Proposed Nutrition Therapy per Phase of Critical Illness

The recent ESPEN guidelines (Singer et al., 2019) highlight the importance of recognising different phases of critical illness when considering route, timing and dose of nutrition support. Phases include: early acute phase, late acute phase and rehabilitation or chronic phase (i.e. post-acute phase) – see Figure 1. See Table 1 for nutritional targets during the different phases.

Figure 1: Phases of critical illness

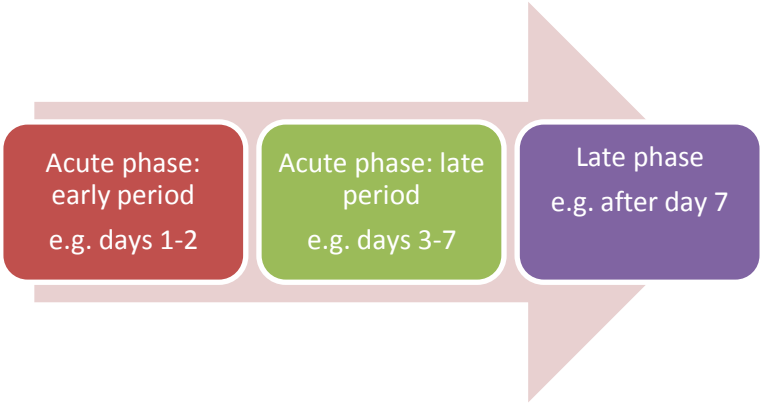

Table 1 Proposed nutrition therapy according to phase of critical illness (to be used as a guide and not to replace clinical judgement)

	Days* in ICU	Kcal Goal	Protein Goal	Considerations
Early Acute	0-2	≤15-20 kcal/kg	≤1g/kg	**Energy:** Include non-nutritional energy sources. Consider endogenous energy production and patient's capacity to mount this response. Unclear whether a very malnourished patient/starved patient will produce as much endogenous glucose as a well-nourished acutely unwell patient. Consider refeeding syndrome risk. Consider contraindications to feeding/feeding other than trickle feeding. **Protein:** Unknown whether patients with high losses, e.g. on CRRT, or with large wounds need more in first 2 days.
Late Acute	2-7	15-20-25 kcal/kg	1.2-1.5g/kg	**Energy:** Include non-nutritional kcal sources. Consider refeeding syndrome risk. Consider patients clinical status, more caution in patients who are sicker/not improving/deteriorating compared to less caution in patients who are improving. **Protein:** Progressive increase to target. Aim for more protein in patients with losses (e.g. CRRT, wounds, steroids, high drain outputs). Consider renal function if not on CRRT.

Post-acute chronic phase	7+	25-30 kcal/kg	1.5-2g/kg	**Energy:** Progressive increase to target. Monitor for signs of overfeeding. **Protein:** Protein targets in ICU patients remain unclear. Aim for more protein in patients with losses (e.g. CRRT, wounds, steroids, high drain outputs). Consider renal function if not on CRRT.
Post-acute rehabilitation phase	7+	25-30+ kcal/kg	1.5-2g/kg	**Energy:** Monitor for overfeeding. Consider activity level, amount and type of physiotherapy. Monitor dry weight; functional status e.g. hand dynamometry and physical status (NFPE/SGA) if trained. **Protein:** Consider renal function if not on CRRT. Consider activity level, amount and type of physiotherapy. Monitor functional status e.g. hand dynamometry and physical status (e.g. NFPE/SGA) if trained.

Key: *CRRT – continuous renal replacement therapy; NFPE – nutrition focused physical examination; SGA – subjective global assessment.*
**Number of days is only a guide, each patient's critical illness journey will differ. Critical illness may have commenced prior to ICU admission, or a few days into ICU admission. Acute phases may recur, e.g. new sepsis in a previously stable patient.*

Table 2 Medication infusions used in ICU and possible nutritional implications

Medication	Possible nutritional implications
Inotropes/vasopressors, e.g. noradrenaline, adrenaline, 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. - Ischaemic bowel is a rare complication associated with EN. For patients on vasopressor therapy, monitor all signs of enteral feeding intolerance closely, including (but not limited to) abdominal distension, increased GAV/GRVs, decreased passage of stool, hypoactive bowel, increased metabolic acidosis and/or base deficit. If suspect gut ischaemia, EN may need to be withheld until symptoms and interventions are stabilised (McClave et al. 2016).
Sedatives e.g. midazolam infusion, propofol infusion, dexmedetomidine, fentanyl, remifentanyl, vercuronium (muscle relaxant), sodium thiopentone	- 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 and Propofol 1% contain LCT fat (0.01g fat/ml) and 1.1kcal/ml. Propofol 2% contains 0.1g fat/ml and 1.1 kcal/ml (but lower volume needed compared with Propofol 1%).

Opioid analgesics, e.g. morphine infusion	-	Reduce gastric emptying and lead to disordered motility in the duodenum. Ensure adequate laxatives.
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.
Citrate	-	Net energy absorption from citrate during CVVH is not known but can be estimated if 50% absorption is assumed, as follows: [concentration of citrate containing solution in mmol/l x volume in ml/hr] x 0.59kcal x 0.50 = estimated energy provision (kcal).
Amiodarone (anti-arrythmic drug)	-	Metoclopramide (prokinetic) is contraindicated when on amiodarone infusion.
Inotropes/vasopressors, e.g. noradrenaline, adrenaline, 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. - Ischaemic bowel is a rare complication associated with EN. For patients on vasopressor therapy, monitor all signs of enteral feeding intolerance closely, including (but not limited to) abdominal distension, increased GAV/GRVs, decreased passage of stool, hypoactive bowel, increased metabolic acidosis and/or base deficit. If suspect gut ischaemia, EN may need to be withheld until symptoms and interventions are stabilised (McClave et al. 2016).

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.