUFA* <ol style="list-style-type: none"> <li>1. Structured Lipids (MCT/LCT)*</li> <li>2. Olive oil based</li> </ol>	Reduced PUFA and specific n 6: n 3 ratio <ol style="list-style-type: none"> <li>1. Fish oil</li> <li>2. Soy/MCT/Olive/Fish Oil</li> <li>3. Soy/MCT/Omega 3TG*</li> </ol>

Table 5: Types of lipid emulsions

\*PUFA – Polyunsaturated Fatty Acids  
 MCT – Medium Chain Triglycerides

LCT – Long Chain Triglycerides  
 TG - Triglycerides

## Annexure 9: Refeeding syndrome

Refeeding syndrome (RFS) is defined as a range of metabolic and electrolyte alterations occurring as a result of the rapid reintroduction and/or increased provision of calories after a period of decreased or absent caloric intake which is a life-threatening situation.

This is not an unusual complication, with an incidence of 15% of geriatric population, 25% of cancer patients and 28% of anorexia nervosa patients. In the case of malnourished catabolic patient on artificial feeding (EN/PN) this incidence rises up to 50%, especially within first three days after starting the nutritional support (EN/PN).

RFS may manifest in a wide variety of severities, from slight, clinically insignificant decrements in electrolyte levels to severe and sudden decreases, which lead to, or risk development of, end organ failure if not preempted or corrected. Decrement of any of the phosphate, potassium or magnesium may signal total-body deficit and requires monitoring or intervention.

### RFS diagnostic criteria are outlined as the following:

A decrease in any of three electrolytes (serum phosphorus, potassium, and/or magnesium) levels by 10%–20% (mild RFS), 20%–30% (moderate RFS), or >30% and/or organ dysfunction resulting from a decrease in any of these and/or due to thiamin deficiency (severe RFS), and occurring within 5 days of reinitiating or substantially increasing energy provision.

### Criteria for determination of patients at risk of RFS.

<b>One of the following</b>	<b>Two of the following</b>
BMI < 16kgm <sup>-2</sup>	BMI < 18.5kgm <sup>-2</sup>
Unintentional weight loss >15% in past 3-6 months	Unintentional weight loss >10% in past 3-6 months
Very little or no nutritional intake for > 10 days	Very little or no nutritional intake for > 5 days
Low level of serum magnesium, phosphate, or potassium prior to feed.	History of alcohol or drug abuse including insulin, chemotherapy, antacids or diuretics.

Table 6: Criteria for determining patients at risk of RFS  
(Adopted from NICE Guideline on Refeeding syndrome)

## Diseases and clinical conditions associated with an increased risk of RFS.

- Acquired immunodeficiency syndrome
- Chronic alcohol or drug use disorder
- Dysphagia and esophageal dysmotility (e.g. eosinophilic esophagitis, achalasia, gastric dysmotility)
- Eating disorders (e.g., anorexia nervosa)
- Food insecurity and homelessness
- Failure to thrive, including physical and sexual abuse and victims of neglect (particularly children)
- Hyperemesis gravidarum or protracted vomiting
- Major stressors or surgery without nutrition for prolonged periods of time
- Malabsorptive states (e.g., short-bowel syndrome, Crohn's disease, cystic fibrosis, pyloric stenosis, maldigestion, pancreatic insufficiency)
- Cancer
- Advanced neurologic impairment or general inability to communicate needs
- Post bariatric surgery
- Postoperative patients with complications
- Prolonged fasting (eg, individuals on hunger strikes, anorexia nervosa)
- Refugees
- Protein malnourishment

## General recommendations

- Identify patients at risk and adequate assessment.
- Carefully restore circulatory volume according to the hydration state.
- Energy intake should be instituted carefully and gradually.
- Empirical supplementation of electrolytes can be started before initiation of feeding. (unless serum levels are high)
- IV/ oral thiamine 200-300mg, at least 30 minutes before feeding.

## Macronutrient provision

### Day 1-3

- Start feeding (by all routes), at 10 kcal/kg/day and slowly increase to 15 kcal/kg/day.
  - Carbohydrate 50-60%
  - Fat 30-40%
  - Protein 15-20% (1-1.5g/kg/day)

- For high-risk patients such as BMI <math>14\text{kgm}^{-2}</math>, food intake <math><25\%</math> of requirement > 15 days or weight loss >math>20\%</math> of body weight, start feeding more carefully with only 5 kcal/ kg/day.

#### Day 4-6

- Increase energy up to 10-20 kcal/kg/day.

#### Day 7- 10

- Energy increase to 20 to 30 kcal/kg/day.

### Electrolytes

Measure base line serum level

D1 - D3	<ul style="list-style-type: none"> <li>• Supplement</li> <li>• Monitor every 12 hours for the first 3 days in high-risk patients</li> </ul>
D4 - D6	<ul style="list-style-type: none"> <li>• Supplement</li> <li>• Monitor every 2<sup>nd</sup> day</li> </ul>

If  $\text{PO}_4^{3-} < 0.6 \text{ mmol/L}$ , replace 30-40 (max) mmol phosphate intravenously over 12-24 hours. If oral route is used, should be given in divided doses.

Should stop the infusion pump 4hrs before drawing blood for serum phosphate levels to prevent misinterpretations.

Potassium <math><3.5 \text{ mmol/L}</math> supplement 20-40 mmol KCL intravenously over 4-8 hours.

Magnesium <math>< 0.5\text{mmol/L}</math>, give 6g  $\text{MgSO}_4$  intravenously over 3-6 hours, afterwards 5g over 12-24 hours intravenously. Oral magnesium is administered; it should be given in divided doses. (oral  $\text{MgSO}_4$  preparations can cause diarrhoea as a side effect)

If electrolytes become difficult to correct or drop precipitously during the initiation of nutrition, decrease calories/grams of dextrose by 50% and gradually advance the dextrose/calories by approximately 33% of goal every 1–2 days based on clinical presentation.

## Fluids

Maintain hydration to achieve a urine output of at least 0.5–1.0 mL/kg/hour ( $\approx$ 12–24 mL/kg/day), while restricting total fluid intake to goal-directed limits.

## Salt

- Restrict sodium to <1mmol/kg/day.
- If edema develops reduce further.

## Vitamin

- 200% of Rerecommended daily Intake (RDI), except iron.
- Iron should be supplemented from day 7 onwards.

## Monitor

<b>Parameter</b>	<b>D1 - D3</b>	<b>D4 - D6</b>	<b>D7 - D10</b>
Body weight	Daily	daily	twice weekly
Edema	Daily	daily	daily
Blood pressure Pulse rate Hydration state	Daily	daily	daily
Electrolytes	Daily	once in two days	twice weekly

## Annexure 10: Catheter related infections

Catheter related blood stream infections (CRBSI) are one of the commonest and lethal complications of the central venous catheters. Administration of PN increases the risk of CRBSI.

### How to prevent CRBSI

- Optimum PN prescription
- Inspect line entry site daily
- Proper line care
  - **There should be a dedicated lumen for PN in the absence of a separate line.** The PN infusion must NOT be disconnected and reconnected once the infusion has commenced.
  - If for any reason the PN is disconnected, the bag and giving set MUST be discarded.
  - Hang time for PN should not exceed 24 hours.
  - Vials of separate PN components should be discarded after 24 hours of even a small amount has been used from it. Selection of appropriate insertion site is important.
- Adhere to central venous catheter care bundle
- Use of single-lumen catheters

### Procedure of line care (At patient bedside):

1. Check the expiry date and any visible color change or damage.
2. Remove PN from sealed bag (if multi chamber bag).
3. Check PN against prescription and hang on drip pole. (if multi chamber bag or given directly from the PN vials).
4. Wash hands properly.
5. Clean and disinfect the trolley/ tray surface.
6. Open dressing pack onto clean trolley top and prepare sterile field with needed equipment.
7. Put on sterile gloves.
8. Clamp giving set.
9. Insert giving set into infusion port of PN bag with non-touch technique.
10. Slowly release clamp to allow the line to prime.
11. Place end of giving set on sterile field whilst priming.
12. Open out sterile towel and leave on sterile field.
13. Clean the end of the central venous catheter with 2% Chlorhexidine solution/ 4% Betadine thoroughly.
14. Allow central venous catheter to drop onto the sterile towel.
15. Flush line with 10ml 0.9% sodium chloride using push pause technique.
16. When administration set is primed, connect to designated port on central venous catheter.
17. Set pump for new infusion, open administration set clamp, set pump to run.

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