NATIONAL ENTERAL NUTRITION PRACTICE

GUIDELINES FOR ADULTS

health
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Directorate: Nutrition
national Department of Health
Private Bag X828
Pretoria
0001
Tel: (012) 395 9621
Fax: 086 632 8484
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www.health.gov.za

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MP MATSOSO
DIRECTOR GENERAL: HEALTH

ACRONYMS

ABW	actual body weight
ALI	acute lung injury
ARDS	acute respiratory distress syndrome
ARF	acute renal failure
ATI	abdominal trauma index
BEE	basal energy expenditure
BCAA	branched chain amino acid
BMI	body mass index
BMR	basal metabolic rate
BW	body weight
CHO	carbohydrate
COAD	chronic obstructive airway disease
COPD	chronic obstructive pulmonary disease
CRF	chronic renal failure
CRP	c - reactive protein
CRRT	chronic renal replacement therapy
CVI	cerebrovascular incident
CVP	central venous pressure
DM	diabetes mellitus
DRI	dietary reference intake
Ecg	electrocardiogram
EN	enteral nutrition
FR	French
GFR	glomerular filtration rate
GI	gastrointestinal
GIT	gastrointestinal tract
GL	glycaemic load
GRV	gastric residual volume
HACCP	hazards analysis and critical control points
HD	haemodialysis
HOB	head of bed
IBD	inflammatory bowel disease
IBW	ideal body weight
ICU	intensive care unit
IHD	ischemic heart disease
ISS	injury severity score
IU	international unit
IV	intravenous
IVF	intravenous fluid
KCL	potassium chloride
Kcal	kilocalories
LFT	liver function test
MCT	medium chain triglyceride
MODS	multiple organ dysfunction syndrome
MOF	multi-organ failure
MSG	monosodium-l glutamate
MVO_2	myocardial oxygen consumption
MUFA	mono-unsaturated fatty acids
Ω-3 FA	omega-3 fatty acid
NCJ	needle catheter jejunostomy
NGT	nasogastric tube
NJT	nasojejunal tube
NPE	non-protein energy
NPO	nil per os
PEG	percutaneous endoscopic gastrostomy
PH	potential hydrogen
PMV	prolonged mechanical ventilation (>21 days for at least six hours per day)
PN	parenteral nutrition
PO	post-operative
REE	resting energy expenditure
RNA	ribonucleic acid
RRT	renal replacement therapy
RV	residual volume
RQ	respiratory quotient
SCFAs	short chain fatty acids
SBS	short bowel syndrome
SOFA	sequential organ failure assessment
TB	tuberculosis

TBSA	total body surface area
TE	total energy
TEN	total enteral nutrition
TIBC	total iron binding capacity
TPN	total parenteral nutrition
U&E	urea and electrolytes
VAP	ventilator associated pneumonia
Vit B Co	vitamin B complex
VO^2	oxygen uptake
VCO^2	carbon dioxide production

1 Scope and purpose

The goal of this document is to provide guidelines and suggest practical strategies for the implementation of a successful enteral feeding regime in adult patients at public health facilities.

Enteral nutrition is defined as the administration of nutrients via the gastro-intestinal tract orally or by tube, catheter or stoma distal to the oral cavity. [1]

The method used for enteral feeding will be determined by the patient's adaptability and ability to tolerate the method of feeding as well as by the site of the damage to the gastro-intestinal tract. This is but one example of the application of medical nutrition therapy to improve patient health outcome, improve quality of life and reduce patient care costs. The prescription, composition, preparation and the method of administration requires special care.

The content of the guideline document focuses on assessing nutritional status, indications for the use of enteral feeding, contra-indications, nutritional requirements, formulating the enteral feeding regimen, handling of complications and monitoring and evaluation of enteral therapy.

2 Background and motivations

Historically, starvation was an accepted approach in the treatment of ill patients. However, currently it is said that providing adequate and appropriate fluid and nutrients to sick patients is a basic duty.[2] ``Adequate nutrition is a vital part of successful treatment, and should be sold as such``. [3]

Malnutrition is said to occur in about 15-70 per cent of hospital patients. In addition, malnutrition is often undiagnosed in about 70 per cent of patients admitted to hospital. It is of further concern that 70-80 per cent of admitted malnourished patients are discharged from hospital without receiving any nutritional support. A patient's disease state, coupled with the length of hospital stay further worsens malnutrition and is often associated with death. Weight loss during hospitalisation is mainly due to reduced food intake, malabsorption, modified metabolism, increased nutrient and energy requirements, lack of early nutritional assessment and treatment, medicine-nutrient interactions, mechanical reasons and the actual disease condition. Thus, nutritional status screening, assessment and monitoring is essential in reducing morbidity and mortality amongst hospitalised patients. [3]

A multidisciplinary approach in providing nutritional support is critical in ensuring effective assessment and treatment interventions. Active nutritional support programmes implemented by a nutritional support team can prevent malnutrition and weight loss. This support team consists of multi-disciplinary healthcare workers i.e. medical doctors, professional nurses and dietitians. The team to provide nutritional support may utilise different technical approaches, such as oral, enteral and parenteral nutrition, in a complementary fashion to one another. A registered dietitian with a competency in nutritional support is qualified to assume responsibility for the assessment, planning, implementing and monitoring of enteral, parenteral and specialised oral therapies associated with patient care. [4]

3 Nutritional assessment

Nutritional status assessment is the first step to ensure the successful outcome of enteral feeding.

A comprehensive nutritional assessment consists of a combination of the following methods:

3.1 Anthropometric methods

It is the measurement of the physical dimension and gross composition of the body. The methods include:

- height/ recumbent length/ knee height/ arm span/ demi span/ ulna length
  - actual body weight or ideal body weight
- mid-upper arm circumference
- skinfold thickness

Note: Ideal body weight must be adjusted downward to compensate for missing limbs or paralysis as outlined in **Table 1** below.

TABLE 1: Adjustment of desirable body weight for amputees [5]

Body segment	Average % of body weight
Lower arm and hand	2.3
Trunk with extremities	50.0
Entire arm	5.0
Hand	0.7
Entire lower leg	16.0
Below knee including foot	5.9
Foot	1.5

Estimated weight = $\frac{100 - \%\ \text{amputation}}{100} \times \text{IBW for original height}$

In case of presence of oedema and/or ascites: Use IBW for calculations.

3.2 Biochemical methods

It is measuring a nutrient or its metabolite in blood, faeces or urine or measuring a variety of other components in blood and other tissues that have a relationship to nutritional status. The methods include:

- serum protein
- liver function tests
- calcium, magnesium, phosphate test
- haemoglobin
- serum ferritin (iron levels)
- serum lipid and lipid profile levels
- general electrolytes
- urea and creatinine
- Total proteins
- glomerular filtration rate (GFR)
- c-reactive protein (CRP)
- glucose
- albumin (should not be used as an independent criterion)

3.3 Clinical methods

Include the detection of signs and symptoms that indicate malnutrition.

Methods include:

- medical history
- physical examination

3.4 Dietary methods if applicable [6]

Generally involve surveys measuring the quantity of the individual foods and beverages consumed during the course of one to several days or assessing the pattern of food use during the previous several months. These can provide data on intake of nutrients or specific classes of foods.

Methods include:

- 24-hour recall
- food record or diary
- food frequency questionnaire
- diet history

3.5 Medication

Find relevant medicines listed under **Annexure 1** of the document. Pay special attention to any medicines that may affect the gastrointestinal tract.

4 NUTRITIONAL INTERVENTION

4.1 MEDICAL NUTRITION THERAPY GOALS

4.1.1 Indications and contra-indications for the use of enteral tube feeding are indicated in **Table 2**.

TABLE 2: Indications and contra-indications for enteral feeding [7]

INDICATIONS	CONTRA-INDICATIONS
Decreased food intake: • Inability to consume sufficient food (< 80% of TE) • Neurological disorders, e.g. coma, meningitis, cardiovascular incident/episode (CVI) • Psychiatric conditions, e.g. severe depression, Anorexia Nervosa • Senility • Cachexia • Dysphagia (difficulty in swallowing) • Severe existing malnutrition • Anorexia	• Adequate oral intake (>80% of TE)
Mechanical GIT disorders: • Facial, mandible or dental injuries • Head, neck or mouth trauma or malignancy • Obstruction of the esophagus or upper duodenum • Severe stomatitis or mucosal damage (Stevens Johnson Syndrome or mucositis) • Delayed gastric emptying or short bowel syndrome (SBS) • Radiation to head and neck • Inability to swallow, coma • Incomplete bowel obstruction • Entero-cutaneous fistula with output (<500 ml per day)	• Complete intestinal obstruction (except if able to feed distal to the obstruction) • Intestinal perforation • High output fistula (> 500 ml per day)

Gastrointestinal dysfunction: • Inflammatory bowel disease (IBD) including ulcerative colities (UC) and Crohn's Disease • SBS • Pancreatitis • Abdominal radiation therapy • Some intestinal surgery • Impaired ability to digest and absorb nutrients/ malabsorption syndrome • Sprue, enteritis (e.g. radiation therapy, chemotherapy) • Non-specific diarrhoea associated with malnutrition • Biliary tract disease • Chronic vomiting and infectious intestinal diseases • Gastroparesis	• Upper GIT haemorrhage • Intractable vomiting and diarrhoea • Fresh uncertain anastomoses • Severe acute pancreatitis • Risk for aspiration (except if jejunostomy tube is in place for feeding) • Shock, haemodynamically unstable • Paralytic ileus
Hypermetabolic conditions: • Severe trauma • Septicaemia • Major surgery • Neurologic disorders e.g.multiple sclerosis • from TPN to normal food • Major burns • Ventilated patients • Cancer therapy and bone marrow transplantation	• Adequate food intake • Not haemodynamically stable

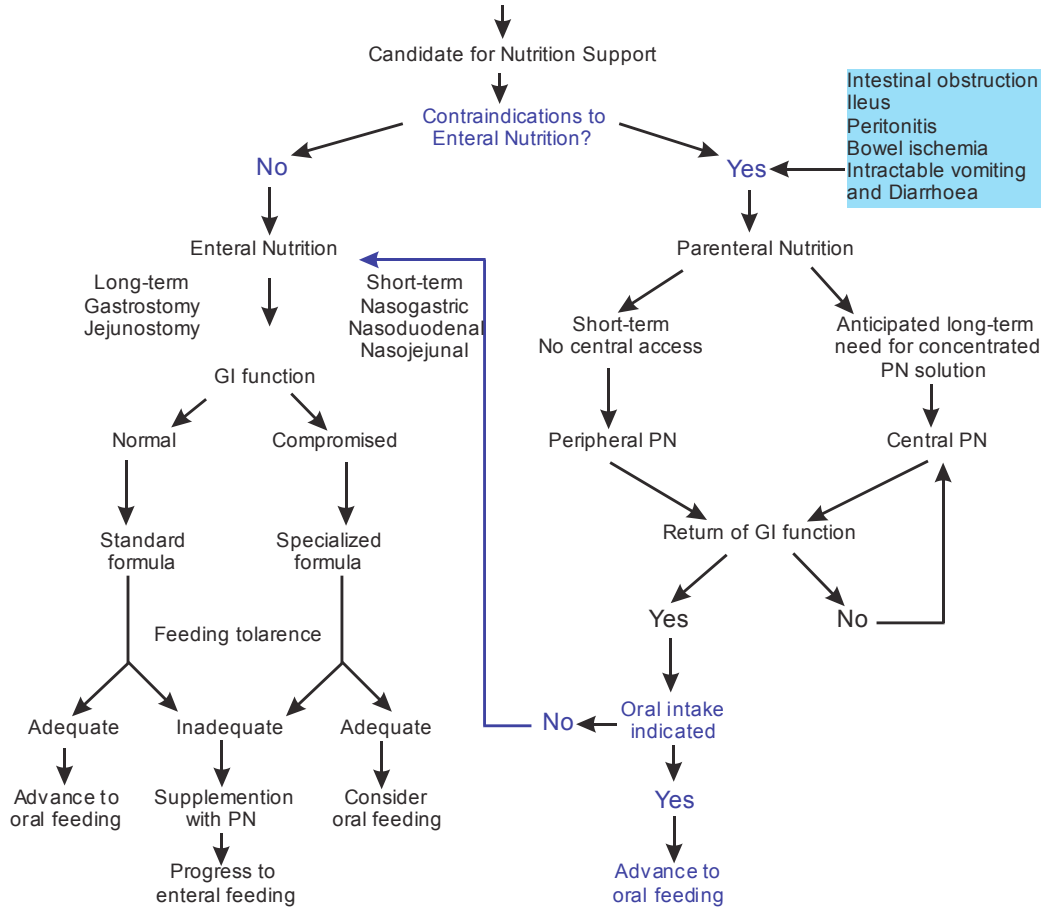
Adapted from Zaloga G.P. Timing and route of nutritional support. In: Zaloga G.P editors. Nutrition in Critical Care. St. Louis, M.O: Mosby; 1994;p. 267-330

Post-operative ileus is not a contraindication. Feeding directly into the small intestine with semi-elemental short-peptide formulas is recommended

N.B the above guidelines are relative and decisions should be based on individual presentations.

4.1.2 Enteral nutrition route of administration algorithm

FIGURE 1: Route of administration algorithm [8]:

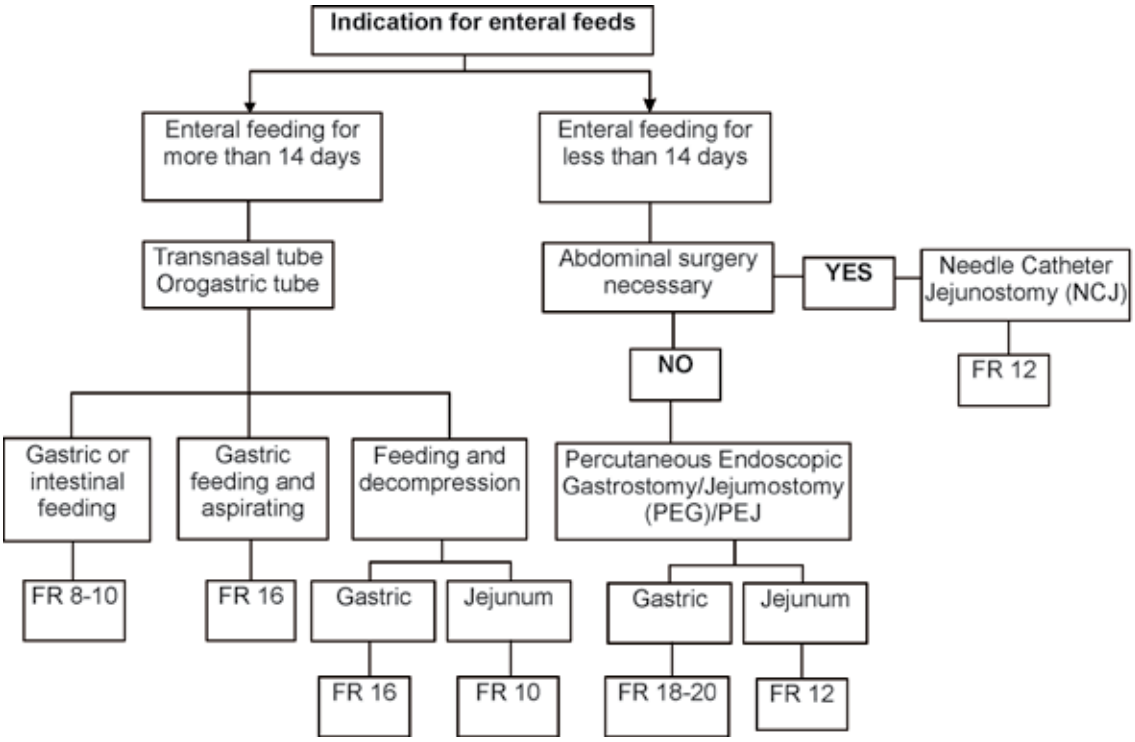


Indication for enteral feed

Adapted from: Ukleja A, Freeman KL, Gilbert K, Kochevar M, Kraft MD, Russel MK, Shuster MH, and Task Force on Standards for Nutrition Support: Adult hospitalized patients, and the American Society for Parenteral and Enteral Nutrition Board of Directors. Nutrition Clinical Practice 2010; 25: 403-414

4.1.2 Access routes

Figure 2: Access route algorithm [9]



Adapted from: European society of enteral and parenteral nutrition, 1998. ESPEN conference report. Nice, France: 16-19

Note: For further information on access routes refer to Annexure 1

4.1.3 Enteral Product Formulations [10]

Enteral products formulations are indicated in **Table 3**.

TABLE 3: Enteral product formulation definitions

Enteral product formulations	Definition
Standard formulas	Enteral formulas of which the composition reflects the reference values for macronutrients and micronutrients for a healthy individual. Most standard formulations contain whole or complete proteins, lipids and fibre. (Non-fibre compositions also exist)
Disease-specific formulas	These formulas include those with adapted macro- and micronutrient compositions to meet the needs of a specific disease (including digestive and metabolic disorders)
Immune modulating formulas (immunonutrition)	These formulas contain substrates to modulate immune functions
Low energy formulas	These formulas provide less than 0.9kcal/ml
Normal energy formulas	These formulas provide 0.9 – 1.2kcal/ml
High energy formulas	These formulas provide more than 1.2kcal/ml
High protein formulas	These formulas contain 20% or more of total energy from protein
Whole/complete protein formulas (polymeric)	These formulas contain intact proteins
Peptide-based formulas (oligomeric)	These formulas contain protein predominantly in peptide form
Free amino acid formulas (monomeric)	These formulas contain single amino acids as the protein source
High lipid formulas	These formulas contain more than 40% of total energy from lipids
High mono-unsaturated fatty acids (MUFA) formulas	These formulas contain 20% or more of total energy from MUFA

FIGURE 3: Diagram illustrating the method of choosing an enteral feed [11]

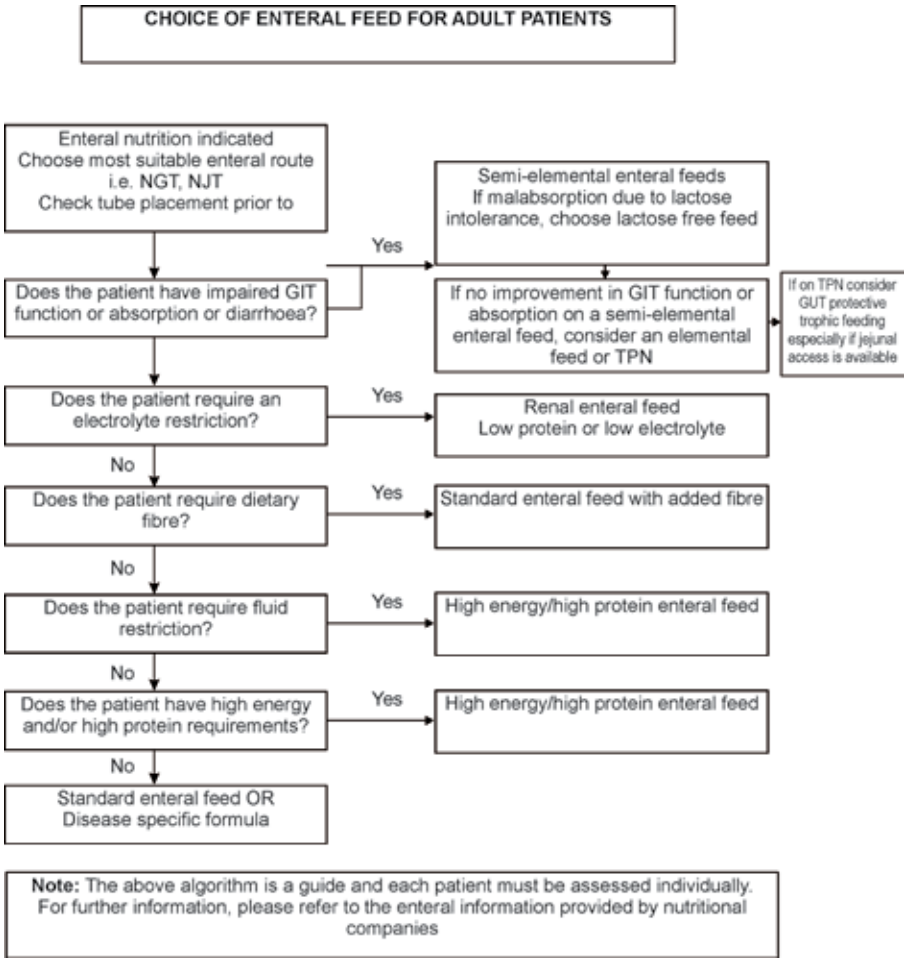
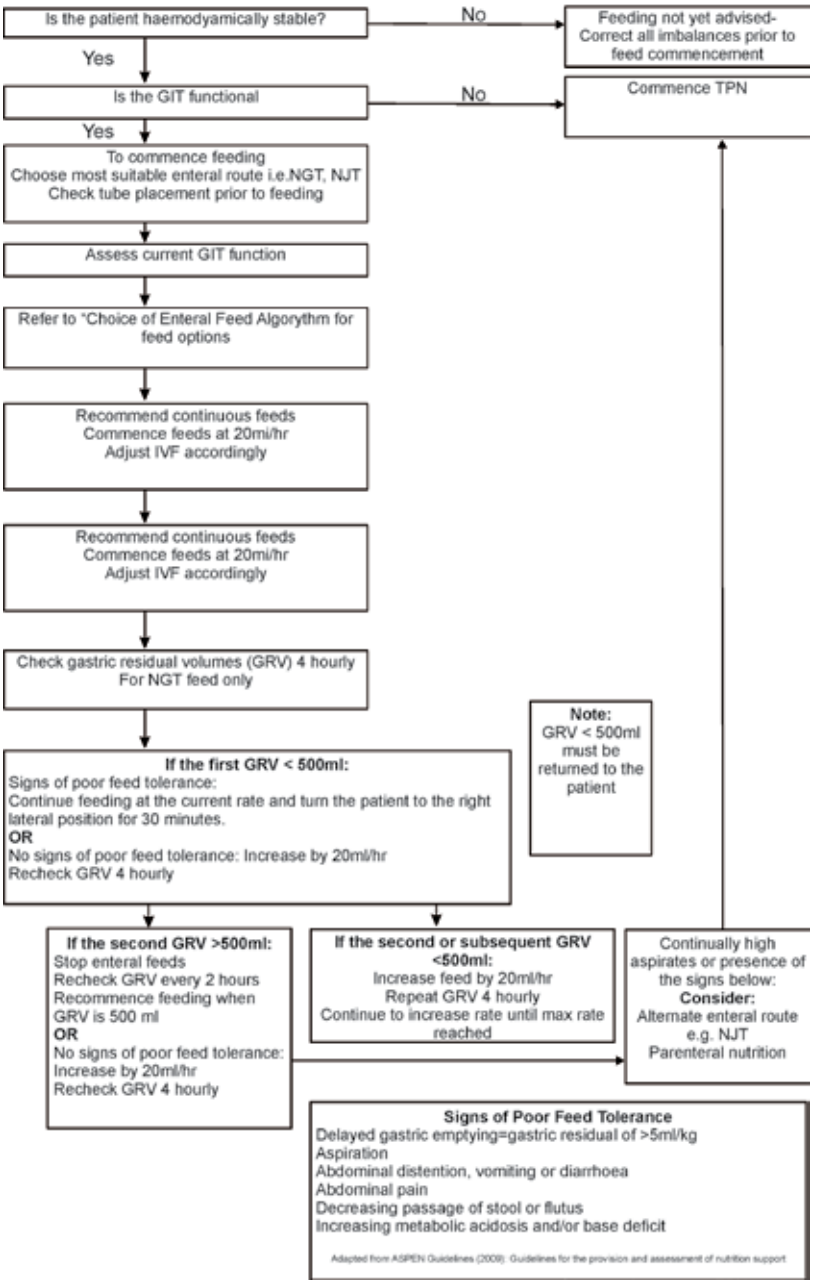


FIGURE 4: Diagram illustrating the initiation of enteral feeding [12,13]



4.1.4 Initiation of enteral feeding and risk of refeeding syndrome [14]

- Enteral delivery method, initiation and advancement of EN regimens should be based on patient condition, age, enteral route (gastric vs. small bowel), nutrition requirements, and GI status.
- Full strength, isotonic formulas for initial feeding regimen should be chosen.

The mnemonic "CAN WE FEED" can assist in planning an enteral feeding regime and initiate early enteral feeding. The following checklist could be used in an ICU setting (Refer to **Annexure 3**).

FIGURE 5: Gastric test feed guideline [15,16,17]

The following test guideline was developed by the enteral nutrition clinical working group and was found to be practically accepted for use at public health facilities.

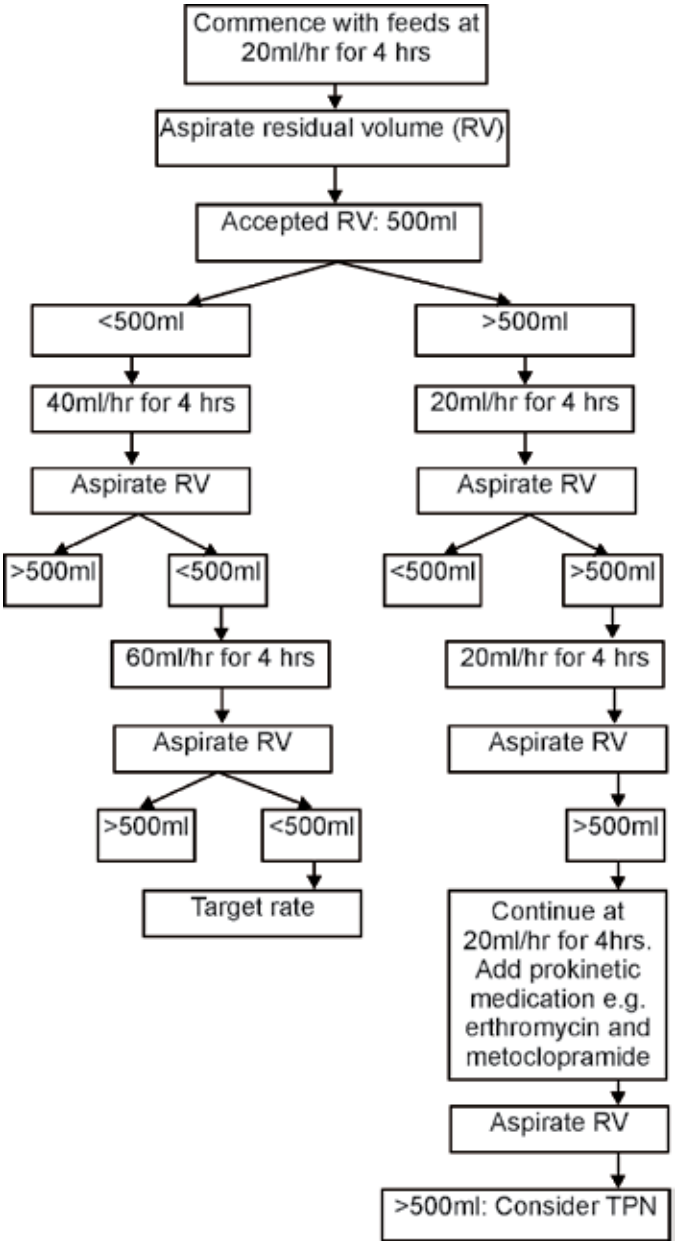
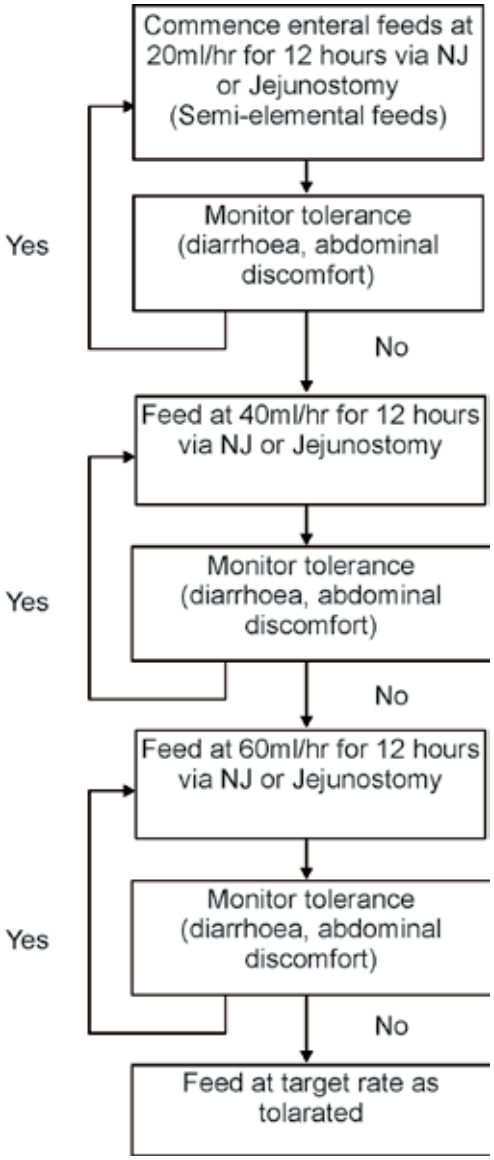


FIGURE 6: Small bowel test feed guideline [18]

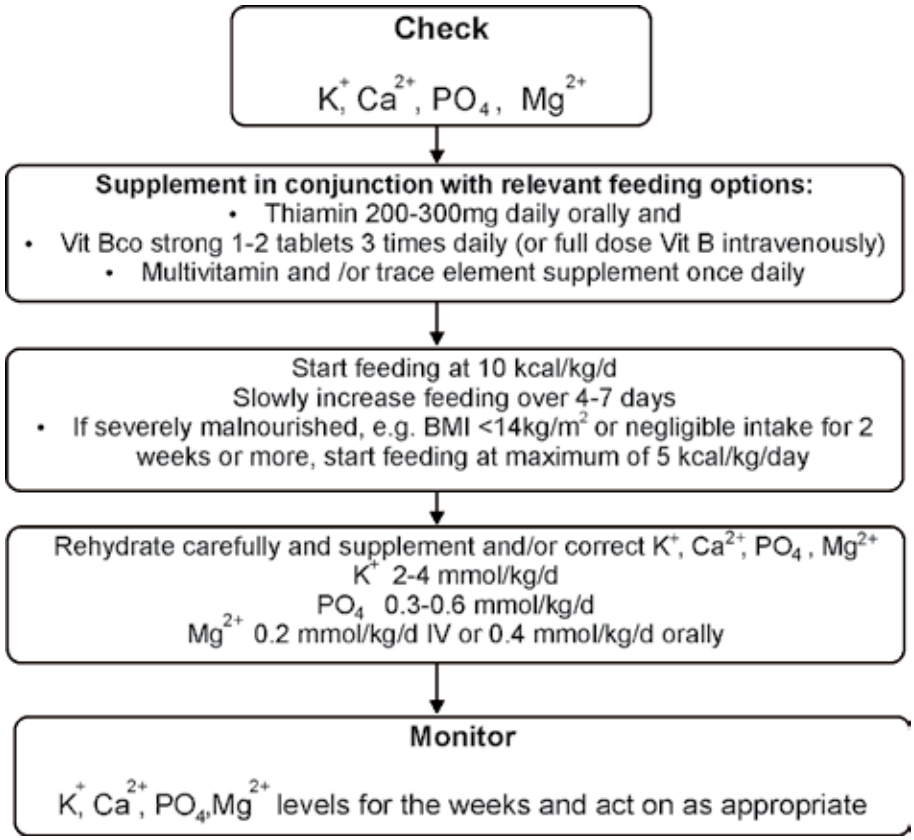
Small bowel feeding is associated with a reduction in pneumonia in critically ill patients when compared to gastric feeding. Thus, if feasible, it is recommended for use in patients with a high risk for intolerance to EN, risk for regurgitation, aspiration, patients that repeatedly demonstrate high gastric residuals.

The following test guideline was adopted and was found to be practically accepted for use at public health facilities.



NOTE: Should the target rate not be reached in 48 hours then supplemental TPN should be considered.

FIGURE 7: Prevention / management of refeeding syndrome [19]



Adapted from NICE and BAPEN guidelines. Mehanna H, Nankivell PC, Moledina J, Travis J. Head and Neck Oncology 2009; 1(4)

TABLE 4: Refeeding regime for patients at risk of refeeding syndrome [20]

Day	Calorie intake (all feeding routes)	Supplements
Day 1	-10 kCal/kg/day -For extreme cases (BMI < 14kg/m^2 or no food > 15 days): 5 kCal/kg/day -Carbohydrate: 50-60% -Fat: 30-40% -Protein: 15-20%	-Prophylactic supplement -PO_4^{2-}: 0.5-0.8mmol/kg/day -K^+: 1-3mmol/kg/day -Mg^{2+}: 0.3-0.4 mmol/kg/day -Na^+: <1 mmol/kg/day (restricted) -IV fluids: restricted, maintain "zero" balance -IV thiamine + vitamin B complex 30 minutes prior to feeding
Day 2-4	-Increase by 5 kCal/kg/day If low or no tolerance stop or keep minimal feeding regime	-Check all biochemistry and correct any abnormality -Thiamine and vitamin B complex orally or IV till day 3 -Monitoring as required
Day 5-7	-20-30 kCal/kg/day	-Check electrolytes, renal and liver functions and minerals -Fluid: maintain zero balance -Consider iron supplement from day 7
Day 8-10	-30 kCal/kg/day or increase to full requirement	-Monitor as required

4.1.5 Infusion methods

There are three types of feeding options that can be chosen from. These are bolus feeding, intermittent feeding and continuous feeding. See **Table 5** for a comparison of the feeding methods.

TABLE 5: Comparison of feeding methods [21,22]

BOLUS FEEDING	INTERMITTENT FEEDING	CONTINUOUS FEEDING
Description		
The intermittent, rapid feeding of large volumes of formula divided into six/eight regular daytime feedings administered 3 or 4 hourly	Continuous controlled delivery of a feed, by either gravity or pump-assisted method with a rest period of about 4-6 hours daily	Continuous controlled delivery of a feed over 24 hours without interruption, either by gravity or pump-assisted method
Volume/rate		
±250-350ml per feed, depending on requirements and tolerance	Usually between 50-125ml/hr	Usually between 50-125ml/hr
Special considerations/precautions		
Give special attention to minimising risk of bacterial contamination Consider alternative infusion method if very high quantities of feeds are required Monitor for vomiting and aspiration in prevention of ventilator associated pneumonia (VAP) and other complications	Monitor for vomiting and aspiration in prevention of VAP and other complications	Monitor for vomiting and aspiration in prevention of VAP and other complications

Note: Patients` heads should be elevated to at least 30 to 45 degrees during feeding to prevent micro-aspiration

4.1.6 Safety

Serious harm and death may occur due to adverse events occurring throughout the process of ordering, administering and monitoring. These include:

- enteral misconnections
- metabolic abnormalities
- broncho-pulmonary aspiration
- mechanical tube complications
- enteral access device misplacements
- GI intolerance related to formula contamination

Promoting patient safety in enterally fed patients is dependent on continuous surveillance and recognition of potential areas of harm and medical errors. **Table 6** provides information on safety measures that should be observed in relation to enteral nutrition.

TABLE: 6: Enteral nutrition related safety measures [14]

AREA	SAFETY MEASURES
Enteral nutrition formulas	• Clear and accurate labeling of formulas which include: – patient demographics – formula type – delivery site/device – administration method and rate – time and date the formula is prepared and hung – *"Not for IV use"* label to decrease risk of enteral misconnections • Prevent contamination in preparation/storage/administration: – implementation of quality control measures and corrective actions – critical points should be documented – use HACCP – controlled environment – aseptic techniques are essential – hand hygiene is very important – wash and use alcohol rub – if formulas are not used after preparation - **refrigerate** – unused open formulas must be **discarded** • Hang time: – **8 hours:** Sterile formula in OPEN system – **12 hours:** Sterile formula in OPEN system at home – **24 hours:** Sterile formula in CLOSED system – reconstituted formula should not be exposed to room temperature for longer than **4 hours** • Stability of the products: – important to maintain product integrity – conditions of storage and composition of container can influence stability, which includes: o light o temperature o oxygen exposure – degree of fatty acid oxidation increases with storage time – vitamin losses found in formulas stored > 9 months
Administration sets	• Flushes – recommended: **Water** – water to use: o tap water/bottled water - healthy, immune competent patients o purified water -acute or chronically ill patients o saline – flush feeding tubes with: o 30 ml of water every 4 hours during continuous feeding **or** o before and after intermittent feeding • Change administration sets every **24 hours** • Enteral misconnections – how to resolve problem: – colour-coded enteral set tips – luer adaptors – training staff to connect lines – trace line back to their origins to ensure safe insertion – label feeds: "WARNING for enteral use ONLY"
Enteral feeding pumps	• Periodic calibration is needed to ensure: – proper function – proper delivery within 10% of prescribed amount of formula • Calibration of pumps are done according to the manufacturing company's requirements
Patient	• Positioning: – head-of-bed at 30 - 45º to prevent aspiration and pneumonia but contraindicated when: o hemodynamically unstable o unstable spine o prone positioning o certain medical procedures – strategies to increase use of an elevated HOB position: o medical orders o staff education o reverse trendelenberg (head up) position • Maintenance considerations of feeding devices – useful methods to confirm tube placement: o determine external length of tube since time of placement o observing for negative pressure when attempting to withdraw fluid from the tube o observing unexpected changes in residual volume o measuring pH of feeding tube aspirates

4.2 DIETARY AND NUTRITIONAL RECOMMENDATIONS

4.2.1 Macronutrients

Macronutrient requirements of critically ill patients are reflected on **Table 7**.

TABLE 7: Macronutrient requirements of general critically ill patients [13,23,24]

Nutrient	Krause's	ASPEN	ESPEN
Energy: BMI <18.5			25–30 total kcal/kg ABW/day
Normal body weight	25 – 30 kal / IBW	25 – 30 kCal / kg (IBW)	Initial phase: 20-25kcal/kg/d (ABW) Recovery phase:25 – 30 kCal/kg (ABW)/d
Hypocaloric feeding (obese patient)	18 – 20 kCal /IBW	11-14 kCal/ kg (ABW)or 22 – 25 kCal/kg (IBW)	
Protein	0.8 – 2.0 g	BMI < 30: 1.2–2.0 g/kg (ABW) BMI 30-40: ≥2.0 g/kg (IBW) BMI >40: ≥2.5 g/kg (IBW)	Target of 1.5 g/kg 1.3-1.5g/kg (IBW)
Carbohydrates	60 – 70 % TE		
Fats	15 – 40 % TE		
Fluid	30-35ml/Kg	30-35ml/Kg	

4.2.2 Indirect calorimetry

Steps to improve accuracy in measuring indirect calorimetry:

- 30 minute bed rest prior to measuring
- TEN / TPN at same rate during measuring
- ventilator settings should not be changed 90 minutes before taking the measurement
- avoid anxiety in the patient
- try to avoid interruptions by healthcare professionals while measuring
- one reading takes about 30 minutes
- REE varies within 24 hours

TABLE 8: Interpreting RQ value of indirect calorimetry [25]

RQ VALUE	INTERPRETATION
>1	Hyperventilation Lipogenesis/overfeeding
1	CHO oxidation
0.85 (Optimal)	Mixed substrate oxidation Mixed diet
0.82	Protein oxidation
0.7	Fat oxidation/underfeeding
<0.7	Gluconeogenesis (muscle wasting)

4.2.3 Micro-nutrients

Current recommendations indicate that the daily administration of reference values for both vitamins and trace elements are adequate.

- *Electrolyte requirements:*

Electrolytes should be replaced according to the clinical situation. The following may however be used as a guideline per day:

- Sodium 1 – 2 mmol/kg
- Potassium 0,7 – 1mmol/kg
- Calcium 0,1mmol/kg
- Magnesium 0,1mmol/kg
- Phosphorous 0,4 mmol/kg [2]

It has been documented that vitamin and mineral requirements are increased in the following conditions: Stress (vitamins B2, B6, pantothenic acid, C and Zn); for an increased demand on the immune system function (vitamins A, D, E, B6, pantothenic acid; C and folic acid and Zn); during wound healing (vitamins A, B2, C and selenium); and for the prevention of free radical/ peroxidative injury (vitamins C and E). Many medicines have been shown to increase vitamin and mineral requirements. Varying degrees of mal-absorption must also be considered in the critically ill [2].

There are no specific guidelines for general enteral nutrition however, in specific circumstances **Table 9** can be used:

TABLE 9: Suggested enteral vitamin supplementation in the critically ill [26]

Vitamin	Recommendations for the uncomplicated critically ill patient
Vitamin A	25 000 IU
β Carotene	15 - 50 mg
Vitamin D	400 IU/day
Vitamin E	400 IU/day
Vitamin K	1,5 µg/kg/day
Vitamin B1	10 mg/day
Riboflavin	10 mg/day
Niacin	200 mg/day
Pantothenic Acid	100 mg/day
Vitamin B1	20 µg/day
Biotin	5 mg/day
Folic Acid	2 mg/day
Vitamin C	1 000 mg/day

TABLE 10: Suggested trace element supplementation in the critically ill [2]

Trace element	Recommendations for the enteral supplementation of the uncomplicated critically ill patient
Selenium	100 µg/day
Zinc	25 – 50 mg/day
Manganese	5 - 7 mg/kg/day
Chromium	> 50 – 200 µg /day
Molybdenum	0,2 – 0,5 mg/day

4.2.4 Pharmaconutrition

Immune-system enhancing nutrients are those that have been demonstrated to have measurable effects on the immune system. Of these the most important are:

- Arginine
- Omega-3 fatty acids
- Nucleotides

TABLE 11: Indications, contra-indications and recommended dosages of specialised nutrients [27,28,29,30,31,32,33,34,35]

Specialised nutrient	Indication	Recommendation
Arginine	• Should be considered in trauma and surgery patients to improve wound healing ***Contra-indications:*** ▪ Should be avoided in patients with systemic sepsis ▪ Should not be used in critically ill patients	• Although specific recommendations are not available, dosages of 20g per day have been proposed or 9% of the protein energy intake • Optimal levels is not yet determined, but dosages of 15 – 30g per day in enteral fed critically ill patients appears to be safe
Omega-3 fatty acids (Fish oils, borage oils and antioxidants)	• Omega-3 fatty acid supplementation recommended in patients with ALI and ARDS	• Doses of up to 5g per day of omega-3 fatty acids have been used in critically ill patients • Omega-6:Omega-3 ratio:2:1 to 4:1
Dietary fibre	Dietary fibre has many benefits in critical patient care. • It delays gastric emptying and small intestinal transit time. • Improves salt and water absorption. • Improves the integrity of the gut mucosa and increases intestinal bulk. • Dietary fibre also absorbs carcinogens, modifies bile salt secretion and influences intestinal micro-flora. Short-chain fatty acids (SCFAs) are produced by dietary fibre and are responsible for: ✓ absorption of sodium and water ✓ mucosal energy ✓ mucosal blood flow ✓ mucosal cell proliferation ✓ mucosal cell differentiation ✓ mucus release ✓ prevention of colitis	• 25 – 30 g/day
Fructo-oligosaccharides (FOS)	• Fructo-oligosaccharides are highly soluble, with a low viscosity that results in the reduction of constipation and diarrhea. • It improves liver function and reduces cholesterol and triglyceride levels.	• *5 – 10 g*
Medium-chain triglycerides	• Medium-chain triglycerides are useful when fat mal-absorption is involved. • They also may have a greater protein-sparing effect than long-chain triglycerides.	Short bowel syndrome: 20 – 60 g MCT /d
Nucleotides and antioxidants	• RNA-nucleotides keep the gut mucosa barrier intact and it stimulates the immune system. • A reduce oxidative stress.	
Probiotics	• Should be considered in critically ill to reduce VAP incidences – reduce colonisation of the respiratory tract with pseudomonas aeruginosa • Antibiotic associated diarrhoea (AAD) – antibiotics most commonly associated with AAD are Aminopenicillins with or without Clavulanic acid, Cephalosporins and Clindamycin ***Contra-indications***: ▪ Saccharomyces Boulardii should be avoided in ICU patients ▪ Probiotics should be use with caution in severe acute pancreatitis	Saccharomyces Boulardii appears to be most effective for preventing AAD. Lactobacillus rhamnosus GG has also proven effective

4.3 DISEASE RELATED CONDITIONS

TABLE 12: Disease specific requirements [45,46,47,48,49,50,51,52,53,54,55,56,57,58]

LIVER DISEASE						
Diseases	**Energy**	**Protein**	**Carbohydrate**	**Fat**	**Fluid**	**Other**
➢ Alcoholic steatohepatitis	1.3 x BMR Without ascites: Actual body weight With ascites: Ideal body weight EN: 35-40kcal/kg/d	Well nourished, moderately malnourished: 1.2 g/kg/d Severely malnourished: 1.5 g/kg/d EN: polymeric protein formula	50 – 60% NPE Give as glucose	40-50% NPE	See general recommendations	Water soluble vitamins: thiamin (vit B1), pyridoxine (vit B6), nicotinamide, folic acid. Thiamin prior to commencement due to high risk for Wernicke encephalopathy Fat soluble vitamins: All, look at Vit K if jaundice with fat-malabsoprtion Minerals and trace elements:
➢ Liver Cirrhosis	Weight to be used: Without ascites: Actual body weight With ascites: Ideal body weight 25-40kcal/kg/d Stable and malnourished: REE x 1.2-1.4 Without encephalopathy: REE x 1.2-1.4 Acute encephalopathy: REE x 1.2-1.4 PN: 30 – 35 kcal/kg dry body weight EN: 35-40kcal/kg/d Ascites: energy dense formula	Without encephalopathy: 1 – 1.5 g/kg/d Compensated cirrhosis: 1.2 g/kg/d (no malnutrition) Decompensated cirrhosis with severe malnutrition: 1.5 g/kg/d Acute encephalopathy: 0.6-0.8g/kg/d (short term until cause determined and treated) EN: polymeric protein formula	50 – 60% NPE Give as glucose In case of hyperglycaemia: 2 – 3 g/kg/d + IV insulin infusion	40 – 50% NPE Lower in omega 6	See general recommendations	Water, electrolytes, water – and fat soluble vitamins, trace elements If ascites: Na < 2000mg
➢ Liver transplant and surgery	124 x BMR 1.3 X REE (NPE)	EN: 1.2 – 1.5 g/kg/d EN: polymeric protein formula			See general recommendations	
➢ Acute liver failure	1.2 – 1.3 x REE	0.8 – 1.2 g/kg/d	2- 3 g/kg/d	0.8 – 1.2 g/k/g/d	See general recommendations	

RENAL DISEASES						
Diseases	**Energy**	**Protein**	**Carbohydrate**	**Fat**	**Fluid**	**Other**
➢ Acute kidney injury	25 – 30 kcal/kg/d (total energy) Hidden energy sources: lactate, citrate, glucose from treatment 20-30kcal/kg	No catabolism, no RRT: 0.8 – 1.0 g/kg/d Moderate catabolism, on RRT: 1.2 – 1.5 g/kg/d Severe catabolism, on RRT e.g CRRT: 1.7 – 2.0 g/kg/d or 1.8 – 2.5 g/kg/d On IHD: 1.5 – 2.0 g/kg/d *RRT – renal replacement therapy	3-5g/kg (max 7g/kg)	0.8-1.0g/kg		Thiamin Vit C Se and Cu
➢ Chronic kidney disease	< 60 years-35Kcal/kg/Day >60 years-30-35Kcal/kg/Day	If GFR- <25ml/min + not on dialysis- 0.6g/kg/day If 25-55ml/min -0.6g/kg/day If >55ml/min-0.8g/kg/day If Stable on HD-1.2g/kg/day If Stable on PD-1.2-1.3g/kg/day Acute Illness-1.2-1.3g/kg/day	50-60% of TE	25-35% of TE	See general recommendations	Limit Sodium to 2-3g/day
PULMONARY DISEASES						
Diseases	**Energy**	**Protein**	**Carbohydrate**	**Fat**	**Fluid**	**Other**
Prolonged mechanical ventilation (PMV)	REE: (V02 x 3.941)+((VCO2 x 1.11) x 1440 (Weir equation) 20 – 30kcal/kg/d Penn state, Mifflin st jeor Indirect calorimetry	1.2 – 1.5g/kg ABW/d	Use general recommendation-literature is inconclusive	ARDS: Omega-3 fatty acids (fish oils, borage oils) Use general recommendation-literature is inconclusive	See general recommendations	Dietary Fiber: 21-38g/d Vitamin D, phosphate, routine supplementation antioxidants
COPD	94% to 146% of predicted requirements	1.2 – 1.7 g/kg dry body weight / d (15-20% of total energy)	40 – 55% Total energy	30 – 45% Total energy	See general recommendations	

INJURIES						
Diseases	**Energy**	**Protein**	**Carbohydrate**	**Fat**	**Fluid**	**Other**
Traumatic brain injury (TBI)	Penn states that mortality improves with every 10kcal/ kg/d but plateau at 25 kcal/kg/d 140% (range: 120 -250%) of basal energy expenditure (BEE) using predictive equation If sedated or on barbiturates: max 120% BEE ESPEN: 25-30kcal/ kg desirable weight/d ASPEN: 20 – 25 kcal/kg desirable weight /d 35 – 45 kcal/kg/d	First 2 weeks: 1 – 1.5g./kg/d There-after: 1.5 – 2 g/kg/d BCAA recommended 2 – 2.5 g/kg/d	Glycaemic control: First 2 weeks: 8.3 to 8.9 mmol/L See general recommendations	See general recommendations	See general recommendations	Early EN (within 24 hrs) – 50% of energy and 1–1.5 g/ kg protein requirements
SPINAL CORD INJURY						
	Energy	**Protein**	**Carbohydrate**	**Fat**	**Fluid**	**Other**
Spinal cord injury	Acute phase: Predictive equation + stress factor of 1.2 + activity factor of 1.1 * weight = (admission weight) Rehabilitation phase: 22.7kcal/ kg body weight/d (quadriplegic) (Total energy intake) 27.9kcal/ per kg weight/d (paraplegic) The higher the injury, the lower energy requirements If pressure ulcers present: 30kcal to 40kcal/ kg body weight/day or Harris-Benedict times stress factor (1.2 for stage II ulcer, 1.5 for stage III and IV ulcers).	Acute phase: 2 g/kg/d Rehabilitation phase: 0.8-1 g/ kg/d If pressure ulcers present: 1.2g to 1.5g of protein per kg body weight per day (Stage II pressure ulcers) 1.5g to 2.0g of protein per kg body weight per day (Stage III and IV pressure ulcers).	45 - 65% TE	20 – 35% TE (recommended: 30% TE)	Min of 1.5 L / day 1mL/1 kcal	15 g fiber / day Zinc, vit A and C, B-complex
OTHER DISEASES						
Diseases	**Energy**	**Protein**	**Carbohydrate**	**Fat**	**Fluid**	**Other**
Stroke	Total energy: 110-115% TEE No difference between acute and chronic: 25 – 45kcal/kg/d	1-1.5g/kg/d 1.2 – 1.5g/kg/d			30-35 ml/kg	

	Energy	Protein	Carbohydrate	Fat	Fluid	Other
Burns	Curreri formula Xie et al Toronto formula _- 4343 + (10.5 x % TBSA) + (0.23 x caloric intake) + (0.84 x REE by Harris-Benedict) + (114 x t˚) - (4.5 x days after injury) 1.5-3g/kg/d	1.5-2.0g/kg/d Major burns: 2 – 2.5g/kg/day Optimal NPE:N ratio: 100:1	55-60 % of NPE Max 5mg/kg/min glc infusion rate Monitor and maintain serum glucose levels as close as possible to normal levels 50-60%	< 35%TE 20-30%		Zinc, Cu, Se, Vit B1, C, D, E Vit C 25mg/ml IV in first 24 hrs

	Energy	Protein	Carbohydrate	Fat	Fluid	Other
Congestive cardiac failure	25kcal/kg/day to 31-35kcal/kg/day If Cardiac Cachexia 160-180% of REE	1.3-1.5g/kg/day	See general recommendations	Minimum of 1g omega 3 per day See general recommendations		Sodium limited to 1200-2400mg/day

	Energy	Protein	Carbohydrate	Fat	Fluid	Other
Pancreatitis	25–35 kcal/kg/d	1.2–1.5 g protein/kg/d	50% TE	30% TE In case of steatorrhea, decrease fat intake to 0.5g/kg/d, if steatorrhea persists change fat source to MCT	See general recommendations	Chronic pancreatitis – need supps of fat soluble vits, Ca, Mg, Zn, thiamine and folic acid. See attached reference.

	Energy	Protein	Carbohydrate	Fat	Fluid	Other
Gastrointestinal Tract Failure (Inflammatory Bowel Disease)	See general recommendations	1.3-1.5g/kg/day	See general recommendations	See general recommendations Short Bowel Syndrome- MCT-20-60g/day	See general recommendations	Vitamin B6 and B12 If patient has diarrhea- Supplement with zinc, selenium and potassium If on corticosteroids- give calcium and Vitamin D

Diseases	**Energy**	**Protein**	**Carbohydrate**	**Fat**	**Fluid**	**Other**
Oncology	Ambulate Patients-30-35kcal/kg/day-TE Bed Ridden Patients-20-25kcal/kg/day of TE Weight Gain-30-40kcal/kg/day of TE Hypermetabolic/ Stressed 35kcal/kg/day of TE Haemopoietic cell transplant-30-35kcal/kg/day of TE	Non Stressed-1-1.2g/kg/day Hypercatabolic-1.2-1.6g/kg/day Haemopoietic cell transplant-1.5-2g/kg/day Severe Stress-1.5-2.5g/kg/day	60% NPE	40% NPE	See general recommendations	Omega 3 fatty acids are beneficial Micronutrients -100% DRI

4.4 STOPPING A TUBE FEED (exit criteria)

A tube feed may be stopped:

- When nutritional assessment by a dietitian confirms that the patient is able to orally ingest at least 80% of his/her nutritional requirements for 3 consecutive days**.**
- In selected cases of swallowing difficulties; the speech therapist needs to confirm swallowing capability and adequate oral motor skills before oral intake can commence.
- When complications develop and require further nutrition intervention such as total parenteral nutrition (TPN).

Removing the tube:

- In the hospital setting the tube may be removed by a health professional preferably a registered nurse.
- Button and Percutanous endoscopic gastrostomies (PEGs) need to be removed surgically
- A gastrostomy tube may be removed by the stoma therapy nurse or a nurse at the ward or clinic level

Please note

- It is imperative that both the dietitian and medical team be informed and/or involved in the decision before any feeding tube is removed

- The patient's weight and height needs to be recorded on the day that the tube is removed and regular follow- ups scheduled to monitor progress.

5 Monitoring

5.1 NUTRITIONAL ASSESSMENT MONITORING AND FOLLOW-UP

TABLE 13: Monitoring the patient receiving enteral nutrition [13,23]

Parameter	Frequency
Abdominal distention and discomfort	Daily
Fluid intake and output	Daily
Gastric residuals	Every 4 hours where appropriate
Signs and symptoms of oedema or dehydration	Daily
Stool output and consistency	Daily
Weight	At least 3 x per week
Nutritional intake adequacy	Daily
Serum electrolytes, blood urea nitrogen, creatinine	At least 2-3 x per week
Calcium, magnesium, phosphorous	Weekly, or as ordered
Serum glucose	4-6 hourly

Note: Once tolerance of feeds is established it is not recommended to monitor gastric residuals frequently as this may lead to inappropriate interruption of enteral feeding.

GIT function and tolerance should be assessed daily to determine the initiation of appropriate feeding and tolerance of feeding. GIT function should be assessed in terms of bowel sounds, tympani, nasogastric/fistula drainage and abdominal distension (measure circumference), intra-abdominal pressures, abdominal x-ray/sonar, failure to pass flatus/stool, vomiting and diarrhoea (test for *C. difficle*) or constipation. Clearly it is important to identify the patient at risk of enteral feeding intolerance as indicated in **Table 14**:

TABLE 14: Risk factors for feeding intolerance [3]

Admission diagnosis	Head injury/spinal cord injury, central nervous system diseases, major surgery, pancreatitis, sepsis, burns
Biochemical abnormalities	Hyperglycaemia, hypokalaemia, hypophosphatemia
Clinical history	Diabetes mellitus, renal insufficiency, endocrine diseases, prior GIT surgery
Formula related issues	Osmolality, large volume/rapid infusion of formula, , formula pH, infusion of very cold formula, high-fat formula/type of fat, bacterial or fungal infection of formula, inappropriate formula
Others	Pain, anxiety, infection
Medicines	Opioids (particularly pentobarbital), hypnotics, inotropes, sedatives, analgesics, anticholinergics

5.2 COMPLICATIONS OF ENTERAL FEEDING

TABLE 15: Complications related to enteral nutrition [23,59]

Problem	Effects	Management
Tube-related (access or administration problems)		
Presence of tube	Damage to the nose, pharynx, or oesophagus Sinusitis	Early placement of small bore polyurethane tube strongly recommended Pharyngostomy or orogastric tube placement is recommended
Blockage of tube lumen	Inadequate feeding	Flush with luke warm water before and after medication
Misplacement of a nasogastric tube intracranially	Brain trauma, infection, base of skull fracture, severe facial fractures	Use an orogastric placement
Misplacement or migration of a nasogastric or orogastric tube in the tracheobronchial tree	Pneumonia	Check placement of tube using radiography before initiation of feeding
Dislodgement of a gastrostomy or jejunostomy tube; leakage	Peritonitis	After being dislodged, a tube may be replaced into the peritoneal cavity. If tubes were originally placed using invasive techniques, replacement is more difficult and more likely to cause complications
Formula-related leading to gastrointestinal complications		
Intolerance of one of the formula's main nutrient components	Diarrhoea, GI discomfort,* nausea, vomiting, mesenteric ischemia (occasionally), constipation, distention, bloating, maldigestion, malabsorption, micronutrient deficiencies	If bolus feeding- change to continuous feeding If on polymeric feed-change to semi-elemental Consider supplemental TPN if requirements cannot be met using EN If malabsorption occurs due to pancreatic insufficiency- add pancreatic enzymes
Osmotic diarrhoea	Frequent, loose stools	Monitor tolerance to the feed given and change accordingly Monitor the osmolarity of the feed and adjust accordingly
Nutrient imbalances	Electrolyte disturbances, hyperglycaemia, volume overload, hyperosmolarity	Body weight and blood levels of electrolytes, glucose, Mg, and phosphate should be frequently monitored (daily during the first week)
Other		
Reflux of tube feedings or difficulty with oropharyngeal secretions	Aspiration	Flex upper body to an angle of 30-45 degrees
Delayed gastric emptying	High gastric residuals	Should be checked 4 hourly If using polymeric feeds –change to semi-elemental feeds Consider prokinetic medicines Consider supplemental TPN if requirements cannot be met using EN Jejunal access if possible
Metabolic complications		
Medicine-nutrient interactions	Refer to Table 16	
Refeeding syndrome	Refer to Table 3	

*GI discomfort may have other causes, including reduced compliance of the stomach due to shrinkage caused by lack of feeding, distension due to volume of feeding, and decreased gastric emptying due to dysfunction of the pylorus.

5.3 MEDICINE-NUTRIENT INTERACTION

TABLE 16: Medicines affecting GI function that are used in the critically ill

Medicine type	Medicine	Effect	Medicine-nutrient interactions
Medicines affecting GI perfusion	Adrenaline	Affect predominantly α-receptors at high doses with resultant splanchnic vasoconstriction	Hypokalemia, nausea, vomiting
	Dopamine	Low doses act on β_2 and DA_1 receptors, relaxing smooth muscle. DA_1 effect may be protective even during α-receptor stimulation. High doses cause intense vasoconstriction via α-receptor stimulation	
	Digoxin	Constricts mesenteric vasculature	
Medicines affecting GI flora	Antibiotics, particularly broad spectrum, e.g. cephalosporins and ampicillin	Disturbs the balance of commensal to pathogenic flora, allowing proliferation of pathogens	
Medicines used in prevention of GI bleeding	Adrenalin	Potent vasoconstrictor, reducing splanchnic blood flow and hepatoportal pressure	
	Somatostatin	Reduces gastric and pancreatic secretion, GI blood flow, small intestine transit and nutrient absorption	
Anti-diarrhoeal agents	Loperamide	Reduces GI motility and secretions by interacting with opioid and cholinergic receptors	
	Codeine phosphate	Opioid action inhibiting non-adrenergic and non-cholinergic nerves and exciting cholinergic nerves, reducing peristalsis	
Prokinetic agents	Metoclopramide	Increases gastric emptying, duodenal/jejunal motility and gastro-oesophageal tone	
Enteral feed/nutrition interaction	Phenytoin	The pharmacological action of phenytoin is reduced	Long term therapy: folate deficiency, and rarely megaloblastic anaemia, interference with vit D metabolism
Medicines reducing GI motility	Opiates, e.g. morphine	Delayed gastric emptying, reduced biliary and pancreatic secretions, diminished propulsive contractions in small and large intestine	
Medicines promoting osmotic diarrhoea	Sorbitol containing oral syrups, e.g. KCL syrup	Excess amounts can increase intraluminal osmolarity producing movement of fluid into the gut and causing diarrhoea	
Laxative agents	Osmotic laxatives, e.g. lactulose, sorbitol	Lactulose is metabolised to lactate and other organic acids by colonic bacteria. These substances exert an osmotic effect and increase stool water	Lactulose contraindicated in galactosemia
	Stimulant laxatives e.g. senna	These stimulate the myenteric plexus, inducing increased smooth muscle contraction	

Table 17: Special considerations for medicine administration via enteric tubes

Problem/interaction	Effect/consequence	Examples	Solution/ recommendation
Changes in pH after mixing EN and pharmaceutical agents together	Acidic preparations (such as syrups) cause the greatest problems, with increased clumping of the EN formula or enteral tube obstruction from precipitate formation	Ferrous sulfate liquid frequently clog the feeding tube when mixed directly into the EN formulation	Use the oral route whenever possible. Consider alternative routes (i.e., buccal, nebulized, rectal, intravenous, transdermal). If a feeding tube must be used for medication administration, oral liquid dosage forms are preferred. • Elixirs and suspensions are preferable to syrups • Dilute hyperosmolar solutions in at least 30 mL of water
Components of the EN formula itself can influence the risk for an interaction	• Protein in the form of hydrolyzed or free amino acids appears to have a higher compatibility with medicines than intact protein products • Enteral products with fiber generally are not compatible with medications		Do not mix medications directly into EN formulations. Give each medication separately and flush feeding tube with 30ml water between medications
Medication administration devices (i.e., tubing) can interact with medicines	Complexation, altering final medicine potency and causing a therapeutic failure from suboptimal medication delivery. Phenytoin absorption may be reduced by up to 70%, thus decreasing serum medicine levels	Adherence of phenytoin and carbamazepine suspensions to the walls of PVC enteric tubes can result in inadequate medicine delivery to patients	Diluting and irrigating the tubes prior to administration of these oral suspensions significantly improved medicine recovery and the final amount received by the patient.
Complexation of medications with components of EN formulations can occur, reducing the efficacy of the agent.	Decreased bioavailability from proposed binding with divalent cations in the EN formulations has resulted in increased time to peak concentrations and decreased peak concentrations of fluoroquinolones	Fluoroquinolone antibiotics, including ciprofloxacin, levofloxacin, and ofloxacin	To ensure proper medicine delivery: • Parenteral administration of fluoroquinolones in patients with intravenous access • The solid dosage form (i.e., tablet) should be crushed into a fine powder and mixed in 30 mL of water. if enteral administration cannot be avoided • Flush the feeding tube with 30 mL of water following administration to clear any residual medication
The manufacturing processes for certain medications are specialised	Crushing a tablet or opening the contents of a capsule, alters the intended dosage form and the medication may not act as intended	Enteric-coated tablets, sustained-release or extended release coated capsules or tablets, sublingual and buccal tablets, and microencapsulated products	Never open or crush in order to administer through a feeding tube

Table 18: Specific medicine-enteral nutrition interactions[60,61]

MEDICINE	CAUSES	SOLUTION	CAUTION
Phenytoin suspension	Possible explanations include: • binding of phenytoin to the protein source (calcium caseinates), binding to divalent cations (calcium, magnesium) • binding to the feeding tube	• Hold EN one hour before and one hour after phenytoin administration • Using the capsule formulation (versus the suspension) as the powder from the capsules appears less likely to bind • Change to a bolus feeding regimen (e.g., 240 mL given four times per day) and administer phenytoin between boluses • Administer intravenous phenytoin via the feeding tube, as the bioavailability is unchanged, but the maximum concentration of phenytoin is significantly greater and the time to maximum concentration is significantly shorter when compared with the suspension formulation • Some institutions prefer to not hold EN at all, administer higher doses of phenytoin suspension, and closely monitor serum phenytoin concentrations • In general, phenytoin suspension given through a feeding tube, should be diluted with 20–60 ml of water to enhance absorption and increase the dissolution rate	Can cause underfeeding due to insufficient feeding time or feed intolerance due to high infusion rate. To minimise the amount of time that the feedings are held, phenytoin suspension should be given twice daily rather than more often if possible. • Phenytoin dosages will require adjustment if the feeding regimen is discontinued or temporarily held to prevent toxic levels
Proton pump inhibitors e.g. Lansoprazole	Formulated as delayed-release capsules containing enteric-coated granules. When ingested by mouth, the delayed-release capsule protects the base-labile granules until they reach the alkaline pH of the duodenum, at which time the granules dissolve and the medicine is absorbed. Crushing the enteric-coated granules can result in tube clogging and dissolving the granules in water can destroy the medication before it reaches the absorption site (i.e., small intestine).	• Mix intact granules with an acidic medium (e.g., apple or orange juice) and flush with the acidic medium after administered down a gastric feeding tube. • If the feeding tube terminates in the small bowel (i.e., jejunum), alkaline liquids should be used to dissolve the medicine granules prior to administration. Dissolve intact granules in sodium bicarbonate 8.4% solution. Pour suspension down feeding tube, flush with 30ml water and hold feeds for at least one hour.	• Enteric coated, delayed-release tablets cannot be crushed and should not be administered via gastric or jejunal feeding tubes • Products available as a packet of granules that is reconstituted with water to form a suspension, however, has been reported to clog feeding tubes as it contains xanthan gum

6. Home based enteral nutrition

6.1 Patient education [62,63]

Bolus feeding is most often the preferred way of feeding, when using a PEG tube.

Care must be taken to flush the PEG tube, with clean water, before and after administration of food or medication. Usually at least 30 milliliters of water is used to flush the tube.

Feeds are administrated by using a feeding syringe; 60ml catheter tip syringe. Care must be taken not to push feeds through the PEG, but to make use of gravity or slowly push down the plunger of the syringe.

The family/caregiver of the patient must be educated to care for the patient at home.

Person responsible for education:

- At primary level: A nurse or the community dietitian must reinforce information.
- At tertiary and secondary level: The hospital dietitian and/or nurse at discharge.

The patient discharged on tube feeding and caretaker should be taught:

- Safe preparation of tube feeding.
- To emphasise the importance of feeding rate according to prescription to maintain nutritional requirements.
- To recognise symptoms of intolerance.
- How to manage simple problems.
- Where to call for guidance and when to call the doctor or the dietitian.
- To maintain social contact at mealtimes.

6.2 TUBE CARE [58,59]

- Check the length of the PEG tube daily.
- Check that the lower disk of the PEG tube fits tightly to the skin daily.
- Flush the tube regularly with lukewarm water to prevent clogging of the tube. If clogged, unclog the tube with bicarbonate of soda mixed in warm water.
- Clean the skin around the stoma twice daily.
- Take care to keep the skin around the stoma dry, check daily for any redness around the stoma.
- Turn the tube daily.

6.3 FORMULATIONS

6.3.1 Home based

Blenderised or pureed food can be used if a tube greater than 20 French is inserted. Take care to prevent clogging of the tube; this can be done by thinning the puree with nutritious liquids e.g. milk. Meal plan must be calculated by a dietitian and additional supplementation provided if required. [62]

6.3.2 Commercial

Any commercially available formula can be used, as long as it fulfills the patient's diet prescription as calculated by a dietitian. Take fluid recommendations into consideration when using commercially prepared formulations [62]
Note: Patients should be monitored at least monthly.

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ANNEXURES

ANNEXURE 1: ACCESS ROUTES [4,23,64]

Access Route	Indication	Advantages	Disadvantages	Comment
Gastric feeding Orogastric or nasogastric Pharyngostomy	• Patients requiring short term enteral nutrition (3-4 weeks) • Orogastric tubes not suitable for awake patients	• Easy to place, less expertise required for placement • Normal digestive, hormonal and bacteriocidal processes in stomach • Increased protection against stress ulcers due to increased blood flow to the stomach and the buffering effect • More feed options available	• Higher risk for aspiration • Increased risk for sinusitis (NG tubes) • Incompetence of lower oesophageal sphincter predisposing patient to regurgitation and aspiration	Default route for most patients. Recommended tube types: • Polyurethane or silicone • 8 – 10Fr • Length of 91 – 120cm Verification of tube position • Aspirating gastric content • Auscultation of air insufflation into stomach • Radiographic confirmation of tube tip (Gold standard) **Note: If Oesophageal Varices is present, place tube cautiously.**
Small bowel feeding • Nasoduodenal (post pyloric) • Nasojejunal (post ligament of treitz)	• Intolerance to gastric feeding (abdominal distension & discomfort, vomiting, persistant high GRV (>400ml) • Gastroparesis	• Potentially lower risk of aspiration • Reduced stimulation of pancreatic secretions	Placement is more resource & skill dependant	Placement methods: • Intra-operative • Endoscopic or fluoroscopic guidance • Spontaneous that depends on tube migrating into the duodenum by peristalsis
Enterostomies Gastrostomy or PEG Jejunostomy or PEJ (Both can be done surgically or via percutaneous endoscopy)	• Patient requires long term enteral nutrition (>4-6 weeks) e.g. neurologically impaired • Evaluation by multidisciplinary team is indicated to establish if a. Benefit outweighs risk of placement b. Insertion near end of life is warranted c. Patient is close to achieving oral feeding **CONTRA INDICATIONS** • Ascites • Haemocoagulation disorders	• Larger bore feeding tubes can be used (16 – 24Fr) resulting in less clogging of tubes • Improved comfort and mobility for patients • Prevent complications associated with nasal tubes • Use of buttons (skin level device) can be more aesthetic – no bulkiness under clothing. Also appropriate for active patients. • Buttons also useful in patients who pull out tubes e.g. dementia patients	• General anaestetic and laparotomy required for surgical placement. More invasive method. • Skin may break down from leakage • Peritonitis can occur with premature removal – within the first few weeks after insertion • Tube dislodgement • Tube migration	• Knowledge of GI anatomy, and motility, prior GI surgery, patency of upper GIT, intended use and intended length of therapy must be part of decision making process. • Patient's potential risk for anaesthesia, effect of pre-existing co-morbidities and expected patient outcomes must be assessed before placement. • Avoid placement of catheters not intended for use as enteral devices e.g. urinary catheters or drainage tubes. Use of such tubes leads to enteral misconnection as well as tube migration which can cause obstruction

ANNEXURE 2: IMMUNONUTRITION RECOMMENDATIONS [65]

Patients	CCCPG	ESPEN	ASPEN/SCCM
General	Arginine (no benefit) No recommendations Antioxidants (possible benefit)	No recommendations	Arginine (possible benefit) Antioxidant (benefit)
Elective surgery	No recommendations	Arginine (benefit)	Arginine (benefit)
Trauma	Arginine (no benefit) No recommendations	Arginine (benefit) No recommendations	Arginine (benefit) Antioxidant (benefit)
Burns	Arginine (no benefit) No recommendations	No recommendations Antioxidant (benefit)	Arginine (benefit) Antioxidant (benefit)
Sepsis	Arginine (harm)	Arginine (harm)	Arginine (harm) Antioxidant (benefit)
ALI/ARDS	Ω-3 FA and GLA (benefit) Arginine (no benefit) No recommendations	Ω-3 FA (benefit) No recommendations Antioxidant (benefit)	Ω-3 FA and GLA (benefit) No recommendations Antioxidant (benefit)
Enteral feeding intolerance	Whole-protein formulas for most patients, hydrolysed protein formulas for patients with GI dysfunction	Whole-protein formulas for most patients, hydrolysed protein formulas for patients with GI dysfunction	Hydrolysed protein formulas for patients with GI dysfunction

ANNEXURE 3: CHECKLIST FOR THE ICU SETTING

C= Commodities			
Severity of illness: Calculate score, as indicated by patient ICU admitting diagnosis			
APACHE II Ranson Criteria SOFA ISS			
Preexisting conditions:			
Diabetes Mellitus? **Liver dysfunction?** **Renal dysfunction?** Alcohol abuse and related malnutrition? Medicine abuse and related malnutrition	 	**Yes** **Yes** **Yes** **Yes** Yes	**If yes, carefully target glucose control** **If yes, carefully monitor protein control** **If yes, carefully monitor for malnutrition refeeding syndrome** If yes, carefully monitor for malnutrition refeeding syndrome If yes, carefully monitor for malnutrition refeeding syndrome
Age			
Age _____			
N=Nutrition Risk Screening			
Initial screening			
BMI <20.5? Weight loss in the last 3 months? Reduced dietary intake in past week? Severe illness?			
Final screening (Complete if "yes" to any of the above questions)			
Part I Impaired Nutrition Status			
Absent Mild Moderate Severe	 	**Score 0:** Score 1: Score 2: Score 3:	**Normal Nutrition status** Weight loss >5% in 3 months or food intake <50-70% normal in last week Weight loss >5% in last 2 months OR BMI 18.5-20.5 OR food intake <25-50% normal in last week Weight loss >5% in last months (>15% in last 3 months) OR BMI <18.5 + impaired general condition OR food intake 0-25% normal in last week
Part II Severity of the disease			
Absent **Mild** **Moderate** Severe	 	**Score 0:** **Score 1:** **Score 2:** Score 3:	**Normal nutrition requirements** **Hip fracture, chronic patients (HD, DM, cancer, cirrhosis, COPD) with acute complication** **Major abdominal surgery, stroke, severe pneumonia, hematologic malignancy** Head injury, bone marrow transplantation, APACHE III score >10
Part I Impaired NS score _____ + Part II Severity of Disease Score ____ + 1 (if age >70) ____ = _____ Total (If total of 3 or more, nutrition support is indicated)			
W=Wait for resuscitation			
Proceed with caution if answer if YES. Hold feeding if answer is NO.			
Fluid resuscitation complete? **Mean arterial pressure ≥65mmHg?** **Stable pressor agents for 24 hours?** **CVO_2 ≥ 70% or MVO_2 ≥ 65%?** **CVP 8-12mmHg?** **Serum lactate <22mg/dl?** Base excess < 5mEq?	 	**Yes** **Yes** **Yes** **Yes** **Yes** **Yes** Yes	**No** **No** **No** **No** **No** **No** No
E= Estimate energy requirements			
Calories			
BMI <30: use 25-30 kcal/kg ABW/d			
BMI ≥30: use 11-14 kcal/kg ABW/d			
Protein			
BMI <30: use 1.2-2g/kg ABW/d			
BMI 30-40: use ≥2g/kg ABW/d			
BMI <40: use 2.5g/k ABW/d			
F= Formula section			
Candidate for arginine-containing pharmaconutrition formula		**Yes**	**No**
Criteria: Major surgery, trauma (ATI score >20), burns (TBSA>30%), cancer, critically ill on mechanical ventilation			
Candidate for Anti-inflammatory pharmaconutrition formula		**Yes**	**No**
Criteria: ARDS or ALI			
Candidate for Malassimilation formula: Small peptide? MCT oil		**Yes**	**No**
Fibre containing		**Yes**	**No**
If no to all above, then candidate is for standard enteral formula			

E=Enteral access					
Access site	**Nasoenteric**		**Yes**		**No**
	Oroenteric (concern for sinusitis)		**Yes**		**No**
	Percutaneous (anticipate feeds > 4 weeks)		**Yes**		**No**
Level of infusion	Stomach		Yes		No
	Postpyloric		**Yes**		**No**
	Below ligament of Treitz		Yes		No
Need for simultaneous gastric decompression (aspirate/feed tube			Yes		No

E=Efficacy				
Days NPO				
Initial rate				
Goal rate				
Cumulative Caloric Balance				
Rapid ramp-up rate				
Goal volume/day				
Initiate volume-based feeds		Yes		No
	Gastric (max 280ml/hr)		Postpyloric (max 150ml/hr	

D= Determine tolerance		
1st GRV >500ml		
Continue current infusion, recheck in 4 hrs		
Normalize serum electrolytes		
Initiate metoclopromide 10mg IV q 6 hrs		
Initiate Narcan 8 mg in saline per tube q 6 hrs		
Elevate head of bed		
Turn patient to right lateral decubitis position		
2nd GRV>500ml		
Hold enteral infusion		
Restart infusion once GRV <500ml		
Recheck GRV in 2 hrs.		

Part II Severity of the disease				
S-glucose 80-150 mg/dl or 4.4-8.3 mmol/L		Yes		No
Passage of stool/gas		Yes		No
Diarrhoea (>250 ml/day stool output per rectum OR 1000ml/day output ileostomy)				
Remove sorbitol from oral/enteric medications **Obtain stool cultures/axin assay to rule out infectious diarrhoea** **Initiate opiates once infectious etiology ruled out (lamotil, immodium, paregoric)** **Consider fibre-containing formula and/or small peptide/MCT formula** **Provide fibre additive**				

Notes

Notes

National Department of Health
Civitas Building
Cnr Thabo Sehume and Struben Streets
Pretoria
0001

Switchboard: 012 395 8000