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CRITICAL CARE PROGRAMME

NUTRITION SUPPORT (ADULTS)

REFERENCE DOCUMENT 2012

CRITICAL CARE

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Critical Care Programme
Reference Document for Nutrition Support Guideline 2012 (Adults)

Introduction

Critically ill patients have complex nutritional needs and require intensive nutritional input. As part of the metabolic response to injury, resting energy expenditure may be raised, leading to extensive catabolism, hyperglycaemia, progressive lean body mass loss, changes in serum trace element levels, fluid retention, and reduced synthesis of visceral proteins such as albumin. Contributing to poorer outcome is the previously reported high prevalence of malnutrition (40%) in Intensive Care Unit (ICU) patients[1].

Catabolism combined with malnutrition can lead to several unwanted clinical sequelae:

- Impaired wound healing.
- Impaired immune response.
- Impaired coagulation capacity.
- Impaired gut function.
- Muscle wasting.
- Reduced respiratory muscle function.

Evidence suggests that nutrition support can slow catabolism in ICU patients[2]. This can improve patient outcome and reduce subsequent duration of recovery, thereby leading to a reduced length of hospital stay and reduced overall hospital costs. A number of studies have shown that survival from intensive care was improved with better nutritional adequacy and with the use of evidence-based nutrition support guidelines.[3,4,5]

The overall goal of feeding ICU patients is to provide nutrition support to those who need it, consistent with their medical condition, nutritional status, metabolic capability and available route of administration.

Impact of an intensive care dietitian

The dietitian is considered central to the provision of nutrition support to those patients in need of it, and is ideally placed to provide nutritional screening and assessment[4]. Dedicated dietetic staffing to ICU has been associated with better provision of nutrition support and may result in improved patient outcomes.[7,8]

A recent international multicentre prospective observational study outlined best achievable nutrition practices in participating ICUs relative to evidence based critical care nutrition clinical practice guidelines[9]. Analysis of the data showed that the presence or absence of a dietitian in intensive care had a significant effect on determining performance with respect to nutrition practices.[10] The presence of a dietitian was associated with top performance,[10] and was considered a primary enabling factor that affected adherence to internationally recognised nutrition guidelines in ICU.[11,12] Another recent study showed improvements in early introduction and route of feeding, as well as better achievement of nutritional targets associated with the presence of an ICU dietitian.[13]

Assessment and requirements

Nutritional screening

All ICU admissions, should be screened to assess their need for nutrition support.[2,14,15,16,17] Recommend nutrition support within 24 to 48 hours of ICU admission (or once haemodynamically stable) for:

- Undernourished or hypercatabolic patients[14-16].
- Ill patients expected to stay in ICU for 3 days or more[16].
- Patients not expected to commence diet within next 5 days or more[2].

A 'nutrition risk in the critically ill score' (NUTRIC Score) has recently been validated for screening ICU patients. Further validation studies are needed.[18]

Assessment/requirements

Before initiation of feeding, nutritional assessment should consider[2]:

- Recent weight loss.
- Nutrient intake prior to admission.
- Level of disease severity.
- Co-morbid conditions.
- Function of gastrointestinal tract.

In the critical care setting, the traditional protein markers such as albumin, prealbumin, transferrin and retinol binding protein are a reflection of the acute phase response and do not accurately represent nutritional status in the ICU setting.

Requirements should be assessed individually and provided according to tolerance. Overfeeding critically ill patients can have detrimental effects on outcome[19,20]. Conversely, persistent underfeeding has been associated with increasing complications[21]. Over aggressive feeding during the acute phase of injury may also promote adverse outcome effects[22,23]

Recommended macronutrient requirements are summarised in Table 1. Some validated equations used to calculate energy requirements in the critically ill are shown in Table 2.

Table 1 Recommended macronutrient requirements for use in ICU

Nutrient	Recommendation *(per kg recommendations infer per kg per 24 hours.)*	Guideline Source
Energy	Individualise. Use validated equations, in the absence of indirect calorimetry.	PENG 2007[24] NSIG 2010[25]
	Use 25-30kcal/kg, or predictive equations, or indirect calorimetry.	ASPEN 2009[2]
	20-25kcal/kg in acute phase of critical illness. 25-30kcal/kg in recovery phase.	ESPEN 2006[16]
	25kcal/kg	ESPEN 2009[17]
	Consider hypocaloric feeding in critically ill obese (BMI >30kg/m^2), e.g. 60-70% of target energy requirements, or 11-14kcal/kg actual body weight, or 22-25kcal/kg ideal body weight.	ASPEN 2009[2]

Protein	1.3-1.5g protein/kg.	ESPEN 2009[17]
	1.2-2.0g protein/kg if BMI<30kg/m^2. 2g/kg ideal weight if BMI 30-40kg/m^2. 2.5g/kg ideal weight if BMI >40kg/m^2.	ASPEN 2009[2]
	Caution with excess nitrogen in severely ill.	NICE 2006[6]
Glucose	Minimum 2g/kg	ESPEN 2009[17]
	Maximal glucose oxidation rate is 4-7 mg/kg/minute/24hours. Ideally keep to ≤5mg/kg/minute/24hours.	ESPEN 2009[17]
	3-5 (maximum 7) g/kg.	ESPEN 2006[16]
Fat/lipid	0.7-1.5g/kg.	ESPEN 2009[17]
	0.8-1g/kg in sepsis/SIRS.	PENG 2007[24]
	Consider lipid source.	CPG 2009[15]

Table 2 Sample validated requirement equations used in ICU

Author & Year	Equation
Ireton-Jones 1992[26] (for spontaneously breathing patients)	EEE (s) = 629 - 11(A) + 25(W) - 609(O)
Ireton-Jones 2002[27] (for ventilated patients)	EEE (v) = 1784 - 11(A) + 5(W) + 244(G) + 239(T) + 804(B)
Penn State 2003/2004[28] (using Mifflin St. Jeor)	RMR= Mifflin-St Jeor (0.96) + T_{max}(167) + V_E(31) - 6212
Modified Penn State 2011[29] (for ≥60year olds with BMI ≥30kg/m^2)	RMR = Mifflin-St Jeor (0.71) + T_{max}(85) + V_E(64) - 3085
Mifflin St. Jeor 1990[30] ***for use with Penn State equation***	*Men: 10(weight) + 6.25(height) – 5(age) + 5* *Women: 10 (weight) + 6.25(height)) – 5(age) - 161*

EEE is estimated energy expenditure (kcal/24hr.); v is ventilator dependent; s is spontaneously breathing; A is age (years); W is body weight (kg); G is gender (male=1, female=0); T is diagnosis of trauma (present=1, absent=0); B is diagnosis of burn (present=1, absent=0); O is obesity (>30% above IBW from Metropolitan Life Insurance Tables, present=1, absent=0); RMR= Resting Metabolic Rate; Tmax is maximum body temperature in the previous 24 hours (degrees Celsius); Ve is minute ventilation (litres per minute)at the time of measurement read from the ventilator. Height in cm.

Whether kcal/kg, indirect calorimetry or use of predictive equations should be used to assess requirements in ICU remains unclear[15,31]. For extremely overweight or underweight patients, or patients with severe sepsis and/or multi-organ dysfunction syndrome (MODS), estimating requirements is more difficult. Indirect calorimetry may be beneficial for these patients, but is often unavailable and is not appropriate for certain patients. Clinical judgement and close monitoring of these patients is paramount.

Feeding the malnourished patient

Refeeding syndrome is a life threatening condition encompassing acute micronutrient deficiencies, fluid and electrolyte imbalances, and disturbances of organ function and metabolic regulation that may result from over-rapid or unbalanced nutrition support provision to malnourished patients[6]. Effects include:

- Severe hypophosphataemia (whole body depletion).
- Fluid balance abnormalities (acute overload/depletion).
- Hypokalaemia.
- Hypomagnesaemia.
- Altered glucose metabolism.
- Vitamin deficiency.
- Cardiac failure, pulmonary oedema and dysrhythmias.
- Risk of death.

At risk patients[6]

People who have not eaten for more than 5 days should have nutrition support introduced at no more than 20kcal/kg/24 hours initially. Increase feeding rates to meet full needs if clinical and biochemical monitoring reveals no refeeding problems.

High risk patients[6]

Table 3 NICE 2006[6] criteria for determining which patients are at high risk of developing refeeding problems

One or more of the following:	**Two or more of the following:**
- BMI less than 16 kg/m^2	- BMI less than 18.5 kg/m^2
- unintentional weight loss greater than 15% within the last 3–6 months	- unintentional weight loss greater than 10% within the last 3–6 months
- little or no nutritional intake for more than 10 days	- little or no nutritional intake for more than 5 days
- low levels of potassium, phosphate or magnesium prior to feeding.	- a history of alcohol abuse, or drugs including chemotherapy.

Nutrition support in patients at high risk of refeeding syndrome[6]

- Start nutrition support at ≤10 kcal/kg/day, increase levels slowly to meet or exceed full requirements by day 4 to 7 (consider 5 kcal/kg/day in extreme cases, eg. anorexia nervosa patients).
- Restore circulatory volume and monitor fluid balance and overall clinical status closely.
- Providing immediately before and during the first 10 days of feeding: oral thiamine 200–300 mg daily, or full dose daily intravenous vitamin B preparation, Pabrinex® 1and 2, one to two pairs once to three times daily for 3 to 5 days (use the higher more frequent dose for chronic alcohol abusers). Give a balanced multivitamin/trace element supplement once daily.
- Provide oral, enteral or intravenous supplements of potassium, phosphate and magnesium unless pre-feeding plasma levels are high (in accordance with local hospital policies/protocols on electrolyte replacement). Pre-feeding correction of low plasma levels is unnecessary, but low levels must be supplemented as they occur throughout refeeding.

Nutrition support provision

1. Enteral nutrition

Enteral feeding is the preferred route of feeding for ICU patients[2,14,15,16,19,32]. Evidence suggests enteral feeding helps to:

- Maintain gut integrity.
- Prevent gut stasis.
- Maintain gut mass.
- Maintain gut associated lymphoid tissue.
- Prevent stress ulceration.

Early enteral feeding (within 24-48 hours of ICU admission) benefits ICU patients.[14,15,16]

Enteral feeds

- Enteral feeds are more nutritionally complete, are better metabolically handled, and often cost less than parenteral solutions.
- Standard feeds are appropriate for most ICU patients[16].
- Arginine supplemented feeds are not recommended in severely septic patients due to possible adverse effects on outcome[2,14,15,16].
- Standard feed formulations are appropriate for the majority of patients with AKI on CRRT[33]. Consider renal feeds if uncontrolled electrolyte derangements[33].
- An enteral feed rich in eicosapentaenoic acid, gamma-linolenic acid and antioxidants conferred a 19.4% risk reduction in mortality rate in ARDS and ALI ICU patients[34] with severe sepsis. A recent meta-analysis[35] evaluated outcome data from studies using this feed and reports significantly more ventilator-free days; 83% risk reduction in developing new organ failures ($p<0.0001$); 60% risk reduction in 28-day in-hospital all-cause mortality ($p=0.001$). Recent guidelines on nutrition support in Intensive Care patients encourage use of this feed in patients with ARDS and severe ALI.[2,15]

Enteral Glutamine

Enteral supplementation of glutamine has demonstrated outcome benefits in burns[36,37] and trauma patients[38]. There are conflicting recommendations over use of enteral glutamine in other critically ill patients[2,15]. Glutamine powder mixed with water can be given enterally in 2-3 divided doses to provide 0.3-0.5g glutamine per kg per day[2].

Bowel sounds

The presence of bowel sounds is not a necessary prerequisite for commencing enteral feeding in an ICU setting[2,19]. Normal myoelectric activity in the bowel returns after surgery in the absence of bowel sounds[39,40]. Bowel sounds are not necessarily correlated with bowel peristalsis[41]. Enteral nutrition can commence in surgical patients without waiting for flatus or a bowel motion.[42]

Gastric aspirate volumes

With large bore NG tubes, initially aspirate the stomach of critically ill patients every 4 hours.[42] Gastric aspirate/residual volume measurement correlates poorly with gastric emptying, as well as incidence of regurgitation and aspiration.[41,42] Once clinical condition stabilises and gastric aspirate/residual volumes are consistently normal, consider fine bore NG tube for feeding. Review feeding policy if raised gastric aspirate/residual volumes[42,43]. Acceptable gastric residual volume levels of between 250 and 500ml have been advocated for ICU patients – see Table 4.

Table 4 Cut off values for gastric aspirate volumes

Gastric aspirate/residual volume cut off recommendation for enteral feeding in ICU	Source of recommendation
250-500ml	American Society for Parenteral and Enteral Nutrition (ASPEN) Guidelines 2009[2]
≥250ml	Canadian Clinical Practice (CPG) Guidelines 2003[14] and 2009[15]
>500ml – withhold feed & reassess	North American Summit on aspiration in the Critically Ill Patient: Consensus statement 2002[43]; ASPEN 2009[2]
<500ml – avoid withholding feed unless other signs of intolerance	American Society for Parenteral and Enteral Nutrition (ASPEN) Guidelines 2009[2]

Confirming nasogastric tube position

- Radiographic confirmation of correct positioning of any blindly-placed tube (small or large bore) should be obtained prior to its initial use for administration of feed or medications[42].
- Bedside pH checks can also be used to check position. Gastric acid suppression therapy may affect pH readings[42]. The NPSA recommends that a pH of <5.5 confirms gastric position[44]. A recent study, however, recommends a pH of 5.0 as a safer, reliable, and practical cut-off[45]. An Irish study in 2008 reported a high correlation between using pH strips and using a calibrated pH meter to check pH of enteral aspirates with r-values approaching 1 in all cases.[46] The NPSA recommend radiological confirmation of nasogastric tubes if pH is >5.5.[44]
- The exit site of a feeding tube should be marked at the time of initial placement. Observe for a change in the external tube length during feeding.[42]
- In adult patients the auscultatory method should not be relied upon to differentiate between gastric and respiratory placement of feeding tubes.[42]

Feed administration guidelines[42]

- Closed enteral feeding systems should be used where possible.
- Administration sets for closed system enteral nutrition formulas should be changed per manufacturer guidelines. Giving sets for open systems should be changed at least every 24 hours.
- Use sterile water for flushing tubes or for enteral water infusion. Flush feeding tubes regularly.
- Sterile liquid formulas should be used in preference to powdered reconstituted feeds.

- Closed-system enteral nutrition formulas can hang for 24 hours.
- Sterile decanted formulas should have a maximum 8 hour hang-time.
- Reconstituted powdered feeds should have a maximum 4 hour hang-time.
- Store unopened liquid enteral feeds as per manufacturer's guidelines and use before expiry date.
- Enteral nutrition prescriptions should include: patient identifiers, the feed formula, the enteral access device/site, and the administration method and rate.
- A head-of-bed elevation of 30 to 45^{o} is recommended during feeding, unless contra-indicated.

Feed rate guidelines:

- There are limited prospective data to form strong recommendations about initial starting rates for enteral feeding. Formulas are frequently commenced at full strength at a lower rate and advanced to goal rate in set increments, e.g. 20ml/hour, over set timeframes, e.g. every 8 hours, until target rate is achieved. Feeds should not be diluted (with rare exceptions).[42]
- Some authors recommend commencing feeds at full target rate in stable patients.[47,48] Aiming for target feed volumes per 24 hours has also been advocated to improve nutritional adequacy.[48,49]
- A recent ARDSNET randomised trial (EDEN trial)[50] showed that early trophic enteral feeds (25% of goal calories) were associated with similar outcome benefits to full enteral feeds in younger, normo-well nourished patients with a relatively short ICU stay. Other studies[4,51] have shown that the most significant outcome benefits from full nutrition therapy occur in patients with low BMI, high BMI, and with prolonged stays in ICU (>7days). A large observational study showed that reaching >80% of nutritional target was associated with improved mortality.[5]

Strategies to improve enteral feeding tolerance

For patients with inadequate feed tolerance:

- Consider use of prokinetics[4,14,15,16,43,52], e.g. metaclopramide and/or erythromycin, unless contraindicated. Efficacy declines after 2-3 days when prescribed alone, or after 6 days when prescribed as a combination[53]. Routine use of prokinetics is not recommended unless signs of feed intolerance are present.[16] Significant side-effects can occur with use of either prokinetic[46] (seek advice from pharmacy).
- Consider use of laxatives if no bowel motion, where there is no contraindication[52].
- Reduce use of opiates where possible[6,43].
- Consider patient positioning. Ensure head of patient is elevated to 30 to 45 degrees,[2,6,14,15,43] where possible.
- Consider post-pyloric access for feeding.[14,15,16,43]
- Control hyperglycaemia if present[43].
- Correct abnormal electrolytes and avoid hypokalaemia, where possible. [43,52]

Post-pyloric feeding

Routine nasojejunal feeding in ICU patients is not required unless gastric feeding intolerance is present.[42] Critically ill patients at high risk of aspiration, or who have demonstrated gastric feed intolerance, should be fed via post-pyloric route.[2,15,16]

Small bowel nasoenteric feeding tubes can migrate upward into the stomach. Monitor pH, changes in external tube length, and changes in gastric residuals[42]. Check X-rays to confirm location of feeding tube tip initially, and as needed.[42]

Success rates with nasoenteric tube placement are high via endoscopic (96%) and fluoroscopic techniques (94%)[54]. Sonographic and magnet-assisted placement has success rates of 85% and 60%, respectively[55,56]. Placement using tip pH-sensors is between 50% and 97% successful[57-59]. Blind bedside placement is variable with reported levels of between 15% and 100% in the literature[60,61]. An Irish study reported an 86% success rate in blind bedside insertion of nasojejunal tubes (mainly placed by a nurse specialist or dietitian)[62]. A recent study using an electromagnetically guided nasointestinal tube system in ICU patients with gastric feed intolerance was successful in post-pyloric tube placement in 87% of cases[63].

2. Parenteral nutrition

Consider parenteral nutrition when enteral feeding is not possible or adequate[2,6,19]. Standard bags can be tailored to the individual by adjusting infusion rates. Daily micronutrients should be provided routinely in PN regimen or as a separate intravenous infusion[14.15,17]. Micronutrients above the normal recommendation may be needed in case of excess loss/need[15]. Consider parenteral glutamine[2,14,15,17].

Some authors recommend initiating PN in the critically ill if enteral feeding cannot commence within 24 to 48 hours of ICU admission[17,64]. When used to supplement insufficient enteral feeding, late parenteral nutrition (day 8) was associated with improved outcomes compared with early PN initiation in one study.[65] Another study found that supplemental PN on day 4 of insufficient enteral feeding, to reach 100% of nutrition needs, had significant outcome benefits.[66] A reasonable trigger time of 72 hours for commencing PN in ICU, could be used where EN has failed or is contraindicated.

Central venous access device (CVAD)

The use of femoral vein for PN is relatively contraindicated, since this is associated with a high risk of contamination at the exit site, and a high risk of venous thrombosis.[67]

Intravenous Glutamine

Significant improvements in six month mortality rates, and length of stay have been demonstrated in ICU patients on parenteral feeding who were supplemented with intravenous glutamine[68]. Significant cost savings were also noted[69]. Parenteral doses of 0.5g L-glutamine/kg/day[2] and 0.2 to 0.4g L-glutamine/kg/day[17] have been recommended. Several international guidelines recommend the use of IV glutamine in parenterally fed ICU

patients.[2,15,17] The outcome benefits of supplemental IV glutamine, however, are not consistently demonstrated, as evidenced by the recent SIGNET trial.[70] See local intensive care unit guidelines for current practice.

Addition of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) to lipid emulsions in PN regimens used in ICU

High circulating levels of inflammatory mediators such as eicosanoids, cytokines and reactive species, are seen in very critically ill patients and have been associated with poor outcomes.[71] Intravenous fish oil can decrease synthesis of inflammatory mediators and can improve EPA and DHA levels in cell membranes[17]. This may be associated with improved outcomes such as mortality, infection rate, antibiotic usage and length of ICU or hospital stay[72,73], although results are inconsistent.

Lipid emulsions should be an integral part of PN in ICU for energy and to ensure essential fatty acid provision, especially in longer-term PN[17]. There is currently insufficient data to recommend a particular lipid type for to be used in PN for critically ill patients[15]. Avoidance of lipids high in soybean oil has been advocated by some[15] for use in short-term PN, but clinical judgement is needed. Triglyceride levels should be measured to assess lipid clearance[25] - see local guidelines.

Other considerations

Glycaemic control

In 2001, Van den Berghe's group demonstrated that intensive insulin therapy to strictly control blood glucose levels between 4.4 and 6 mmol/l, significantly reduced ICU mortality in surgical ICU patients[74]. Mortality benefits were not seen in medical ICU patients in a 2006 study by the same group (although morbidity benefits were shown)[75].

In 2009, the NICE-SUGAR study[76] investigators recommended a blood glucose target of 10mmol/l. Strict glycaemic control (target blood glucose of 4.5-6 mmol/l), increased the absolute risk of death at 90 days by 2.6%. Severe hypoglycaemia (blood glucose less than 2.2mmol/l) was significantly more common with intensive glucose control.

Systems that can offer continuous glucose monitoring are being investigated. All ICU patients should have their blood glucose levels maintained at or below 10 mmol/l[15,76]. Feeding over 24 hours may aid glycaemic control in ICU. See local intensive care unit intravenous insulin infusion protocols for achieving glycaemic control.

Feeding the obese critically ill patient[77]

There is an increasing prevalence of obesity in hospitalised patients. A consensus workshop on nutrition therapy in the severely obese critically ill patient published conclusions and consensus recommendations in 2011. These may provide guidance for patient management in the absence of large randomised trials. Recommendations include:

- The obese, critically ill patient may be expected to have a greater number of underlying co-morbidities and subsequently more complications than lean counterparts. The effect of obesity on ICU and hospital mortality is both controversial and uncertain.

- Critically ill patients at increased health risk due to obesity-related conditions may be identified by the presence and extent of comorbidities and functional limitations.
- Specialised equipment should be acquired to manage the unique impact of obesity on delivery of care in the ICU.
- At initial assessment weight and BMI should be considered "vital signs" for the obese patient and carefully recorded in the medical record.
- Initial assessment of biomarkers of the metabolic syndrome (serum levels of triglyceride, cholesterol, and glucose) is also recommended.
- Prolonged periods of NPO (nil by mouth) are not justified.
- Basic principles of critical care nutrition should be applied to the obese critically ill patient. The need for and the benefit gained from early enteral nutrition (EN) is no different from that of their lean counterparts.
- Optimal enteral access and level of feeding within the gastrointestinal tract may require post-pyloric feeding into the small bowel.
- Caloric requirements should be measured when possible by indirect calorimetry. In the absence of indirect calorimetry, use predictive equations validated in patient populations that include critically ill obese patients.
- High-protein hypocaloric feeding should be provided to the obese ICU patient. Consider the use of prebiotics or probiotics to beneficially alter the gut microflora.

Additional micronutrients

Evidence supporting routine supplementation of micronutrients in addition to meeting recommended daily intakes by nutrition support, is unclear. Some guidelines do exist – see Table 5. Avoid toxicity in patients with hepatic and renal insufficiency.[78]

Table 5 Micronutrient supplementation in ICU

Additional micronutrient supplementation	Source of recommendation
Supplemental combined vitamins and trace elements should be considered in critically ill patients receiving nutrition support.*	Canadian Clinical Practice (CPG) Guidelines 2009[15] American Society for Parenteral and Enteral Nutrition (ASPEN) Guidelines 2009[2]

Additional studies to delineate optimal dosage, route and combination of micronutrients are needed.

Infusions commonly used in ICU with nutritional implications

Table 6 outlines commonly used medication infusions in ICU and potential nutritional implications.

Table 6 Medication infusions used in ICU and possible nutritional implications

Medication	Possible nutritional implications
Inotropes e.g. noradrenaline infusion, adrenaline infusion, vasopressin.	- Increasing levels indicate severity of illness/unstable patient. - Inotropes can lead to hyperglycaemia. - Inotropes can increase energy requirements. - Avoid overfeeding patients with raised or increasing inotropic requirements.
Sedatives e.g. midazolam infusion, propofol infusion.	- Sedatives reduce energy requirements. - Sedatives reduce gut motility by relaxing visceral smooth muscle. - Propofol contains lipid which must be considered when devising

	nutrition support prescription, e.g. Lipuro contains MCT/LCT fat (0.01g fat/ml) and 1.058kcal/ml; Diprivan contains LCT fat (0.01g fat/ml) and 1.1kcal/ml.
Opioid analgesics e.g. morphine infusion.	- Reduce gastric emptying and lead to disordered motility in the duodenum.
Dopamine infusion.	- Decreases proximal gastric tone and decreases contractions in gastric antrum.
Gastric acid reducing agents.	- Can stimulate gastrin which inhibits gastric emptying.
Intravenous 5% Dextrose	- Gives 50g carbohydrate per litre, equivalent to 200kcal per litre.
Dialysate	- Consider energy derived from glucose containing dialysates.

When significant amounts of nutrients are provided or lost through means other than the nutrition support formula (e.g. intravenous infusions, drugs, dialysis mode), the nutrition care plan should be adjusted accordingly.[79]

Monitoring of Nutrition Support:[6,25,79]

An interdisciplinary approach is advised. See local guidelines for monitoring of nutrition support. Monitoring guidelines should include regular:

- Nutritional assessments.
- Measurement and interpretation of relevant biochemistry and haematological parameters.
- Clinical assessment (including gastrointestinal function, and changes in clinical condition that may have implications for requirements, fluid status, presence of organ failure, mode of dialysis, etc.).
- Dietary assessment if applicable.
- Nutrition support assessment (including nutritional adequacy, feed tolerance, etc.).
- Other patient-specific factors.

Swallow assessment and Speech and Language Therapist input:

The provision of diagnostic and therapeutic support is fundamental to the care pathway of critically ill people. Patients with critical care needs are frequently intubated due to respiratory failure, need for mechanical ventilation, assistance with secretion management and pulmonary hygiene and airway obstruction[80]. Intubation, by itself, can impair swallowing over a period of up to three days post extubation in patients with no other cause for dysphagia[81].

The current literature demonstrates a large amount of clinical evidence demonstrating that a tracheostomy tube influences swallowing[82]. The highest dysphagia frequencies occur following prolonged intubation. Current research suggests dysphagia frequency ranges from 3%- 62% as the period of intubation increases from 124.8- 346.6 mean hours[83].

Furthermore, patients with a tracheostomy may have communication problems that affect their ability to be involved in their own care[84]. All people with critical care needs who have communication and / or swallowing difficulties due to organic, concomitant or psychogenic disorders should have access to a timely and responsive speech and language therapy service.[85]

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