Importance of older age for nutrition management

Sergio H. Loss[a], *Luciana V. Viana*[b,d] *and Marina V. Viana*[a,c]

Purpose of review
To review the impact of nutrition on critically ill older adults, focusing on the role of comorbidities such as malnutrition, sarcopenia, and frailty, as well as the importance of nutritional support for outcomes such as mortality, recovery, and long-term disability.

Recent findings
Malnutrition is highly prevalent in the elderly and is strongly associated with adverse outcomes, including increased mortality, longer ICU stays, and higher rates of infection. In addition, frailty, multimorbidity, and cognitive decline significantly contribute to the vulnerability of older patients in the ICU. Evidence suggests that early individualized nutritional management, including adequate protein intake and prevention of the refeeding syndrome, is essential. However, age-specific guidelines are lacking.

Summary
Older adults admitted to the ICU face unique challenges owing to physiological decline, chronic diseases, and diminished nutritional reserves. Frailty and malnutrition are key predictors of poor outcomes in older adults. However, nutritional strategies tailored to older adults remain poorly defined. Whether optimized nutritional support through early assessment and age-appropriate interventions improves survival, reduces complications, and enhances quality of life after ICU discharge is a crucial clinical question to be answered by focused research.

Keywords
frailty, ICU, nutritional support, older adults

INTRODUCTION

The United Nations predicts that between 2019 and 2050, the population of adults aged 65 years and older will double across many regions. Current estimates indicate that approximately one-quarter of older adults are malnourished or at a risk of malnutrition [1]. Older adults are particularly vulnerable to malnutrition owing to factors such as reduced food intake, changes in metabolism, and the presence of chronic diseases, which can exacerbate frailty, multimorbidity, and cognitive decline [2]. Malnutrition, in combination with sarcopenia and a general loss of functional autonomy, is a contributing factor to the overall fragility of older adult ICU patients [2,3].

The impact of malnutrition on critically ill older adults is profound, affecting both those who are malnourished at the time of hospital admission and those who develop severe catabolism during intensive care. It is associated with higher mortality rates, prolonged hospital stays, and increased susceptibility to infection due to compromised immune function [2,4]. In addition, low-grade inflammation, immunosenescence, and gradual deterioration of immune function with age contribute to what is often called 'inflammaging', which undermines recovery and increases the risk of adverse events [3]. Furthermore, the inability to adequately feed critically ill older adults during their first week in the ICU is associated with increased mortality rates [5].

This review highlights the importance of nutritional management in older age and interrelated conditions, such as anorexia, malnutrition, sarcopenia, frailty, and cachexia that accompany these patients before, during, and sometimes after their ICU stay (Fig. 1).

DEFINITIONS AND OUTCOMES

The United Nations defines an older person as someone over 60 years of age. Age is a well established independent predictor of mortality in critically ill

[a]Critical Care Unit, [b]Endocrinology Division, Hospital de Clínicas de Porto Alegre, [c]Medical Sciences Post-Graduation Program and [d]Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil

Correspondence to Marina V. Viana, PhD, Hospital de Clínicas de Porto Alegre, Ramiro Barcelos 2350, 90034-003 Porto Alegre-RS, Brazil. E-mail: maviana@hcpa.edu.br

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KEY POINTS

- Malnutrition, sarcopenia, frailty, and cachexia are highly prevalent in critically ill older adults and strongly predict poor outcomes.
- Frailty assessment at admission guides early survivorship discussions and may impact optimal nutritional strategies.
- Early individualized nutritional management with comprehensive assessment and adequate protein intake is probably a cornerstone in strategies aimed at improving survival and recovery.
- Older adults remain underrepresented in nutritional clinical trials, leaving critical gaps in age-specific guidelines.
- Integration of nutrition with rehabilitation strategies offers the best chance to preserve function and improve post-ICU quality of life.

patients, with the risk increasing progressively with age. Table 1 lists the studies that evaluated the outcomes of critically ill older adults in the last 5 years [3,5–9]. Multiple large cohort studies and systematic reviews have demonstrated that older adults, particularly those aged 75–80 years and above, experience higher ICU, in-hospital, and long-term mortality rates than younger cohorts, even after adjusting for illness severity and comorbidities [10,11]. In addition, 1-year mortality rates in those more than 80 years can approach or exceed 40–45% following critical illness, especially when mechanical ventilation is required [12]. Interestingly, patients aged at least 90 years had similar in-hospital mortality to octogenarians but showed higher posthospital mortality, a finding that likely reflects their naturally lower life expectancy [6].

In elderly ICU survivors, long-term mortality rates may approximate those of age-matched and comorbidity-matched controls after the first-year postadmission, except in patients with high-risk conditions such as acute-on-chronic respiratory failure [13]. The underlying disease strongly influences ICU length of stay [7,8,14–16]. While older patients can achieve short-term outcomes comparable to younger individuals, they frequently face higher long-term risks [7].

Beyond chronological age, the pre-ICU health status of older adults, including frailty, comorbidities,

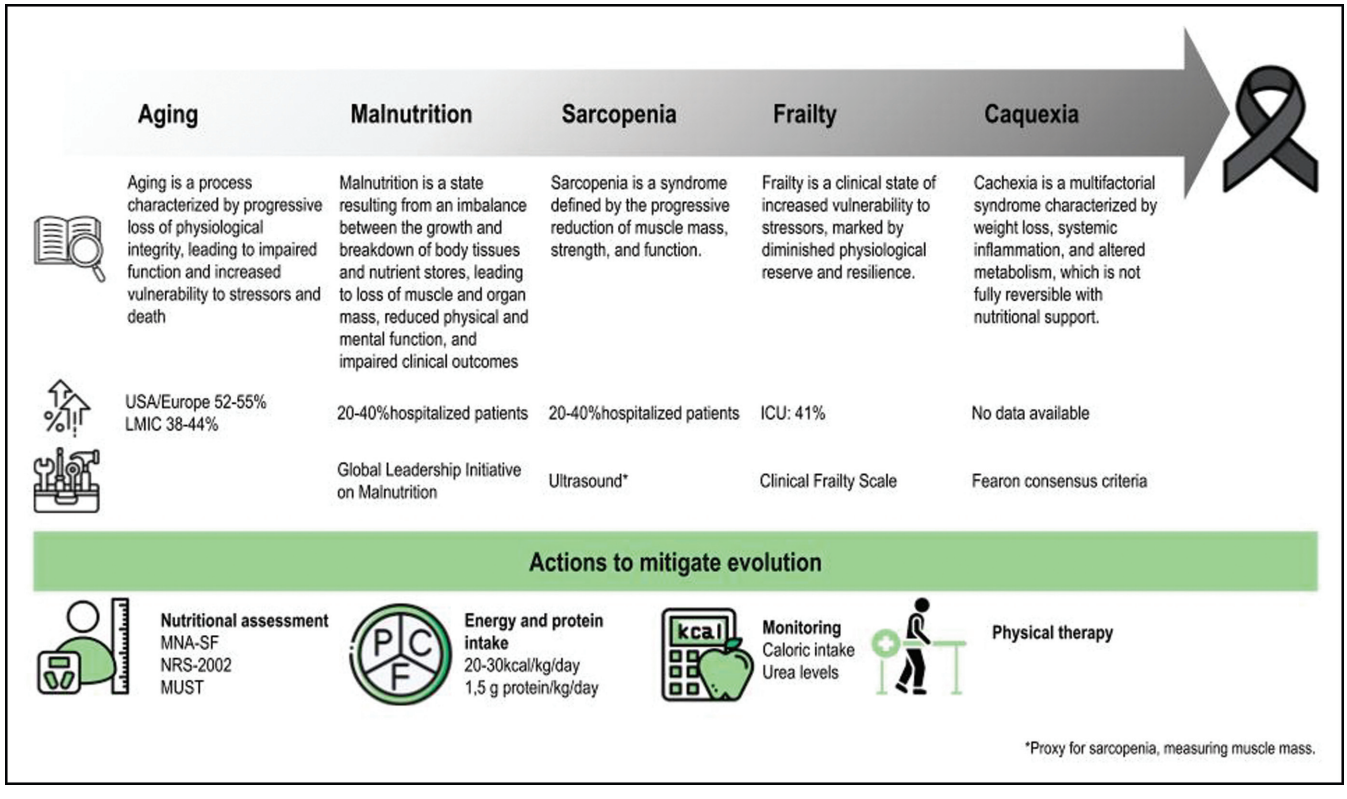

FIGURE 1. Conceptual framework linking aging, malnutrition, sarcopenia, frailty, and cachexia in elderly critically ill patients, highlighting diagnostic tools and strategies to mitigate progression. LMIC, low-middle income countries; MNA-SF, Mini Nutritional Assessment Short-Form; MUST, Malnutrition Universal Screening Tool; NRS2002, Nutrition Risk Screening 2002; USA, United States of America.

Table 1. Association between old age and outcomes of critically ill patients

Study	Design	Comparisons	Key outcomes	Main findings
Haas *et al.* (2020)	National observational study (11 years)	90+ vs. 80–89	ICU mortality, hospital mortality, 1-year mortality	ICU mortality lower in 90+ (13.8 vs. 16.1%); 1-year mortality higher (55 vs. 42.7%)
Rockstrom *et al.* (2023)	Retrospective cohort (COVID-19 ICU patients)	≥65 vs. <65	Mortality, comorbidities, organ failure	Mortality higher in ≥65 (41 vs. 15.6%); age not independently associated with organ failure
Loss *et al.* (2022)	Observational single center cohort	≥60 vs. <60	ICU mortality, hospital mortality	Mortality higher in ≥60 (61.1 vs. 34.8%) mainly undergone MV (81.1 vs. 51.4%)
Chung *et al.* (2023)	Retrospective cohort	Age-based stratification	28-day mortality, postdischarge disposition	Mortality similar, but elderly less likely to return home; more discharged to long-term care
Guillon *et al.* (2020)	Propensity-matched cohort	80+ vs. controls	Long-term mortality, healthcare utilization	Higher post-ICU mortality and healthcare use in 80+ patients
Guidet *et al.* (2020)	Multicenter prospective cohort study (VIP2 study)	Patients 80 years or above	ICU and 30-day survival	72.5% ICU survival; 61.2% 30-day survival
Vallet *et al.* (2023)	Review (mainly from VIP2 study)	Very old patients	Age-related syndromes, ICU processes, outcomes	Frailty significantly impacted ICU decisions and outcomes
Rodríguez-García *et al.* (2024)	Comparative cohort study	<85 vs. ≥85	ICU stay, treatment aggressiveness	≥85 had shorter ICU stays, less aggressive treatment

COVID-19, coronavirus disease 2019; MV, mechanical ventilation.

cognitive impairment, and functional status, further influences mortality risk [12,13]. Frailty and preexisting disabilities are particularly strong indicators of poor outcomes, and the presence of sepsis or acute organ dysfunction further increases the age-related risk [12].

Malnutrition

Malnutrition results from an imbalance between the growth and breakdown of body tissues and nutrient stores, resulting in loss of muscle and organ mass, diminished physical and mental function, and impaired clinical outcomes [17]. Malnutrition can be present prior to ICU admission or can develop during the ICU stay. Malnutrition in older adults is a complex and multifactorial issue, often resulting from a combination of reduced food intake due to acute or chronic illness and socioeconomic factors, such as food insecurity [1].

Anorexia is often seen in older patients [18] and refers to the loss of appetite or decreased desire to eat, which is a nonspecific symptom associated with a wide range of medical conditions, including chronic diseases, infections, inflammation, malignancy, and liver disease [5,18,19]. The onset of anorexia in critically ill patients is closely linked to the systemic inflammatory response accompanying acute illness. Inflammation, mediated by proinflammatory cytokines such as interleukin-1β, interleukin-6, tumor necrosis factor-α, and interleukin-18, directly affects central appetite regulation and peripheral metabolic pathways, leading to reduced food intake and anorexia [5,20▪]. While this response may serve as an adaptive mechanism to reallocate metabolic resources in the acute phase, the optimal duration of this adaptive anorexia is uncertain, and prolonged suppression of nutritional intake may ultimately impair recovery. The severity of inflammation is proportional to the degree of appetite suppression, and this effect is most pronounced during the acute phase of critical illness when metabolic demands are high and adaptive responses to starvation are overridden by the inflammatory milieu [2,5,20▪].

Sarcopenia

Sarcopenia is now recognized as a generalized skeletal muscle disease characterized by low muscle mass, reduced muscle strength, and function [21]. The prevalence of sarcopenia in ICUs is estimated to be approximately 41% [22]. An increasing number of studies have shown that critically ill patients usually

suffer from sarcopenia due to factors such as nutritional status, inflammation, coexistence of diseases, and inactivity [23]. A recent meta-analysis showed an almost two-fold increase in mortality in patients with sarcopenia compared to those without sarcopenia, regardless of age [22].

The evaluation of sarcopenia in the ICU remains challenging. Screening for sarcopenia using SARC-F questionnaire (Strength, Assistance with walking, Rising from a chair, Climbing stairs, and Falls) is sometimes problematic in ICU patients, making muscle mass assessment critical in this population. Muscle strength and function may also be difficult to assess because of the severity of the illness. Yet, methods for quantifying muscle mass in the ICU remain heterogeneous [22]. Techniques include bedside ultrasound, bioelectrical impedance analysis (BIA) and cross-sectional imaging (CT or MRI) [24▪]. The most widely studied imaging method was ultrasound, with measurements taken at the rectus femoris, quadriceps, and biceps brachii cross-sectional area or thickness [24▪]. Both nutrition and exercise will at some timepoint during critical illness contribute to preventing and treating sarcopenia [25].

Frailty and outcomes

Frailty is a multidimensional syndrome characterized by decreased physiological reserve and increased vulnerability to stressors. Robust evidence demonstrates that frailty is independently associated with increased all-cause mortality, higher rates of hospitalization, and greater risk of disease-specific adverse events [26–28]. Older adults living with frailty experience deficits across multiple domains, rendering them particularly susceptible to even minor stressors. When exposed to the substantial physical, physiological, and psychosocial demands imposed by invasive procedures and surgery, individuals with frailty constitute one of the highest risk groups within the perioperative population. In this context, they face an elevated risk of major morbidity, delirium, cognitive decline, impaired functional recovery, and mortality. Evidence indicates that frailty is specifically associated with a two-fold to five-fold increase in the likelihood of postoperative complications, death, nonhome discharge, and onset of new disabilities [29,30].

The prevalence of frailty on ICU admission varied from 30 to 45% depending on the criteria used [31▪▪]. In a cohort study, prevalence was similar among participants aged 50–60, 60–70, and 70–80, but increased only after age 80 [31▪▪,32]. Frailty severity is dynamic and can be assessed during recovery from critical illness using both the Clinical Frailty Scale (CFS) and the Frailty Index (FI), each of which has been associated with worse outcome [31▪▪]. Frailty is also linked to higher mortality and poorer physical health-related quality of life in long-stay ICU patients at 6 months [33]. Importantly, the admission CFS can help guide discussions with patients and families about the complexities of survivorship during a prolonged ICU stay [33].

Cachexia

Cachexia, described by Hippocrates, the father of medicine (460–370 BC), as a condition in which 'the flesh is consumed and becomes water… the abdomen fills with water, the feet and legs swell, the shoulders, clavicles, chest, and thighs melt away [34]', can be a marker of the severity of previous diseases or a consequence of ICU treatment. In contrast to sarcopenia, cachexia is a complex metabolic syndrome associated with underlying illness (most commonly cancer, chronic heart failure, or other end-stage organ diseases) and is defined by involuntary weight loss, muscle wasting (with or without fat loss), and prominent systemic inflammation. Persistent inflammation, immunosuppression, and catabolism syndrome (PICS) exemplify the pathophysiological milieu in which cachexia develops, particularly in older patients with chronic critical illness. Unlike sarcopenia, cachexia is driven by pro-inflammatory cytokines and metabolic derangements that lead to anorexia, increased energy expenditure, and resistance to nutritional interventions, affecting mainly glycolytic myofibers type I (in sarcopenia, there is preferential atrophy and loss of type IIb myofibers) [35]. Thus, nutritional support alone is insufficient to reverse cachexia in critical care patients (as well as cachexia of any cause) [36].

NUTRITIONAL MANAGEMENT

Effective nutritional management is crucial for reducing all described complications and minimizing the risk of refeeding syndrome and aspiration pneumonia, which are prevalent in this demographic and can lead to increased morbidity and mortality [37]. The complexity of managing nutrition in older ICU patients is compounded by the lack of studies and specific guidelines tailored to their needs, necessitating a nuanced approach to care [37,38,39▪▪]. A systematic review including randomized controlled trials (RCTs) from various topics, including nutrition, conducted between 2009 and 2022, showed that only 6 of 253 RCTs in critical care reported the proportion of older adults, limiting the ability to draw conclusions about the association between interventions and outcomes for this population [40]. Table 2 shows important RCT in the ICU

Table 2. Characteristics of major randomized nutrition trials and representation of older adults

Study	Intervention	Outcomes	Mean age (SD)	*N* estimated above 80 years old (%)	Subgroup analysis of older patients
EPaNIC, 2011	Early supplemental PN in patients intolerant to EN (goal: 25–30 kcal/kg/day) vs. no supplemental PN (low-calorie low-protein feeding) until D6	Shorter ICU LOS with low-calorie/low-protein feeding (no early supplemental PN) vs. early supplemental PN[a] Fewer injections and shorter MV duration with low-calorie/low-protein feeding No impact on mortality	64 (15)	664 (14)	Yes[a]: age cut point 70 years no difference in functional outcome
EDEN, 2012	480 kcal/day (5–6 kcal/kg/day; 0.2–0.4 g protein/kg/day) up to ICU D6, vs. 25–30 kcal/kg/day; 1.2–1.6 g protein/kg/day	No impact on ventilator-free days of trophic vs. standard feeding[a] No impact on infections, LOS, or D60 mortality of trophic vs. standard feeding	52 (17)	50 (5)	No
PERMIT, 2015	Low calorie (40–60% of 25–30 kcal/kg/day) and standard protein intakes (1.2–1.6 g protein/kg/ day) vs. standard intakes until ICU D14	No impact on D90 mortality of permissive low calorie vs. standard feeding[a] No impact on infections or LOS	50,2 (19,4)	56 (6)	No
TARGET, 2018	High-calorie and standard protein intakes (36 kcal/kg/day; 1.4 g/kg/day) vs. standard calorie (24 kcal/kg/day) and protein intakes until ICU D28	No impact on D90 mortality of high-calorie intakes vs. standard[a] No impact on infections or LOS	57 (16,5)	323 (8)	Yes: age cut point 65 years no difference in the outcomes
NUTRIREA-3, 2023	Low calorie and protein intakes (6 kcal/kg/day; 0.2–0.4 g/kg/day) vs. standard intakes (25 kcal/kg/day; 1–1.3 g/kg/day) until ICU D7	Shorter time for ICU discharge with low vs. standard calorie and protein intakes[a] No impact on D90 mortality Less gut ischemia and liver disfunction Shorter MV duration with low vs. standard intakes	66 (13)	428 (14)	No
EFFORT, 2023	High protein ($\geq$2.2 g/kg/day) and standard energy intakes vs. standard calorie and protein ($\leq$1.2 g/kg/day) intakes until ICU D28	No impact on time to discharge alive from ICU of high-protein intakes vs. standard[a] No impact on infections or mortality	57 (17)	117 (9)	Yes: age cut point 59 years no difference in the outcomes
PRECISe, 2024	High vs. standard enteral protein (2 vs. 1.3 g/kg/day)	Worse health-related quality of life in critically ill patients No improvement in functional outcomes during 180 days after ICU admission.	64 (14)	118 (13)	Yes: age cut point 65 years no difference in quality of life and mortality

Table 2 (*Continued*)

Study	Intervention	Outcomes	Mean age (SD)	*N* estimated above 80 years old (%)	Subgroup analysis of older patients
TARGET, 2025	Augmented enteral protein vs. standard [1.48 (1.09–1.81) vs. 0.94 (0.70–1.19) g/kg/day]	No improvement in number of days free of the index hospital and alive at day 90.	Median: 61 IQR (48-71)	Not possible to estimate	Yes: age cut point 70 no difference in the outcomes

[a]Secondary analysis published separated.

field and the proportion of elderly patients in each study [39,41–43▪▪]. It is noteworthy that recent trials more frequently include subgroup analyses focusing on older critically ill patients [41–43], and that the EPANIC trial follow-up also incorporated such an analysis with a 2-year follow-up [44].

Effective nutritional management can significantly reduce these risks, thereby decreasing morbidity and mortality rates [5]. Understanding the assessment, timing, route, and composition of enteral nutrition, as well as the prevention and management of adverse events, is essential for optimizing care in this vulnerable population. In other words, proper nutrition is fundamental for improving outcomes in older adult patients in critical care settings [45]. The following sections detail the importance of nutritional management in older ICU patients.

Assessment

Evaluating the nutritional status of critically ill older adults requires a comprehensive, multimodal approach that combines screening tools, diagnostic assessments, and both objective and functional measures owing to the complex interactions between aging-related physiological changes, existing comorbidities, and the acute impact of critical illness [17]. For older adults, the Mini Nutritional Assessment Short-Form (MNA-SF) is the best-validated tool (a score <12 indicates the risk of malnutrition) [17]. The diagnosis of malnutrition in older adults should follow the Global Leadership Initiative on Malnutrition (GLIM) framework, which requires at least one phenotypic criterion (weight loss, low BMI, or low muscle mass) and one etiological criterion (reduced intake/assimilation or inflammation) [17]. For those aged older than 70 years, a BMI less than 22 kg/m^2 is considered malnourished, and less than 20 kg/m^2 indicates severe malnutrition [17]. Other tools, such as the Nutrition Risk Screening 2002 (NRS-2002), Malnutrition Universal Screening Tool (MUST), and Short Nutritional Assessment Questionnaire (SNAQ), have been validated for use in hospitalized adults. However, they are also commonly applied to critically ill older adults, despite the lack of specific validation in this population [2,46]. Initial screening should be performed within 24–48 h of admission [17]. Routine laboratory markers, such as serum albumin, prealbumin, and transferrin, are not reliable indicators of nutritional status in critically ill patients, because they behave as negative acute-phase reactants. Their levels reflect inflammation and illness severity rather than nutritional reserves [2].

Timing

As mentioned, older critical care patients are fragile and particularly susceptible to complications, mainly patients above 76 years old, which were identified as independent risk predictors for 28-day mortality in a recent study [38], highlighting the vulnerability of this population to malnutrition and adverse outcomes. Early nutritional intervention should be prioritized upon ICU admission whenever feasible [17]. Feeding initiation requires adequate resuscitation, followed by careful and gradual advancement under close monitoring [17,38]. Early nutritional assessment and age-specific and muscle-specific interventions may play an important role in supporting better clinical and functional outcomes in this population. Oral nutrition can be particularly challenging in elderly patients due to impaired chewing, dysphagia, and age-related anorexia [17]. We recommend beginning nutrition within the first 48 h of ICU stay, targeting approximately 25% of the estimated nutritional goal initially.

Target

To date, no specific recommendations regarding caloric intake have been established for critically ill older adults. Elderly patients in critical care commonly exhibit marked anabolic resistance. However, there is still a paucity of robust evidence specifically addressing the nutritional requirements of this population, particularly concerning long-term functional outcomes and the optimal timing for protein escalation. Although higher protein intake (>1.5 g/kg/day) may

improve nitrogen balance, current evidence does not support the routine use of high-dose protein during the acute phase of critical illness in older adults, due to the absence of proven clinical benefit and the potential risk of harm [41,42,47–49]. Measuring urea nitrogen to check nitrogen balance does not help titrate protein intake, making nutritional therapy strategies even more challenging [50]. Moreover, older individuals often experience catabolic crises that necessitate comprehensive nutritional management to enhance their recovery and maintain their physical and cognitive functions [2].

CHALLENGES AND FUTURE PERSPECTIVES

The impact of nutrition on elderly patients admitted to the ICU remains an open question. Elderly patients often present with conditions such as prior malnutrition, frailty, sarcopenia, and cognitive decline that must be carefully evaluated at admission, as they are intrinsic to their nutritional status. Future research focusing on this population is essential, and subgroup analyses by age should be encouraged in nutritional studies. Moreover, nutrition cannot be dissociated from physical therapy, as early mobilization is critical to preserving functionality. Together, these represent the mainstays of nonpharmacological care in the ICU.

Building on this foundation, nutrition remains the cornerstone of care for critically ill older adults, yet it is often insufficient to fully counteract the long-term consequences of chronic disease and critical illness. While past pharmacologic attempts to preserve muscle mass or restore appetite have largely fallen short, ensuring adequate nutritional support is a critical first step in reducing morbidity and improving outcomes. Emerging therapies, such as ponsegromab (recently shown in a phase 2 trial to increase weight, activity, and reduce cachexia symptoms in cancer patients) offer a glimpse of what the future may hold [51▪]. Combining robust nutritional strategies with innovative interventions could transform recovery trajectories for this vulnerable population, highlighting the importance of both present care and future research.

CONCLUSION

Older adults represent a growing and highly vulnerable proportion of the ICU population, where malnutrition, sarcopenia, frailty, and cachexia converge to worsen outcomes. While large nutritional RCTs have included older participants, age-specific analyses remain scarce, leaving uncertainty regarding optimal energy and protein targets in this group. Current evidence supports early, individualized, and cautiously progressive nutritional support integrated with physical rehabilitation. Future research should prioritize stratification by advanced age and long-term functional outcomes. Tailored nutritional strategies may ultimately improve survival and preserve quality of life in critically ill older adults.

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Conflicts of interest

There are no conflicts of interest.

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- ▪ of special interest
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