THE COLLEGE OF ANAESTHESIOLOGISTS OF SRI LANKA

WORKING GROUP

Correspondance: anascol@slt.net.lk

Dr Vihara Dassanayake
Dr Bimal Kudavidanage
Dr Chamila Jayasekera
Dr Kanishka Indraratna
Dr Saman Karunathillake
Dr Sidarshi Kiriwattuduwa
Dr Chamila Pilimathalawwe
Dr Tharanga Perera
Dr Buddhika Vidanagama
Dr Buddhika Habaragamuwa
Dr S Mathanalagan
INTRODUCTION

These guidelines apply to nutritional support in adult patients in critical care units of Sri Lanka. In this document, **enteral feeding** refers to non-volitional delivery of nutrients via a tube into the gastrointestinal tract, and **parenteral feeding** refers to aseptic intravenous delivery of sufficient nutrients where adequate alimentary delivery of nutrients is not possible.

Critically ill patients are in a catabolic state induced by severe disease and appropriate nutritional support should be initiated as early as possible, in all patients admitted to the critical care unit unless indicated otherwise. Starvation and underfeeding in critical care patients are associated with increased morbidity and mortality.

Nutritional support can be provided by enteral or/and parenteral routes, enteral being the preferred one.

It is important in patients who are malnourished and those who are at risk of malnutrition. (Appendix 1)

During a critical illness, in addition to catabolic stress, there is an increased inflammatory response leading to increased nutritional requirement. Also there is an altered gut morphology and function, causing impaired digestion and absorption.

Poor nutrition in critically ill patient causes decreased immunity, decreased respiratory muscle function and a reduced respiratory capacity, ventilator associated pneumonia, difficult weaning off ventilator and poor wound healing.

**Assessment of Nutritional Status**

Traditional nutritional assessment tools are not validated for use in the critical care setting. The assessment usually include

- Evaluation of weight loss
- Previous nutrient intake
- Level of disease severity
- Co morbid conditions
- Function of the gastrointestinal tract
• Serum Albumin level
• Daily nitrogen balance (Appendix 2)

**Calculation of Energy & Nutrient requirement** (Appendix 2)

Though there are several formulae and methods available to calculate the energy & nitrogen requirement for nutritional support, they are not validated for the use in critical care patient and they are cumbersome to use.

**Practical approach for calculation of energy & nutrient requirement:-**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>20-30 kcal/kg/day*</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>50-55% of total calorie intake</td>
</tr>
<tr>
<td>Lipid</td>
<td>30-35% of total calorie intake</td>
</tr>
<tr>
<td>Protein</td>
<td>1.2-1.5g/kg/day**</td>
</tr>
</tbody>
</table>

*ASPVN 2009

**extra losses should be replaced; but should not exceed 2g/kg/day;**

Table 1

**EStabLishing Enteral Feeding on ICU**

Enteral Nutrition is preferred as it

• Maintains gut integrity by maintaining tight junctions between intraepithelial cells, stimulating blood flow and inducing release of trophic endogenous agents
• Modulate stress and systemic immune response
• Attenuate disease severity
• Can be used as a conduit for the delivery of immune modulating agents
• As an effective means of stress ulcer prophylaxis
Enteral feeding should be started **within 24-48 hours** following admission if volitional intake is unlikely within 3 days, provided

- The patient is haemodynamically stable (MAP > 60mmHg, stable on low doses of pressor agents)
- There is a functioning gastrointestinal tract

Presence or absence of bowel sounds or evidence of passage of flatus/stool is **NOT** required for the initiation of enteral feeding in the critical care setting. Enteral nutrition promotes gut motility and as long as the patient is haemodynamically stable, it is safe to feed through mild to moderate ileus.\(^{(7)}\)

**Access Techniques**

1. Gastric Feeding
2. Small bowel feeding - if there is high risk of aspiration or intolerance to gastric feeding

Gastrointestinal access for up to 4-6 weeks is usually achieved using a orogastric/nasogastric (NG) or naso-jejunal (NJ) tube, although placement of a percutaneous gastrostomy or jejunostomy should be considered sooner if feeding is likely to be prolonged (more than 6 weeks).

Most enteral feeds are given in to the stomach to allow the use of hypertonic feeds, higher feeding rates & bolus feeding.

Large bore feeding tubes should be avoided as they irritate the nose, pharynx & oesophagus and increase the risk of gastric reflux & aspiration. They are used initially to facilitate measurement of gastric residual volume and changed to a finer bore feeding tube once enteral feeding is established.

How to place a nasogastric tube is outlined in appendix 3.

**Administration of Feeds**

Modes of administration could be either one of the following

- **Bolus feeds** - administration of 200-400ml of feeds down a feeding tube over 15-60 minutes at regular intervals. A 50ml syringe can be used with or without a plunger, for feeding. This technique may cause bloating, diarrhoea & “dumping syndrome”.
- Intermittent feeds - moderate rates of feeding via either gravity or pumps. Depending on patient’s needs, a break in feeding of 6 hours or more are used.
- Continuous feeds – prevent diarrhoea/dumping in some patients but results in higher intragastric pH levels than bolus feeding which can promote bacterial growth.

**What to give enterally?**

Presently the enteral feeds are prepared locally for each patient in the critical care unit. Refer to the chart of nutritional values of food items which is attached when prescribing the enteral feeds. (Appendix 4)

There are commercially available enteral formulations which can be used on their own to provide most of the total nutritional requirement of a critically ill patient, even though these may not be freely available in the state sector.

Such commercially available fortified milk formula may be added as appropriate where available.

If the relatives are requested/allowed to bring feeds (eg: soup), they should be advised on what to add and how to prepare.

Prescribe a multivitamin to be added to the feed (Should not be added to a hot feed)

If available, always consider polymeric preparations for enteral feeding. However in a situation of proven or suspected intestinal malabsorption, a semi-elimental enteral feed may be introduced in patients with severe or persistent diarrhoea associated with the administration of a polymeric feed.

Preparation of the enteral formula (feed) should be done in a clean environment using hygienic technique by a trained personnel (nurse/pharmacist).

Purified water (boiled cooled water) or sterile water should be used for irrigation/flushes, reconstitution of formula & dilution of medication.

Sterile gloves should be used when handling and administering enteral feeds and all efforts must be taken to minimize contamination.
### Suggested Algorithm for Establishing Enteral Feeding on ICU

**Ensure correct position of NG tube EVERYTIME the NG tube is used**

**Commence feeds at 30mls/hour**

**Aspirate after 4 hours**

- **<250 ml**
  - Replace normal* aspirate
  - Increase feed by 30ml/hr (ie: 60ml/hr)

- **>250 ml**
  - Replace normal* aspirate 250 ml
  - Continue to feed at 30ml/hr

**Aspirate after 4 hours**

- **<250 ml**
  - Replace normal* aspirate
  - Increase feed by 30ml/hr every 4 hours up to a maximum of 90ml/hr or target rate

- **>250 ml**
  - Replace normal* aspirate 250 ml
  - Reduce rate by 30ml/hr to minimum of 10ml/hr & continue to feed

**Consider pro-kinetins & other measures to enhance tolerance**

**Continue to check aspirate after 4 hourly**

- **<250 ml**
  - Feed at 10ml/hr until aspirate is <250ml

- **>250 ml**
  - >500 ml or cannot increase feed

*Normal aspirate would be mainly the feed & gastric juice. Discard faecal, curdled, bilious or coffee ground aspirates

**Consider:** post-pyloric feeding (eg: NJ/TPN) possible surgical causes
Practice Recommendations for Enteral Feeding:

- Evaluate all enterally fed patients for risk of aspiration
- Ensure that the feeding tube is in the proper position before initiating feeding and everytime the patient is fed.
- Keep the head of the bed elevated at 30-45 degrees at all times during the administration of enteral feeding.
- When possible, use a large-bore tube only for the first 1-2 days of enteral feeding (as there is an increased risk of sinusitis & discomfort with large bore tubes) & evaluate the gastric residual volume (GRV) using a 50ml syringe.
- Check GRV every 4 hours during the first 48 hours for gastrically fed patients. Once the enteral feeding goal rate is achieved and/or the large bore tube is replaced with a softer small bore feeding tube, GRV monitoring may be reduced to every 6-8 hours in non-critically ill patients. However, every 4 hour measurements are prudent in critically ill patients.
- If the GRV is > 250ml after a second gastric residual check, a pro-motility agent should be considered in adult patients, if there are no contraindications. Discontinue pro-motility agents after 24-48 hours if ineffective and they should not be used routinely.
  - Metoclopramide 10mg IV tds
  - Erythromycin 150-250 mg IV oral qds
- A GRV of >500ml persistently should result in holding or reducing the enteral nutrition (EN) temporarily & re-assessing the patient’s tolerance.
- Tolerance can be enhanced by minimising sedation, reducing opiate use, maintaining serum potassium within normal limits, especially avoiding hypokalaemia and controlling hyperglycaemia.
- Chlorhexidine mouth wash should be used thrice a day to prevent ventilator associated pneumonia.
- Consider post pyloric feeding, when the GRV consistently remains >500ml.
- Increase feed only as tolerated, observing for any signs of vomiting, nausea, regurgitation & abdominal discomfort/distension.
• For GRV 200 – 500 ml, implement measures to reduce risk of aspiration.

Factors that increase risk of aspiration are:
  - Patient with endotracheal tube
  - Patient on mechanical ventilation
  - Age >70 years
  - Reduced level of consciousness
  - Patient position
  - Transport out of ICU
  - Poor nursing care
  - Poor oral health
  - Use of bolus intermittent feeding

• Blue food colouring should not be used as a monitor for aspiration.\(^{(7)}\)

• Once a maximum rate of 90 ml/hour or the target rate has been achieved, continue at this rate & feed over 20 -22 hours & rest the gastro-intestinal tract for 2-4 hours. If insulin administration is needed, it is safer and more practical to administer feeding continuously over 24 hours

• Blood glucose level should be monitored a minimum of every 4 hours for 48 hours, aiming for less than 10mmol/L. Twice daily thereafter, unless otherwise indicated. If blood glucose level is > 10mmol/L commence a sliding scale insulin regime.

• If the feed is stopped for a procedure or for any period of time, continue to monitor blood glucose levels and review the insulin regime.

• Effort should be taken to minimise the time period the patient is kept nil by mouth for diagnostic tests and procedures to prevent inadequate delivery of nutrients and prolonged periods of ileus.

• Check the serum sodium levels & if >145mmol/l look for possible causes e.g dehydration, high sodium content in medication. If sodium level is above 150mmol/l, use low salt feeds.

• Additional fluids may be required. Flush NG tube with 30-50mls sterile water before & after feeds and before and after any medication.

• Change the giving set of an open system every 24 hours and in a closed system, 24-48 hours or as per manufacturer's guideline.
• Any signs of intolerance should be closely scrutinised as possible early signs of gut ischaemia (a rare complication occurring in <1%); signs to look for are,
  - Abdominal distension
  - Abdominal pain
  - Increasing nasogastric tube output or gastric residual volume
  - Decreased passage of stool & flatus
  - Hypoactive bowel sounds
  - Increasing metabolic acidosis and/or base deficit

Enteral feeding should not be stopped for gastric residual volumes <500 ml in the absence of other signs of intolerance.

**ESTABLISHING PARENTERAL NUTRITION IN ICU**

Consider whether parenteral nutrition (PN) is appropriate. **Do not start PN until enteral feeding has been tried for at least 5 days or unless it is contraindicated.**

**Indications for PN:**

• If enteral feeding is not feasible for 7 days
• If target EN was not achieved after 7 days, as supplemental to EN
• Should consider in patients who are malnourished or at risk of malnutrition and meet following criteria,\(^{(3)}\) (Appendix 1)
  - Inadequate or unsafe oral and/or enteral nutritional intake
  - Non-functional, inaccessible or perforated gastrointestinal tract
• If a patient is expected to undergo major upper GI surgery and EN is not feasible, PN should be started–
  - If the patient is malnourished, start PN 5-7 days prior to surgery & continue to post operative period
  - If the EN cannot be initiated before 7 days after surgery
For people who are not severely ill or injured, nor at risk of refeeding syndrome (Appendix 1) the suggested nutritional prescription for total intake should provide the following.

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energy</td>
<td>20-30 kcal/kg/day</td>
</tr>
<tr>
<td>Protein</td>
<td>1.2-1.5 g/kg/day (0.12-0.24g Nitrogen/kg/d)</td>
</tr>
<tr>
<td>Fluids</td>
<td>30-35 ml/kg/day</td>
</tr>
<tr>
<td>Vitamin B</td>
<td>100-300mg/day for 3 days if patient is alcohol dependant</td>
</tr>
<tr>
<td>Multivitamin/Trace elements</td>
<td>Once daily - in appropriate doses</td>
</tr>
<tr>
<td>K+*</td>
<td>1-2 mmol/kg/day</td>
</tr>
<tr>
<td>Phosphates*</td>
<td>0.3-0.6mmol/kg/d</td>
</tr>
<tr>
<td>Mg++*</td>
<td>0.2 mmol/kg/day</td>
</tr>
</tbody>
</table>

*should be guided by the serum level

Table 2

not available in SL at the time of publication of this guideline
### CALCULATION OF PARENTERAL NUTRITION FOR A 70 kg PATIENT

1. **CALCULATE ENERGY REQUIREMENT**

   20-30 kcal/kg/d*

   *Eg: 70 x 30 = 2100 kcal/d

   *refer appendix 3 for the most appropriate daily requirement for the patient

2. **CALCULATE CARBOHYDRATE**

   CARBOHYDRATE = 50 - 55% (minimum of 2g/kg/day)^7; 2100 x 50% = 1150 kcal

   Carbohydrate 1g produces 4 kcal

   50% dextrose contains 500g in 1000ml; i.e. 1ml = 0.5g

   Daily 50% dextrose requirement = (1150 ÷ 4) ÷ 0.5 = 575 ml

3. **CALCULATE FAT**

   About 30% of calories to be supplied by fat

   *Eg: 2100 x 30% = 630 kcal

   1g of fat produces 9 kcal

   10% Lipofundin contains 100g of lipids in 1000ml; 1ml = 0.1g

   Daily 10% Lipofundin requirement = (630 ÷ 9) ÷ 0.1 = 700 ml

   Consider Energy provided by Propofol; 10% Propofol provides 1.1kcal/ml as fat

4. **CALCULATE PROTEIN REQUIREMENT**

   1.2–1.5g protein per kg per day;
   1.2x70=84g

   10% aminoplasmin contain 100g of protein per 1000ml; 1ml=0.1g

   Daily 10% aminoplasmin requirement= (1.2x70)÷0.1 = 840 ml

5. **FLUID REQUIREMENT**

   30-35ml/kg/day

   = 35 x 70 = 2450 ml/day

   Consider the volume of fluid given as infusions

   **MINERALS** *(Refer page 14)*

<table>
<thead>
<tr>
<th>Daily requirement/kg</th>
<th>For a 70kg adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>K⁺</td>
<td>1-2 mmol</td>
</tr>
<tr>
<td>Mg⁺⁺</td>
<td>0.2 mmol</td>
</tr>
<tr>
<td>Phosphates</td>
<td>0.3-0.6 mmol</td>
</tr>
</tbody>
</table>

   *Should be guided by the monitoring of serum level*

**FINAL PRESCRIPTION FOR 24 HOURS**

- 10% Lipofundin - 630 ml
- 50% Dextrose - 575 ml
- 10% Aminoplasmin - 700ml
- KCl - 140 mmol
- MgSO4 - 14 mmol
- the balance fluid requirement to be prescribed as an appropriate intravenous fluid
Electrolyte/ vitamin & mineral requirements

Providing **micronutrients** (Glutamine/ Fish Oil/Anti-oxidants) as well as including full range of **trace elements & vitamins** is an integral part of nutritional support.

Thiamine & Vitamin C deficits pose special risks. Thiamine supplements (100-300mg/daily) should be provided in the first three days to patients with possible deficiency and for patients with alcohol abuse as thiamine deficiency is more common among the critically ill.

**Practice Recommendations for Parenteral Feeding:**

**Access for Parenteral Nutrition**

Centrally administered PN could be via a centrally placed (internal jugular vein or subclavian vein) or peripherally placed (PICC) central venous catheter and a lumen should be dedicated in a multilumen catheter. Femoral CVC should be avoided as the risk of infection is higher with them. Tunnelling of subclavian catheter or a PICC is recommended if PN is likely to be needed for a long term (> 30 days).

Administration via peripheral venous catheter may be done in patients who need short term PN and those who have no other need for a central line. The mixture should be of low osmolarity (<850 mOsm/l). But viscid solutions like lipid emulsions cannot be given peripherally. Though not available in the state sector, there are commercially available preparations for peripheral PN.

**Mode of delivery**

Continuous administration of PN should be used as a preferred method of infusion in severely ill patient who require PN.

Cyclical delivery of PN should be considered when using a peripheral venous cannula.
### Monitoring

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>DAILY</th>
<th>THRICE A WEEK</th>
<th>WEEKLY</th>
<th>PRN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>Initially</td>
<td></td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Catheter site</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Glucose</td>
<td>Initially</td>
<td>✔️</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrolytes</td>
<td>Initially</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( PO_4^- ) /( Mg^{++} )/( Ca^{++} )/BUN/Cr</td>
<td>Initially</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Triglycerides</td>
<td>✔️</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Total Bilirubin/ LFT</td>
<td>Initially</td>
<td>✔️</td>
<td>✔️</td>
<td></td>
</tr>
<tr>
<td>Temperature</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FBC</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hb/HCT</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lymphocyte count</td>
<td>✓</td>
<td></td>
<td>✔️</td>
<td></td>
</tr>
</tbody>
</table>

- **Complications:**
  - GI tract related (fatty liver/cholestasis/GI atrophy/Refeeding syndrome)
  - Vascular access related (catheter related sepsis)
  - Metabolic (hyper & hypoglycaemia/electrolyte imbalances/pre-renal azotemia)
  - Fluid overload

- Highlight the start of each 24 hour feed period.
- Giving sets must be clearly labelled (date & time) and changed every 24 hours.
- Check the expiry date of the parenteral feed being delivered.
- Monitor blood glucose levels. Aim for <10mmol/L blood glucose levels.
- If the feed is stopped for a procedure or for any period of time please continue to monitor blood glucose levels & review insulin regime.
- In a patient stabilised on PN, periodically repeated efforts should be made to initiate EN. As tolerance improves, volume of EN calories should be increased and PN calories supplied decreased.
NUTRITION GUIDE IN SPECIAL CIRCUMSTANCES

Pulmonary Failure

- Speciality high lipid low carbohydrate formulations designed to manipulate the respiratory quotient and reduce CO\textsubscript{2} production is not recommended for routine use in ICU patients with acute respiratory failure.
- Avoid total caloric provision that exceeds energy requirements, as CO\textsubscript{2} production increases significantly with lipogenesis.
- Fluid restricted calorically dense formulations should be considered for patients with acute respiratory failure.\textsuperscript{(8)}

Renal Failure

- Should be placed on standard enteral formulations, and standard ICU recommendations for protein and calorie provisions should be followed. If significant electrolyte abnormalities exist or develop, a speciality formulation designed for renal failure may be considered. ie. Speciality formulations lower in certain electrolytes than standard products may be beneficial in the ICU patient with ARF.
- Patients receiving haemodialysis or continuous renal replacement therapy should receive increased protein, up to a maximum of 2.5g/kg/day.\textsuperscript{(8)}

Hepatic Failure

- Traditional assessment tools should be used with caution in patients with cirrhosis and hepatic failure, as these tools are less accurate and less reliable due to complications.
- Energy needs in critically ill patients with liver disease are highly variable and are difficult to predict by simple equations.
- EN is the preferred route of nutrition therapy in ICU patients with acute / chronic liver disease. EN improves nutrition status, reduces complications, and prolongs survival in liver disease patients and recommended as the optimal route of nutrient delivery.
- Protein should not be restricted as a management strategy to reduce risk of developing hepatic encephalopathy. Protein requirements for the patient with hepatic failure should be determined in the same manner as for the general ICU patients.
Branched chain amino acid formulations should be reserved for the rare encephalopathic patient who is refractory to standard treatment with luminal acting antibiotics and lactulose. (8)

**Pancreatitis**

- Patients with acute pancreatitis should be evaluated for disease severity on admission.
- Patients with severe acute pancreatitis should have a naso-enteric tube placed and EN initiated as soon as fluid volume resuscitation is completed. These patients have minimal chance of establishing oral feeds within 7 days.
- Patients with severe acute pancreatitis will have improved outcome when provided early EN. These patients may be fed enterally by the gastric or jejunal route.
- In patients with severe acute pancreatitis, tolerance to EN may be enhanced by
  - Early initiation of EN
  - Displacing the level of infusion of EN more distally in the GI tract
  - Changing the content of the EN delivered from intact protein to small peptides and fat free elemental formulation
  - Switching from bolus to continuous infusion
- For patients with severe acute pancreatitis when EN is not feasible, use of PN should be considered. PN should not be initiated until after the first 5 days of hospitalization, during which period EN should be attempted repeatedly. (8)

**Sepsis**

- Starting calculated amount of nutrition before haemodynamic stability may be harmful.
- In very severe sepsis, it is very difficult to determine,
  - benefit of very early EN
  - appropriate amount
  - nature of nitrogen supply
  - the risk benefit ratio of lipids
- Modern metabolic approach in septic patients,
  - Immune modulating enteral formulations used for appropriate patient populations (7)
  - prevention of gut failure in stress
Arginine and omega-3-fatty acids need further investigations

**Simple guideline**

- Restriction of energy supply both in carbohydrate and lipids - < 1000 kcal/day for 2-3 days.
- Cautious increase in nitrogen supply above 0.20g/kg/day
- Adequate supply of magnesium and phosphorous, trace elements – zinc, selenium, Vitamins – E & K

**Obese patient**

- In Critically ill obese patient, permissive underfeeding or hypocaloric feeding with enteral nutrition is recommended.
- For BMI >30, the goal should not exceed 60%-70% of the target energy requirements or 11-14 kcal/kg actual body weight per day (22-25 kcal/kg ideal body weight per day).
- Protein should be provided in a range of
  - ≥2g/kg ideal body weight per day for BMI 30-40
  - ≥2.5g/kg ideal body weight per day BMI ≥40

**Nutrition therapy in End of life situations**

- Specialised nutrition therapy is not obligatory in cases of end of life situations.
- Decision to provide nutrition therapy should be based on effective patient/family communication, realistic goals and respect for patient autonomy.
REFERENCES

2. NPSA: interim advice for health care staff; February 2005.
3. NICE guidelines on Nutrition support in adults; February 2006
5. ICU rapid resource: www.criticalcarenutrition
8. ASPEN Guideline for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of critical care medicine and American society for parenteral and enteral nutrition: http://pen.sagepub.com/content/33/3/277
Appendix 1

DEFINITIONS OF MALNOURISHED & AT RISK OF MALNUTRITION AND REFEEDING SYNDROME

Malnourished - defined by any of the following.
- A BMI of < 18.5Kg/m²
- Unintentional weight loss greater than 10% within the last 3-6 months
- A BMI of < 20Kg/m² and unintentional weight loss greater than 5% within the last 3-6 months

At risk of malnutrition, defined as those who have
- Eaten little or nothing for > 5 days or are likely to eat little or nothing for 5 days or longer
- A poor absorptive capacity and or high nutrient loss and/or increased nutritional needs from causes such as catabolism

REFEEDING SYNDROME

Chronically malnourished patients are at risk of refeeding syndrome and giving too much too soon to these patients can lead to
- Severe hypophosphotaemia
- Fluid balance abnormalities
- Hypokalaemia
- Hypomagnesaemia
- Altered glucose metabolism
- Vitamin deficiency

Patients at risk of developing refeeding problems
A.) Patients has one or more of the following
  - BMI < 16kg/m²
  - Unintentional weight loss >15% within the last 3-6 months
  - Little or no nutritional intake for > 10 days
  - Low level of potassium/ phosphate/magnesium prior to feeding

OR

B.) Patients have 2 or more of the following
  - BMI < 18.5kg/m²
  - Unintentional weight loss >10% within the last 3-6 months
  - Little or no nutritional intake for >5 days
  - History of alcohol abuse or drugs including insulin/chemotherapy/antacids & diuretics
Appendix 2

CALCULATION OF ENERGY & NUTRIENT REQUIREMENT

Consider energy provision from propofol, dextrose infusions etc when calculations are done.

- **Calculation of Energy Requirement**
  1. Indirect calorimetry – less practical in ICUs
  2. Harris Benedict formulae (may be less accurate in ICU patients) – Resting energy expenditure (REE)

<table>
<thead>
<tr>
<th></th>
<th>REE Rate in kcal/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>$66.5 + (13.7 \times W) + (5 \times H) - (6.8 \times A)$</td>
</tr>
<tr>
<td>Women</td>
<td>$655 + (9.6 \times W) + (1.7 \times H) - (4.7 \times A)$</td>
</tr>
</tbody>
</table>

- W- weight in kg  
- H- height in cm  
- A- age in years

REE needs to be multiplied by the stress level

<table>
<thead>
<tr>
<th>Stress Level</th>
<th>Multiplication factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgery</td>
<td>1.2</td>
</tr>
<tr>
<td>Starvation</td>
<td>0.85</td>
</tr>
<tr>
<td>Trauma</td>
<td>1.35</td>
</tr>
<tr>
<td>Sepsis</td>
<td>1.6</td>
</tr>
<tr>
<td>Severe Burn</td>
<td>2.1</td>
</tr>
</tbody>
</table>

3. In ventilated critically ill patients – **Faisy equation**

\[
\text{Energy Expenditure (kJ/day)} = (8 \times W) + (15 \times H) + (32 \times MV) + (94 \times BT) - 4834
\]

- MV = Minute Ventilation in l/min
- BT = Body Temperature in centigrades
- 1 kcal = 4.184KJ

In practice, a pragmatic estimation of energy requirements:

= 20-30 kcal/kg/day

10% added energy needs for every degree above >37C

- **Nitrogen (N) balance**
  - N Balance = (protein intake (g) /day /6.25) – (urinary N g/day) + (skin & stool loss g/day)
  - Skin & stool loss = 2- 4 g/day
  - Urinary N = (urinary urea (g/24hrs) / 2.14) + 2 to 4g. (*Urinary N should be measured in a 24hr urine collection but in emergency a 4 hour collection may suffice. Exact determination of the duration and volume of the urine collection is crucial for accurate calculation of N balance*)
PLACEMENT OF A NASOGASTRIC OR OROGASTRIC FEEDING TUBE

- Explain the procedure to the patient if conscious
- **Always use a radio opaque tubes in ICU patients (if available)**
- Orogastric tubes are preferred for patients with head or maxillofacial injury
- Mark the tube at a distance equal to that from xiphisternum to the nose via the ear lobe (50-60cm)
- Lubricate the tube externally with gel or water
- Check nasal patency (if possible) by “sniff” with each nostril occluded in turn. Clear nostril can be sprayed with lignocaine to minimize discomfort
- Sit patient upright with the head level. Slide tube gently backwards along the floor of the clear nostril until visible at the back of the pharynx (10-15cm)
- If the patient is co-operative, ask them to take a mouthful of water & then advance the tube (5-10cm) as they swallow
- Repeat the water swallow/advance until the preset mark on the tube reaches the nostril
- Withdraw the tube at any stage if the patient is distressed/coughing or cyanosed
- If there is difficulty in passing the tube, ask the patient to tilt the head forwards or turn it to one side. Never push the tube against resistance
- Check position of the NG tube
  - i) pH testing - pH 5.5 or less (if PH testing strips are available)
  - ii) X-ray –
  - iii) checking the position of the tube by injecting air through it & listening for bubbles with a stethoscope is unreliable(2)
- Documentation – Size of the tube
  - Length at entry/ length from entry point to end of the tube (external tube length)
  - Method/s used to confirm the position
- Check & document pH & external tube length, at least twice per 24 hours and if continuous feeds are being given, during the rest period.
### Appendix 4

**PROXIMATE ENERGY & NUTRIENT CONTENTS OF COMMON FOOD ITEMS USED IN SRI LANKA**

(Amounts are per 100g of edible portion)

<table>
<thead>
<tr>
<th>Name of foodstuff</th>
<th>Energy (Kcal)</th>
<th>Protein (g)</th>
<th>Carbohydrate (g)</th>
<th>Fat (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cereals</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rice, parboiled</td>
<td>349</td>
<td>8.5</td>
<td>77.4</td>
<td>0.6</td>
</tr>
<tr>
<td>Whole grain</td>
<td>346</td>
<td>11.8</td>
<td>71.2</td>
<td>1.5</td>
</tr>
<tr>
<td>Wheat flour</td>
<td>341</td>
<td>12.1</td>
<td>69.4</td>
<td>1.7</td>
</tr>
<tr>
<td><strong>Roots &amp; Tubers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Onion, Red</td>
<td>59</td>
<td>1.8</td>
<td>12.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Onion, Bombay</td>
<td>50</td>
<td>1.2</td>
<td>11.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Potato</td>
<td>97</td>
<td>1.6</td>
<td>22.6</td>
<td>0.1</td>
</tr>
<tr>
<td><strong>Pulses &amp; Legumes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cowpea</td>
<td>328</td>
<td>24.1</td>
<td>54.5</td>
<td>1.0</td>
</tr>
<tr>
<td>Dhal, Red</td>
<td>348</td>
<td>25.1</td>
<td>59.0</td>
<td>0.7</td>
</tr>
<tr>
<td>Dhal, Yellow</td>
<td>385</td>
<td>22.3</td>
<td>57.6</td>
<td>1.7</td>
</tr>
<tr>
<td>Soybean</td>
<td>482</td>
<td>43.2</td>
<td>20.9</td>
<td>19.5</td>
</tr>
<tr>
<td><strong>Leafy Vegetables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cabbage</td>
<td>27</td>
<td>1.8</td>
<td>4.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Carrot leaves</td>
<td>77</td>
<td>5.1</td>
<td>18.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Gotukola</td>
<td>37</td>
<td>2.1</td>
<td>6.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Kankun</td>
<td>28</td>
<td>2.9</td>
<td>3.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Mukunuwanna</td>
<td>73</td>
<td>5.0</td>
<td>11.6</td>
<td>0.7</td>
</tr>
<tr>
<td>Lettuce</td>
<td>21</td>
<td>2.1</td>
<td>2.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Kola Gova</td>
<td>48</td>
<td>5.1</td>
<td>5.9</td>
<td>0.4</td>
</tr>
<tr>
<td>Spinach</td>
<td>26</td>
<td>2.0</td>
<td>2.9</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>Vegetable/fruits</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breadfruit</td>
<td>113</td>
<td>1.5</td>
<td>26.0</td>
<td>0.4</td>
</tr>
<tr>
<td>Brinjal</td>
<td>24</td>
<td>1.4</td>
<td>4.0</td>
<td>0.3</td>
</tr>
<tr>
<td>Mango</td>
<td>44</td>
<td>0.7</td>
<td>10.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Fruit</td>
<td>Calories</td>
<td>Protein</td>
<td>Fat</td>
<td>Carbohydrates</td>
</tr>
<tr>
<td>------------------------</td>
<td>----------</td>
<td>---------</td>
<td>-----</td>
<td>---------------</td>
</tr>
<tr>
<td>Papaya</td>
<td>27</td>
<td>0.7</td>
<td>5.7</td>
<td>0.2</td>
</tr>
<tr>
<td>Pumpkin</td>
<td>25</td>
<td>1.4</td>
<td>4.6</td>
<td>0.1</td>
</tr>
<tr>
<td>Ripe Tomato</td>
<td>20</td>
<td>0.9</td>
<td>3.6</td>
<td>0.2</td>
</tr>
<tr>
<td>Apple</td>
<td>59</td>
<td>0.2</td>
<td>18.4</td>
<td>0.5</td>
</tr>
<tr>
<td>Avocado Pear</td>
<td>215</td>
<td>1.7</td>
<td>0.8</td>
<td>22.8</td>
</tr>
<tr>
<td>Banana, ripe</td>
<td>116</td>
<td>1.2</td>
<td>27.2</td>
<td>0.8</td>
</tr>
<tr>
<td>Grapes, blue</td>
<td>58</td>
<td>0.6</td>
<td>13.1</td>
<td>0.4</td>
</tr>
<tr>
<td>Grapes, pale green</td>
<td>71</td>
<td>0.5</td>
<td>16.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Guava</td>
<td>51</td>
<td>0.9</td>
<td>11.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Lemon</td>
<td>57</td>
<td>1.0</td>
<td>11.1</td>
<td>0.9</td>
</tr>
<tr>
<td>Lime</td>
<td>59</td>
<td>1.5</td>
<td>10.9</td>
<td>1.0</td>
</tr>
<tr>
<td>Mango, ripe</td>
<td>74</td>
<td>0.6</td>
<td>16.9</td>
<td>0.4</td>
</tr>
<tr>
<td>Orange juice</td>
<td>9</td>
<td>0.2</td>
<td>1.9</td>
<td>0.1</td>
</tr>
<tr>
<td>Papaya, ripe</td>
<td>32</td>
<td>0.6</td>
<td>7.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Passion fruit</td>
<td>54</td>
<td>0.9</td>
<td>12.4</td>
<td>0.1</td>
</tr>
<tr>
<td>Pineapple</td>
<td>46</td>
<td>0.4</td>
<td>10.8</td>
<td>0.1</td>
</tr>
<tr>
<td>Wood apple</td>
<td>134</td>
<td>7.1</td>
<td>18.1</td>
<td>3.7</td>
</tr>
</tbody>
</table>

**Milk & Milk Products**

<table>
<thead>
<tr>
<th>Product</th>
<th>Calories</th>
<th>Protein</th>
<th>Fat</th>
<th>Carbohydrates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk, Buffalo</td>
<td>117</td>
<td>4.3</td>
<td>5.0</td>
<td>8.8</td>
</tr>
<tr>
<td>Milk, Cow's</td>
<td>67</td>
<td>3.2</td>
<td>4.4</td>
<td>4.1</td>
</tr>
<tr>
<td>Milk, powdered, whole, cow's</td>
<td>496</td>
<td>25.8</td>
<td>38.0</td>
<td>26.7</td>
</tr>
<tr>
<td>Butter</td>
<td>729</td>
<td>---</td>
<td>---</td>
<td>81</td>
</tr>
<tr>
<td>Cheese</td>
<td>348</td>
<td>24.1</td>
<td>6.8</td>
<td>25.1</td>
</tr>
<tr>
<td>Curd</td>
<td>60</td>
<td>8.1</td>
<td>3.0</td>
<td>4.0</td>
</tr>
<tr>
<td>Ice cream</td>
<td>140</td>
<td>4.0</td>
<td>28.8</td>
<td>3.5</td>
</tr>
<tr>
<td>Yoghurt</td>
<td>90</td>
<td>3.6</td>
<td>17.6</td>
<td>0.8</td>
</tr>
</tbody>
</table>

**Fish & other sea foods**

<table>
<thead>
<tr>
<th>Product</th>
<th>Calories</th>
<th>Protein</th>
<th>Fat</th>
<th>Carbohydrates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anguluva</td>
<td>91</td>
<td>19.3</td>
<td>---</td>
<td>1.0</td>
</tr>
<tr>
<td>Atavalla</td>
<td>121</td>
<td>20.0</td>
<td>---</td>
<td>4.2</td>
</tr>
<tr>
<td>Balaya</td>
<td>105</td>
<td>21.0</td>
<td>---</td>
<td>2.0</td>
</tr>
<tr>
<td>Halmassa, fresh</td>
<td>164</td>
<td>19.3</td>
<td>0.2</td>
<td>9.6</td>
</tr>
<tr>
<td>Halmassa, dried</td>
<td>408</td>
<td>48.1</td>
<td>0.3</td>
<td>23.9</td>
</tr>
<tr>
<td></td>
<td>Value 1</td>
<td>Value 2</td>
<td>Value 3</td>
<td>Value 4</td>
</tr>
<tr>
<td>----------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Kiri Mora</td>
<td>112</td>
<td>18.0</td>
<td>---</td>
<td>4.0</td>
</tr>
</tbody>
</table>

**Meat & Poultry**

<table>
<thead>
<tr>
<th></th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>Value 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>262</td>
<td>10.0</td>
<td>---</td>
<td>14.0</td>
</tr>
<tr>
<td>Goat liver</td>
<td>107</td>
<td>20.0</td>
<td>---</td>
<td>3.0</td>
</tr>
<tr>
<td>Goat meat</td>
<td>118</td>
<td>21.4</td>
<td>---</td>
<td>3.6</td>
</tr>
<tr>
<td>Turkey</td>
<td>268</td>
<td>20.1</td>
<td>---</td>
<td>20.2</td>
</tr>
<tr>
<td>Egg, hen</td>
<td>178</td>
<td>13.3</td>
<td>---</td>
<td>13.8</td>
</tr>
<tr>
<td>Egg white, hen</td>
<td>52</td>
<td>10.7</td>
<td>1.1</td>
<td>0.2</td>
</tr>
<tr>
<td>Egg yolk, hen</td>
<td>336</td>
<td>16.8</td>
<td>---</td>
<td>29.0</td>
</tr>
</tbody>
</table>

**Fats & Oil**

<table>
<thead>
<tr>
<th></th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>Value 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coconut milk</td>
<td>430</td>
<td>3.4</td>
<td>11.9</td>
<td>41.0</td>
</tr>
<tr>
<td>Coconut oil</td>
<td>883</td>
<td>---</td>
<td>---</td>
<td>99.9</td>
</tr>
<tr>
<td>Cod liver oil</td>
<td>930</td>
<td>---</td>
<td>---</td>
<td>90.9</td>
</tr>
<tr>
<td>Ghee, cow</td>
<td>900</td>
<td>---</td>
<td>---</td>
<td>100.0</td>
</tr>
<tr>
<td>Margarine</td>
<td>70.5</td>
<td>---</td>
<td>---</td>
<td>85.0</td>
</tr>
<tr>
<td>Olive oil</td>
<td>980</td>
<td>---</td>
<td>---</td>
<td>99.9</td>
</tr>
<tr>
<td>Soybean oil</td>
<td>883</td>
<td>---</td>
<td>---</td>
<td>99.9</td>
</tr>
</tbody>
</table>

**Miscellaneous**

<table>
<thead>
<tr>
<th></th>
<th>Value 1</th>
<th>Value 2</th>
<th>Value 3</th>
<th>Value 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bee’s honey</td>
<td>319</td>
<td>0.3</td>
<td>79.5</td>
<td>---</td>
</tr>
<tr>
<td>Jaggery (cane)</td>
<td>383</td>
<td>0.4</td>
<td>95.0</td>
<td>0.1</td>
</tr>
<tr>
<td>Jaggery (coconut)</td>
<td>340</td>
<td>1.0</td>
<td>83.5</td>
<td>0.2</td>
</tr>
<tr>
<td>Jam</td>
<td>260</td>
<td>0.4</td>
<td>69.0</td>
<td>---</td>
</tr>
<tr>
<td>Sugar (brown)</td>
<td>389</td>
<td>0.2</td>
<td>97.0</td>
<td>---</td>
</tr>
<tr>
<td>Sugar (white)</td>
<td>400</td>
<td>---</td>
<td>100.0</td>
<td>---</td>
</tr>
<tr>
<td>Leaves dried (Tea)</td>
<td>293</td>
<td>24.5</td>
<td>58.8</td>
<td>2.8</td>
</tr>
</tbody>
</table>

**References**

