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Original article

Nutrition therapy for critically ill patients across the Asia–Pacific and Middle East regions: A consensus statement

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SUMMARY

Background & aims: Guidance on managing the nutritional requirements of critically ill patients in the intensive care unit (ICU) has been issued by several international bodies. While these guidelines are consulted in ICUs across the Asia–Pacific and Middle East regions, there is little guidance available that is tailored to the unique healthcare environments and demographics across these regions. Furthermore, the lack of consistent data from randomized controlled clinical trials, reliance on expert consensus, and differing recommendations in international guidelines necessitate further expert guidance on regional best practice when providing nutrition therapy for critically ill patients in ICUs in Asia–Pacific and the Middle East.

Methods: The Asia–Pacific and Middle East Working Group on Nutrition in the ICU has identified major areas of uncertainty in clinical practice for healthcare professionals providing nutrition therapy in Asia–Pacific and the Middle East and developed a series of consensus statements to guide nutrition therapy in the ICU in these regions.

Results: Accordingly, consensus statements have been provided on nutrition risk assessment and parenteral and enteral feeding strategies in the ICU, monitoring adequacy of, and tolerance to, nutrition in the ICU and institutional processes for nutrition therapy in the ICU. Furthermore, the Working Group has noted areas requiring additional research, including the most appropriate use of hypocaloric feeding in the ICU.

Conclusions: The objective of the Working Group in formulating these statements is to guide healthcare professionals in practicing appropriate clinical nutrition in the ICU, with a focus on improving quality of care, which will translate into improved patient outcomes.

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1. Introduction

International bodies, including the American Society for Parenteral and Enteral Nutrition (ASPEN), the European Society for Clinical Nutrition and Metabolism (ESPEN), Society of Critical Care Medicine (SCCM) and Canadian Critical Care Nutrition Group at the Clinical Evaluation Research Unit (CERU), have formulated guidelines on when and how nutrition therapy should be administered to critically ill patients in the intensive care unit (ICU) [1–4]. These guidelines have been developed following comprehensive reviews and analyses of available data at the time of drafting, but technical and ethical difficulties in performing randomized controlled trials of nutrition therapy in the ICU mean the evidence is relatively weak compared with other areas of medicine. Many of the latest recommendations in the 2016 ASPEN/SCCM Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient rely on 'expert consensus' [4]. These guidelines and expert consensus, are largely developed in the context of North American and European practices. However, critically ill patients in the ICU in the Asia–Pacific and Middle East regions may not be subject to the same principles of nutrition management due to differences in culture, nutrition prior to entering the ICU and overall healthcare accessibility [5].

A recent study in China indicated that nutrition therapy in the ICU is being guided by a heterogeneous mixture of international and local guidelines [6]. While >80% of respondents to a survey indicated that they rely on the guidelines issued by ASPEN, >40% refer to more than one set of guidelines, including guidelines issued by ESPEN and the Chinese Society of Intensive Care Medicine [6]. However, half of the survey respondents did not believe that the ASPEN guidelines represented "best practice" for critically ill patients in China [6]. Similar difficulties in applying multiple sets of international guidelines have been reported in India [7].

In India and Jordan, enteral nutrition (EN) is prescribed almost exclusively by physicians [7,8]. Only around 40% of Jordanian ICU nurses report having guidelines on administering EN, and while 70% of nurses reported having a nutritional team within their hospital, only 15–28% had a nutritional team within their ICU [8,9]. Qualitative evidence suggests that nurses in Jordan are developing evidence-based protocols for administering EN when formal guidelines are absent, and are aware of the potential benefits of working within a multidisciplinary nutritional support team in the ICU [5,9].

The Asia–Pacific and Middle East Working Group on Nutrition in the ICU was formed to identify, examine and address local (unit-level) challenges and barriers to optimal nutrition therapy in the ICU. The Working Group convened in April 2016 to develop tailored guidance for ICUs in the region by developing a series of consensus statements for managing nutrition therapy for critically ill adult patients in the ICU.

2. Consensus statement development methodology

To identify current gaps in knowledge and practice across the region, a survey was developed and disseminated to ICU healthcare professionals in the region. The questions and answers from the survey, supplemented with a literature review, provided the basis for the questions posed to the Working Group to aid the development of consensus statements.

Members of the Working Group were divided into four groups, with each group researching and developing preliminary consensus statements in response to a subset of questions. The full Working Group reviewed, discussed and edited the preliminary consensus statements on the basis of the currently available data and their individual practical experience as experts in the Asia–Pacific and Middle East region.

The final statements were created via a Delphi method. If >70% of the Working Group accepted the final statement in the form that it was voted on, then it was considered to have been adopted. If <70% agreement occurred, the reasons for disagreement were to be identified and addressed before a second ballot was undertaken on the revised final consensus statements. If consensus was not reached in the second ballot, it was to be accepted that it was not possible to reach consensus and the question would instead be highlighted as an area requiring additional research.

3. Consensus statements

The full series of questions, consensus statements and the rationale behind these statements is detailed below. For all statements, unanimous agreement amongst the Working Group was achieved in the first vote.

3.1. Nutritional risk assessment in the ICU

Question: Should all patients admitted to the ICU undergo nutritional risk assessment?

Answer: All patients admitted into ICU should have nutritional risk assessment, preferably within 24 h of admission, or as soon as feasible. Nutrition risk assessment should be performed using a validated tool, such as Nutrition Risk Screening (2002 version; NRS-2002) or modified Nutrition Risk in Critically ill (NUTRIC) score. Formal risk assessment should not delay initiation of nutritional therapy.

Supplementary statement: While compromised baseline nutritional status or high nutritional risk should mandate timely nutritional provision as a clinical priority, assessment as well-nourished or low nutritional risk should not prohibit the early initiation of nutrition therapy provision.

Rationale: Patients entering the ICU have a higher nutrition risk than patients undergoing general admission to hospital. Malnutrition is associated with poorer clinical outcomes, including post-operative complications and mortality, although it must be noted that the definition of 'malnutrition' is likely to differ between institutions and healthcare professionals [4,10,11]. Therefore, it is recommended that a patient's nutritional risk be assessed as soon as feasible, ideally at the time of admission to the ICU, and preferably within 24 h, to facilitate timely initiation of EN within a timeframe of 24–48 h [4]. Assessment within 24 h is particularly important given the higher rates of malnutrition in many Asian countries compared with other regions [12], and as such, this should be factored into early nutritional risk assessments of critically ill patients.

While results from the survey indicate that the majority of respondents (55%) use subjective global assessment (SGA) to determine if a patient is malnourished, and some studies support the use of SGA in predicting nutritional outcomes in the ICU [13,14], a tool previously validated for assessing nutritional risk in the ICU should be used to assess the risk of malnutrition. While NRS-2002 score can be used for screening, the modified NUTRIC score (http://www.criticalcarenutrition.com/resources/nutric-score) is considered to be the optimal method of assessing nutritional risk in the ICU because it considers both nutritional status and disease severity [4,15–17]. Furthermore, as interleukin (IL)-6 measurement is not required for the 'modified' NUTRIC score [17], these tests should be feasible in many ICUs in the Asia–Pacific and Middle East regions. NRS-2002 was also developed to predict the outcomes of nutritional intervention in critically ill patients, and experience in Turkey has indicated its utility in identifying malnourished patients

independently of BMI [18]. However, NRS-2002 and the modified NUTRIC score are not exclusive nutritional risk assessment options [11].

Furthermore, nutrition therapy should not be delayed pending a formal nutritional risk assessment. Patients in the ICU characteristically have significantly increased metabolic demands putting them at higher risk of harm. This means lack of nutritional support for malnourished patients carries greater risk than providing support for well-nourished patients [19].

Question: What is currently the best method of determining total calorie requirements in an ICU patient?

Answer: Indirect calorimetry is the gold standard in determining calorie requirements and should be utilized where available. Where indirect calorimetry is not available, a weight-based predictive equation (25–30 kcal/kg) is an acceptable alternative method to guide caloric prescription. At the extremes of BMI, these calculations become inaccurate and may need adjustment. A weighing scale should be used at the time of admission, if available. If unavailable, recent weight, or estimated weight, can be used. Irrespective of the method used to determine caloric requirements, regular monitoring and re-assessment should be performed.

Rationale: While indirect calorimetry is the 'gold standard' for measuring resting energy expenditure in critically ill patients [20], it is recognized that many ICUs in Asia–Pacific and the Middle East will not have access to an indirect calorimeter (86% of survey respondents do not have access to indirect calorimetry and 76% of those who have access use indirect calorimetry infrequently). Therefore, when indirect calorimetry is not available, weight-based predictive equations, such as the Harris-Benedict, Penn State University or Mifflin-St. Jeor equations, are acceptable alternatives alongside clinical judgment, ie, the 'rule-of-thumb' method that was used by 73% of survey respondents [4,20]. When estimating a critically ill patient's resting energy expenditure the patient's actual weight should be used [20]. However, it must be noted that assessing the 'true' weight of patients in the ICU can be difficult, for example, in patients who have received aggressive resuscitation and subsequently carry extra fluid weight that may confound weight calculations, hence the Working Group suggest recent weight as an appropriate estimate for use in calculating resting energy expenditure. At the extremes of BMI, these calculations may become inaccurate and may need adjustment, but it must be noted that these adjustments are recommended on the basis of expert opinion and are not strictly evidence-based [20]. As an example, for patients with a BMI >50 kg/m^2, calculations may be adjusted to 22–25 kcal/kg ideal body weight/day [4]. Further compounding the difficulty in acquiring weight measurements is the lack of bed scales in ICUs across the region.

In a 2013 study on the prevalence of overweight and obesity worldwide, Asian countries had fairly lower rates of obesity for both men and women 20 years and older [21]. The average obesity prevalence of Asian men was 4.8% while, for Asian women, prevalence was 5.5% [21]. In Australasia, the rates were much higher at 27.6% for men and 29.8% for women [21]. For Middle East countries, obesity was also noted to be more prevalent with rates of 20.3% for men and 33.9% for women [21]. The prevalence of obesity among ICU patients in Asia was calculated at only 9%, as reported from the International ICU Nutrition Survey of 2013 (unpublished data; D.K. Heyland, personal communication).

Permissive hypocaloric feeding (defined as <20 kcal/kg/day with adequate protein [1.2–2.2 g/kg/day]) is not appropriate for most patients, but can be appropriate for some patients with a low nutrition risk and specific conditions, such as obese patients or patients with acute respiratory distress syndrome requiring mechanical ventilation for >72 h, and should be given for a maximum of 6 days [3,4]. Expert consensus in the ASPEN guidelines suggests that permissive hypocaloric feeding, while maintaining protein targets, is an option for preserving lean body mass and mobilizing adipose stores in obese patients, while avoiding the metabolic complications of overfeeding. This consensus was formed on the basis of limited data suggesting comparable, if not better outcomes, compared with normocaloric feeding, provided protein intake approached or achieved targets [4]. A degree of weight loss for obese patients in the ICU may assist with nursing care, reduce the risk of comorbidities and increase insulin sensitivity, which may help avoid worsening hyperglycemia in critically ill patients with diabetes [4]. Recent data suggest an increased risk of nosocomial infection with hypocaloric feeding, but lower insulin demand and gastrointestinal (GI) intolerance, so caution is urged in patients who may be malnourished prior to entering the ICU [1,22]. The Working Group considers that, in view of the increasing evidence supporting the benefit of adequate protein provision in the critically ill population, trophic feeding – the intentional feeding of a portion of the stated energy and protein goal, usually 25% of goal energy or 10–15 kcal/kg/day [23] – should only be considered as a bridge to achieving target feeding goals and not continued for more than 4 days. Trophic feeding should not be confused with hypocaloric high protein feeding which has previously been practiced in the obese ICU patient, but is now being extrapolated to non-obese ICU patients.

Regular monitoring and re-assessment of patients' nutritional risk should be performed as the patient's physiological needs may not be met if the estimated resting energy expenditure rate is inaccurate [20]. In the rare case of permissive hypocaloric feeding, the same approach to patient monitoring should be used.

Question: When should nutrition therapy be initiated in the ICU?

Answer: Every attempt should be made to initiate early nutrition therapy as soon as feasible (within 48 h) in critically ill patients requiring nutrition therapy, unless there are significant contraindications. If EN is absolutely contraindicated, parenteral nutrition (PN) should be considered within 48 h of admission in patients at high nutrition risk. Nutrition therapy can be safely started after hemodynamic stability has been achieved.

Rationale: EN supports the functional integrity of the gut, and a loss of this functional integrity is time-dependent following major insult or injury [4,7]. Early EN is likely to reduce the risk of infection and organ failure, and have a positive impact on the patient's length of hospital stay, hence the recommendation that EN is initiated as soon as feasible [4,24]. Early EN in critically ill patients may be feasible as early as <6 h [25].

EN is preferred given the lower risk of infection and reduced hospital length of stay compared with PN [4,26]. However, if EN is contraindicated, PN should be considered to ensure that the patient is receiving the benefits of nutrition therapy [27].

The ASPEN/SCCM guidelines define hemodynamic instability as hypotension (mean arterial blood pressure [MAP] <50 mm Hg), for whom catecholamine agents (eg, norepinephrine, phenylephrine, epinephrine, dopamine) are being initiated, or for whom escalating doses are required to maintain hemodynamic stability [4]. Alternatively, the Surviving Sepsis Campaign defines hypotension in patients with sepsis as systolic blood pressure (SBP) <90 mm Hg or MAP <70 mm Hg or a SBP decrease >40 mm Hg or less than two standard deviations below normal for age in the absence of other causes of hypotension [28]. Patients with stable blood flow parameters (ie, hemodynamic stability) can be safely administered nutrition therapy even if patients are receiving vasopressor therapy, although caution should be exercised in patients who are undergoing active titration of vasopressors [1,4,29]. Hemodynamic stability may be defined as achieving the target hemodynamic goals without further escalation of vasoactive infusions or fluid

boluses in the preceding 2 h. For the patient in shock, EN may be initiated as soon as shock has stabilized (Shock Index ≤1 for at least 1 h [Shock Index = heart rate/SBP]) [30].

Question: In a critically ill patient who requires nutrition therapy, should therapy be initiated with EN or with PN?

Answer: Enteral nutrition is the preferred choice unless contraindicated.

Supplementary statement: When EN is contraindicated, PN should be considered to avoid nutritional compromise.

Rationale: The relative benefits of EN versus PN in patients in the ICU are well established, particularly regarding the reduced risk of infection and decreased length of hospital stay, and have been extensively reviewed [1,4]. For patients who have contraindications for EN, PN should still be considered to ensure that patients receive appropriate nutritional therapy to help avoid the consequences of nutritional compromise [1].

Question: Should PN be considered for patients at high nutrition risk when EN is not feasible?

Answer: Yes, when EN is contraindicated or not feasible, PN should be considered as soon as possible (within 48 h) in high nutritional risk patients who are hemodynamically stable. For optimal patient care, appropriate intravenous (IV) access protocols (central or peripheral), infection control practices and hang times (up to 24 h per bag) should be adhered to when providing PN.

Rationale: While EN is preferable in the ICU, PN should be initiated when EN is not feasible or contraindicated [1,4]. As with EN, PN should be initiated as soon as possible as part of providing optimal care for patients with high nutritional risk [4]. However, it is noted that while PN should be considered within 48 h, this is not synonymous with PN being initiated within 48 h, as this will be dictated by patient circumstances. PN should only be initiated within 48 h after considering an appropriate caloric and protein target for the patient's clinical condition, with care taken to prevent refeeding syndrome or hyperglycaemia.

When administering PN, appropriate IV access protocols for both central and peripheral access, should be followed, as well as infection control practices being upheld. Optimal care should be provided to patients by adhering to evidence-based infection control processes, and properly maintaining and monitoring PN [31]. Both the US Centers for Disease Control [32] and European Union [33] offer resources that can be used to help develop and improve infection control in hospitals.

Custom-mixed bags prepared in a pharmacy may be preferred, if available, but it is noted that only pre-mixed bags are an option in some instances. Strict adherence to labeled admixture practices and ensuring hang time of no longer than 24 h is essential.

The Working Group recognizes that PN can be more costly than EN and that nutrition practice is dictated by differences in medical payment schemes, PN availability and knowledge in PN use.

Question: What is the preferred route of EN delivery?

Answer: Unless otherwise contraindicated, gastric feeding (through nasal or oral gastric tubes) should be attempted.

Rationale: EN via a gastric, as opposed to jejunal, tube is preferred due to easier technique and feasibility at the bedside, thereby reducing time to initiation of nutrition therapy [4,34]. Gastric tube feeding is also associated with a shorter time between tube insertion and reaching goal feeding rate compared with jejunal feeding [34]. While it is acknowledged that there is evidence to suggest that a jejunal tube decreases the risk of infection, reports of the relative efficacy of gastric versus jejunal tubes are inconsistent and no difference in the length of hospital stay or mortality have been reported [1,4]. Therefore, on the balance of the available body of evidence, and in alignment with the broader context of these consensus statements, facilitating early initiation of nutrition therapy using a gastric tube takes precedence over delayed nutrition therapy via a jejunal tube in the absence of data that suggest a clear benefit of potentially delayed feeding via a jejunal tube.

Question: With what kind of formula should EN be initiated?

Answer: Standardized high-protein polymeric formulas are the preferred choice for most patients. Routine use of disease-specific formulas is not recommended for initiation.

In specific patient groups, specialized formulas can be considered where available.

- Immune-modulating enteral formulas for perioperative and trauma patients.
- Oligomeric/monomeric (peptide/medium chain triglyceride [MCT]-containing) formulation for patients with a compromised GI tract.

Current evidence does not support blenderized/mixed feeds as an optimal choice, but the Working Group acknowledges that blenderized/mixed feeds are being used in some institutions in the region.

Rationale: Standardized high-protein polymeric formulas, comprising whole proteins as opposed to peptides are the preferred choice for most patients receiving nutrition therapy in the ICU, but it is recognized that access to these formulas may be limited for many ICUs in Asia–Pacific and the Middle East (38% of survey respondents use blenderized tube feeds) [1,4]. It is imperative to provide the patient with the best available nutrition therapy, in which case blenderized/mixed feeds may be acceptable, but it should be noted that a high degree of variability in nutrient concentrations has been reported amongst blenderized feeds, even within institutions, and may deliver lower amounts of nutrients than expected [7,35,36]. Furthermore, if blenderized feeds are used, they should be administered as soon as possible given the relatively high risk of contamination that is aggravated by lengthened times between preparation and administration [35,37]. This is in agreement with the World Health Organization (WHO) technical consultation on hospital nutrition practices in South-East Asia where they noted that blenderized diets have not been shown to be effective in delivering adequate nutrients and should be avoided especially in the very sick hospitalized patient (eg, severely malnourished critical care or geriatric patient). However, these may be given if standardized high-protein polymeric formulas are not available [38]. Apart from nutrient inconsistencies and an increased risk of infection during delivery and preparation, blenderized tube feeds pose other potential problems (https://med.virginia.edu/ginutrition/wp-content/uploads/sites/199/2014/06/Parrish-Dec-14.pdf). Such feeds can clog feeding tubes and may be difficult to deliver via an enteral pump. Furthermore, the suggested hang time for each infusion must not exceed 2 h to prevent bacterial contamination. Other suggestions on the optimal preparation and use of blenderized tube feeds are available in the link provided above.

The Working Group has deemed it more culturally acceptable to avoid using the term “commercial formulas” or “industrialized formulas”, making it appear that these are not scientific and evidence-based. Unless specified as “blenderized”, all other EN formulas mentioned in this paper are science-based, specialized nutrition.

While it is acknowledged that a reduced risk of adverse events has been reported for peptide versus polymeric formulas in some studies, the data are inconsistent. Therefore, their general use on the basis of an improved cost:benefit ratio cannot be recommended [1,39,40]. Furthermore, the routine use of specialized formulas (eg, disease- or organ-specific formulas) when initiating nutrition therapy is not recommended in the absence of a clear benefit in a general ICU setting [4,39].

There is limited evidence for use of specialized formulas outside of perioperative and trauma patients in the ICU and patients with a compromised GI tract, for example, patients with persistent diarrhea, suspected malabsorption or who are at risk for ischemic bowel. Immune-modulating enteral formulas enriched with arginine, nucleotides and omega-3 fatty acids may offer a superior treatment option compared with standard formulas for perioperative and trauma patients [1,4,41]. Furthermore, data indicate that oligomeric/monomeric (peptide/medium chain tryglyceride-containing) formulations are better tolerated by patients with a compromised GI tract because these peptides are water-soluble and quickly absorbed by the intestine and metabolized by the liver [39,41].

3.2. Enteral nutrition dosing in the ICU

Question: How quickly should a patient at high nutrition risk be advanced towards reaching their nutrition goal?

Answer: Critically ill patients with high nutrition risk should have their protein and calories advanced towards their prescribed goal as quickly as clinically feasible and safe, reaching at least 80% of goal within 5 days. Patients at high nutrition risk should be monitored and managed for refeeding syndrome.

Rationale: The first nutrition priorities for any patient admitted to the ICU are to determine nutrition goals by assessing their nutritional status and initiating nutrition therapy as soon as feasible [1,4]. Reaching nutrition goals is a subsequent priority. Furthermore, while EN is the preferred option for administering nutrition therapy, nutrition goals should be achieved using any available and appropriate means [1,4]. In particular, supplemental PN should be administered within 72 h in high-risk patients receiving EN [4].

Accordingly, it was agreed that the expert consensus on timelines for reaching nutrition goals reported in the ASPEN guidelines (increasing feeding to goals within the first week of ICU stay) should be adopted in the Asia–Pacific and Middle East regions [4].

Refeeding syndrome is defined as potentially fatal changes in fluid and electrolyte levels in malnourished patients caused by rapid metabolic and hormonal changes occurring when reinitiating nutrition after prolonged fasting [42]. For patients with risk factors for refeeding syndrome (Table 1), the Working Group recommends following the treatment protocol outlined in Section 1.4.8 of the National Institute for Health and Care Excellence guideline for nutrition support for adult: oral nutrition support, enteral tube feeding and parenteral nutrition (https://www.nice.org.uk/Guidance/cg32) [43].

Question: How much protein should be provided to a critically ill patient?

Answer: Protein requirements in the range of 1.2–2.2 g/kg/day should be provided to critically ill patients. Adjustments to the protein goals below or above this range can be made depending on the nature of the illness, organ function and catabolic stress.

Supplementary statement: The Working Group acknowledges that recent literature has highlighted the benefits of achieving higher protein goals.

Rationale: Each patient's protein requirements depend on organ function, severity of illness and catabolic stress. For example, protein requirements may be higher in burns patients or patients with multi-trauma [4].

Protein intake of 1.2–2.2 g/kg/day should be appropriate for critically ill patients, although it should be noted that the upper bounds of this range is greater than the 2.0 g/kg/day recommended by the 2016 ASPEN/SCCM guidelines as recent data indicate that protein intake can be increased in patients receiving EN without increasing the risk of adverse events [4,44]. Likewise, weight-based equations for determining appropriate protein intake requirements may be overly simplistic. So, in the absence of adverse events being reported in patients administered protein above their requirements, it is preferable to avoid protein levels that are too low, and therefore inadequate [4,44].

For certain patients (ie, those with high protein loss) increasing protein intake (up to 2.5 g/kg/day) may be considered, but there is a paucity of strong data from clinical trials to recommend this. Protein intake exceeding 2.5 g/kg/day can increase the risk of oxidation or proteinuria, so clinical judgment should be used if considering this level of protein [45].

Question: Is it appropriate to consider supplemental PN?

Answer: For patients with high nutritional risk, supplemental PN can be considered if EN fails to provide more than 60% of nutrition goal (calories and proteins) after 3 days. For all other patients, supplemental PN can be considered where EN fails to provide more than 60% of nutrition goal (calories and proteins) after 7 days.

Rationale: International guidelines on the timing of initiating PN are conflicting. The ASPEN/SCCM guidelines favor a delay in providing supplemental PN until at least 7 days after initiating EN for all patients [4], while ESPEN recommends that all patients who are not expected to be on normal nutrition within 3 days should receive PN within 24–48 h if EN is contraindicated or not tolerated [46]. It is the view of the Working Group that, in context of the higher prevalence of malnutrition amongst the general population in the Asia–Pacific and Middle East regions [12], delaying supplemental PN may compound the risks associated with a negative energy balance in critically ill patients, including infection, and increased days of mechanical ventilation and ICU stay [47].

Furthermore, there are limited data comparing early versus late PN, often with mixed or unclear outcomes [48]. However, early PN is associated with superior uptake of calories and protein compared with late EN and PN, indicating that it should be considered early for patients with a high nutrition risk, and supplemental PN in patients receiving <60% of the target energy provision at Day 3 has been shown to decrease the risk of infection in patients in the ICU [48,49]. Therefore, starting supplemental PN, as stated by the Working Group, is considered to be appropriate for patients who have been assessed as having a high nutrition risk and EN has failed to provide more than 60% of nutrition goals (calories and protein) after 3 days in the ICU.

While supplemental PN should ideally be guided by indirect calorimetry to prevent overfeeding and if sufficient precautions are

Table 1
Risk factors for refeeding syndrome [42].

Patient has one or more of the following:	OR	Patient has one or more of the following:
• BMI < 16 kg/m^2 • Unintentional weight loss >15% within the last 3–6 months • Little or no nutritional intake for >10 days • Low potassium, phosphate or magnesium levels prior to initiating EN or PN		• BMI < 18.5 kg/m^2 • Unintentional weight loss >10% within the last 3–6 months • Little or no nutritional intake for >5 days • A history of alcohol abuse or drugs, including insulin, chemotherapy, antacids or diuretics

taken to avoid overfeeding, there is a low risk of harm to patients at high nutrition risk after 3 days. During this time, the catabolic response to trauma resolves while offering the ability to reach nutrition goals faster [19].

3.3. Monitoring adequacy of, and tolerance to, enteral nutrition in the ICU

Question: How regularly should patients be monitored for adequacy of, and tolerance to, EN?

Answer: In critically ill patients fed by EN, we recommend daily monitoring of clinical parameters for:

- Adequacy of calorie and protein intake (according to hospital protocol).
- Intolerance (for example, abdominal pain, abdominal distension, flatus, diarrhea, GI reflux and vomiting, reduced bowel activity).

Rationale: Daily monitoring is recommended to ensure that patients are moving toward nutrition goals, it is estimated that <50% of critically ill patients will reach their target energy intake during their stay in the ICU. In a 2013 report, the prevalence of iatrogenic underfeeding in Asian ICUs was 82%, potentially due to feeding interruptions related to ventilation-related procedures, nasogastric aspiration or GI symptoms appearing [4,50,51]. Daily monitoring using clinical parameters can help identify undernutrition and facilitate appropriate action. It is recommended that institutions develop a daily monitoring protocol [4]. Several examples of hospital nutritional protocols are available online that may be used as resources to support protocol development (see Clifford *Crit Care Resusc* 2010, Canadian Critical Care Guidelines or SCCM/ASPEN guidelines) [3,4,52].

Intolerance to EN has been observed in approximately 33% of patients in Asia, and almost half of patients in the Middle East, and is associated with lower energy and protein intake. In turn, this leads to poorer clinical outcomes [53]. However, based on the International ICU Nutrition Survey of 2013, the rate of EN interruption due to severe diarrhea in Asian ICUs was minimal at only 0.56% (unpublished data; D.K. Heyland, personal communication). Intolerance may be observed as abdominal pain, abdominal distention, flatus, diarrhea, GI reflux and vomiting or reduced bowel activity, but this should not be considered to be an exhaustive list of symptoms [4,53,54].

At this time, there is insufficient evidence to support a recommendation highlighting which laboratory parameters should be monitored, and how frequently, in patients receiving nutrition therapy in the ICU [55].

Question: Should any of the following measures be proactively employed to prevent aspiration: (i) Head-of-bed elevation; (ii) Selective use of motility agents; (iii) Use of continuous EN.

Answer: (i) Critically ill patients receiving EN should have the head of bed elevated (to 30–45°) unless there is a significant contraindication. (ii) Use of motility agents routinely as a measure to prevent aspiration is not warranted. It is recommended in critically ill patients who experience feeding intolerance. (iii) Continuous EN is recommended in patients at high risk of aspiration; the Working Group acknowledges that there are different methods of continuous EN. At the current time, bolus feeding in the ICU cannot be recommended.

Rationale: Raising the head of the bed for patients on EN to a 30–45° angle is recommended to reduce the risk of aspiration [3,4,56]. However, raising the head of bed to this range may be contraindicated for some patients, for example, those who are hemodynamically unstable [56].

Alterations in gut motility may occur in the ICU and are often related to medications, such as opiates, proton pump inhibitors, midazolam and calcium channel blockers [57]. This can lead to diarrhea, abdominal distention, vomiting or regurgitation, which can be relieved with prokinetic agents, such as erythromycin, domperidone and metoclopramide [4,57]. While these motility agents improve gastric emptying and tolerance of EN, they have not been shown to significantly improve clinical outcomes and in the case of erythromycin, may also increase the risk of microbial antibiotic resistance [4]. Therefore, while the routine use of motility agents cannot be recommended for all patients, their selective use may improve tolerance of EN in patients exhibiting symptoms of intolerance [58].

Patients who are intolerant to bolus EN should be given continuous EN as this may reduce the risk of aspiration and pneumonia and result in fewer interruptions to nutrition therapy [4]. It was therefore the consensus of the Working Group that EN feeding in the ICU should be delivered continuously, especially in the early phase of an ICU stay. However, once patients are more stable and demonstrate greater tolerance to EN, bolus delivery is an option as it mimics physiologic patterns of feeding and may reduce costs by decreasing the use of special feeding equipment and pumps. Some recent examples in the literature have shown tolerance to bolus feeding amongst critically ill patients [59,60].

Question: Would you recommend the routine monitoring of gastric residual volumes (GRVs) during EN?

Answer: Measurement of GRVs correlates poorly with aspiration risk and is associated with decreased calorie delivery; therefore, routine measurement of GRV is unnecessary. GRV monitoring should be considered in patients who exhibit signs of intolerance, eg, nausea, vomiting, abdominal pain, abdominal distension or deterioration in overall status. If GRV is measured, hospital protocols should be established for cut-off values: Volumes over 500 mL should result in withholding of feeds.

Rationale: Methods of measuring GRVs are not standardized or validated and lack reproducibility [61]. Furthermore, GRV alone does not correlate with radiologic abdominal findings and the link between gastropulmonary aspiration and ventilator-assisted pneumonia is uncertain [61,62]. The potential adverse impact of routinely measuring GRV on nutrition therapy to assess feed tolerance, including interruptions to EN, tube clogging and costs do not outweigh the potential benefit of detecting GI intolerance that may not have been initially detected via an alternate method [4,61]. However, measuring GRV does offer a simple method of investigating GI dysfunction (eg, small bowel obstruction) in patients exhibiting signs of intolerance, such as nausea, vomiting, abdominal pain, abdominal distension or deterioration in overall status [61].

While it is recommended that individual hospitals should develop nutrition protocols for the ICU that include GRV cut-off values, evidence suggests that GRVs <500 mL do not increase the risk of regurgitation, aspiration or pneumonia, so feeds should only be withheld when a patient's GRV is >500 mL [4]. However, observational studies have suggested that a GRV of >150 mL may indicate slow gastric emptying and a risk of vomiting, and a GRV ≥250 mL or two or more GRVs ≥200 mL are independent risk factors for aspiration [61]. In addition, the likelihood of pulmonary complications is increased when a combination of GRV, vomiting and/or clinical GI symptoms are observed [59]. Therefore, GRVs should be individualized for each patient as monitoring may be indicated in patients with clinical symptoms. Furthermore, when administering EN, steps should be taken to reduce the risk of aspiration and improve tolerance to gastric feeding, such as using a prokinetic agent, continuous infusion, chlorhexidine mouthwash, as well as elevating the head of bed, and diverting the level of feeding to a lower point in the GI tract [3,4].

3.4. Institutional processes for nutrition therapy in the ICU

Question: Would you recommend the development and implementation of nutrition therapy protocols?

Answer: We recommend the development and implementation of institutional nutrition therapy protocols. These may provide strategies to overcome the barriers to achieving delivery of nutrition therapy to meet nutrition goals.

Rationale: Clear and consistent guidance on nutrition therapy is necessary to achieve optimal outcomes for patients in the ICU, particularly when patients are being treated by a multidisciplinary team. Furthermore, levels of education, knowledge and experience with nutrition therapy in the ICU throughout Asia–Pacific and the Middle East are variable, so developing and implementing institutional protocols are essential for consistent, timely and appropriate delivery of nutrition therapy [5,9,10].

Question: Who is responsible for nutrition therapy in the ICU?

Answer: We recommend that patients requiring nutrition therapy should receive co-ordinated care from a multidisciplinary team.

Rationale: It is suggested that ideally a Nutrition Therapy Team should be multidisciplinary and can include [10].

- Intensivists/Clinical Nutrition Physicians
- Dietitians
- Clinical pharmacists
- Nurses
- Physical therapists.

It is recognized that this multidisciplinary Nutrition Therapy Team is an ideal and for most institutions in Asia–Pacific and the Middle East, forming teams with members from each of these specialities may not be feasible, and facilitating daily reviews of nutrition therapy strategies alongside other therapy targets, such as fluid balance goals, may be challenging [5,7,9]. For example, only 36% of survey respondents indicated that their hospitals had a nutrition team and only 55% of these teams provided daily ICU coverage. However, nurses in Jordan, for example, believe that being included in a multidisciplinary team is likely to enhance nutrition therapy in the ICU [5]. Likewise, this list of specialities provided should not be considered to be exhaustive and any other healthcare professional who may be able to appropriately contribute to the nutritional wellbeing of patients in the ICU should be invited to participate as a member of the Nutrition Therapy Team.

Every team member should be encouraged to document and communicate information that is relevant to a patient's nutritional status to facilitate rapid and optimal nutritional interventions, as necessary, to improve patient outcomes [5,10]. Communication within the team is a key aspect of facilitating effective outcomes from a multidisciplinary nutrition team.

4. Areas requiring additional research

Many areas of nutrition therapy in the ICU remain under-researched, with limited, often inconclusive, data being available to support evidence-based guidelines, which in turn lead to many guidelines and recommendations being made on the basis of expert consensus. However, there are currently several areas of interest that require more research, particularly in this region.

For example, the potential role of permissive hypocaloric feeding is not clear. Importantly, 'optimal nutrition' may not necessarily be defined as replacing 100% of the energy lost as catabolic processes take hold following trauma. However, studies of hypocaloric feeding have reported inconsistent results that have been complicated by potentially confounding factors, such as patient comorbidities, and differences in study design [22]. Furthermore, these studies have largely been performed in North America, so caution is required in extrapolating data from these studies to the Asia–Pacific and Middle East regions.

The role of permissive hypocaloric feeding is also intertwined with the use of supplemental PN alongside EN, which is also subject to inconsistent data, but as noted in the consensus statements, certain interventions may be appropriate for sub-populations, rather than all patients in the ICU, but as yet data from sufficiently powered patient sub-population studies are not available [4,22].

Furthermore, examining outcomes in patients administered science-based versus blenderized feeds is of interest. Currently, there are limited studies within the ICU setting and endpoints have been limited to the composition and contamination of feeding preparations rather than clinical outcomes [35–37]. While cultural sensitivities may play a role in defining the choice of feed that is selected, additional objective evidence may be necessary to support and guide the use of standardized formulas in the ICU.

Likewise, whether or not GRVs should routinely be measured in the ICU remains a controversial topic, despite being addressed in evidence-based guidelines [4,62]. Therefore, region-specific data on clinical correlates for GRVs in patients could be used to guide regional and local protocol development surrounding the use of GRVs in the ICU.

Some studies have also suggested that early PN to complement EN may increase, rather than prevent, muscle loss [63]. Therefore, additional research on defining optimal protein intake and timing, and the potential of early mobilization to help prevent muscle loss may be of interest.

5. Future directions

Following the publication of these consensus statements, a follow-up survey will be conducted to assess if these statements have been implemented. These survey data will also be used to gauge and guide future research and consensus papers.

6. Conclusions

Nutrition therapy for critically ill patients in the ICU in the Asia–Pacific and Middle East regions presents unique challenges compared with other areas of the world. While many elements of guidelines issued by international bodies may be relevant and applicable to ICUs within these regions, institutions should develop their own protocols and form multidisciplinary Nutrition Therapy Teams to implement optimal nutrition therapy for patients that can be adapted to local and individual requirements.

Conflicts of interest

M. Sioson disclosed speaking engagements on behalf of Nestle, Abbott Nutrition, B. Braun, Fresenius Kabi and JW; M.B. Mat Nor disclosed relationships with Nestle Health Science (educational grant recipient) and J.E. Palo disclosed medical education or conference support from Abbott, Fresenius Kabi and Nestle. All other authors have no financial disclosures.

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