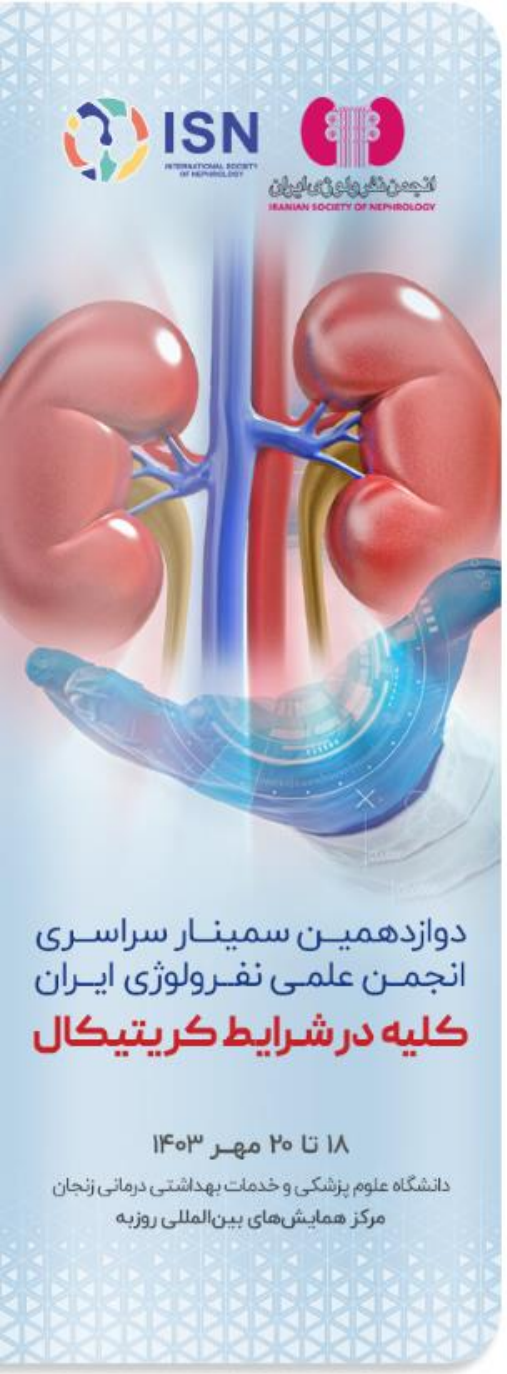

Nutritional Considerations in Critically Ill patients with AKI

Dr.Hossein Imani
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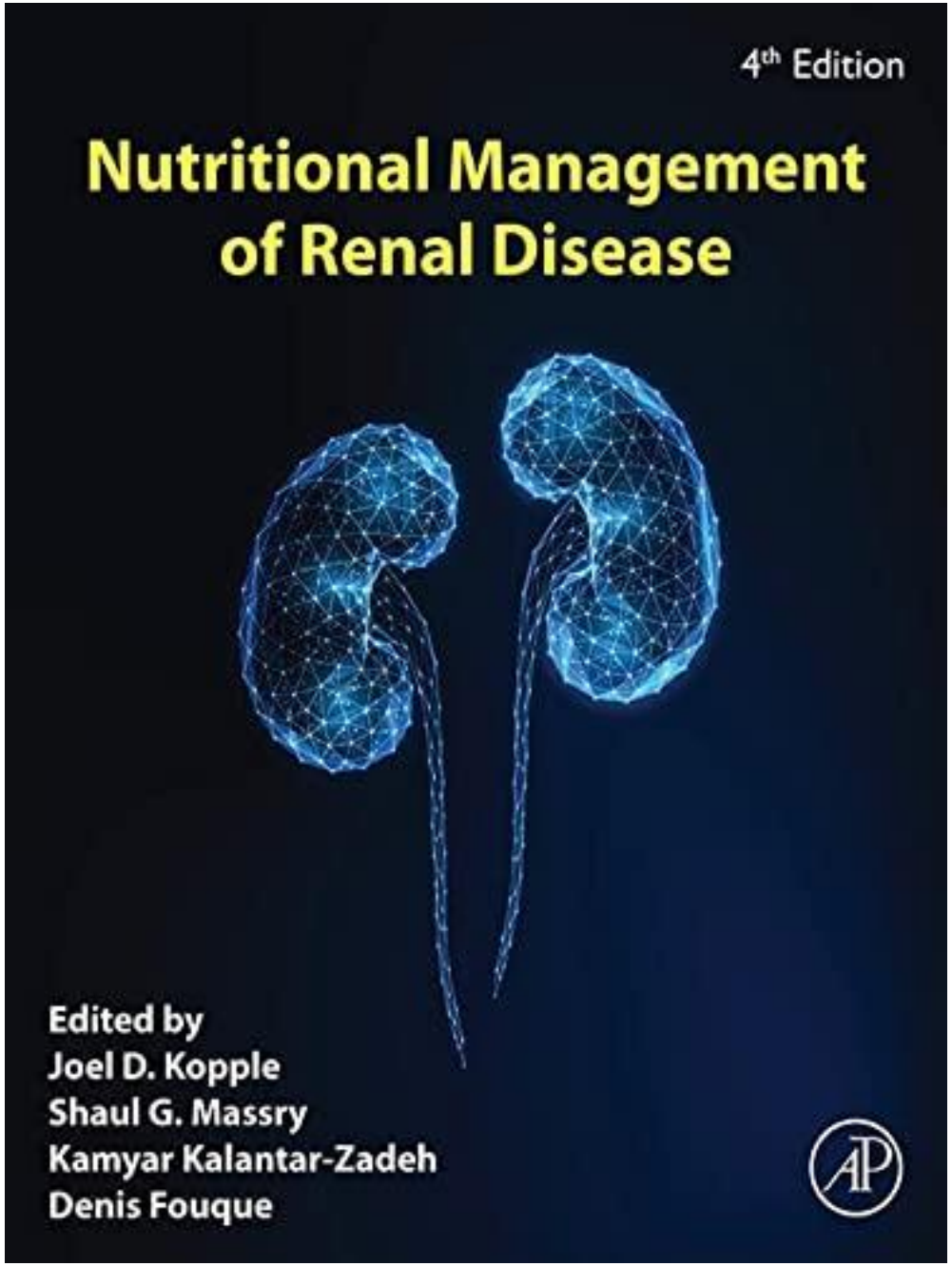
(Associate Professor Of Clinical Nutrition)



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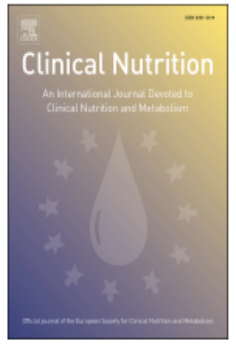

ESPEN practical guideline on clinical nutrition in hospitalized patients with acute or chronic kidney disease

Alice Sabatino, Enrico Fiaccadori, Rocco Barazzoni, Juan Jesus Carrero, Adamasco Cupisti, Elisabeth De Waele, Joop Jonckheer, Cristina Cuerda, Stephan C. Bischoff

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INTERNATIONAL SOCIETY OF RENAL NUTRITION & METABOLISM

INTERNATIONAL SOCIETY OF RENAL NUTRITION AND METABOLISM

XXI ICRNM
JUNE 16-20, 2025
BERLIN, GERMANY

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BERLIN GERMANY
DIALYSIS AKTUELL NUTRITION
ICRNM 2025

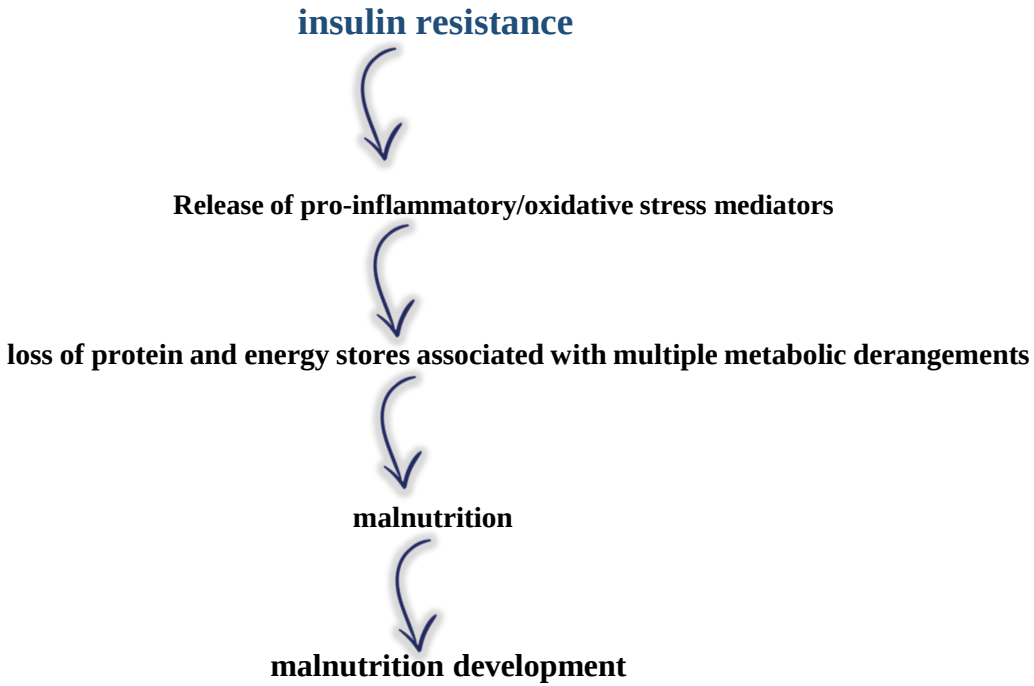
1) Kidney function impairment has negative effects on carbohydrate, protein, and lipid metabolism, exerts a pro-inflammatory effect, and has a major impact on the anti-oxidative system.

2) AKI/AKD increase the risk for malnutrition by inducing multiple metabolic derangements and, frequently, by reducing nutrient intake.

3) There is no uniform and validated criteria to define malnutrition in hospitalized patients with AKI/AKD. Studies to validate the ESPEN endorsed GLIM criteria in patients with kidney disease should be performed.

The acute loss of kidney homeostatic function plays a central role in the worsening of the dysmetabolic status typical of critical illness.

- inadequate spontaneous nutrient intake
- metabolic acidosis
- insulin resistance
- chronic inflammation
- intestinal dysbiosis
- infection and oxidative stress



Indication for medical nutrition treatment

1) Medical nutrition therapy should be provided to any patient with AKI/AKD, AKI on CKD staying in the ICU for more than 48 h.

2) In malnourished non-critically ill hospitalized patients with AKI/AKD and those patients at risk for malnutrition who can safely feed orally but cannot reach their nutritional requirements with a regular diet alone, **ONS** shall be offered

3) Intradialytic parenteral nutrition (IDPN) shall be applied in malnourished non-critically ill hospitalized patients with CKD and KF on hemodialysis, or the same patients if at risk of malnutrition that fail to respond or do not tolerate ONS or EN.

4) EN, PN, or EN and PN shall be given to critically and non-critically ill hospitalized patients with AKI/AKD, unable to achieve at least 70% of macronutrient requirements with oral nutrition

- A cut-off of 48h for the initiation of early nutrition has been established for critically ill patients.

ONS: can add up to 10-12 kcal/kg and 0.3- 0.5 g of protein/kg daily over the spontaneous intake in a 70 kg patient if provided two times a day at least one hour after a meal, thus facilitating the achievement of nutritional targets

ONS benefits:

- in polymorbid (defined as two or more chronic comorbidities) inpatients suggests that ONS may improve nutritional status
- ONS combined with physiotherapy increased energy and protein intake without negatively affecting hospital food consumption while preserving lean body mass during recovery and until three months after discharge
- reduced the number of non-elective readmissions in the following six months after discharge

shall be applied in malnourished non-critically ill hospitalized patients with CKD and KF on hemodialysis, or the same patients if at risk of malnutrition that fail to respond or do not tolerate ONS or EN.

Intradialytic parenteral nutrition (**IDPN) :**

- can be applied only to patients with KF on chronic hemodialysis.
- is a safe and convenient approach for individuals who cannot tolerate oral or enteral administration of nutrients.
- nutritional improvements.

❑criteria to initiate IDPN :

- Poor oral food intake and nutritional supplements
- Intolerance to tube feeds
- Weight loss >10%
- Serum albumin <3.4 g/dL

- History of any of the following:
- Anorexia caused by uremic state
- Anorexia nervosa due to higher levels of urea and creatinine
- Change in the taste of food
- Recurrent illness
- Mental stress
- Hypercatabolism
- Not dialyzed adequately
- Gastroparesis
- Constipation

conditions may interfere with patient’s spontaneous intake:

loss of appetite, delayed gastric emptying, dysphagia,…

- patients receiving EN had significantly lower infectious and non-infectious complications than those receiving PN.

Screening and Assessment

1) Any hospitalized patient with AKI/AKD, and especially those staying for more than 48 hours in the ICU, should be screened for malnutrition.

2) Body composition assessment should be preferred to anthropometry measurements when diagnosing and monitoring malnutrition in hospitalized patients with AKI/AKD.

3) In collaborative patients with AKI/AKD, muscle function should be assessed by hand-grip strength.

BWA2.0

[BWA2.0]

SEE WHAT YOU'RE MADE OF

ID	Height	Age	Gender	Test Date / Time
John Doe	5ft 06.3in	31	Male	04.01.2022 09:13

Body Composition Analysis

	Values	Total Body Water	Fat Free Mass	Weight
Intracellular Water (lb)	65.9	104.1 (77.4~94.6)	142.4 (105.2~128.5)	160.4 (116.8~158.3)
Extracellular Water (lb)	38.1			
Dry Lean Mass (lb)	38.4			
Body Fat Mass (lb)	18.0			

Muscle-Fat Analysis

Weight	(lb)	160.4
SMM Skeletal Muscle Mass	(lb)	81.4
Body Fat Mass	(lb)	18.0

Obesity Analysis

BMI Body Mass Index	(kg/m²)	25.7
PBF Percent Body Fat	(%)	11.2

Segmental Lean Analysis

Based on ideal weight — Based on current weight

			ECW/TBW
Right Arm	(lb)	8.02	0.381
	(%)	117.4	
Left Arm	(lb)	7.14	0.374
	(%)	104.7	
Trunk	(lb)	58.3	0.367
	(%)	107.1	
Right Leg	(lb)	22.27	0.362
	(%)	117.2	
Left Leg	(lb)	21.14	0.365
	(%)	111.3	

ECW/TBW Analysis

ECW/TBW	0.367

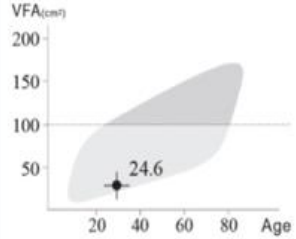
Body Composition History

		09.15.21 07:42	10.01.21 06:50	11.10.21 06:52	12.04.21 06:45	01.02.22 06:30	02.12.22 06:16	03.02.22 06:12	04.01.22 09:13
Weight	(lb)	160.3	161.4	160.9	162.0	165.8	164.1	168.2	160.4
SMM Skeletal Muscle Mass	(lb)	75.2	74.7	74.5	74.5	75.2	73.6	77.2	81.4
PBF Percent Body Fat	(%)	17.5	18.3	18.6	19.0	20.3	21.4	19.8	11.2
ECW/TBW		0.370	0.372	0.370	0.370	0.370	0.368	0.367	0.367

Recent Total

Visceral Fat Area

VFA(cm²)



Body Fat - Fat Free Mass Cotrol

Body Fat Mass	0.0 lb
Fat Free Mass	0.0 lb

(+)means to gain fat/lean (-)means to lose fat/lean

Segmental Fat Analysis

Right Arm	(0.7lb)	49.6%
Left Arm	(0.9lb)	71.9%
Trunk	(8.4lb)	96.7%
Right Leg	(3.1lb)	84.7%
Left Leg	(2.9lb)	80.6%

Research Parameters

Intracellular Water	65.9 lb	(48.1~58.6)
Extracellular Water	38.1 lb	(29.3~35.9)
Basal Metabolic Rate	1765 kcal	(1572~1839)
Waist-Hip Ratio	94.4 lb	(68.6~84.0)
Body Cell Mass	43.4 lb	
SMI	9.4 kg/m²	

Whole Body Phase Angle

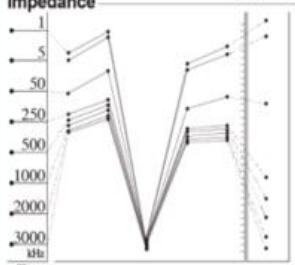
ϕ(°) 50kHz | 8.6°

Segmental Phase Angle

	RA	LA	TR	RL	LL
ϕ(°) 5kHz	2.9	2.9	3.6	4.3	4.2
50kHz	7.3	7.3	8.0	10.2	10.0
250kHz	6.1	6.2	9.2	8.0	7.7

Impedance

Proximal



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Journal of Renal Nutrition
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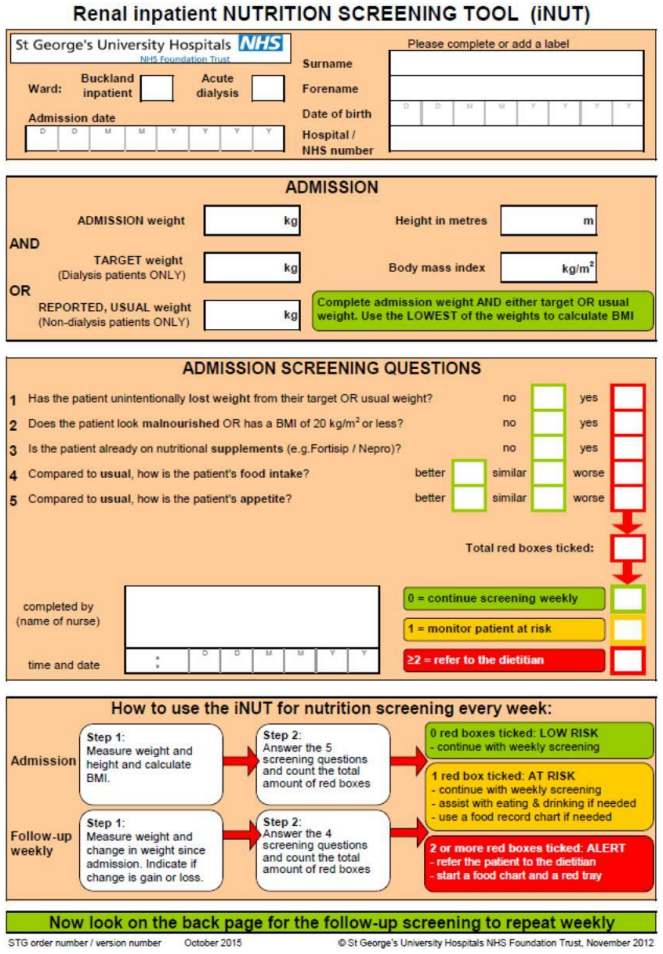
Original Research

Body Composition Analysis as a Predictor of Prognosis for Patients With Acute Kidney Injury Requiring Kidney Replacement Therapy

Buyun Wu MD *, Yudie Peng MD *, Sufeng Zhang MD * †, Wenyan Yan MD *, Min Gao MD *, Yifei Ge MD *, Kang Liu MD *, Xueqiang Xu MD *, Xiangbao Yu MD *, Yamei Zhu BS *, Xianrong Xu BS *, Changying Xing MD, PhD *, Huijuan Mao MD, PhD *

Renal iNUT tool

- questions on appetite, dietary intake, use of nutritional supplements, and kidney-specific details on weight (dry-weight target or edema free target weight).



Renal inpatient NUTRITION SCREENING TOOL (iNUT)

St George's University Hospitals NHS — NHS Foundation Trust

Please complete or add a label

Ward: Buckland inpatient ☐ Acute dialysis ☐

Admission date D D M M Y Y Y Y

Surname

Forename

Date of birth D D M M Y Y Y Y

Hospital / NHS number

ADMISSION

ADMISSION weight ____ kg — Height in metres ____ m

AND

TARGET weight (Dialysis patients ONLY) ____ kg — Body mass index ____ kg/m²

OR

REPORTED, USUAL weight (Non-dialysis patients ONLY) ____ kg

Complete admission weight AND either target OR usual weight. Use the LOWEST of the weights to calculate BMI

ADMISSION SCREENING QUESTIONS

1	Has the patient unintentionally **lost weight** from their target OR usual weight?		no ☐		yes ☐
2	Does the patient look **malnourished** OR has a BMI of 20 kg/m² or less?		no ☐		yes ☐
3	Is the patient already on nutritional **supplements** (e.g.Fortisip / Nepro)?		no ☐		yes ☐
4	Compared to **usual**, how is the patient's **food intake**?	better ☐	similar ☐		worse ☐
5	Compared to **usual**, how is the patient's **appetite**?	better ☐	similar ☐		worse ☐

Total red boxes ticked: ☐

completed by (name of nurse) ____

time and date : D D M M Y Y

0 = continue screening weekly ☐

1 = monitor patient at risk ☐

≥2 = refer to the dietitian ☐

How to use the iNUT for nutrition screening every week:

Admission	Step 1: Measure weight and height and calculate BMI.	Step 2: Answer the 5 screening questions and count the total amount of red boxes	0 red boxes ticked: LOW RISK - continue with weekly screening 1 red box ticked: AT RISK - continue with weekly screening - assist with eating & drinking if needed - use a food record chart if needed
Follow-up weekly	Step 1: Measure weight and change in weight since admission. Indicate if change is gain or loss.	Step 2: Answer the 4 screening questions and count the total amount of red boxes	2 or more red boxes ticked: ALERT - refer the patient to the dietitian - start a food chart and a red tray

Now look on the back page for the follow-up screening to repeat weekly

STG order number / version number October 2015 © St George's University Hospitals NHS Foundation Trust, November 2012

General nutritional assessment

- patient history
- unintentional weight loss
- decrease in physical performance before hospital or ICU admission physical examination
- assessment of body composition, muscle mass, and strength.

Handgrip strength dynamometry has been proposed as a simple and easy diagnostic method for ICU-acquired weakness and can identify disorders even before the changes in body composition parameters are identified, allowing nutritional interventions to be made earlier.

❖Handgrip strength :

Lower than 10 kg at the time of discharge and lower than 15 kg one month after hospital discharge were associated with the risk of death

Timing and Route of feeding

1) Early nutritional support (i.e. provided in less than 48 hours from hospital admission compared to later nutritional support should be performed in polymorbid medical inpatients, as sarcopenia could be decreased and self-sufficiency could be improved.

2) If oral intake is not possible, early EN (within 48 h) in critically ill adult patients should be performed/initiated rather than delaying EN anad also early PN.

Timing and Route of feeding

3) In polymorbid hospitalized patients, ICU patients: EN is the most physiologic route of feeding in comparison to PN, and in general has been linked to **lower infection rates**, **shorter ICU and hospital stay**.

4) There is no evidence linking a reduced renal function with an increase of either gastrointestinal, mechanical, or metabolic complications during EN in patients with AKI/AKD.

Timing and Route of feeding

5) **In case of contraindications to oral and EN**: **PN** should be implemented within three to seven days.

6) Early and progressive PN can be provided instead of no nutrition in case of contraindications for EN in severely malnourished patients

✓Early EN was also related to shorter hospital and ICU stays in comparison to early PN.

✓**Withhold EN in critically ill patients with AKI/AKD when there is:**

uncontrolled shock, uncontrolled hypoxemia and acidosis, uncontrolled upper GI bleeding, gastric aspirate volume > 500 ml/6 h, bowel ischemia, bowel obstruction, abdominal compartment syndrome, and high-output fistula without distal feeding access.

EN should start at low rates and should be increased slowly (over days) until requirements are met.

Clear evidence concerning the incidence and severity of refeeding syndrome in hospitalized patients with kidney disease is not available at present: however, plasma electrolyte and phosphorus levels must be strictly monitored.

- The caloric overfeeding may play a role in the infectious complications of PN.

- the initiation of low-dose PN should be carefully considered and balanced against the risks of overfeeding and refeeding.

Energy requirements

1) In hospitalized patients with AKI/AKD needing medical nutrition therapy, indirect calorimetry should be used to assess energy expenditure to guide nutritional therapy (caloric dosing) and avoid under- or overfeeding.

2) Indirect calorimetry can be performed during CKRT

3) A minimum interval of two hours after an intermittent dialysis session should be preferred to improve the precision of the measurement.


COSMED
2634
0.87
377
327
40.03
0.05
37.46
2.36
933
18.9
Nutrition Therapy
Focused Results
Fast. Accurate. Intuitive.
Rx Only: For safe and proper use of this device, please refer to User's Manual.

chever


COSMED
Q-NRG+

Energy requirements

3) Whenever the clinical condition of the patient is changing, indirect calorimetry shall be repeated.

- energy expenditure of critically ill patients is very dynamic and depends on the phase and the severity of illness, treatment, and extended bed rest

- Past guidelines on ICU patients with AKI have recommended 20-30 kcal/kg/d of non-protein calories or 20-30 kcal/kg/d total calories

it is even more difficult to define the reference body weight to be used to estimate energy expenditure using predictive equations.

fluid overload

low precision

- If indirect calorimetry is not available, the calculation of REE from VO2 (oxygen consumption) from pulmonary arterial catheter or VCO2 (carbon dioxide production) derived from the ventilator will give a better evaluation on energy expenditure than predictive equations.

- In polymorbid medical inpatients with reduced food intake and hampered nutritional status at least 75% of calculated energy and protein requirements should be achieved in order to reduce the risk of adverse outcome.

- Hypocaloric nutrition (not exceeding 70% of EE) should be administered in the early phase of acute illness

- Actual EE should not be the target during the first 72 hours of acute critical illness

- Overfeeding: (to 500 to 1400kcal/d)

❑increased length of stay

❑ increased ventilation duration

❑ increased infection rates

❑increases the risk of refeeding

- After day three, caloric delivery can be increased up to 80-100% of measured energy expenditure.
- under- and overfeeding were both deleterious, and that the optimal amount appeared to be between 70 - 100% of measured EE
- not before the first 48 hours : avoid over-nutrition
- To avoid overfeeding, **early full EN and PN** shall not be used in critically ill patients but shall be prescribed within three to seven days.

- For patients undergoing KRT, the total energy provision by additional calories given in the form of citrate,lactate, and glucose from dialysis/hemofiltration solutions should be included in the calculations to determine the total daily energy provision to avoid overfeeding.

- citrate (3Kcal/g) from regional circuit anticoagulation, glucose (3.4 Kcal/g) from dialysis fluids, and lactate (3.62 Kcal/g) that might be used as a buffer.

- lactate content of replacement fluids and type of anticoagulation (115 – 1300 kcal/d).

- No factor should be applied to the measured REE to compensate for KRT since there is no difference between patients not on KRT as compared to those on KRT.

- critically ill patients with AKI undergoing KRT had similar REE measured by indirect calormetry than AKI patients not on KRT

Protein requirements

1. **KRT** can exert a negative influence on protein balance by inducing amino acid and peptide/protein losses. As a consequence, protein requirements can be increased in patients undergoing KRT.

Protein requirements

- Hospitalized patient with **CKD without acute/critical** illness: **0.6-0.8 g/kg BW/d**

- Hospitalized patient with **CKD** and **KF** on conventional **intermittent chronic KRT without acute/critical illness: =1.2 g/kg BW/d**

- Hospitalized patient with **AKI,** AKI on CKD **without acute/critical illness: 0.8-1.0 g/kg BW/d**

- Hospitalized patient with **AKI**, AKI on CKD, CKD, **with acute/critical illness, not on KRT**: start with **1 g/kgBW/day, and gradually increase up to 1.3 g/kg BW/d if tolerated.**

- **Critically ill patients with AKI** or AKI on CKD or CKD with KF on conventional **intermittent KRT**: **1.3 - 1.5 g/kg/d**

- **Critically ill patients with AKI** or AKI on CKD or CKD with KF on **CKRT or PIKRT**: 1.5 g/kg/d up to 1.7 g/kg/d

Table 1 Current clinical practice guidelines on protein requirement in patients with acute kidney injury (AKI)

Guideline	Year	Patients	Recommendation	Quality of evidence
ASPEN/SCCM[3]	2016	ICU patients with AKI not on hemodialysis or CRRT	Follow the standard ICU recommendations for protein (1.2–2 g/kg actual BW per day)	Expert opinion[a]
		ICU patients on hemodialysis or CRRT	Increased protein, up to a maximum of 2.5 g/kg per day	Very low[a]
ESPEN[2]	2021	Hospitalized patient with AKI, AKI on CKD, CKD, with acute/ critical illness, not on KRT	Start with 1 g/kg BW per day, and gradually increase up to 1.3 g/kg BW per day if tolerated[b]	Grade of recommendation 0[a]
		Critically ill patients with AKI or AKI on CKD or CKD with KF on conventional intermittent KRT	1.3 to 1.5 g/kg BW per day[b]	Grade of recommendation 0[a]
		Critically ill patients with AKI or AKI on CKD or CKD with KF on CKRT or PIKRT	1.5 g/kg BW per day up to 1.7 g/kg BW per day[b]	Grade of recommendation 0, Consensus (82.6% agreement)[a]

[a] As defined by the authors of the guidelines

[b] Pre-hospitalization body weight or usual body weight may be preferred over the ideal body weight. Actual body weight should not be considered for a protein prescription, as per the ESPEN guidelines

AKI: acute kidney injury, BW: body weight, CKD: chronic kidney disease, KF: kidney failure, CRRT/CKRT: continuous renal/kideny replacement therapy, PIKRT: Prolonged Intermittent Kidney Replacement

If available, the pre-hospitalization body weight or usual body weight may be preferred over the ideal BW.

Actual BW should not be considered for a protein prescription.

Protein prescription shall not be reduced in order to avoid or delay KRT start in critically ill patients with AKI, AKI on CKD.

protein catabolism in patients with AKI is only quite partially influenced by protein intake.

medical conservative approach consisting of moderately restricted protein regimens, may be considered only in the case of metabolically stable patients with AKI or CKD, without any catabolic condition/critical illness and not undergoing KRT.

stable CKD patients, medical conservative treatment can help to correct phosphate, sodium, potassium acid-base alterations, also reducing the accumulation of nitrogen waste products, such as urea.

Instead, when catabolic status exists, a conservative approach might only partially correct electrolytes, fluids or acid-base unbalances but invariably worsens nitrogen balance; in most of such cases, KRT start is advised.

CKD patients previously maintained on controlled protein intake (the so-called “low protein diet”) should not be maintained on this regimen during hospitalization if acute illness is the reason for hospitalization.

- critical or acute illness or major surgery : dietary protein restriction is not appropriate.

- absence of a pro-catabolic state : controlled protein intake regimens.

Micronutrient requirements

Because of increased requirements during KF and critical illness, and large effluent losses during KRT, trace elements should be monitored and supplemented. Increased attention should be given to: **selenium, zinc, and copper and**

water-soluble vitamins: **vitamin C, folate, and thiamine**.

Electrolytes abnormalities are common in patients with AKI, AKI on CKD, or CKD with KF receiving KRT and shall be closely monitored.

- optimal dosing of micronutrients in critically ill patients is still a matter of debate.

- **patients on CKRT**, a reduction in serum levels of **zinc, and selenium** have been described.

- When **CKRT** is required for **more than two weeks**, **blood copper** determination should probably be recommended(3mg/day IV)

- reduction in serum levels of folate, vitamins C, E, and thiamine:

- Specifically, a daily loss in the effluent of about 68 mg of vitamin C, 0.3 mg of folate, and 4 mg of vitamin B1 (thiamine) have been reported.

- on **chronic hemodialysis**, **zinc, thiamin, and vitamin B6** were the most deficient micronutrient.

❑**intensive/prolonged KRTs** include **hypophosphatemia, hypokalemia, and hypomagnesemia**.

- **Hypophosphatemia** (serum phosphate levels <2.5mg/dl) has a high reported prevalence (60- 80%) in the **ICU** .

❑ The initiation of KRT is a major risk factor for the development of hypophosphatemia

Disease-specific nutrients

1) No disease-specific enteral nor parenteral formula oriented for patients with reduced kidney function should be routinely utilized in every patient with AKI, AKI on CKD in comparison to conventional formulas. Instead, their use is to be individualized.

Disease-specific nutrients

2) The choice of the most appropriate EN or PN formula should be made based on the calorie and protein ratio to provide the most accurate dosing in clinical practice.

3) In patients with **electrolyte and fluid imbalances**, concentrated “renal” EN or PN formulas with lower electrolyte content may be preferred over standard formulas.

4) There is not enough evidence to support the routine use of omega-3 polyunsaturated fatty acids (PUFA) supplements or PN solutions enriched with omega-3 PUFA in hospitalized patients with AKI, AKI on CKD.

5) In critically ill patients with AKI, additional high dose parenteral glutamine shall not be administered.

6) Serum glucose levels shall be maintained between 140 – 180 mg/dl in hospitalized patients with AKI, AKI on CKD, or CKD with KF.

7) Tight glucose control (80-110 mg/dl) shall not be pursued because of the increased risk of hypoglycemia.

- Insulin resistance is highly prevalent among patients with AKI and is associated with increased mortality risk.

- High blood glucose concentration can be considered one of the best independent predictors of mortality in this clinical setting.

The role of omega-3 PUFA in hospitalized patients with kidney disease and reduced kidney function is at this time point unknown.

However, intravenous lipid emulsions with omega-3 PUFA are recommended by ESPEN for critically ill patients due to their anti-inflammatory and immune modulating effects and these recommendations do not exclude patients with AKI

Thank you for your attention