REVIEW

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CURRENT OPINION

Individualizing post-ICU nutrition: from guideline intent to bedside practice

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Purpose of review

Survivorship of critical illness has increased, shifting attention toward recovery and long-term outcomes. Post-ICU nutrition is emerging as a clinically relevant, yet underperforming contributor to functional recovery and quality of life. Persistent nutritional inadequacy reflects insufficiently defined physiological requirements and limited implementable evidence-based guidance during ICU recovery.

Recent findings

Energy and protein delivery sharply decline after ICU discharge, despite persistent metabolic demands. Underfeeding can result from the absence of recovery-specific targets, patient-level barriers (e.g. appetite loss, dysphagia, fatigue), and fragmented care transitions, including premature feeding-tube removal and suboptimal monitoring of oral intake. Structured patient and family engagement can help operationalize individualized nutritional strategies and improve feasibility without substantial resource burden, acting as continuity agents.

Summary

Post-ICU nutritional failure reflects combined physiological and implementation challenges. Clinicians should recognize the post-ICU hospitalization period as a potential 'metabolic danger zone', requiring a shift from acute-phase restrictive feeding toward strategies prioritizing functional recovery and lean mass preservation. Improving outcomes requires standardized, yet adaptable, care pathways that bridge ICU-to-ward transitions, operationalize individualization, and integrate patient and family input as clinical instruments. Future research should prioritize multicenter implementation studies centered on 'disability-free survival' to inform adaptive, evidence-based nutritional protocols.

Keywords

care transitions, feeding adequacy, individualized nutrition, patient engagement, postintensive care

BACKGROUND

Survivors of critical illness often leave the ICU in a marked catabolic state, characterized by persistent loss of lean mass, delayed functional recovery, and increased ICU and hospital readmission rates [1,2]. This burden continues throughout the post-ICU trajectory

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KEY POINTS

- Post-ICU nutrition is gaining recognition as a determinant in functional recovery and quality of life in ICU survivors.
- Post-ICU nutritional failure is a structural and implementation problem, with nutritional adequacy worsening after ICU discharge, despite known persistent metabolic and functional vulnerability, muscle wasting, and impaired intake.
- Post-ICU nutrition lacks evidence-based operational guidelines.
- Individualized post-ICU nutrition cannot be achieved without patient and family engagement, representing a feasible, low-cost opportunity to enhance recovery and healthcare sustainability.
- There is an urgent need for large, prospective trials to define metabolic requirements, and develop adaptive, evidence-based post-ICU nutritional protocols.

and contributes to postintensive care syndrome (PICS). Despite clear physiological vulnerability, responsibility for nutritional recovery becomes fragmented when patients transition from ICU to general wards. This period is characterized by a transitional nutritional gap, where cessation of artificial nutrition frequently precedes the return of adequate volitional intake by several days or weeks [3]. Consequently, ICU survivors typically receive only 63–83% of prescribed protein and 52–102% of recommended calories during the initial post-ICU weeks, lowest among those receiving oral intake alone [4▪]. These deficits are independently associated with increased mortality and prolonged rehabilitation [5]. Organizational barriers, suboptimal staffing ratios, and limited awareness of the importance of post-ICU nutrition further exacerbate this issue. While ICU nutrition remains a dominant focus, research on post-ICU nutrition in adults has steadily increased (Fig. 1, SDC 1, http://links.lww.com/COCC/A65), highlighting growing recognition of the gap between clinical needs and available evidence. The objectives of this review are to outline the post-ICU nutritional requirements relevant to recovery, summarize why current guidelines and care pathways falter at the transition point, and propose a standardized, yet

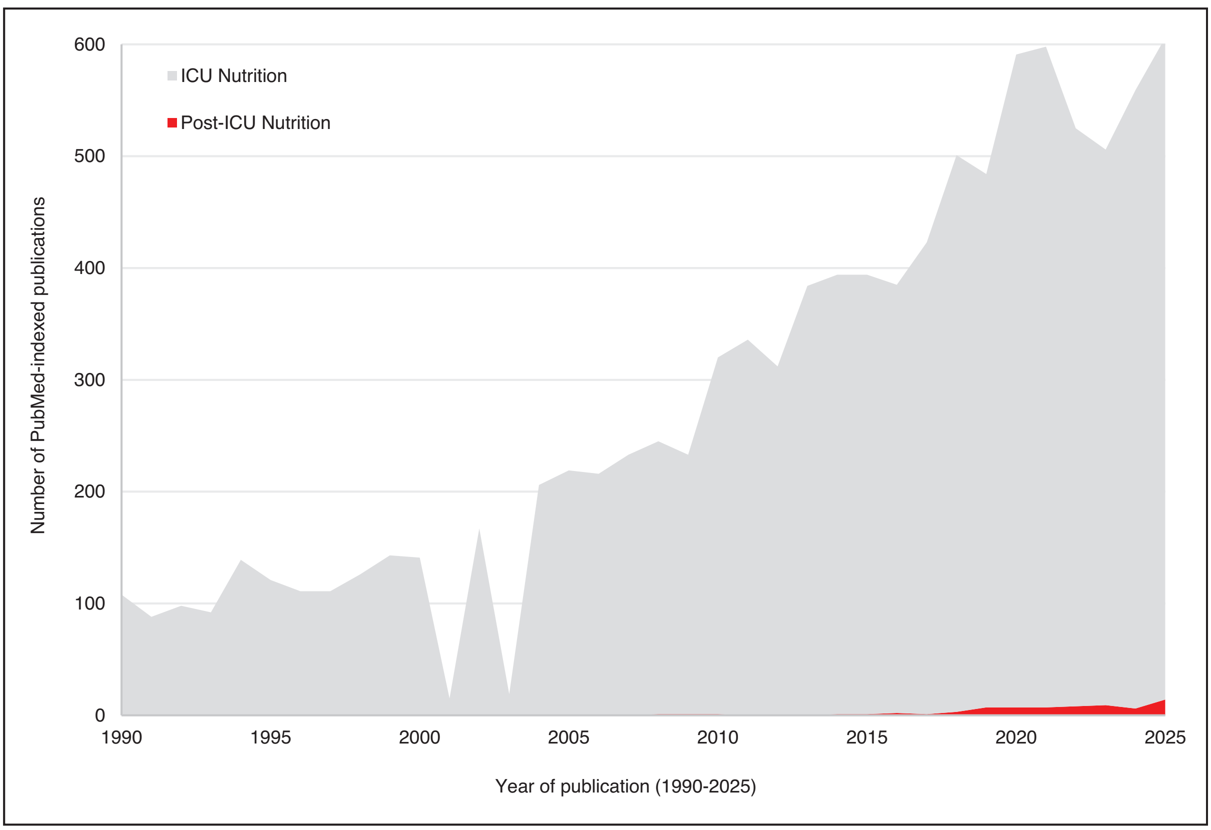

FIGURE 1. Publication trends in adult ICU and post-ICU nutrition research. Annual number of PubMed-indexed publications addressing adult ICU nutrition (grey) and post-ICU nutrition (red) from 1990 to 2025. Details on search strategy are provided in the Supplemental Digital Content, http://links.lww.com/COCC/A65.

individually adaptable, implementation framework suited for testing in multicenter trials.

POST-ICU NUTRITIONAL NEEDS CAN BE ESTIMATED, BUT ARE RARELY MET

Critical illness often induces a hypermetabolic, highly catabolic state driven by inflammation, insulin resistance, and metabolic stress [6]. Resting energy expenditure (REE) increases substantially, with accelerated mobilization of glycogen, fat, and skeletal muscle. Notably, this metabolic phenotype often persists beyond ICU discharge [7], necessitating a shift from acute-phase permissive underfeeding toward recovery-oriented nutritional support. As recovery progresses, endogenous glucose production declines [8], and unlike glucose or fat, the body lacks a dedicated amino acid reservoir. Patients therefore depend entirely on exogenous provision delivered orally, enterally, or parenterally. Given the interindividual variability in disease severity, metabolic rate, and treatment modalities, fixed nutritional prescriptions are insufficient, necessitating accurate, individualized assessment [9▪,10,11▪].

Indirect calorimetry is the gold standard for measuring REE but is infrequently used post-ICU. Predictive equations therefore dominate both clinical practice and research, despite their potential for underestimation or overestimation and poor comparability with indirect calorimetry-derived data [4▪]. Importantly, even when energy expenditure is known, it does not define an optimal recovery-phase target, as anabolic demands add to measured expenditure, without consensus on the required caloric surplus. Ongoing inflammation and anabolic resistance further contribute to heightened caloric and protein needs, with total energy expenditure post-ICU reported up to 1.7 times REE [12].

Post-ICU protein prescriptions follow broad weight-based ranges (0.8–2 g/kg/day) with pragmatic targets around 1.3 g/kg/day protein, offering limited personalization. Advanced tools, including nitrogen balance, bioelectrical impedance analysis, CT-derived muscle mass, and ultrasound, could theoretically refine protein dosing; however, their routine use is restricted by feasibility, cost, and accuracy [13].

Reflecting these increased requirements, international consensus statements recommend ~30 kcal/kg/day, or ~125% of measured REE, and 1.5–2 g of protein/kg/day for survivors, exceeding the targets applied during acute critical illness [11▪]. However, multiple studies demonstrate that energy adequacy decreases by one-third or more within the first 24 h of ICU discharge, with a similar decline in protein adequacy, and remains suboptimal over subsequent days on the ward [9▪,14▪]. A systematic review of eight post-ICU studies confirmed this shortfall, reporting energy adequacy ranged from 52 to 102%, while protein adequacy remained between 63 and 83% [4▪], indicating that even conservative, consensus-based estimates of nutritional requirements are rarely achieved.

Beyond target setting, feeding routes majorly impact post-ICU adequacy. More than half of ICU patients are discharged to the ward without a feeding tube. Among those transferred with a tube in place, 71% undergo tube removal during ward stay, often driven by hospital policy rather than readiness to meet requirements orally [15,16]. Data suggest clinicians perceive tube removal as a 'return to normal', proceeding without a documented prescription [16]. In PROSPECT-I, median energy adequacy fell from 97.3% with a feeding tube to 65% on the first day after removal, and protein adequacy similarly dropped from 91.5 to 60.6% [5]. Similar patterns were reported in the 'Dark Side' study, where patients receiving oral nutrition alone achieved significantly lower targets, compared to those receiving medical nutrition, who reached near-complete energy (62–104%) and protein (59–100%) targets [9▪]. These findings underscore that continued tube feeding, or at least a planned transition using supplemental medical nutrition, is essential to prevent predictable post-ICU deficits [17].

WHY GUIDELINES FAIL TO SUPPORT ADEQUATE POST-ICU NUTRITION

The sustained commitment to evidence-based nutritional care is reflected in the expanding body of clinical practice guidelines for ICU nutrition, including those from the American Society of Parenteral and Enteral Nutrition (ASPEN), the European Society ESPEN, and recent national initiatives [18–30]. These guidelines synthesize trial data to provide robust recommendations on *what* to prescribe, *when*, and in *what dose* during acute critical illness. Guideline development requires high-quality, consistent evidence, which remains scarce and heterogeneous in ICU survivors. Consequently, post-ICU nutrition is left without specific operational direction, poorly positioned between ICU-focused and general ward guidelines.

Future guideline development will require a staged approach (Fig. 2). Until then, interim guidance based on expert consensus recommendations may help bridge the gap between guideline scope and clinicians' operational needs during post-ICU care.

POST-ICU NUTRITION: A STRATEGIC PRIORITY UNDERMINED BY PHYSIOLOGICAL AND SYSTEM-LEVEL BARRIERS

Persistent muscle wasting and nutritional deficits after ICU discharge contribute to delayed functional recovery, prolonged ward stays, and avoidable

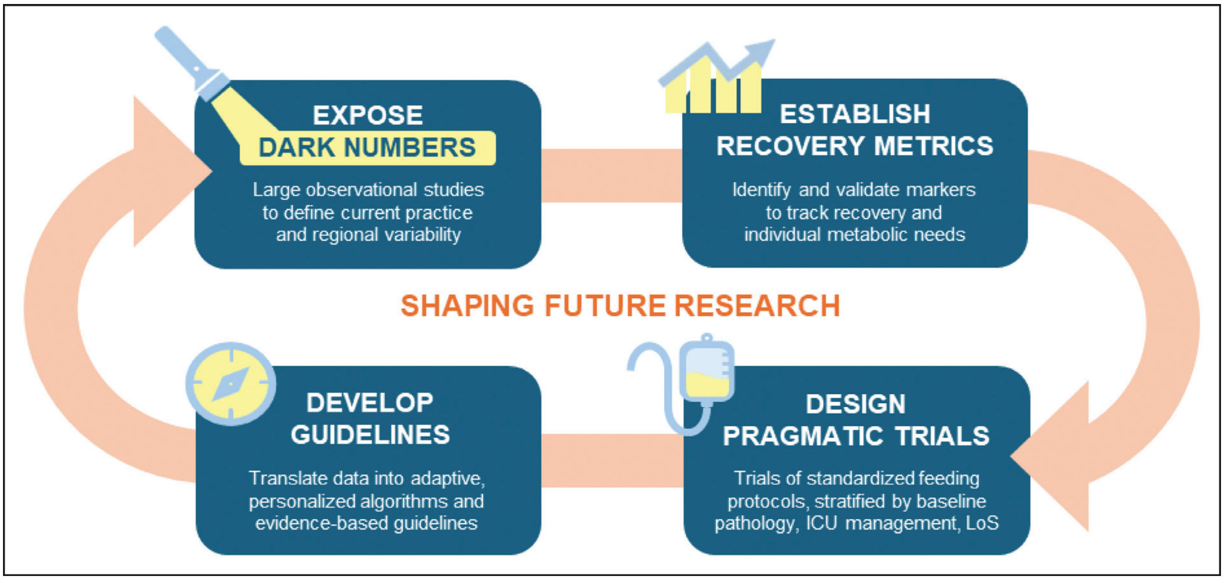

FIGURE 2. A strategic roadmap for future post-ICU nutrition research. The research cycle begins by conducting large observational studies to expose 'the dark numbers' and regional variability by characterizing current practice, followed by establishing recovery metrics to identify individual metabolic needs. These metrics inform the design of pragmatic trials stratified by pathology and ICU management. Results are finally used to develop guidelines, translating evidence into adaptive, personalized feeding algorithms. LoS, length of stay.

readmissions, thereby shifting healthcare utilization downstream rather than preventing it [31]. From an economic perspective, the opportunity cost of not addressing post-ICU nutrition is difficult to justify, with nutritional support consistently proven to yield substantial per-patient savings across general hospitalized populations [32,33]. Oral nutritional supplementation has been associated with reductions in complications, length of stay, readmissions, and mortality, with savings exceeding $50 per invested dollar [12].

Despite this, post-ICU nutrition is often deprioritized in favor of more resource-intensive interventions. Unlike many competing priorities, where incremental benefit demands substantial financial or staffing investment, improvements in post-ICU nutrition can be achieved through optimization rather than expansion of care. In a healthcare environment that is increasingly pressured to achieve more with fewer resources, such efficiency is critical. Integrating nutrition follow-up into routine ward rounds or outpatient frameworks and using low-burden patient-reported or family-reported tools to monitor intake and symptoms represent pragmatic strategies with minimal additional cost [34].

Multidisciplinary alignment, linking nutritional goals with physiotherapy, psychological rehabilitation, and individualized recovery priorities, amplifies impact without proportionally increasing workload. Framing nutrition as part of the recovery continuum, rather than an isolated prescription, supports a shift from short-term survival toward restoration of long-term function, autonomy, and quality of life [18]. Positioning post-ICU nutrition within contemporary healthcare priorities strengthens its strategic relevance, aligning directly with value-based healthcare, resource stewardship, and equity, as malnutrition disproportionately affects older, frailer, and socioeconomically vulnerable survivors [35].

Yet, persistent nutritional inadequacy following ICU discharge reflects the interplay between patient-level difficulties and fragmented health-system processes. Addressing either domain independently is insufficient, as patient vulnerability and organizational constraints frequently co-occur and amplify one another during ICU-to-ward transitions. Effective mitigation, therefore, requires integrated strategies that align physiological considerations with operational improvements (Table 1).

Patient-level barriers are common and multifactorial. Appetite loss, nausea, early satiety, taste changes, and fatigue are symptoms reported in over 70% of survivors, and able to persist up to 3 months post-ICU discharge [16,36,37▪]. Safe oral feeding is further constrained by dysphagia, often compounded by ICU-acquired weakness of the swallowing musculature, which increases aspiration risk [38]. Functional impairment, including reduced muscle strength and coordination, may limit self-feeding, while psychological sequelae, including depression,

Table 1. Determinants of post-ICU nutritional inadequacy and corresponding actionable strategies

Determinant	Clinical impact	Actionable strategy
Patient-level		
Appetite loss, early satiety, nausea and taste changes	Reduced oral intake despite prescribed targets	Routine screening for appetite-limiting symptoms, pharmaceutical support, adapted meal timing/texture/density, high-protein supplements, tube preservation in transition
Dysphagia	Unsafe or insufficient oral intake	Dysphagia screening, speech therapy referral, texture-modified diets, food fortification, oral nutrition supplementation, tube preservation
Reduced muscle strength and coordination	Inability to self-feed	Assisted feeding, family involvement in meal support, adapted cutlery/crockery
Depression, anxiety, PTSS	Reduced motivation to eat, avoidance behaviors	Integrated psychological screening, family involvement, alignment of nutritional goals with the patient's priorities
System-level		
Incomplete ICU-to-ward nutrition handover	Loss of targets, route, and contingency planning	Standardized nutrition handover checklist
Premature feeding-tube removal	Sudden reliance on inadequate oral intake	Predefined criteria for tube removal (e.g. $\geq$75% of requirements achieved orally), maintenance of medical nutrition during transition, nasal bridle use, staff education
Unclear ownership of nutrition on the ward	Missed meals, prolonged underfeeding, delayed escalation	Integration of dietitians into ward rounds and discharge planning, explicit assignment of responsibility for post-ICU nutrition
High workload and staffing constraints	Meal interruptions and limited monitoring	Streamlined meal logistics, use digital or decision-support tools to prioritize nutritional care under resource constraints
Manual documentation of oral intake	Systematic under-recognition of nutritional deficits	Electronic food charting or digital photography-based intake monitoring to improve visibility of oral intake deficits
Knowledge gaps regarding post-ICU needs	Underprescription and low prioritization of post-ICU nutrition	Targeted education on post-ICU energy and protein needs and clinical consequences of underfeeding
Poor continuity across care transitions	Accumulating energy and protein deficits	Empower patient and family, embed completion and handover of nutritional plans in protocols

Strategies reflect pragmatic approaches supported primarily by observational and implementation studies. PTSS, posttraumatic stress syndrome.

anxiety, and posttraumatic stress disorder, reduce motivation to eat and are independently associated with lower intake [17].

These constraints underscore that solely escalating the prescribed doses is insufficient. Mitigation requires symptom-oriented strategies, preservation of medical nutrition during transition, and targeted family involvement. The latter, focusing on meal assistance, cueing, and symptom recognition and monitoring, has been shown to partially counteract intake barriers without adding professional responsibility [11▪,17].

System-level barriers emerge most prominently during care transitions. Nutritional handover from ICU to ward is frequently incomplete, with fewer than 5% of patients being discharged with a comprehensive nutritional plan [14▪,16,39]. On the ward, high patient-to-nurse ratios, limited dietitian presence, and unclear responsibility for nutrition, the so-called ‘ownership gap’, result in missed meals, delayed escalation, and poor intake monitoring [11▪,17]. Reliance on manual charting of oral intake possibly creates systematic under-reporting of oral deficits, while persistent knowledge gaps contribute to underprioritization of post-ICU nutritional care [16,17].

INDIVIDUALIZED POST-ICU NUTRITION IS IMPOSSIBLE WITHOUT PATIENT AND FAMILY INVOLVEMENT

Patient-level barriers are often invisible to clinicians and fluctuate over time. Incorporating the lived experience of patients and families into care planning is therefore fundamental for individualizing post-ICU nutrition [39,40]. Qualitative studies consistently report that patients perceive nutritional care as fragmented, with limited involvement in goal setting and decision-making, particularly after ward transfer [39]. Survivorship research suggests that patients prioritize functional recovery, autonomy, and return to normalcy over nutritional metrics [39,41■].

Patient-reported outcomes (PROs) serve as a practical implementation tool. Structured PROs enable patients and relatives to report intake barriers and symptoms in real time, allowing timely adjustment of nutritional plans in response to patient priorities. Unlike target-driven prescribing, outcome-aligned goals may better support sustained adherence to oral nutritional supplements after discharge [42].

In the post-ICU phase, cognitive, physical, or emotional consequences of critical illness may limit patients' ability to engage consistently in this process. In such cases, family members can act as continuity agents. Relatives possess the most consistent knowledge of patients' preillness preferences, current symptoms, and recovery priorities, yet remain underutilized [43■]. Evidence across ICU and post-ICU settings demonstrates that structured, early inclusion of relatives in nutritional care improves perceived support and empowers participation in care discussions without increasing care complexity [40,42,44].

Monitoring is a critical enabler of this patient-centered and family-centered approach. Technology-enabled visual dashboards can support preference-based food delivery, real-time intake reporting, and visibility of progress in recovery and nutritional adequacy [45■,46]. Recent data indicate that intake monitoring performed by patients and family post-ICU is as reliable as monitoring by healthcare professionals or researchers, directly challenging assumptions that individualized monitoring is resource-intensive [47■]. These findings suggest that engaging patients and families not only improves alignment with recovery priorities but also offers a scalable strategy to sustain individualized nutritional care beyond the ICU.

CONCLUSION

As post-ICU nutrition evolves, progress will rely on moving beyond observational research toward shared definitions, core outcomes, and implementation principles. A key priority is standardization of research reporting. Adoption of a core outcome set, including nutritional intake/adequacy, functional recovery scores, health-related quality of life, and readmission rate, alongside transparent documentation of population, feeding routes, and handover practices, is essential to enable cross-study comparability [11■,48,49■].

Building on this foundation, future research should prioritize pragmatic, multicenter trials that reflect real-world constraints. Comparative evaluations of protocol-driven continuation of medical nutrition versus usual care, and multidiscipline strategies to overcome known barriers to oral intake, are particularly relevant, as are adaptive designs that allow nutritional strategies to respond to changes in intake or recovery status [49■].

Finally, sustained progress requires engagement across the care continuum. Effective post-ICU nutrition depends on coordinated efforts between ICU and ward-based teams, allied health, hospital leadership, and outpatient follow-up. Embedding nutrition within broader recovery pathways, co-designed with patients and informed by PROs, offers a route to preserve individualization across transitions while remaining feasible within existing hospital structures [50]. Together, these steps can move post-ICU nutrition from fragmented practice toward evidence-based, personalized care pathways that truly accelerate recovery.

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Conflicts of interest

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