Individualised nutrition on the ICU – putting the evidence into practice.

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BAPEN, Brighton, UK
9th November, 2016

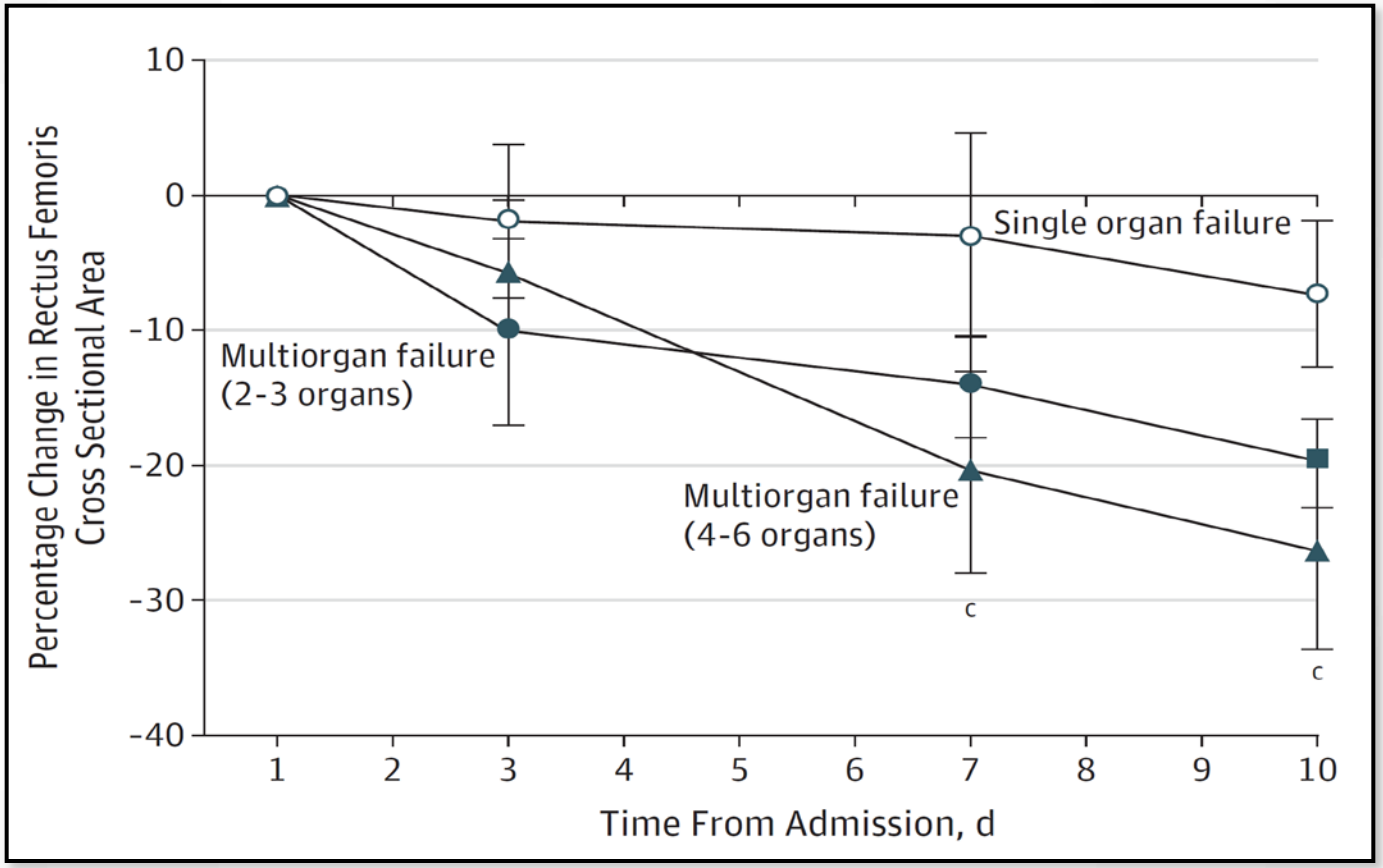
Conflicts

Conference fees, advisory board, consulting and honoraria from:

- Nutricia
- Nestle
- Baxter
- Fresenius Kabi


WAY TO M.T
EVEREST BC

Early and Rapid Muscle Loss



Muscle wasting is significantly greater in the sickest patients

20% loss in RF_{CSA} with > 2 organ failure

26% loss in RF_{CSA} with > 4 organ failure

Puthucheary et al JAMA 2013;310(15):1591-1600

Function and Quality of Life

- Both function and quality of life are significantly reduced post-discharge from the ICU
  - 51% not back at work at 1 year (Herridge et al, 2003)
  - Physical function below age and sex matched controls at both 1 and 5 years (Herridge et al, 2003, 2011)

Due to reduced muscle mass, weakness and fatigue.

Nutritional support during critical illness has the potential to positively influence *(physical, functional and quality of life)* outcomes, but most basic questions remain unanswered…

Preiser *et al. Critical Care* (2015) 19:35
DOI 10.1186/s13054-015-0737-8

CRITICAL CARE

REVIEW Open Access

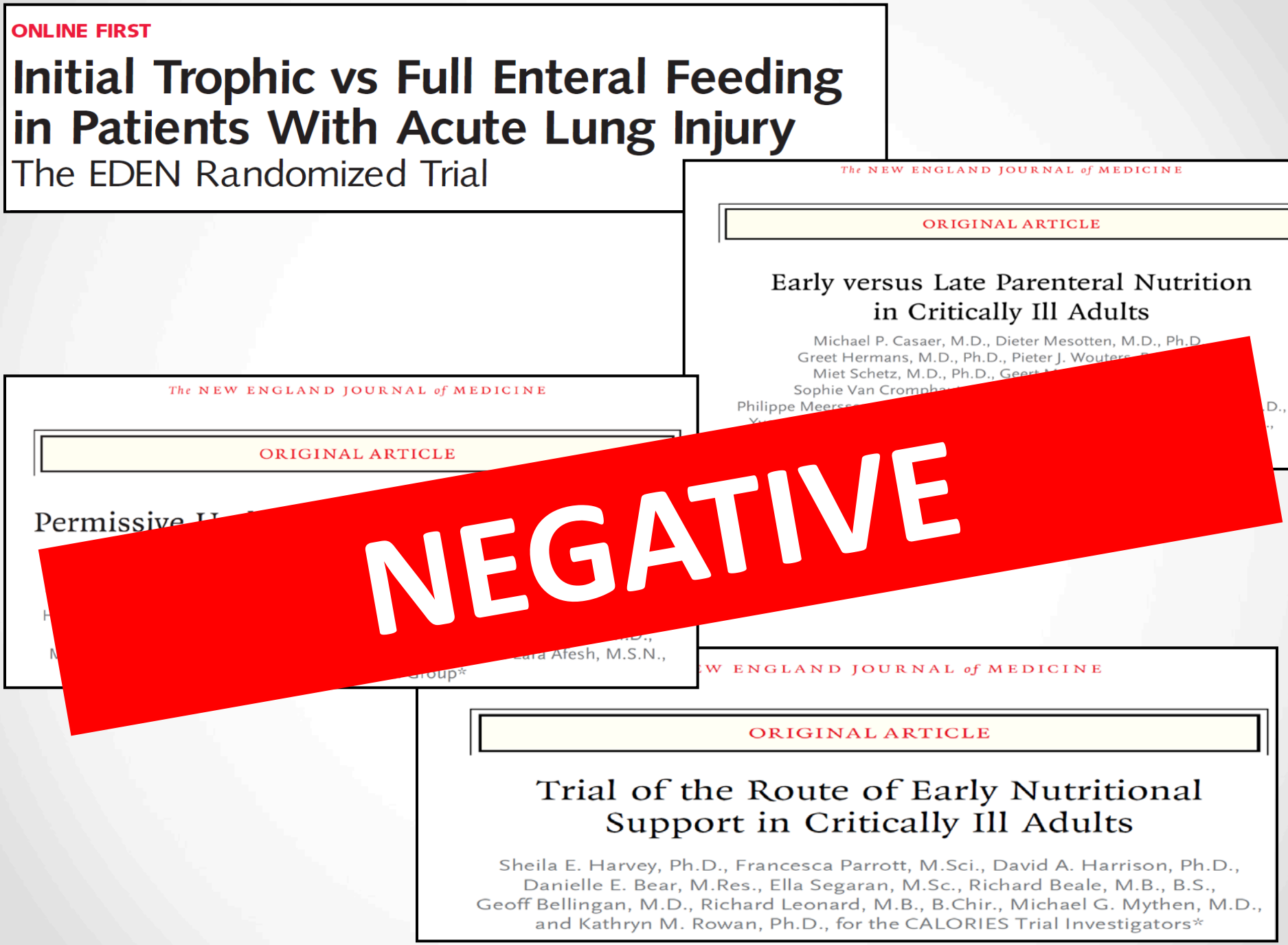
Metabolic and nutritional support of critically ill patients: consensus and controversies

Jean-Charles Preiser[1*], Arthur RH van Zanten[2], Mette M Berger[3], Gianni Biolo[4], Michael P Casaer[5], Gordon S Doig[6], Richard D Griffiths[7], Daren K Heyland[8], Michael Hiesmayr[9], Gaetano Iapichino[10], Alessandro Laviano[11], Claude Pichard[12], Pierre Singer[13], Greet Van den Berghe[5], Jan Wernerman[14], Paul Wischmeyer[15] and Jean-Louis Vincent[1]

Table 1 Areas of uncertainty – opposing views

Topic/area	One viewpoint	Opposing view
Optimal caloric intake	Early match of EE.	Less than EE during the early phase.
Supplemental PN	When EN provision is less than 60% in early course of ICU stay not contraindicated.	Not before day 8 in patients with a body mass index of at least 17.
Optimal protein intake	Equal to nitrogen losses, up to 1.5 g/kg per day.	Less than nitrogen losses.
Re-feeding syndrome	Slowly increase nutritional support to prevent re-feeding syndrome consequences even if this results in increased energy deficit.	Early nutritional support improves outcome also in malnourished patients; re-feeding syndrome consequences should be monitored and immediately treated if necessary.
Role of indirect calorimetry	Yes (patients staying more than 4 days).	No.
Autophagy	Provision of nutrients should be reduced so as not to reduce autophagy capacity as early nutrients provoke a phenotype of suppressed autophagy in human and animal experiments, with functional consequences that impair recovery.	Although experimentally autophagy may be reduced in early critical illness, pharmacological autophagy activation remains to be tested clinically.
Antioxidants	Supplement in case of low levels of antioxidants.	Use pharmacological dosages.
Glutamine	In all patients on PN.	High-dose glutamine increases mortality in critically ill patients, regardless of route of administration.
Omega-3 lipid formulations	Use continuous enteral administration and avoid bolus administration.	Not beneficial in acute respiratory distress syndrome.
High-dose selenium 800 to 4,000 μg/day	High-dose trials (1,000 μg) show greater improvement than low-dose trials.	Potential for toxicity. In selenium-replete populations, 800 to 1,000 μg may be ineffective.
Probiotics	Safe. Avoid use in pancreatitis patients with multiple organ dysfunction syndrome.	May be harmful in ICU patients when given post-pyloric with fiber.
Monitoring GRV	Accept GRV of 250 up to 500 mL per 6 hours.	Abandon GRV monitoring in medical patients and consider in surgical patients.

EE, energy expenditure; EN, enteral nutrition; GRV, gastric residual volume; PN, parenteral nutrition.


ONLINE FIRST
Initial Trophic vs Full Enteral Feeding in Patients With Acute Lung Injury
The EDEN Randomized Trial
The NEW ENGLAND JOURNAL of MEDICINE
ORIGINAL ARTICLE
Early versus Late Parenteral Nutrition in Critically Ill Adults
Michael P. Casaer, M.D., Dieter Mesotten, M.D., Ph.D.
Greet Hermans, M.D., Ph.D., Pieter J. Wouters
Miet Schetz, M.D., Ph.D.,
Sophie Van Cromph
Philippe Meers
The NEW ENGLAND JOURNAL of MEDICINE
ORIGINAL ARTICLE
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W ENGLAND JOURNAL of MEDICINE
ORIGINAL ARTICLE
Trial of the Route of Early Nutritional Support in Critically Ill Adults
Sheila E. Harvey, Ph.D., Francesca Parrott, M.Sci., David A. Harrison, Ph.D.,
Danielle E. Bear, M.Res., Ella Segaran, M.Sc., Richard Beale, M.B., B.S.,
Geoff Bellingan, M.D., Richard Leonard, M.B., B.Chir., Michael G. Mythen, M.D.,
and Kathryn M. Rowan, Ph.D., for the CALORIES Trial Investigators*

Cathy Alberda
Leah Gramlich
Naomi Jones
Khursheed Jeejeebhoy
Andrew G. Day
Rupinder Dhaliwal
Daren K. Heyland

The relationship between nutritional intake and clinical outcomes in critically ill patients: results of an international multicenter observational study

Optimal nutrition during the period of mechanical ventilation decreases mortality in critically ill, long-term female patients: a prospective observational cohort study

Critical Care 2009, **13**:R132 doi:10.1186/cc7993

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Impact of energy deficit calculated by a predictive method on outcome in medical patients requiring prolonged acute mechanical ventilation

Christophe Faisy[1,2]*, Nicolas Lerolle[1,2], [illegible]

Original article

Provision of [illegible] ive

POSITIVE

[illegible] doi:10.1186/cc13720

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Early high protein intake is associated with low mortality and energy overfeeding with high mortality in non-septic mechanically ventilated critically ill patients

Peter JM Weijs[1,2,3*], Wilhelmus GPM Looijaard[1], Albertus Beishuizen[1,4,5], Armand RJ Girbes[1,4] and Heleen M Oudemans-van Straaten[1,4]

Negative impact of hypocaloric feeding and energy balance on clinical outcome in ICU patients

Stéphane Villet[a], René L. Chiolero[b], Marc D. Bollmann[b], Jean-Pierre Revelly[b], Marie-Christine Cayeux RN[b], Jacques Delarue[c], Mette M. Berger[b,*]

Mortality is the primary end-point

Study	Intervention	Results
Nutrition leads to worse outcomes		
EPaNIC	Early vs late PN	↓ Muscle quality in early PN group ↑ Weakness in early PN group (MRC-sum score) Faster recovery in late PN group
MUSCLE-UK	Nil - observational	↑ Protein intake with ↑ muscle wasting
Nutrition improves outcomes		
EDEN	Trophic vs full-feeding	↑ Discharge to rehabilitation facility in trophic feeding group
Early PN	Early PN vs standard care (with contraindications)	Improved SGA & QoL scores (RAND-36) in early PN group
REDOXs	Glutamine, antioxidants	Improvement in physical aspects of SF-36 with improved nutritional adequacy
Refeeding	Restricted vs standard caloric intake	Significantly worse general health (RAND-36) at day 90 in the restricted caloric group
Nutrition makes no difference		
CALORIES	Early PN vs early EN	No difference in QoL (EQ-5D) or Satisfaction with Food-related Life Questionnaire

Restriction of **energy & protein** is beneficial during the **early / acute phase** of critical illness

Hypocaloric feeding whilst meeting **full protein** targets is beneficial during the **early / acute phase** of critical illness

Meeting both energy and protein targets is beneficial during the **early / acute phase** of critical illness

Specific nutrients should be targeted at **specific time points** in critical illness

1. There is no agreed definition for hypocaloric feeding…

- 40-70% of energy requirements (Arabi et al, NEJM 2015)
- 10-20mL/hr (Rice et al, JAMA 2012)
- 15 kcal/kg (Wischmeyer, Curr Opin Crit Care. 2016)

Determining Energy Goals

- Indirect Calorimetry is the 'gold standard' for determining energy requirements in ICU patients

- Use is limited by
  - Cost
  - Time
  - Exclusions
  - Difficulty interpreting the results
  - No suitable machine available yet…

2. Delivery of nutrition in the ICU is simple…

- Current targets are not met
- International Nutrition Survey (Heyland et al, Clin Nutr 2014)
  - 61% energy
  - 57% protein
- Large RCTs
  - EDEN (Rice et al, JAMA. 2012)
  - CALORIES (Harvey et al, NEJM, 2014)
  - PERMiT (Arabi et al, NEJM. 2015)

2. Delivery of nutrition in the ICU is simple…

3. We know the definition of ‘acute / early’ critical illness

Energy Expenditure & Nutrient Utilisation

Endogenous glucose production

Exercise

Time

Acute phase

Recovery phase

Chronic phase

Onset of critical illness

EPaNIC – day 8

MUSCLE UK – day 7

INDIVIDUALISED NUTRITION SUPPORT

- ✓ **IF you should feed (safety and feasibility)**
- ✓ **WHEN you should feed (timing)**
- ✓ **HOW you should feed (route)**
- ✓ **WHAT you should FEED (type and amount)**
- ✓ **WHAT you are trying to achieve**

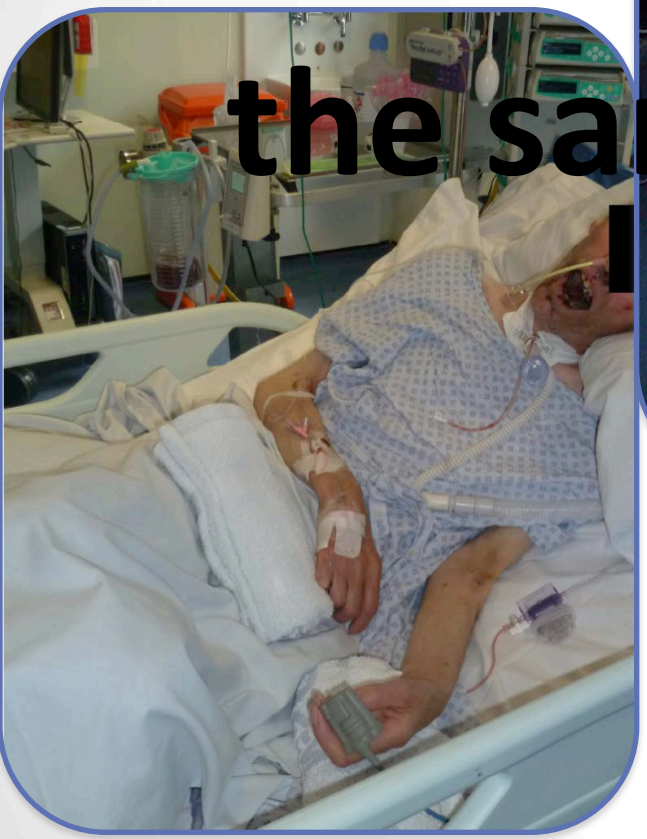

↓ COMPLICATIONS
(septic & non-septic)
WOUND HEALING
GOALS
GUT FUNCTION
↓ MUSCLE WASTING
MEET MACRO AND MICRONUTRIENT REQUIREMENTS

FEEDING PROTOCOLS

- Early enteral nutrition
- Consider safety and feasibility
- Suitable for 48-72 hours

- Consider individual patient differences
  - Energy and protein requirements

Not all patients are the same…



NUTRITION RISK

ASPEN / SCCM Guidelines

- Patients at **low nutrition risk** (eg, NRS 2002 ≤3 or NUTRIC score ≤5), **exclusive PN be withheld over the first 7 days** following ICU admission if the patient cannot maintain volitional intake and if early EN is not feasible.

  [Quality of Evidence: Very Low]

- Patients at **high nutrition risk** (eg, NRS 2002 ≥5 or NUTRIC score ≥5) or severely malnourished, **when EN is not feasible**, we suggest initiating **exclusive PN as soon as possible** following ICU admission.

  [Expert Consensus]

- In patients at **either low or high nutrition risk**, use of **supplemental PN** be considered after **7–10** days if unable to meet >60% of energy and protein requirements by the enteral route alone.

  [Expert Consensus]

McClave et al, 40(6); 2016, JPEN

NUTRIC Score

Variable	Range	Points
Age	<50	0
	50 - <75	1
	≥75	2
APACHE II	<15	0
	15 - <20	1
	20-28	2
	≥28	3
SOFA	<6	0
	6 - <10	1
	≥10	2
Number of Co-morbidities	0-1	0
	≥2	1
Days from hospital to ICU admission	0 - <1	0
	≥1	1

Patients with a low score (0-4) and higher nutritional intake had higher mortality rates

Patients with a high score (5-9) and low nutritional intake had higher mortality rates

Rahman et al, Clin Nutr 2016;35(1):158-62.

NRS 2002

Nutritional Risk Screening (NRS 2002)			
Table 1: Initial screening		Yes	No
1	Is BMI <20?		
2	Has the patient lost weight within the last 3 months?		
3	Has the patient had a reduced dietary intake in the last week?		
4	Is the patient severely ill ? (e.g. in intensive therapy)		
Yes: If the answer is 'Yes' to any question, the screening in Table 2 is performed. **No:** If the answer is 'No' to all questions, the patient is re-screening at weekly intervals. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.			

NRS 2002

Table 2: Final screening			
Impaired nutritional status		**Severity of disease** (≈ increase in requirements)	
Absent **Score 0**	Normal nutritional status	Absent **Score 0**	Normal nutritional requirements
Mild **Score 1**	Wt loss >5% in 3 mths or Food intake below 50-75% of normal requirement in preceding week.	Mild **Score 1**	Hip fracture* Chronic patients, in particular with acute complications: cirrhosis*, COPD*. *Chronic hemodialysis, diabetes, oncology.*
Moderate **Score 2**	Wt loss >5% in 2 mths or BMI 18.5 - 20.5 + impaired general condition or Food intake 25-50% of normal requirement in preceding week	Moderate **Score 2**	Major abdominal surgery* Stroke* *Severe pneumonia, hematologic malignancy*.
Severe **Score 3**	Wt loss >5% in 1 mth (>15% in 3 mths) or BMI <18.5 + impaired general condition or Food intake 0-25% of normal requirement in preceding week in preceding week.	Severe **Score 3**	Head injury* Bone marrow transplantation* *Intensive care patients (APACHE>10).*
Score	+	**Score:**	**= Total score:**
Age	if ≥ 70 years: add 1 to total score above		**= age-adjusted total score:**

Score ≥3: the patient is nutritionally at-risk and a nutritional care plan is initiated

Score < 3: weekly rescreening of the patient. If the patient e.g. is scheduled for a major operation, a preventive nutritional care plan is considered to avoid the associated risk status.

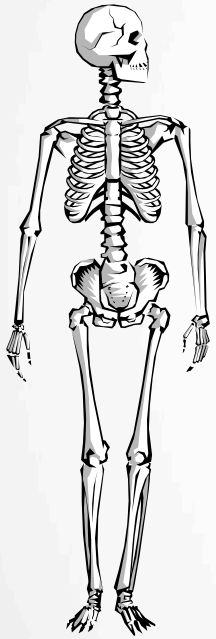
Not all ICU patients are the same!

- Age
- BMI
- Muscle mass
- Severity of illness
- Admission category
- LOS in hospital prior to ICU
- Predicted ICU LOS
- Co-morbidities

CLINICAL JUDGEMENT!

Common Equations for Use in Critical Care	
Harris-Benedict	Males: (13.7516 x W) + (5.003 x H) – (6.755 x A)
	Females: 655.0955 + (9.5634 x W) + (1.8496 x H) – (4.6756 x A)
Ireton-Jones (1992)	(5 x W) – (10 x A) + (281 x sex) + (292 x trauma) + (851 x burn) + 1925
Ireton-Jones (1997)	(5 x W) – (11 x A) + (244 x sex) + (239 x trauma) + (840 x burn) + 1784.
Penn State (1998)	(Harris-Benedict x 1.1) + (Tmax x 140) + (VE x 32) – 5340 Uses actual body weight in non-obese and adjusted bodyweight (25%) in obese
Penn State (2003)	(Harris-Benedict x 0.85) + (Tmax x 175) + (VE x 33) – 6344
Penn State (m)	(Mifflin-St Jeor x 0.96) +(Tmax x 167) + (Ve x 31) - 6212
ACCP	25kcal x kg
Frankenfield	-11,000 - (VE x 100) + (BEE x 1.5) + (DOB dose x 40) + (T x 250) + (diagnosis of sepsis x 300)
Swinamer	(95 x BSA) – (6.4 x A) + (108 x T) + (24.2 x breaths/min) + (81.7 x VT) – 4349
Schofield	Age Males Females 19-29 15.1 x W + 692 14.8 x W + 487 30-59 11.5 x W + 873 8.3 x W + 846 60-74 11.9 x W + 700 9.2 x W + 687 75+ 8.4 x W + 820 9.8 x W + 624
Henry	Age Males Females 10-18 18.4 x W + 581 11.1 x W + 761 18-30 16.0 x W + 545 13.1 x W + 558 30-60 14.2 x W + 593 9.7 x W + 694 60-70 13.0 x W + 567 10.2 x W + 572 70+ 13.7 x W+ 481 10.0 x W + 577
Mifflin-St Jeor	Males: (10 x W) + (6.25 x H) –(5 x A) + 5
	Females: (10 x W) + (6.25 x H) – (5 x A) -161
Faisy	(8 x W) + (14 x H) + (32 x VE) + (94 x T) – 4834

Protein in the Critically Ill



1.2g/kg **1.5g/kg** **2.0g/kg** **2.5g/kg**

General ICU

Trauma

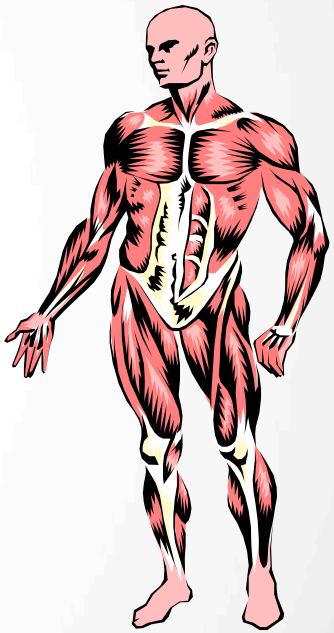
CRRT

Surgical

Trauma

Burns

Obesity



McClave et al. JPEN 2016; 40(2): 159-211

Singer et al. Clin Nutr 2014; 33; 246-251

Choban et al. JPEN 2013; 37; 714-44

Ishibashi et al. Crit Care Med 1998; 26; 1529-35

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The relationship between nutritional intake and clinical outcomes in critically ill patients: results of an international multicenter

Early high protein intake is associated with low mortality and energy overfeeding with high mortality in non-septic mechanically ventilated critically ill patients

Peter JM Weijs[1,2,3*] , Wilhelmus GPM Looijaard[1] , Albertus Beishuizen[1,4,5], Armand RJ Girbes[1,4]
and Helen M Oudemans-van Straaten[1,4]

Original article

Provision of protein and energy in relation to measured requirements in intensive care patients

Matilde Jo Allingstrup[a,*], Negar Esmailzadeh[a], Anne Wilkens Knudsen[a], Kurt Espersen[a],
Tom Ha

[a] Department
[b] Department

mark

Close to recommended caloric and protein intake by enteral nutrition is associated with better clinical outcome of critically ill septic patients: secondary analysis of a large international nutrition database

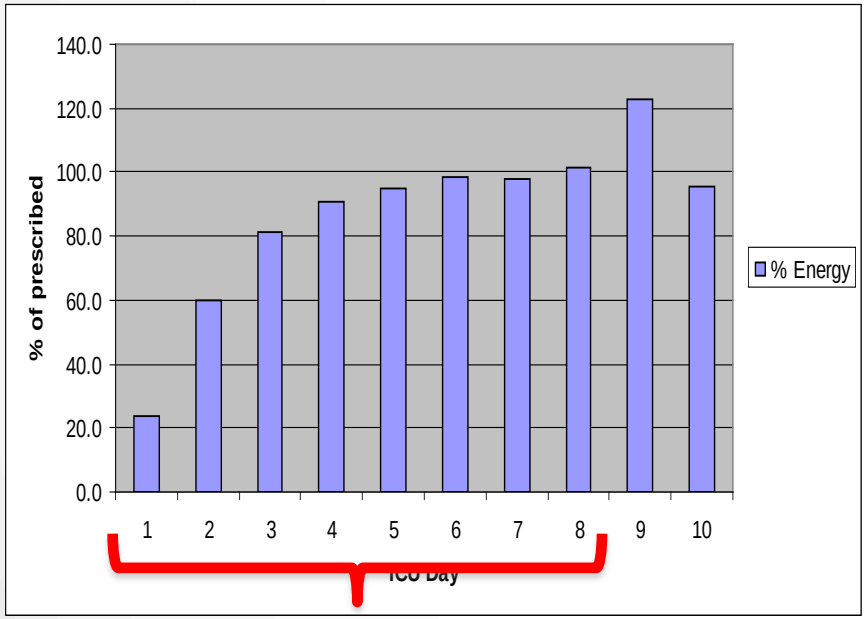
Critical Care 2014, **18**:R29 doi:10.1186/cc13720

Gunnar Elke (gunnar.elke@uksh.de)
Miao Wang (wangm@kgh.kari.net)

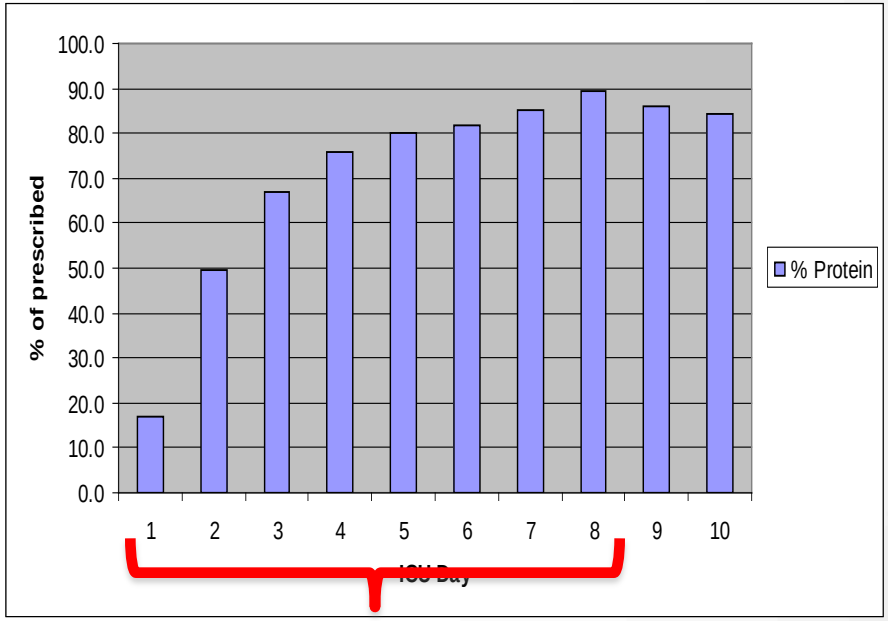
Higher protein is associated with reduced mortality

KNOW WHAT HAPPENS IN YOUR ICU!

ADEQUACY OF FEEDING (ENERGY)



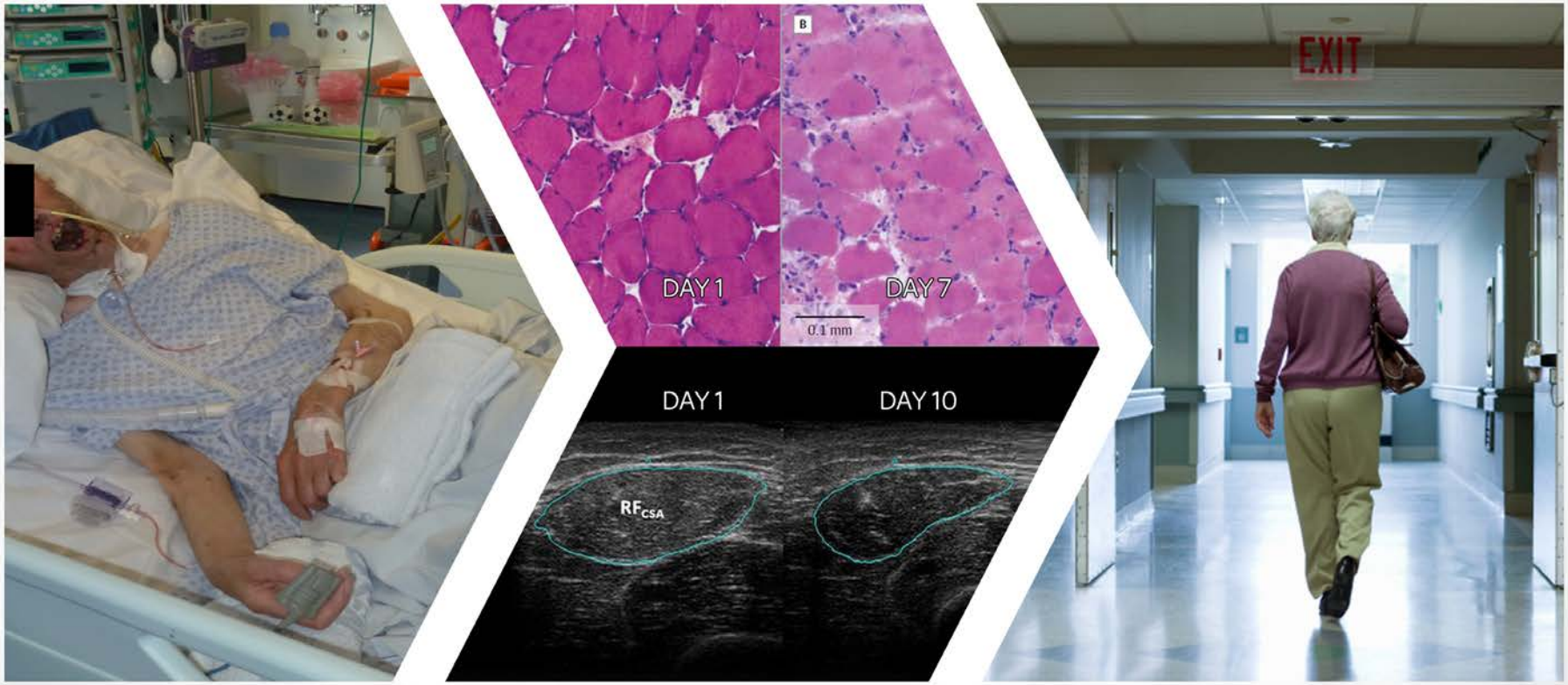
ADEQUACY OF FEEDING (PROTEIN)



- Robust feeding protocol (28 kcal/kg)
- 2 Dietitians
- Review all patients within 48-72 hours
- Bedside post-pyloric feeding tube insertion & early PN

Reddy et al. *Clinical Nutrition*. Sept 2015;34;S38–S39

Translational science in critical care nutrition is lacking!



Bear, Lancet Resp, 2013;
Soeters et al, Clin Nutr, 2015

Our current methods of feed delivery are adequate.

Gut-plasma and plasma-muscle uptake is sufficient.

Energy & protein alone are enough to stimulate protein synthesis and reduce catabolism.

THE IVC STUDY (NCT 02358512)

A Randomised Clinical Trial to Investigate the Effect of Intermittent versus Continuous Enteral Nutrition on Muscle Wasting in Critical Illness.

- 5 sites trained and recruiting
- 2 further planned

UCL

Guy's and St Thomas' NHS
NHS Foundation Trust



HMB-ICU

A Study to Investigate the Effect of β-Hydroxy-β-Methylbutyrate (HMB) on Skeletal Muscle Wasting in Early Critical Illness

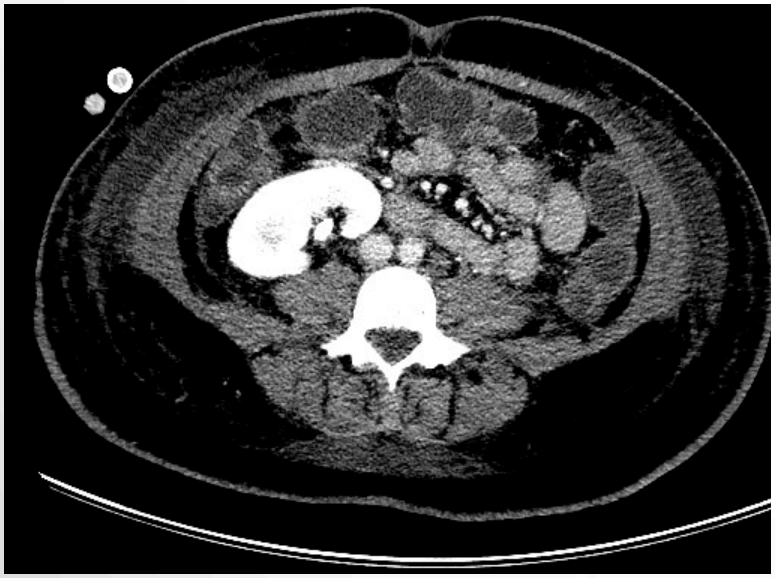
Guy's and St Thomas' NHS Foundation Trust

showing we care

National Institute for Health Research

KING'S College LONDON

The future…



- Right patients
- Right nutrients
- Right time
- Right outcome

Conclusions

- There are many unproven assumptions about feeding & nutrient utilisation in critically ill patients
- **Individualised** nutrition support is **essential**
- **Nutrition Risk tools** can help to determine the right intervention for the right patient in terms of (energy and protein delivery)
- Know your unit, your patients and your practice!
- Further research is required to determine the most appropriate nutrients **and** the most appropriate timing to improve long term outcomes