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Parenteral vs. enteral nutrition: Evidence-based guidelines for critical care

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Abstract
Nutritional support is a cornerstone of care for critically ill patients. Enteral nutrition (EN) and parenteral nutrition (PN) differ in physiologic effects, risks, logistics and cost. Over the last two decades practice has moved toward earlier use of the gut when safe, driven by guideline recommendations and meta-analytic data suggesting reduced infectious complications and intensive care unit length of stay with EN, while mortality effects are inconsistent. However, PN remains essential when EN is contraindicated or insufficient, and supplemental PN can be used to meet energy/protein targets when EN alone cannot. This review synthesizes contemporary guideline recommendations (ESPEN, ASPEN/SCCM), randomized trials, systematic reviews and meta-analyses to present practical, evidence-based guidance for selecting and managing artificial nutrition in critically ill adults. Key recommendations: prioritize EN where feasible and safe; initiate EN early (within 24-48 h) for most patients; use PN when EN is contraindicated or if caloric/protein goals cannot be met after an appropriate trial of EN; monitor for and prevent complications (aspiration, refeeding, catheter infections, hyperglycemia); individualize timing/route in high-risk subgroups.

Keywords: Enteral nutrition, parenteral nutrition, critical care, guidelines, ASPEN, ESPEN, early enteral nutrition

Introduction

Critically ill patients experience rapid metabolic shifts (hypermetabolism, catabolism) and are at high risk for malnutrition, which is associated with worse outcomes (Sharma *et al*., 2019) [38]. Provision of adequate energy and protein is a modifiable element of care that influences infections, organ dysfunction, and recovery (Weijs *et al*., 2014) [45]. Nutrition can be supplied enterally (through the gastrointestinal tract) or parenterally (intravenous), or with a combination (supplemental PN). (Worthington *et al*., 2017) [46] Choosing a route must balance physiologic benefits of gut feeding (e.g., preserved gut integrity and immune function) against aspiration risk and gastrointestinal intolerance; and the risks of PN such as catheter-related bloodstream infection, metabolic complications and cost (Delsoglio *et al*., 2020) [14]. Recent society guidelines (ESPEN, ASPEN) and multiple randomized trials and meta-analyses have informed contemporary practice, emphasizing early enteral nutrition (EEN) when possible but recognizing clear indications for PN.

This narrative review synthesizes recommendations and evidence from major society guidelines and high-quality systematic reviews and meta-analyses published through 2025, including ESPEN practical guidelines for ICU nutrition, ASPEN/SCCM guideline updates, Cochrane reviews and recent RCT meta-analyses. Key online databases and guideline repositories (Clinical Nutrition/ESPEN site, ASPEN, PubMed, Cochrane Library) were the primary sources for guidance and evidence statements referenced here.

Physiologic rationale: why route matters

EN delivers nutrients via the gut and maintains mucosal integrity, gut-associated lymphoid tissue function and normal enterohepatic signaling; it helps preserve the microbiome and reduces bacterial translocation (De Santis *et al*., 2015). PN bypasses the GI tract and provides complete nutrient delivery regardless of gut function; however, PN deprives the gut of luminal nutrients, potentially promoting mucosal atrophy and dysbiosis, and requires central venous access which carries infection and technical risks (Pierre, 2017) [29]. These mechanistic differences underpin the clinical trade-offs seen in trials: EN is associated with fewer infections and shorter ICU stays in many studies, while PN can reliably meet nutritional targets when EN is impossible (Reader *et al*., 2018) [33].

Evidence comparing EN and PN in critically ill adults

1. Mortality

Meta-analyses and systematic reviews over the past decade show inconsistent effects of EN vs PN on overall mortality (Elke *et al*., 2016) [16]. Several pooled analyses report no clear mortality advantage for EN versus PN when confounders are considered; earlier trials that compared PN to delayed EN sometimes showed benefits for early nutritional support, but modern practice compares early EN to early PN or combined strategies with less striking mortality differences. Thus, mortality alone is not the primary driver for route selection (Peter *et al*., 2005) [27].

2. Infectious complications

The most consistent finding across systematic reviews and guideline syntheses is a reduction in infectious complications with EN compared with PN (Petrov *et al*., 2008) [28]. ESPEN and other meta-analyses report lower rates of catheter-related and other infections with EN, a critical consideration given infection-related morbidity and costs (Al-Zubeidi *et al*., 2024).

3. ICU and hospital length of stay (LOS) and ventilator days

Several meta-analyses report shorter ICU and hospital LOS with EN versus PN and some show shorter duration of mechanical ventilation (Damuth *et al*., 2015) [11]. These effects likely follow from lower infection rates and improved gut-mediated immunity, though heterogeneity across trials exists (Chakaroun *et al*., 2023) [8]. Recent meta-analyses focused on early EN show reductions in ICU-LOS versus early PN.

4. Gastrointestinal complications and tolerance

EN is associated with a higher incidence of GI intolerance (high gastric residuals, vomiting, diarrhoea, gastric distension) compared with PN (Xiao*et al*., 2025) [47]. However, many GI issues are manageable with prokinetics, post-pyloric feeding, adjustment of rate/formula or intermittent feeding strategies (Marik and Zaloga, 2003) [22, 48]. The increased GI adverse events must be balanced against the infection benefits of EN.

5. Comparative evidence for supplemental PN (SPN)

When EN cannot meet nutrition goals, supplemental PN added to EN (SPN) has been studied. Evidence suggests SPN can improve calorie/protein delivery and may improve selected outcomes (nutritional adequacy), (Russell and Wischmeyer, 2018) [36] but trials have not uniformly demonstrated clear clinical outcome benefits (mortality) and risk of infection remains a concern unless catheter care is optimal (Johnson, *et al*., 2006) [18]. Guidelines recommend cautious use of SPN when EN is insufficient despite efforts to optimize (Bischoff *et al*., 2015) [6].

6. Quality and certainty of evidence

Many trials vary in patient mix, timing of initiation, energy targets and use of modern infection-prevention techniques, producing heterogeneity and sometimes low certainty for several outcomes (McCleary and Tajchman, 2016) [24]. Cochrane and other reviews often grade evidence as low to moderate certainty for key outcomes, underscoring the need for individualized decisions and further RCTs in targeted populations (Shao *et al*., 2023) [37].

Timing: early vs delayed nutrition

Most contemporary guidelines recommend initiating nutritional support early in the course of critical illness commonly within 24-48 hours for patients who are hemodynamically stable and have a functional or potentially restorable GI tract. Early enteral nutrition (within 24-48 h) is associated with lower infection rates and possibly shorter ICU stay; however, the strength of evidence varies and the patient's hemodynamic status and vasopressor requirements should guide the decision (Pinsky *et al*., 2022) [30]. If EN is contraindicated (e.g., intestinal ischemia, uncontrolled GI bleeding, high-output fistula), early PN may be considered (Compher *et al*., 2022) [9].

Guideline recommendations-how major societies advise practice

1. ESPEN (2019 practical guideline for ICU nutrition)

ESPEN recommends using the enteral route when the gut is functional, initiating EN early in most critically ill patients, and avoiding full-dose EN in the immediate early phase for some patients (titrate to tolerance). ESPEN also provides practical guidance on energy/protein targets, monitoring and use of post-pyloric feeding to reduce aspiration risk. When EN is not possible or insufficient, PN is recommended to meet nutritional requirements after a defined interval (Preiser *et al*., 2021) [32].

2. ASPEN/SCCM (2021/2022 updates)

ASPEN (with SCCM) emphasizes early enteral nutrition for most critically ill adults, with careful attention to caloric/protein targets and avoidance of overfeeding. They acknowledge the role of supplemental PN when energy/protein goals cannot be achieved by EN after an appropriate trial and stress robust catheter care and metabolic monitoring when PN is used. ASPEN guidelines also highlight the need to individualize therapy and consider refeeding syndrome risk (Tewari, 2019; Irving *et al*., 2020) [17, 42].

3. Cochrane and systematic review summaries

Cochrane conclusions generally indicate insufficient high-certainty evidence to declare a mortality benefit of EN over PN across the board, but they note lower sepsis rates with EN in some analyses and call for higher-quality RCTs. Overall recommendations align with society guidance favouring EN when feasible while recognizing PN's role (Sowerbutts *et al*., 2018) [40].

Practical, evidence-based algorithm for route selection (proposed)

1. **Initial assessment (on ICU admission):** evaluate GI tract function, aspiration risk, hemodynamic stability, bowel sounds, evidence of ileus or obstruction, presence of high-output fistula or major GI bleeding (Reintam Blaser *et al*., 2012) [34].

2. **If gut is functional and patient is hemodynamically stable or stabilizing:** start EN early (within 24-48 h) at trophic or full doses depending on stability/tolerance; use gastric feeding initially; consider post-pyloric feeding if high aspiration risk or gastric intolerance (Zaloga *et al*., 2003) [48].

3. **If EN contraindicated (e.g., bowel ischemia, uncontrolled GI hemorrhage, high-output proximal fistula, severe short bowel with no access):** commence PN (preferably via central access) after assessment and start with careful metabolic monitoring and infection prevention strategies (Valla *et al*., 2023) [43].

4. **If EN started but inadequate to meet >60-80% of energy/protein goals after 3-7 days despite optimization:** consider supplemental PN to meet targets, balancing infection risk and ensuring high standards of catheter care (Lal *et al*., 2023) [19].

5. **For malnourished patients or prolonged inability to feed enterally:** consider earlier initiation of PN (after brief EN trial if safe) to avoid nutrition debt-individualize timing (Desachy *et al*., 2008) [15].

Dosing targets and monitoring

In critically ill patients, nutritional dosing and monitoring require careful attention to avoid complications and optimize outcomes. Recent critical care nutrition guidelines recommend conservative early energy provision—often hypocaloric feeding—to prevent overfeeding during the acute phase, followed by gradual progression toward full caloric requirements as tolerated, ideally guided by indirect calorimetry when available (Singer *et al*., 2019) [39]. Protein delivery should be prioritized, with targets ranging from 1.2 to 2.0 g/kg/day depending on the patient's catabolic status, to support nitrogen balance and muscle preservation (McClave *et al*., 2016) [23]. Glycemic control remains essential, as parenteral nutrition (PN) is associated with an increased risk of hyperglycemia; thus, blood glucose levels should be closely monitored and managed to prevent metabolic complications (Casaer & Van den Berghe, 2014) [7]. Additionally, screening for and preventing refeeding syndrome is critical, with vigilant monitoring of serum phosphorus, potassium, and magnesium during initiation and advancement of nutrition support (Crook *et al*., 2014) [10]. Catheter-related infections represent another major concern in PN administration, necessitating strict aseptic technique, routine catheter site inspection, and adherence to central-line care bundles to reduce bloodstream infection risk (Mermel *et al*., 2018) [25]. Gastrointestinal (GI) tolerance should also be regularly evaluated, with monitoring of gastric residual volumes according to institutional protocols; prokinetic agents or post-pyloric feeding may be considered when intolerance is observed (Reintam Blaser *et al*., 2021) [35]. Collectively, these monitoring strategies are integral to ensuring safe, effective, and individualized nutritional therapy in critical care settings.

Complications and mitigation

Complications associated with enteral nutrition (EN) and parenteral nutrition (PN) are well-documented and require vigilant management to ensure patient safety and optimal outcomes. Common complications of EN include aspiration pneumonia, gastric intolerance, and diarrhea, which often result from improper tube placement, rapid feeding rates, or inappropriate formula composition. Effective mitigation strategies involve elevating the head of the bed to 30–45°, using prokinetic agents to enhance gastrointestinal motility, employing post-pyloric feeding tubes in high-risk patients, and adjusting the enteral formula based on individual tolerance (McClave *et al*., 2016; Singer *et al*., 2019) [23, 39]. In contrast, PN is associated with more systemic complications, including catheter-related bloodstream infections (CRBSIs), metabolic derangements such as hyperglycemia, liver dysfunction, and refeeding syndrome, as well as thrombosis linked to central venous catheter use. Preventive measures include strict adherence to central-line care bundles, implementation of glycemic control protocols, cycling PN when feasible to prevent hepatic stress, administering lipid emulsions according to institutional guidelines, and conducting regular laboratory monitoring to detect abnormalities early (Worthington *et al*., 2017; Vanek *et al*., 2019) [44, 46]. By integrating these evidence-based strategies, clinicians can minimize the risks of both EN- and PN-related complications and enhance the overall safety and efficacy of nutritional therapy in critical care settings.

Special populations and scenarios

In specialized clinical populations, nutritional therapy must be carefully tailored to the underlying condition to optimize outcomes and minimize complications. In severe acute pancreatitis, early enteral nutrition (EN) is preferred over parenteral nutrition (PN) whenever tolerated, as it helps maintain gut integrity, reduce infectious complications, and decrease mortality; PN is reserved only when EN is not feasible due to gastrointestinal intolerance or contraindications (Tenner *et al*., 2013; Arvanitakis *et al*., 2020) [3, 41]. Patients with short bowel syndrome or chronic intestinal failure often require long-term PN to meet nutritional needs, necessitating individualized regimens managed by multidisciplinary intestinal failure teams, including gastroenterologists, dietitians, and specialized nurses, to minimize complications such as catheter-related infections and liver dysfunction (Pironi *et al*., 2016; Lal *et al*., 2018) [20, 31]. In hemodynamically unstable patients, particularly those receiving high doses of vasopressors, initiation of EN must be approached with caution because of the risk of intestinal ischemia; many centers delay full feeding until cardiovascular stability is achieved or begin with trophic (low-rate) EN under close monitoring to assess tolerance (Reintam Blaser *et al*., 2021; Singer *et al*., 2019) [39] [35]. These condition-specific strategies underscore the importance of individualized, evidence-based nutritional interventions to support recovery while preventing iatrogenic harm in critically ill patients.

Economic and logistic considerations

EN is generally less expensive and easier to deliver on a large scale than PN, which requires sterile compounding, central venous access, and more intensive monitoring. Resource constraints and local expertise may therefore influence practice, but patient safety and clinical indication should be paramount.

Conclusions

In conclusion, both enteral nutrition (EN) and parenteral nutrition (PN) serve as essential modalities in the nutritional management of critically ill patients, with route selection guided by gastrointestinal function, hemodynamic stability, and overall clinical context. Current evidence and international guidelines consistently advocate for the early initiation of EN when feasible, as it preserves gut integrity, supports immune function, and reduces infectious complications and ICU length of stay compared to PN. Nevertheless, PN remains a vital alternative when EN is contraindicated or insufficient to meet nutritional goals, and supplemental PN can be employed judiciously to prevent cumulative nutritional deficits. The decision-making process should be individualized, emphasizing careful patient monitoring, prevention of complications such as aspiration, refeeding syndrome, and catheter-related infections, and strict adherence to aseptic and glycemic control protocols. In special clinical scenarios such as severe pancreatitis, intestinal failure, or hemodynamic instability, nutrition strategies must be tailored to balance benefit and risk, incorporating multidisciplinary expertise where appropriate. Ultimately, optimal outcomes in critical care nutrition depend on timely intervention, evidence-based practice, and continuous assessment of patient tolerance and metabolic response, ensuring that artificial nutrition serves as a therapeutic tool rather than a source of iatrogenic harm.

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