



# **Management enterální výživy v intenzivní péči**

Marcela Káňová

FN Ostrava

REVIEW

Open Access

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

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

Bear et al. *Critical Care* (2017) 21:226  
DOI 10.1186/s13054-017-1810-2

Critical Care

REVIEW

Open Access

# The role of nutritional support in the physical and functional recovery of critically ill patients: a narrative review



Danielle E. Bear<sup>1,2,3,4,5\*</sup>, Liesl Wandrag<sup>1,2</sup>, Judith L. Merriweather<sup>6</sup>, Bronwen Connolly<sup>4,5,7,8</sup>, Nicholas Hart<sup>3,4,5,†</sup>, Michael P. W. Grocott<sup>9,10,11,†</sup> and on behalf of the Enhanced Recovery After Critical Illness Programme Group (ERACIP) investigators



EDITORIALS

# Provision of Nutrients to the Acutely Ill Introducing the “Baby Stomach” Concept


Preiser & Wernerman, *AJRCCM* 2017;196:1089-90

# Enteral versus parenteral early nutrition in ventilated adults with shock: a randomised, controlled, multicentre, open-label, parallel-group study (NUTRIREA-2)

Jean Belgees, Julie Bobaszko-Helm, Laurent Ehrhard, Jean-Baptiste Lascaros, Aliak Hossain, Nadia Anguel, Laurent Argaud, Karim Asefroune, Pierre Asfar, Frederic Bellac, Vlad Botoc, Annie Dintagno, Hoang-Nam Du, Emmanuel Canet, Daniel Do Silva, Michael Darmon, Vincent Desjardins, Jerome Devogel, Michel Djibre, Frédérique Garstar, Marie Garrouste-Orges, Stéphane Gaudry, Olivier Gombier, Claude Guerin, Bertrand Guidet, Christophe Guillon, Jean Etienne Herbrecht, Jean-Claude Lacherade, Philippe Lucotat, Fridezi Martina, Virginie Martine, Emmanuelle Merlet, Jean-Paul Mira, Saad Neeb, Gael Pilon, Jean-Pierre Ovenot, Jack Richetoux, Jean-Philippe Rigaud, René Robert, Nathalie Rollin, Carole Schwebel, Michel Struelens, François Tinturier, Didier Thivener, Bruno Graudenz, Amélie Le Gouge, for the NUTRIREA-2 Trial Investigators and the Clinical Research in Intensive Care and Sepsis (CRICS) group

**Lancet 2018; 391: 133-43**


Clinical Nutrition xxx (2018) 1-8



Contents lists available at ScienceDirect

**Clinical Nutrition**

Journal homepage: <http://www.elsevier.com/locate/clnu>



Original article

# Timing of PROTEin INTake and clinical outcomes of adult critically ill patients on prolonged mechanical VENTilation: The PROTINVENT retrospective study

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CONFERENCE REPORTS AND EXPERT PANEL

# Early enteral nutrition in critically ill patients: ESICM clinical practice guidelines

Annika Reintam Blaser<sup>1,2\*</sup>, Joel Starkopf<sup>1,3</sup>, Waleed Alhazzani<sup>4,5</sup>, Mette M. Berger<sup>6</sup>, Michael P. Casier<sup>7</sup>, Adam M. Deane<sup>8</sup>, Sonja Fruhwald<sup>9</sup>, Michael Hiesmayr<sup>10</sup>, Carole Ichai<sup>11</sup>, Stephan M. Jakob<sup>12</sup>, Cecilia I. Loudet<sup>13</sup>, Manu L. N. G. Malbrain<sup>14</sup>, Juan C. Montejó González<sup>15</sup>, Catherine Paugam-Burtz<sup>16</sup>, Martijn Poeze<sup>17</sup>, Jean-Charles Preiser<sup>18</sup>, Pierre Singer<sup>19,20</sup>, Arthur R.H. van Zanten<sup>21</sup>, Jan De Waele<sup>22</sup>, Julia Wendon<sup>21</sup>, Jan Wernerman<sup>24</sup>, Tony Whitehouse<sup>25</sup>, Alexander Wilmer<sup>26</sup>, Heleen M. Oudemans-van Straaten<sup>27</sup> and ESICM Working Group on Gastrointestinal Function

## ESPEN Guideline

### ESPEN guideline on clinical nutrition in the intensive care unit



Pierre Singer <sup>a,\*</sup>, Annika Reintam Blaser <sup>b,c</sup>, Mette M. Berger <sup>d</sup>, Waleed Alhazzani <sup>e</sup>, Philip C. Calder <sup>f</sup>, Michael P. Casaer <sup>g</sup>, Michael Hiesmayr <sup>h</sup>, Konstantin Mayer <sup>i</sup>, Juan Carlos Montejo <sup>j</sup>, Claude Pichard <sup>k</sup>, Jean-Charles Preiser <sup>l</sup>, Arthur R.H. van Zanten <sup>m</sup>, Simon Oczkowski <sup>e</sup>, Wojciech Szczeklik <sup>n</sup>, Stephan C. Bischoff <sup>o</sup>

Clinical Nutrition 38 (2019) 48–79

## ESPEN doporučení

- Nutriční podpora by měla být zvažována pro všechny pacienty hospitalizované na ICU, zvláště při hospitalizaci delší než 48 hod
- Všichni kriticky nemocní pacienti hospitalizovaní více než 48 hod na ICU mají mít vyšetřeno nutriční riziko

## Nutriční riziko

- Nutriční skóre: NRS 2002  
NUTRIC
- Clinical frailty score
- Laboratorní parametry
- Vyšetření LBM: CT ( L3)
- Sono
- Handgrip dynamometer

# Nutritional Risk Screening (NRS 2002)

- Initial Screening (yes/no )
  - BMI <20
  - Wt. Loss in last 3mths.
  - Decreased intake in last one week
  - Severe illness

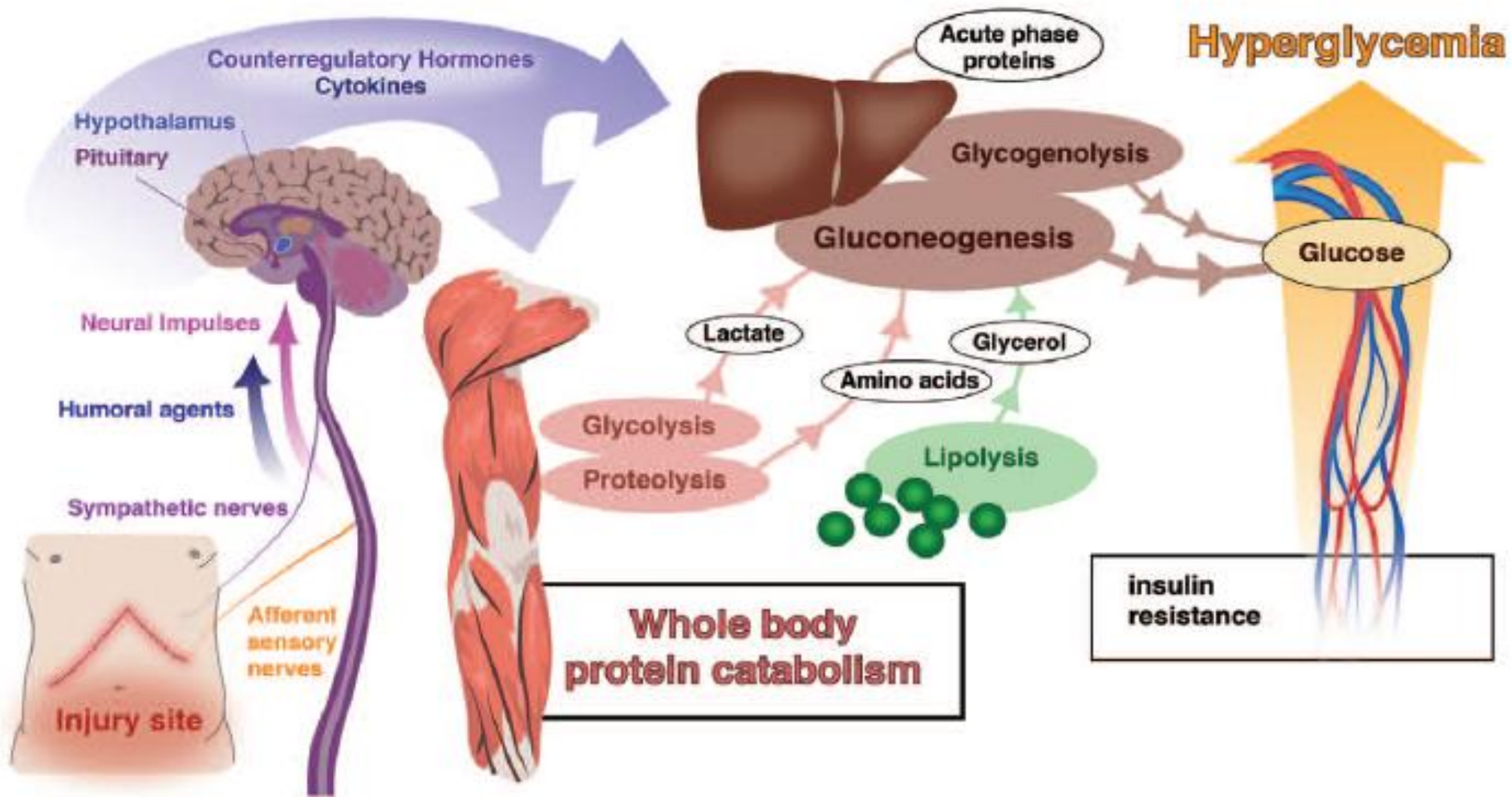
ESPEN guidelines for nutrition screening 2002 Clin. Nutr.2003;22(4):415-421)

## NRS-2002 (final screening)

Score	Impaired status	Treatment
0	Normal	nil
1	Wt. Loss>5% ( 3m) 50-70% intake in 1w	Oral supplement
2	Wt loss> 5% (2m) 50% intake in 1wk	Artificial feed
3	Wt loss>5% (1m) <25% intake	Artificial feed

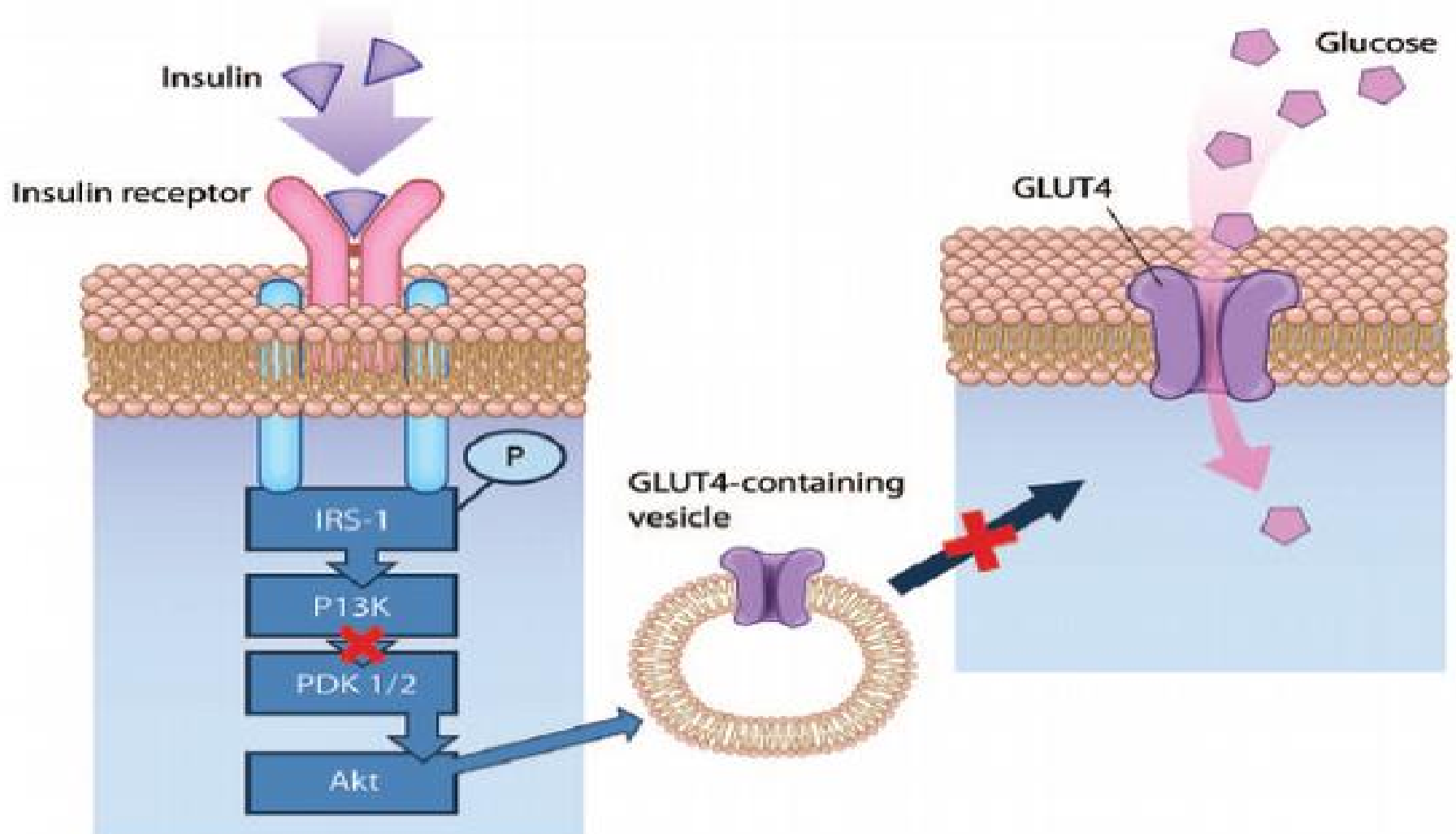
(Clinical Nutrition 2003;22(4):415-421)

# Kriticky nemocní = **katabolismus**





# Inzulinorezistence

## Effect of Insulin on Glucose Uptake

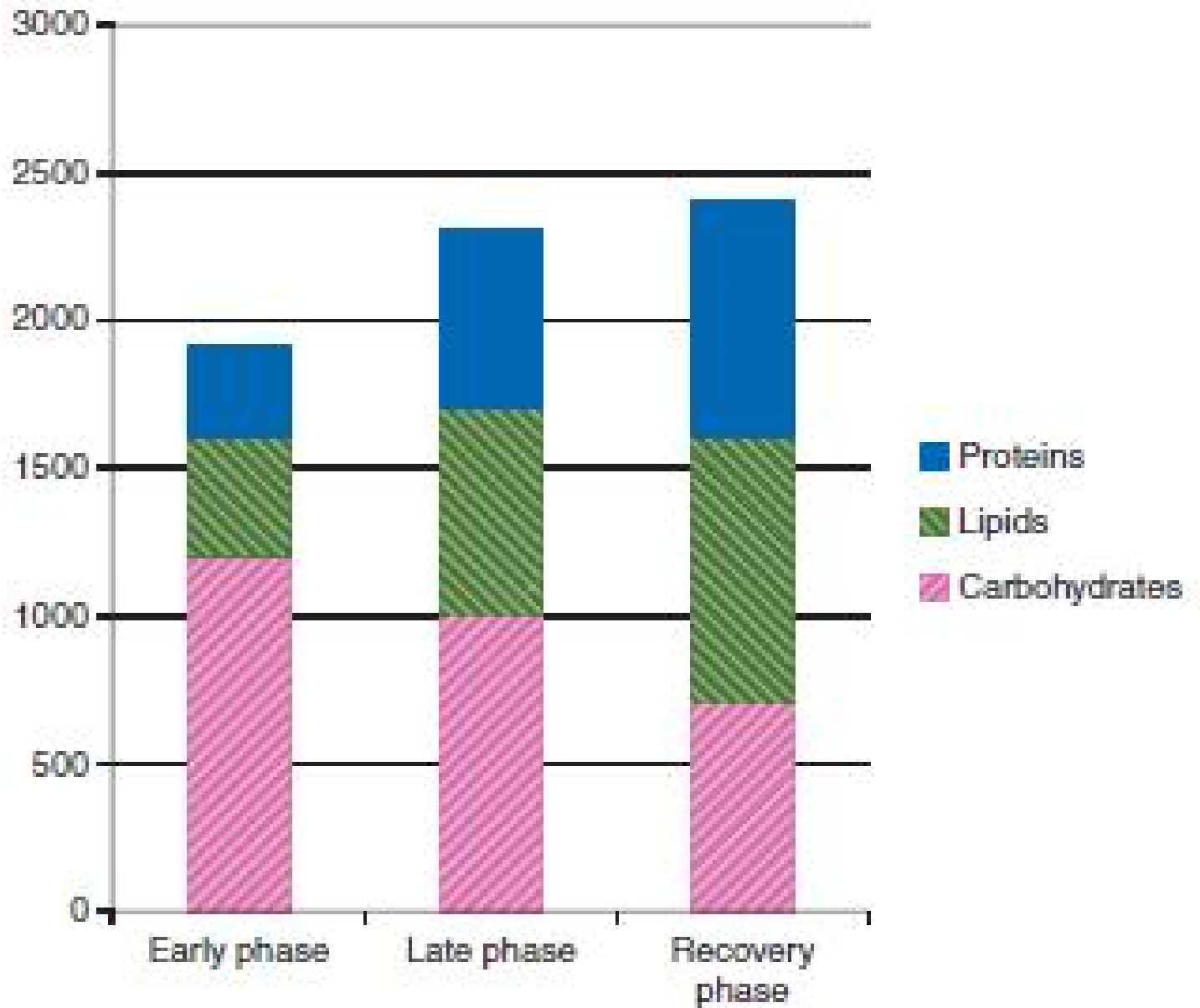


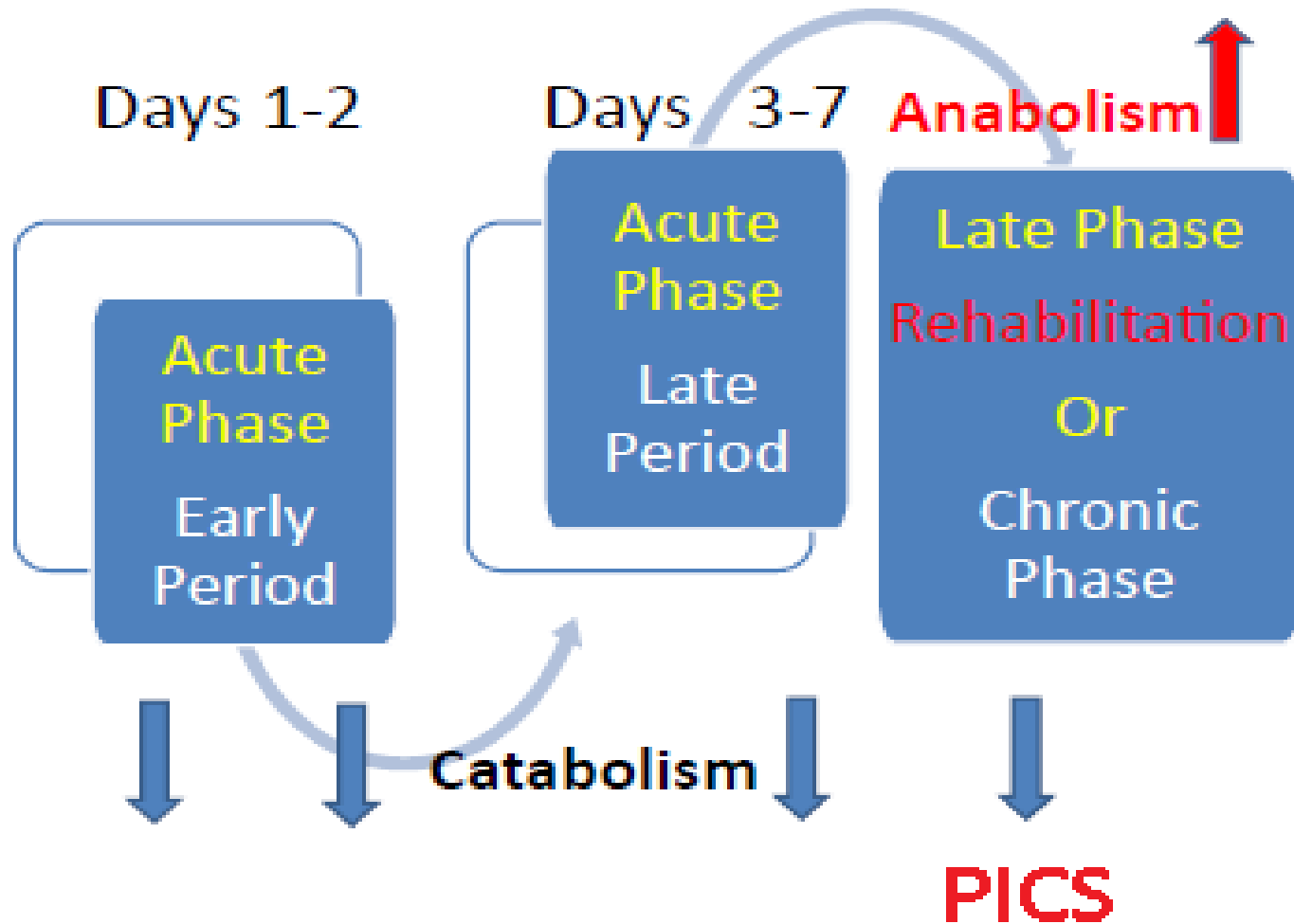
# Kriticky nemocní = **anabolická rezistence**

- Periferní anabolická rezistence   
energie pro životně důležité orgány
- Komplexní metabolická odpověď   
**utilizace substrátů je jen částečně závislá na dostupnosti zdrojů**
- Autofagie

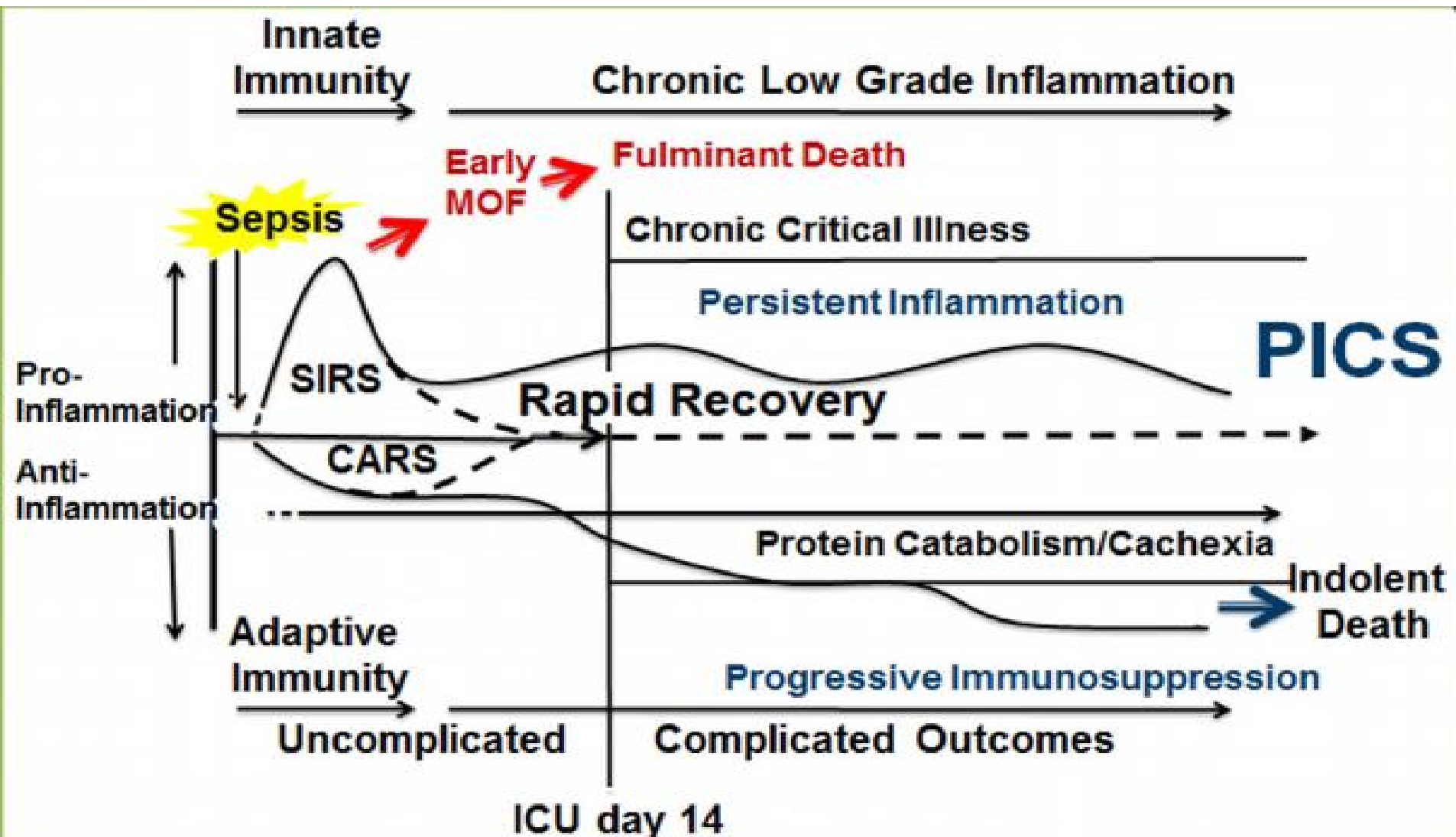


Energy expenditure (kcal day<sup>-1</sup>)





# PICS Persistet inflammatory, immunosuppressed, catabolic syndrome



# Jak na nutriční podporu?

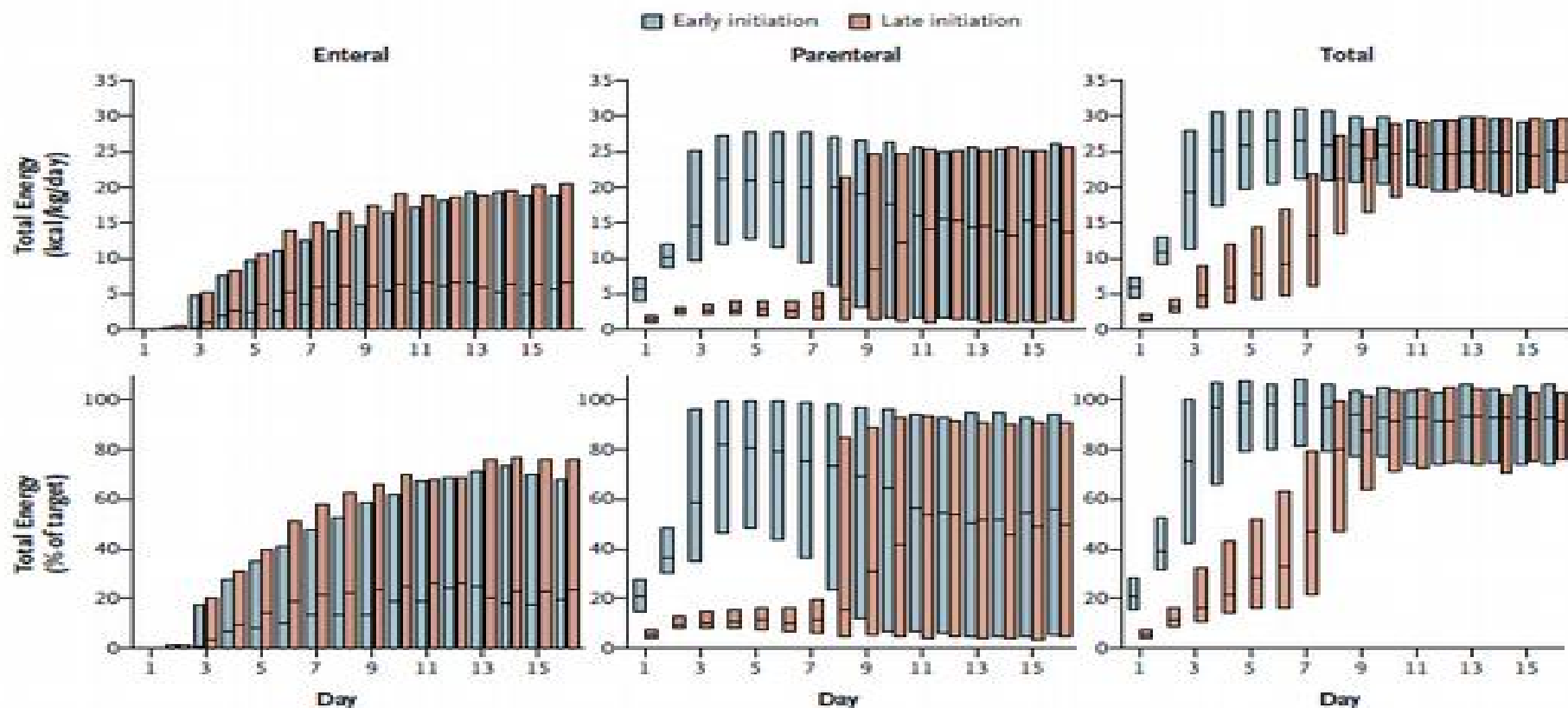
- **Kdy začít ?**
- **Konsenzus:** enterální cestou u kriticky nemocných se snažíme začít **časně do 48 hod** od přijetí
- **ESPEN:** **časná EN** raději než opožděná EN, raději než časná PN (pokles mortality a infekčních komplikací)
- **Pozitiva:** střevní integrita, mikrobiom, limituje přerůstání bakteriálních patogenů a jejich translokaci, imunitní fce GALT, IgA **střevo motor**  
**sepsy**
- **Negativa:** časná výživa (EN +PEN) tlumí **autofagii**

# Kdy začít?

- **Časná enterální nutrice (do 48 hod)**
- **Negativa:** riziko underfeedingu
- Intolerance, neúplná absorpce tenkým střevem, anabolická rezistence
- V časně fázi (48-72) – katabolismus, nelze dosáhnou anabolismu, negat N bilance
- **Dohrazovat energii PN ?**

# 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, R.N., M.Sc.,  
 Miet Schetz, M.D., Ph.D., Geert Meyfroidt, M.D., Ph.D.,  
 Sophie Van Cromphaut, M.D., Ph.D., Catherine Ingels, M.D.,  
 Philippe Meersseman, M.D., Jan Muller, M.D., Dirk Vlasselaers, M.D., Ph.D.,  
 Yves Debaveye, M.D., Ph.D., Lars Desmet, M.D., Jasperina Dubois, M.D.,  
 Anne Van Assche, M.D., Simon Vanderheyden, B.Sc.,  
 Alexander Wilmer, M.D., Ph.D., and Greet Van den Berghe, M.D., Ph.D.



## No. in ICU

Late initiation	2328	1399	913	655	436	313	2328	1399	913	655	436	313	2328	1399	913	655	436	313
Early initiation	2312	1438	975	736	517	371	2312	1438	975	736	517	371	2312	1438	975	736	517	371

## ORIGINAL ARTICLE

## Early versus Late Parenteral Nutrition in Critically Ill Adults

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Alexander Wilmer, M.D., Ph.D., and Greet Van den Berghe, M.D., Ph.D.

### METHODS

In this randomized, multicenter trial, we compared early initiation of parenteral nutrition (European guidelines) with late initiation (American and Canadian guidelines) in adults in the intensive care unit (ICU) to supplement insufficient enteral nutrition. In 2312 patients, parenteral nutrition was initiated within 48 hours after ICU admission (early-initiation group), whereas in 2328 patients, parenteral nutrition was not initiated before day 8 (late-initiation group). A protocol for the early initiation of enteral nutrition was applied to both groups, and insulin was infused to achieve normoglycemia.

### RESULTS

Patients in the late-initiation group had a relative increase of 6.3% in the likelihood of being discharged alive earlier from the ICU (hazard ratio, 1.06; 95% confidence interval [CI], 1.00 to 1.13;  $P=0.04$ ) and from the hospital (hazard ratio, 1.06; 95% CI, 1.00 to 1.13;  $P=0.04$ ), without evidence of decreased functional status at hospital discharge. Rates of death in the ICU and in the hospital and rates of survival at 90 days were similar in the two groups. Patients in the late-initiation group, as compared with the early-initiation group, had fewer ICU infections (22.8% vs. 26.2%,  $P=0.008$ ) and a lower incidence of cholestasis ( $P<0.001$ ). The late-initiation group had a relative reduction of 9.7% in the proportion of patients requiring more than 2 days of mechanical ventilation ( $P=0.006$ ), a median reduction of 3 days in the duration of renal replacement therapy ( $P=0.008$ ), and a mean reduction in health care costs (about \$1,600) ( $P=0.04$ ).

### CONCLUSIONS

Late initiation of parenteral nutrition was associated with faster recovery and fewer complications, as compared with early initiation. (Funded by the Methusalem program of the Flemish government and others; EPaNIC ClinicalTrials.gov number, NCT00512122.)

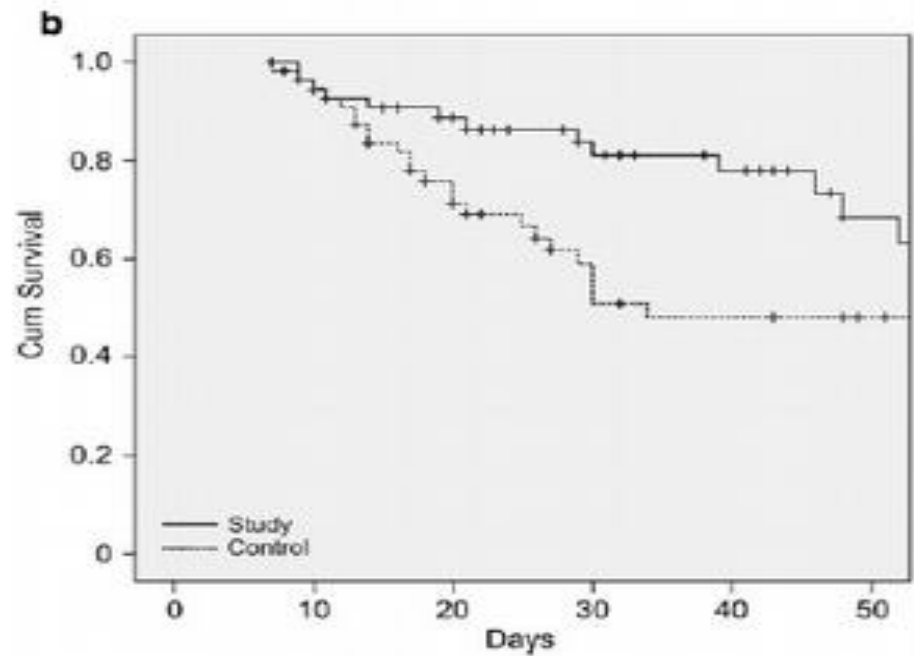
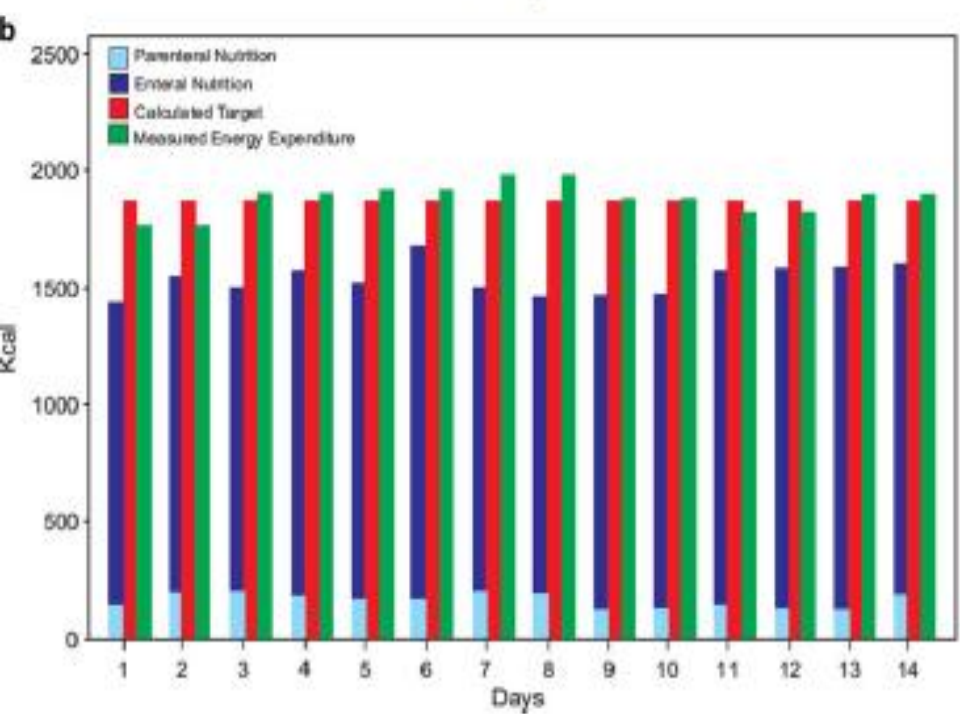
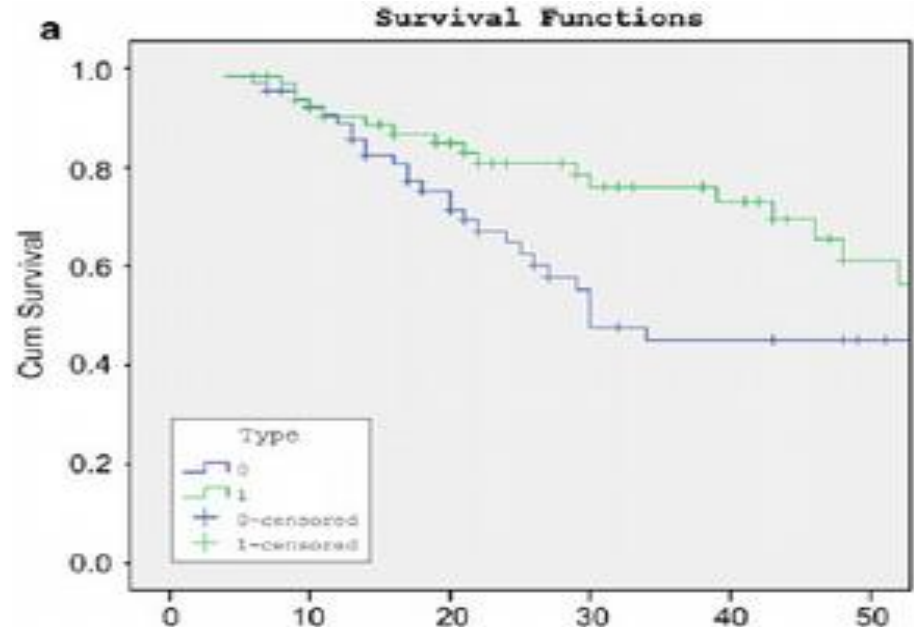
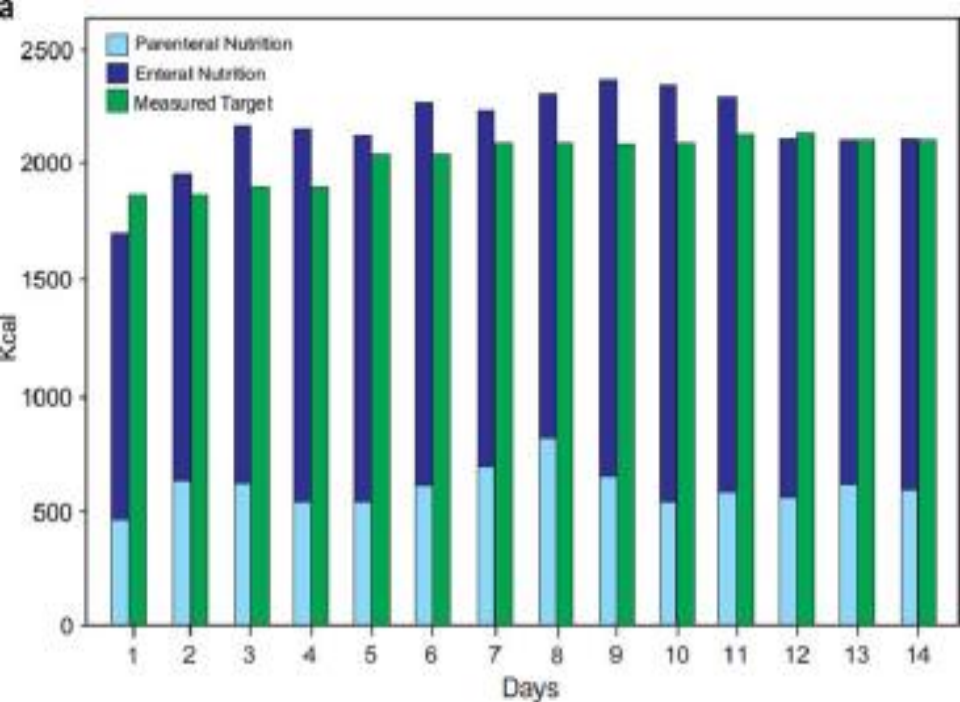
Pierre Singer  
Ronit Anbar  
Jonathan Cohen  
Haim Shapiro  
Michal Shalita-Chesner  
Shaul Lev  
Elad Grozovski  
Miryam Theilla  
Sigal Frishman  
Zecharia Madar

**The tight calorie control study (TICACOS):  
a prospective, randomized, controlled pilot  
study of nutritional support in critically ill  
patients**

- Cíl: zda nutriční podpora řízená opakovaným měřením indirektní kalorimetrií s plnou úhradou E, vede ke zlepšení (mortalita)
- ICU pacienti na UPV
- EN + doplňková PEV dle energetického cíl
- Study group : IC
- Control group: 25kcal/kg /den



# TiCaCo



ESPEN Guideline

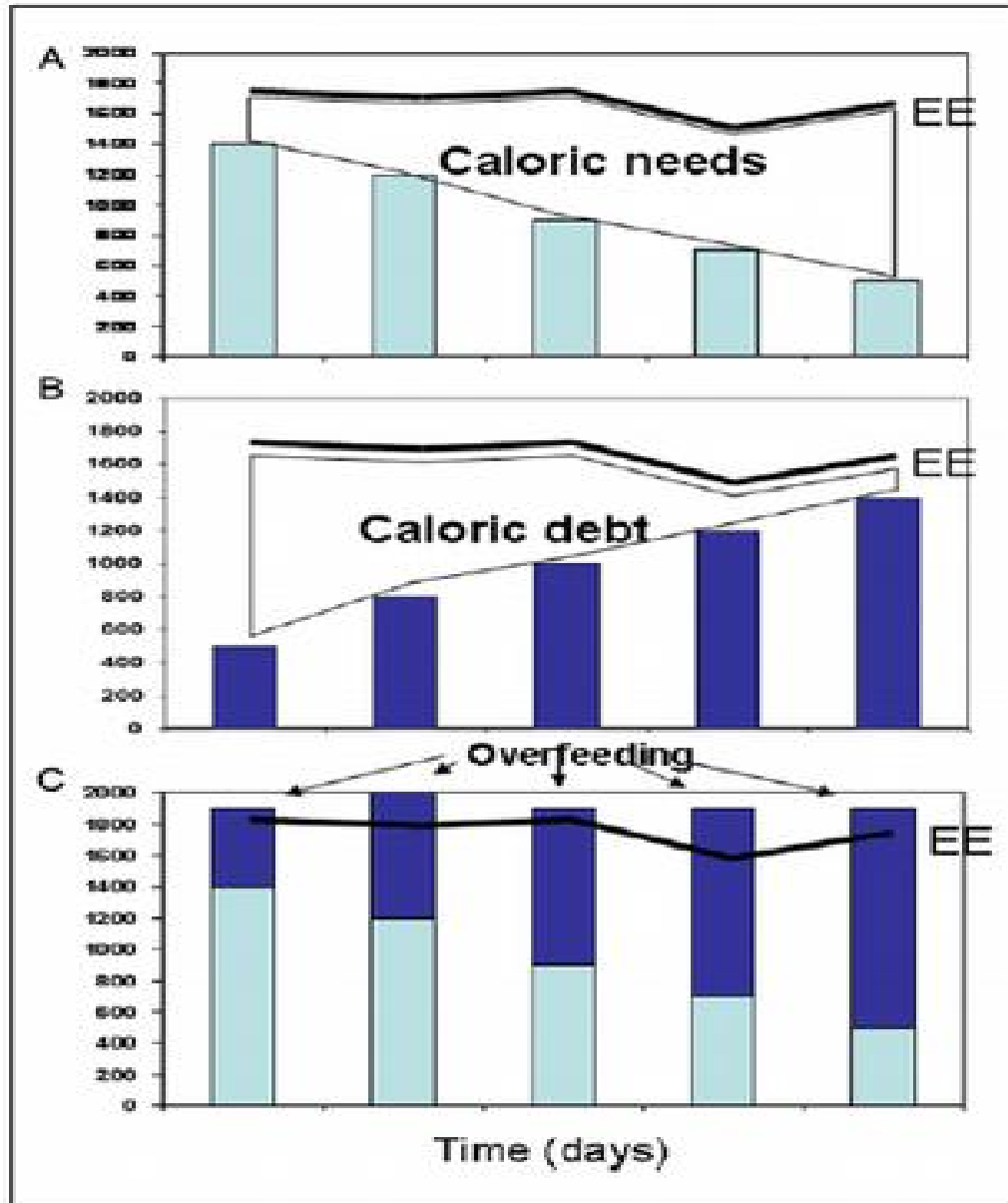
## ESPEN guideline on clinical nutrition in the intensive care unit



Pierre Singer <sup>a,\*</sup>, Annika Reintam Blaser <sup>b,c</sup>, Mette M. Berger <sup>d</sup>, Waleed Alhazzani <sup>e</sup>, Philip C. Calder <sup>f</sup>, Michael P. Casaer <sup>g</sup>, Michael Hiesmayr <sup>h</sup>, Konstantin Mayer <sup>i</sup>, Juan Carlos Montejo <sup>j</sup>, Claude Pichard <sup>k</sup>, Jean-Charles Preiser <sup>l</sup>, Arthur R.H. van Zanten <sup>m</sup>, Simon Oczkowski <sup>n</sup>, Wojciech Szczeklik <sup>n</sup>, Stephan C. Bischoff <sup>o</sup>

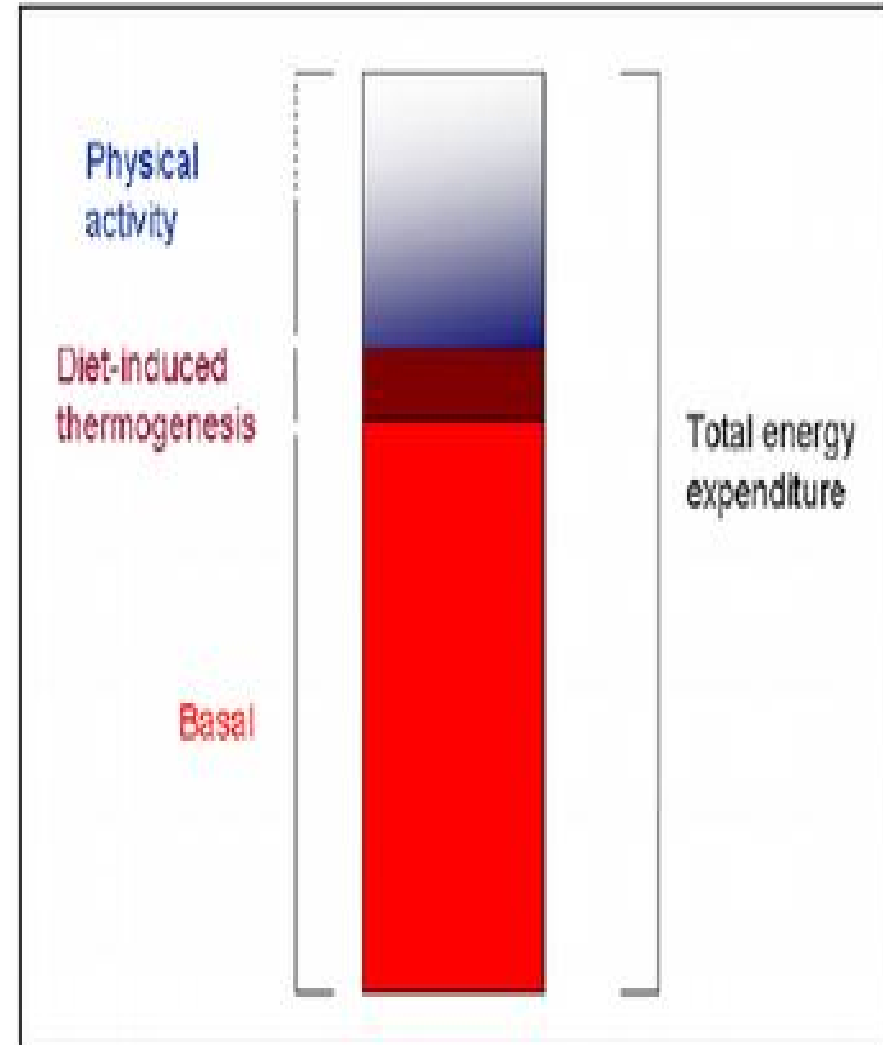
- ***V případě KI p.o. nebo EN, PN má být zahájena od 3.- 7.dne a pozvolna navyšovat dávku***
- *U malnutričních pacientů dříve!*
- *Ne hned plná dávka! (low-dose PN)*
- *Vyhnout se over/underfeedingu a refeedingu!*
- ***KI EN: nekontrolovaný šok, nekontrolovaná hypoxemie, acidoza, krvácení z horního GITu, střevní ischemie, obstrukce, abdominal compartment sy, odpady stagnačního obsahu NGS > 500ml/6 hod,***
- *Vysoce secernující píštěle GITu( není-li přístup za píštělí)*

# Kolik energie ?



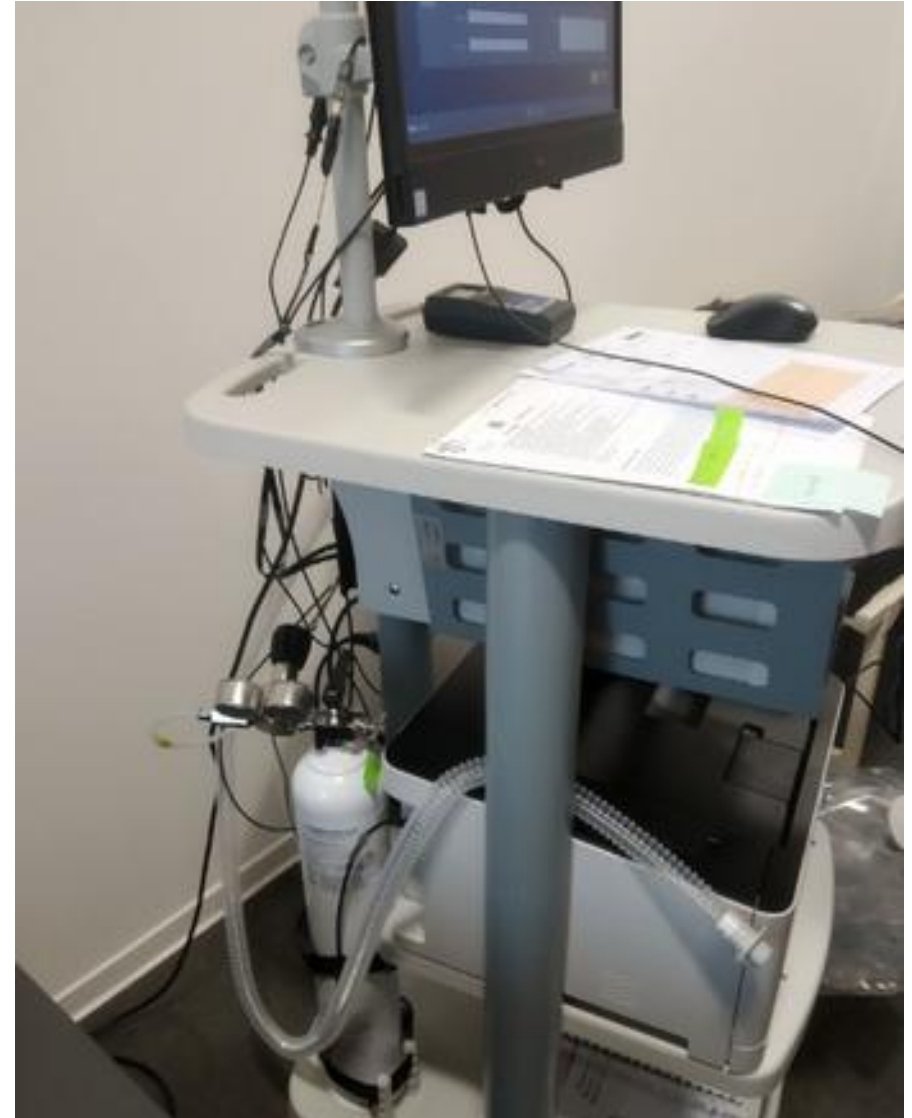
# Kolik energie?

- **Indirektní kalorimetrie**  
(EE, kolik z toho glukoneogeneza?)
- **Časná fáze-**  
hypokalorická nutrice do 70% EE
- Po 3 dnu navyšovat na 80-100% EE
- **Pozdní fáze-** izokalorická nutrice



# Kolik energie?

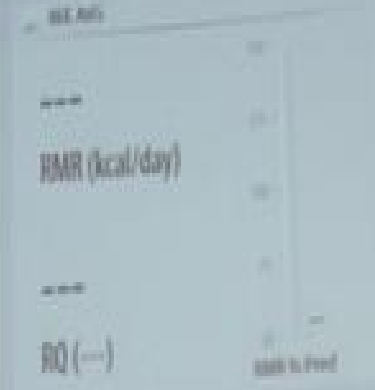
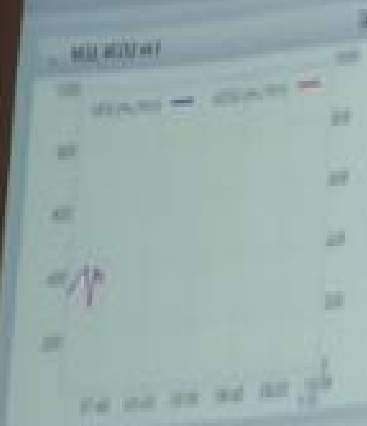
- Kalorimetry jsou drahé (DATEX, Quark..)
- $RQ = VCO_2 / VO_2$
- Weir rovnice
- $EE = [(VO_2 \times 3,94) + VCO_2 \times 1,11] + (uN \times 2,17) \times 1440$
- Klinika: provést v klidu, nejlépe 5 hod lačnění, neměnit ventilční režim, cave leak,  $FiO_2 < 0,6$ ,  $PEEP < 12$ , hemodynamická stabilita
- Měření 30min až 2 hod (často s kont nutricí)





Pozivnica info

Završi



103

43,1

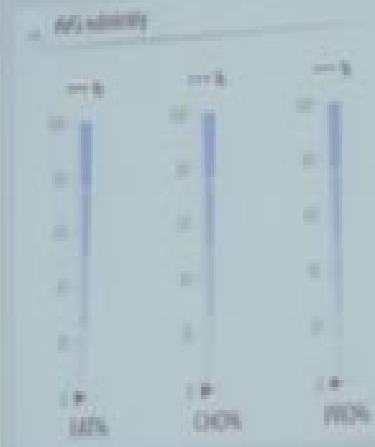
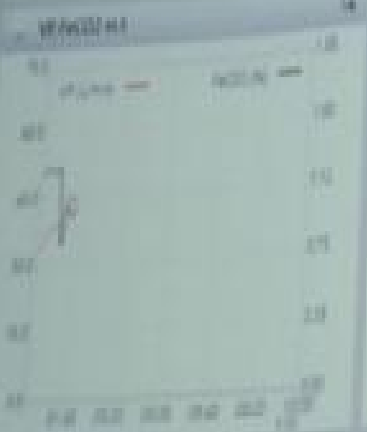
bpm



377

355

2678



43,1

lim

30% 20

00:01:45

UP	VE1	VE2	RR	HR	VO2	FICO2	VO2	VO2	CHOL	PROX	FAN
377	355	0	103	43,1	103	43,1	103	43,1	103	43,1	103

Canopy



# Kolik energie?

- ***VCO<sub>2</sub> u ventilovaných pac. REE= VCO<sub>2</sub> x 8,19***
  - ***Prediktivní rovnice***
  - ***Harris-Benedict***
  - ***Muži:  $13,75wt + 5ht - 6,8age + 66$***
  - ***Ženy:  $9,6wt + 1,8ht - 4,7age + 655$  (x stres.f)***
  - ***Penn state, Toronto...***
  
  - ***Ideální váha na BMI 25***
  - ***Ideální váha=  $25 \times \text{výška}^2$***
- **Fixní potřeba E k váze**
  - **Časné stádium**
  - 15 kcal/kg/den (do 3 dnů 70% EE )
  - **Pozdní stádium**
  - 20-25 kcal/kg/den
  - **Recovery stádium**
  - 25-30 kcal/kg/den
  
  - **Obézní (BMI>30)**
  - 11-14 kcal/kg aktuální váhy
  - 22-25 kcal/ideální váhy
  - Ale vysoký Protein  $\geq 2\text{g/ideální v./den}$



# Kolik proteinu ?

- **Akutní fáze**
- Proteolýza , pokles LBM- ztráta svaloviny  
(až 1kg/den, VLI -glukoplastické AMK)
- Anabolická rezistence + inaktivita
- Syntéza proteinů akutní fáze
- Potřeba cysteinu (syrovátka)- glutathion
- Negativní dusíková bilance
- Rozvoj polyneuromyopatie kriticky nemocných (**CIM**)
- **Zvýšené požadavky na protein**

# Pro Con high protein

## Pro

- Snaha o anabolickou stimulaci/ proteosyntézu
- (syrovátka/ leu/HMB)
- Prevence CIM/sarcopenie (prevence protrahované UPV, nosokom infekcí, dekubitů)
- Hojení ran, imunita (gln/arg)
- Dobře absorbovatelné EN
- Iv AMK roztoky bezpečné

## Con

- Zvýšená oxidace /ureageneze/zatížení ledvin
- Bez vlivu na proteolýzu (HMB ?)
- V akutní fázi tlumí autofágii
- Produkce glukagonu
- AMK- prekurzory (falešných)neuromediátorů

# Kontroverze studií HP v akutní fázi

- Pozitivní efekt HP observační studie

↓ Energie ↑ Protein

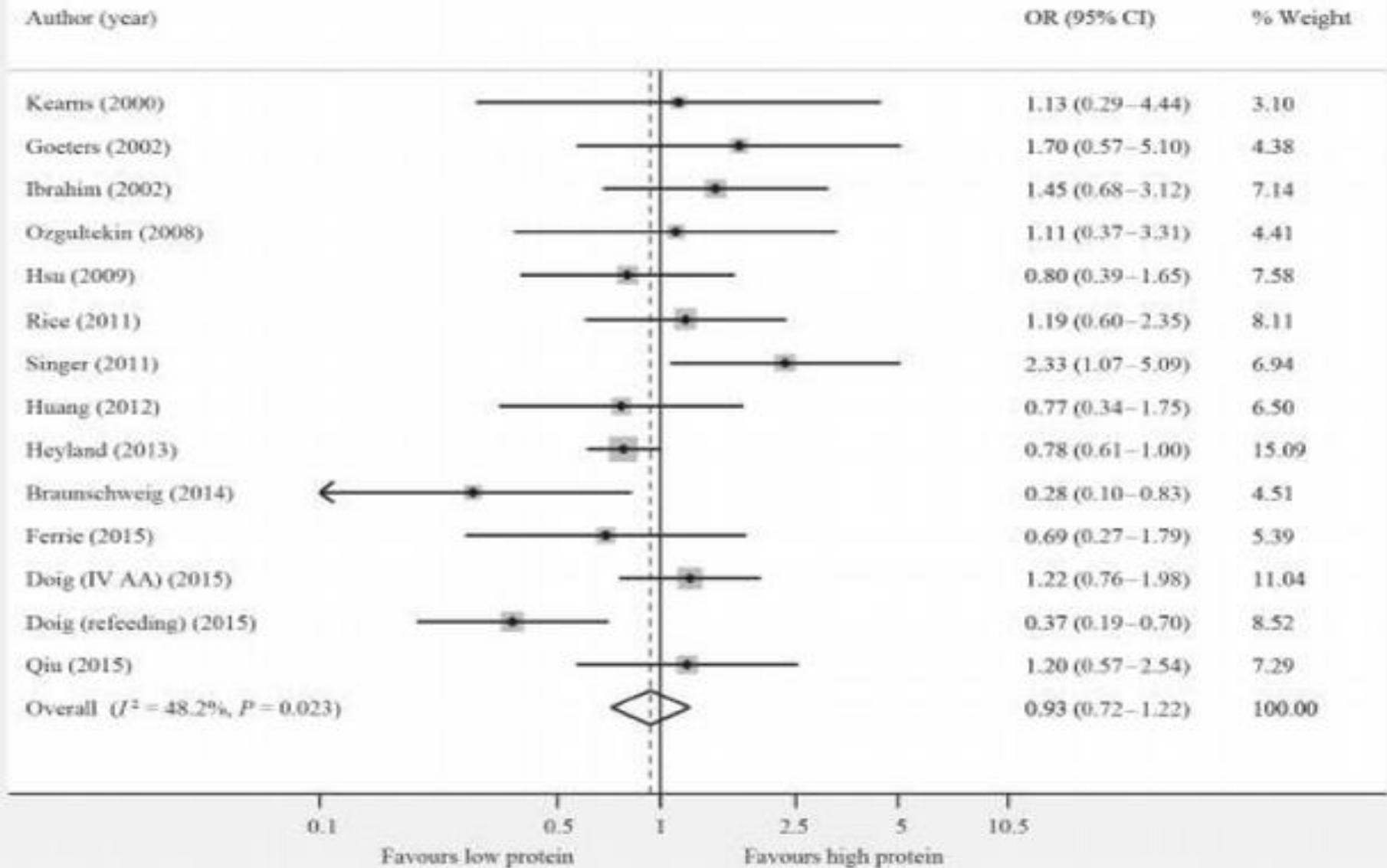
- Formulace hypotézy

- RCT méně přesvědčivé/  
některé škodlivý efekt HP

Fixní poměr  
Energie/protein

# Efekt proteinu na mortalitu

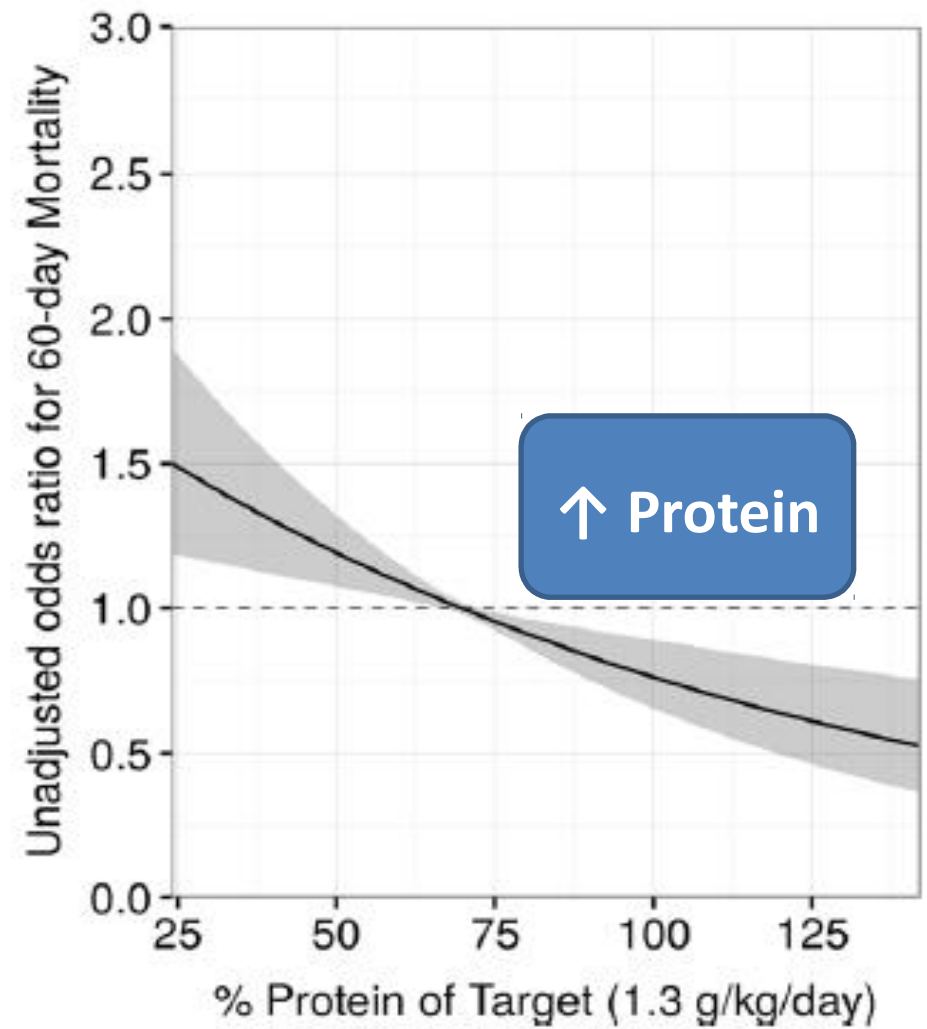
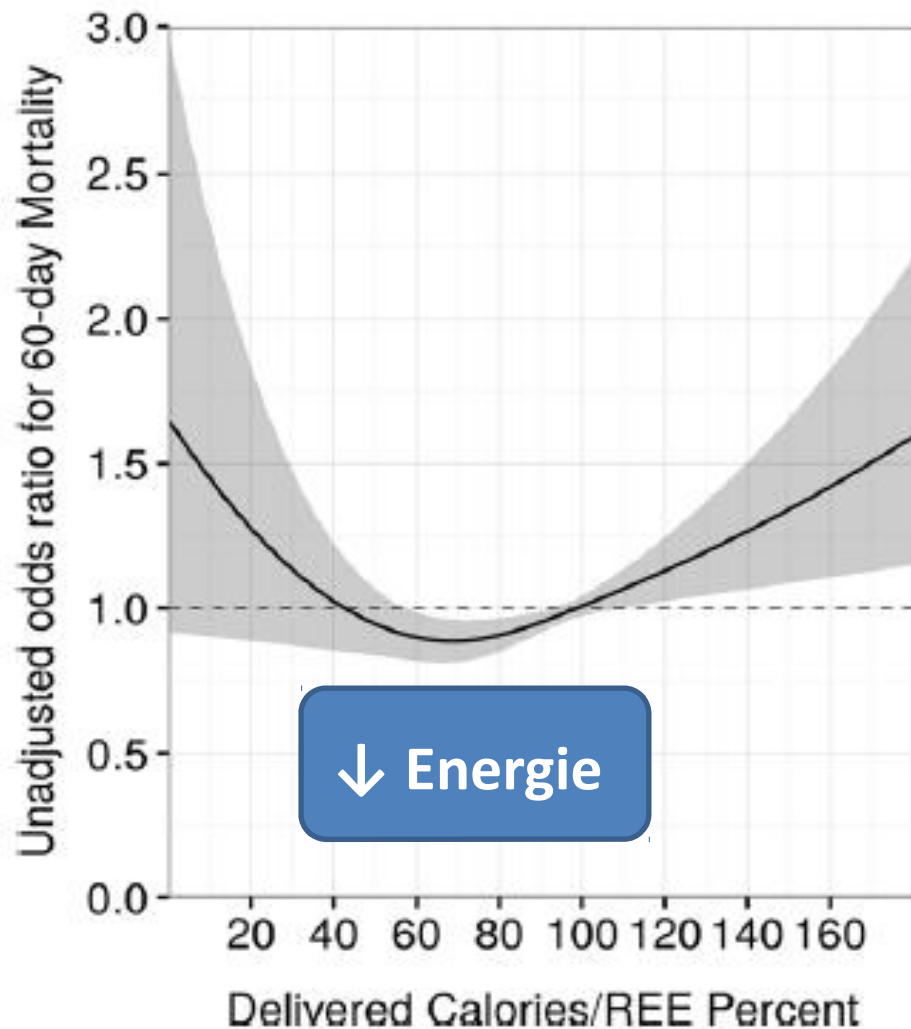
Davis et al, CCR  
2017;19:117-127





# Resting energy expenditure, calorie and protein consumption in critically ill patients: a retrospective cohort study

Oren Zusman<sup>1\*</sup>, Miriam Theilla<sup>2,3</sup>, Jonathan Cohen<sup>2,4</sup>, Ilya Kagan<sup>2</sup>, Itai Bendavid<sup>2</sup> and Pierre Singer<sup>2,4</sup>

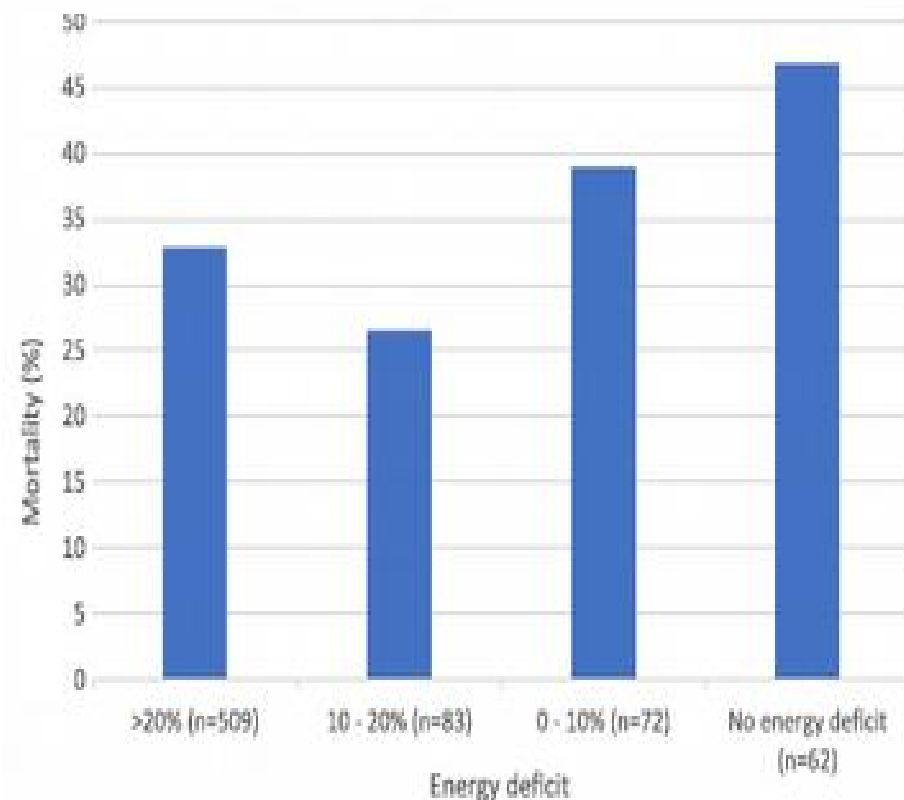
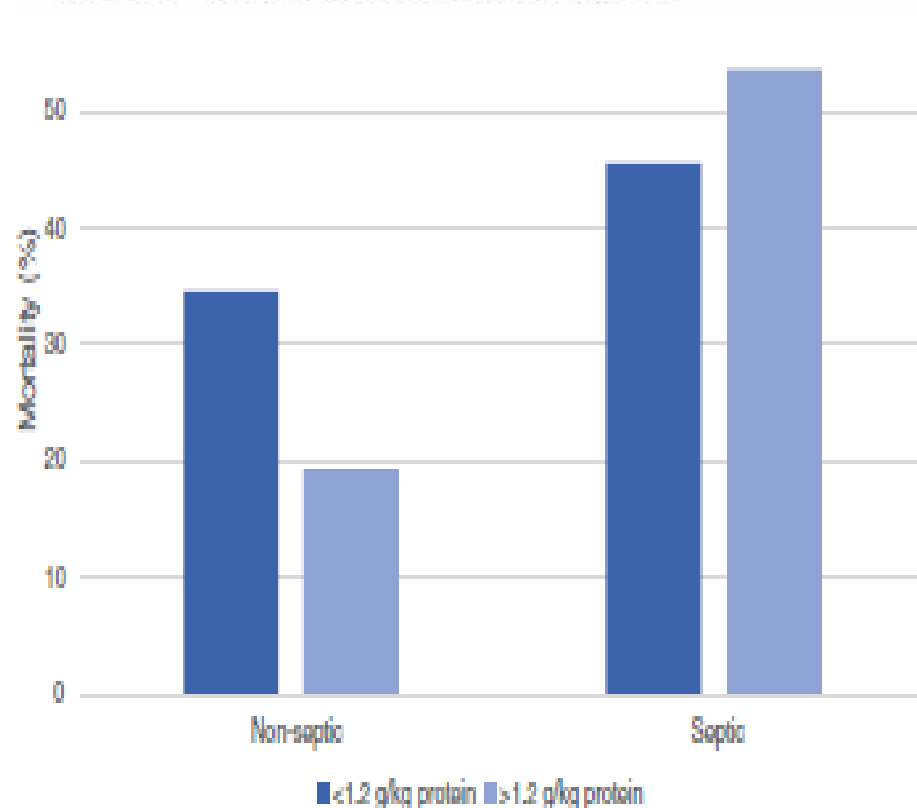


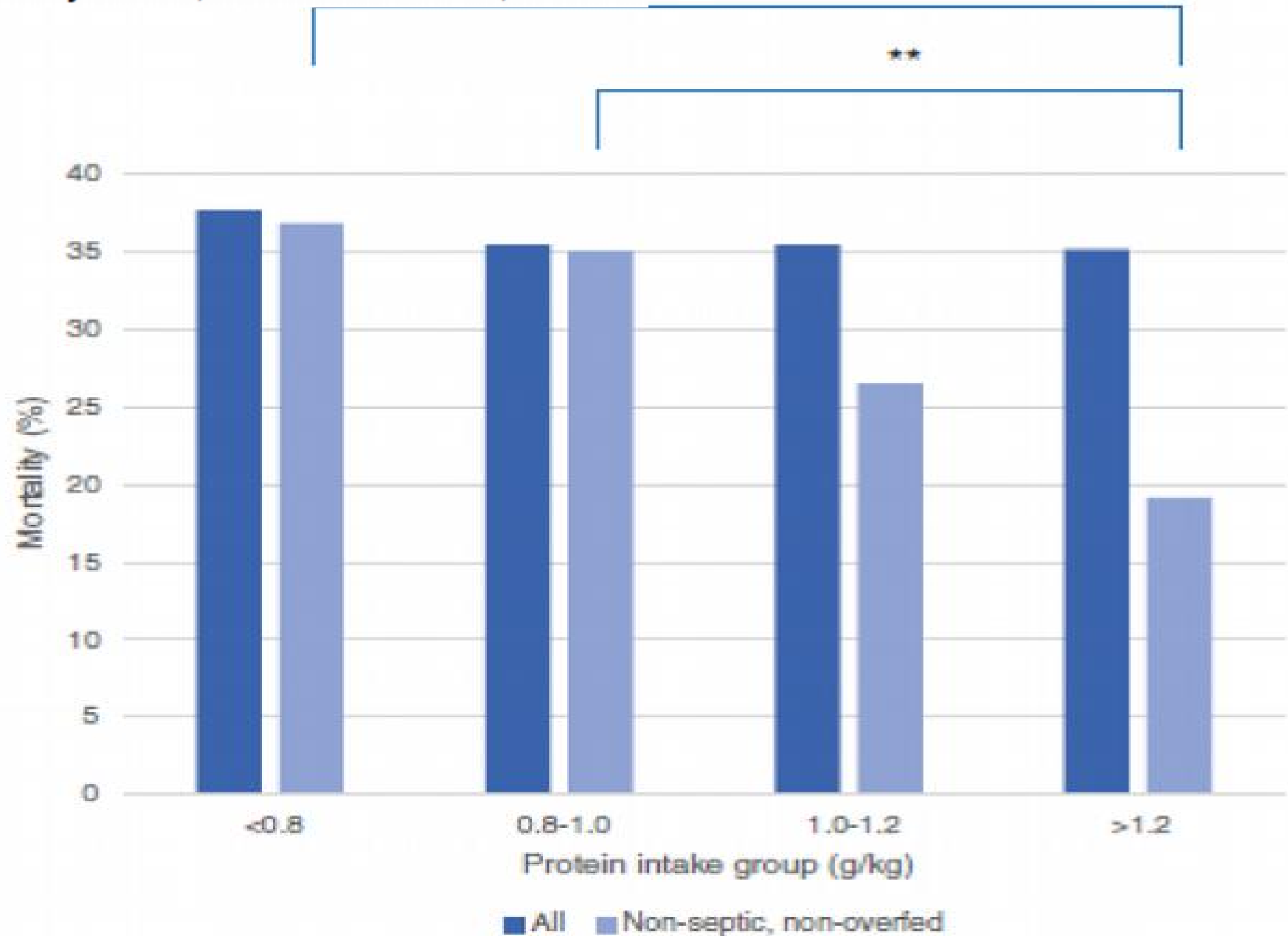
RESEARCH

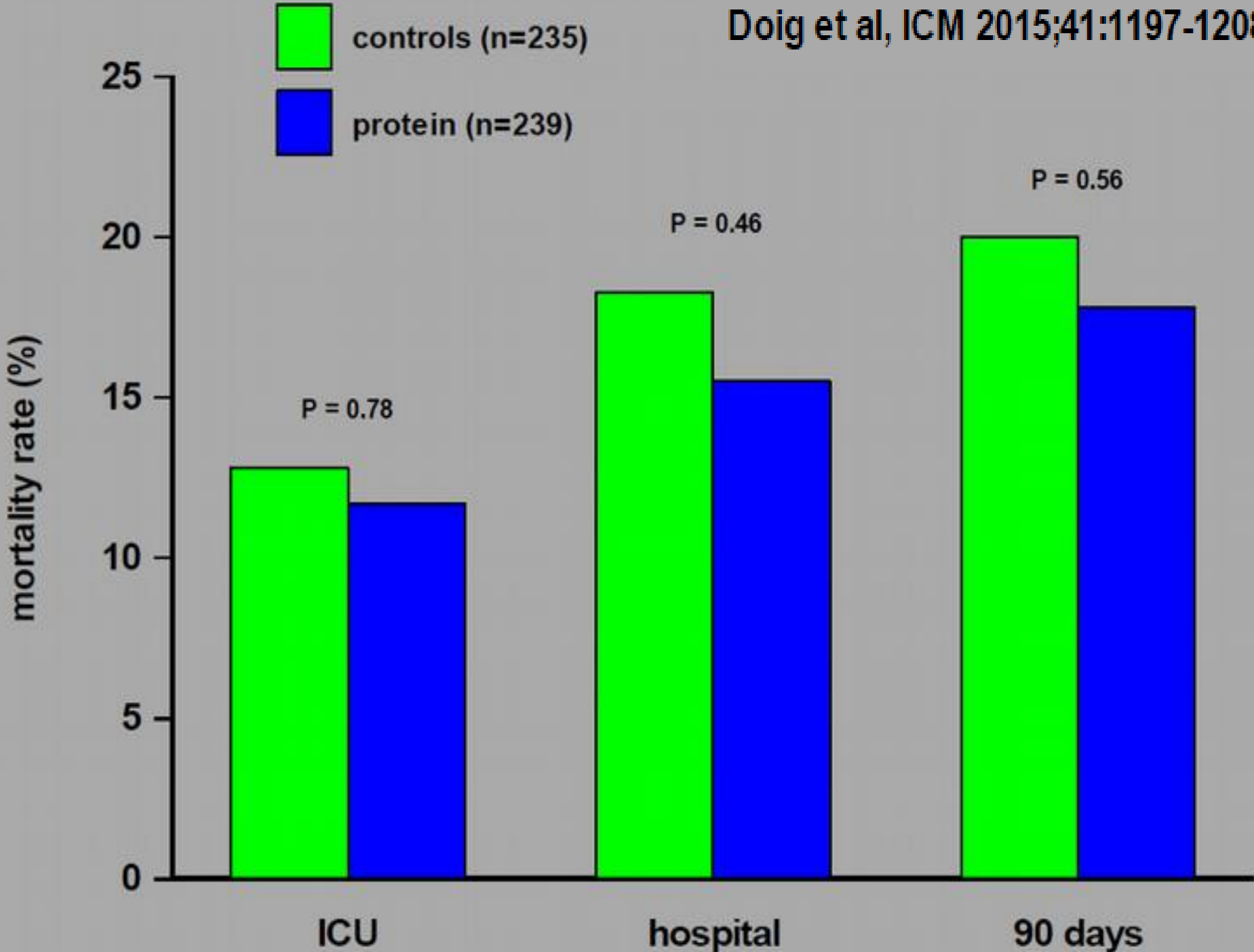
Open Access

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

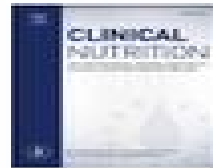
Peter JM Weijs<sup>1,2,3\*</sup>, Wilhelmus GPM Looijaard<sup>1</sup>, Albertus Beishuizen<sup>1,4,5</sup>, Armand RJ Girbes<sup>1,4</sup> and Heleen M Oudemans-van Straaten<sup>1,4</sup>











## Original article

## Timing of PROTein INTake and clinical outcomes of adult critically ill patients on prolonged mechanical VENTilation: The PROTINVENT retrospective study

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- Cíl optimální dávka proteinů u kriticky nemocných během 1. týdne , UPV (455 pac)
- Re: Nejnižší 6. měsíční mortalita:

den	Protein g/kg/den
1.-2.den	< 0,8
3.-5.den	0,8- 1,2
> 5.den	> 1,2

# PROTINVENT

W.A.C. Koekkoek et al. / *Clinical Nutrition* 38 (2019) 883–890

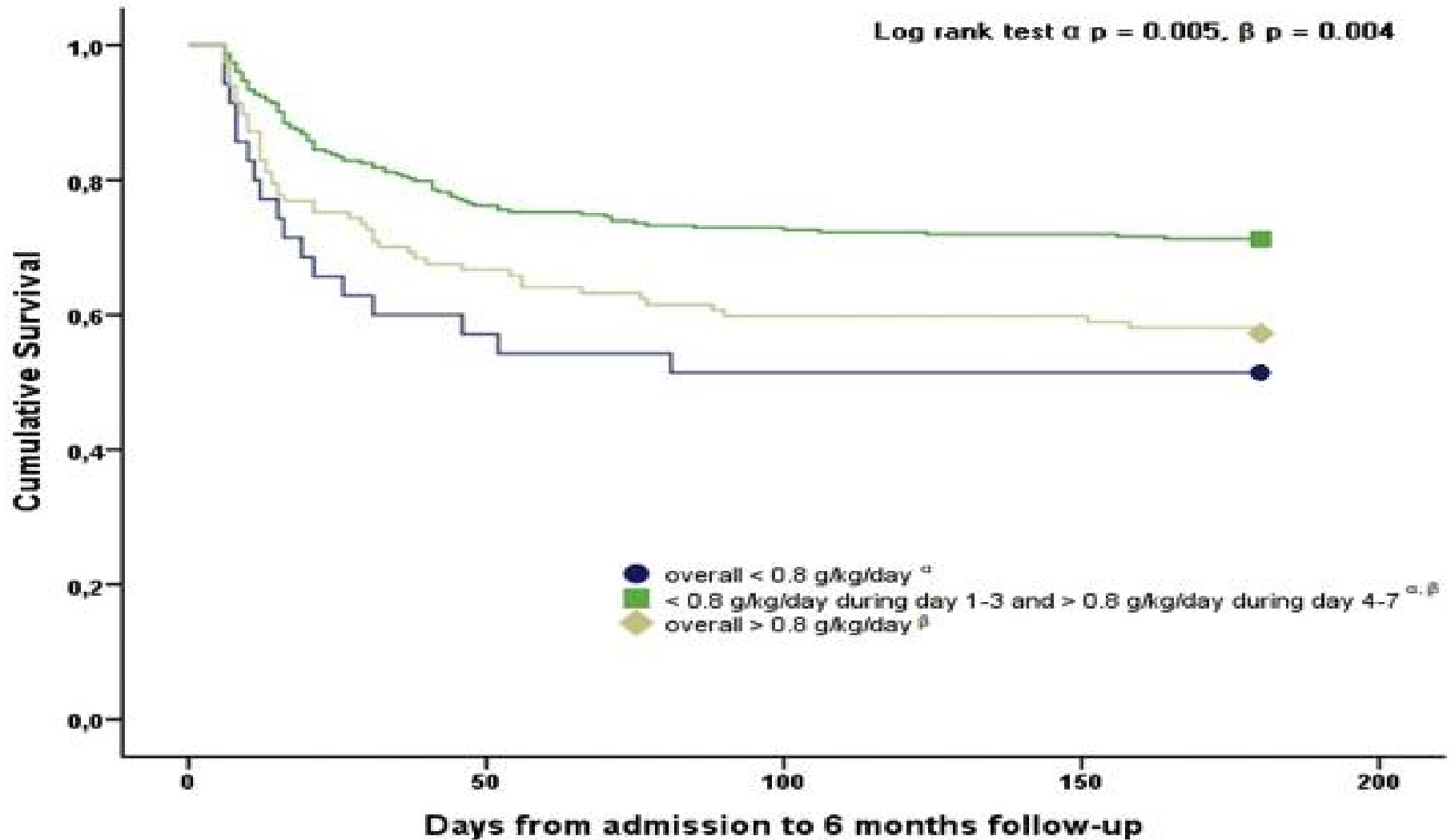


Fig. 2. Six-months survival by Kaplan–Meier estimates for time-dependent protein intake groups.

# Jako bílkovinu ?

## CIM

- Onemocnění- katabolický stav
- Katabolické hormony, kortikoidy
- **Zánět**, sepse- cytokiny
- **Anabolická rezistence**
- Svalová atrofie
- **Stimulace proteolýzy PB**
- **Útlum proteosyntézy**

## Anabolický vliv bílkovin

- **Stimulace rapamycinového systému**
- Syrovátka (bohatý zdroj leucinu (14 %), BCAA (26%))
- HMB (hydroxymethybutyrát-metabolit leu)

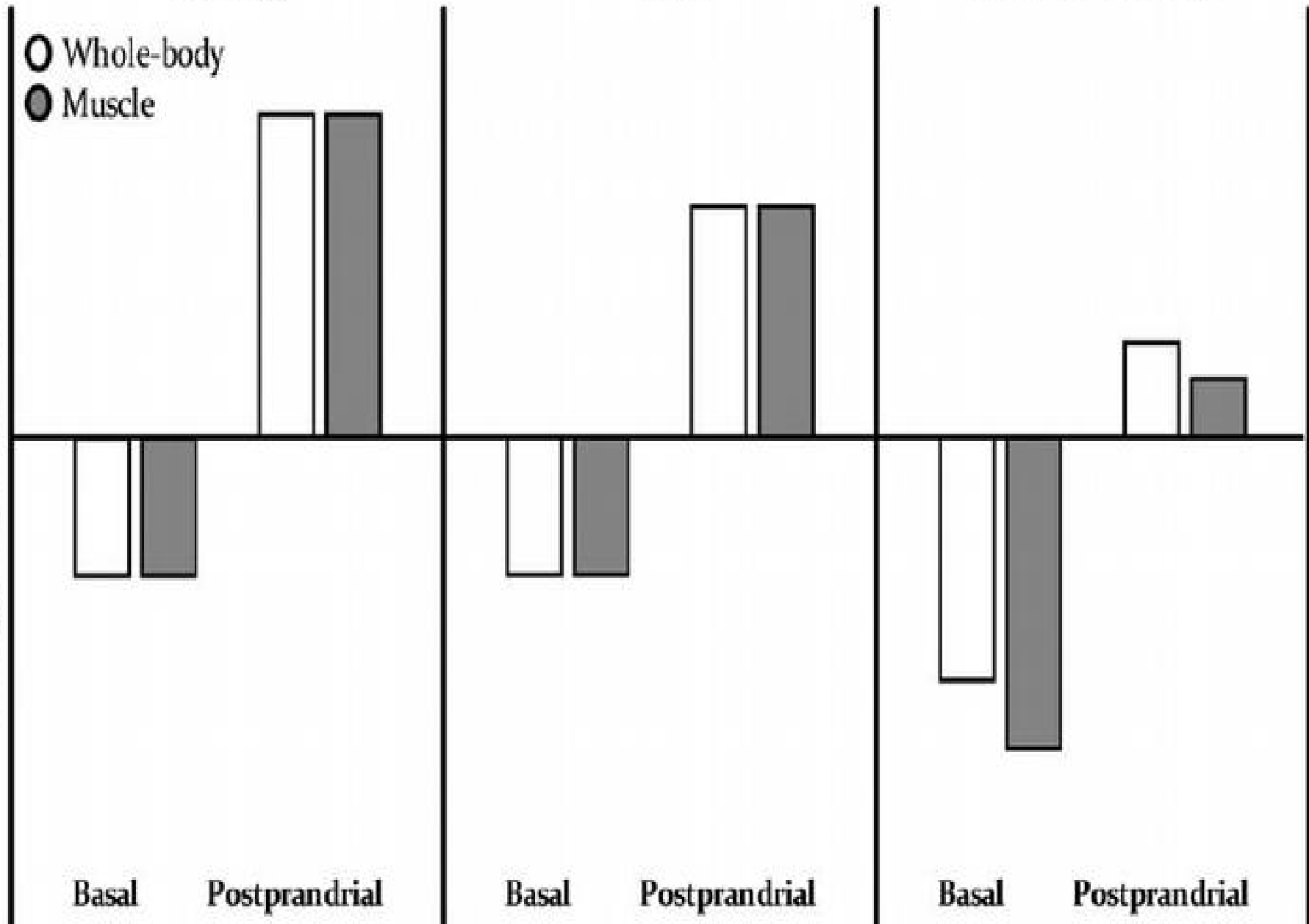
Young

Old

Critical Illness

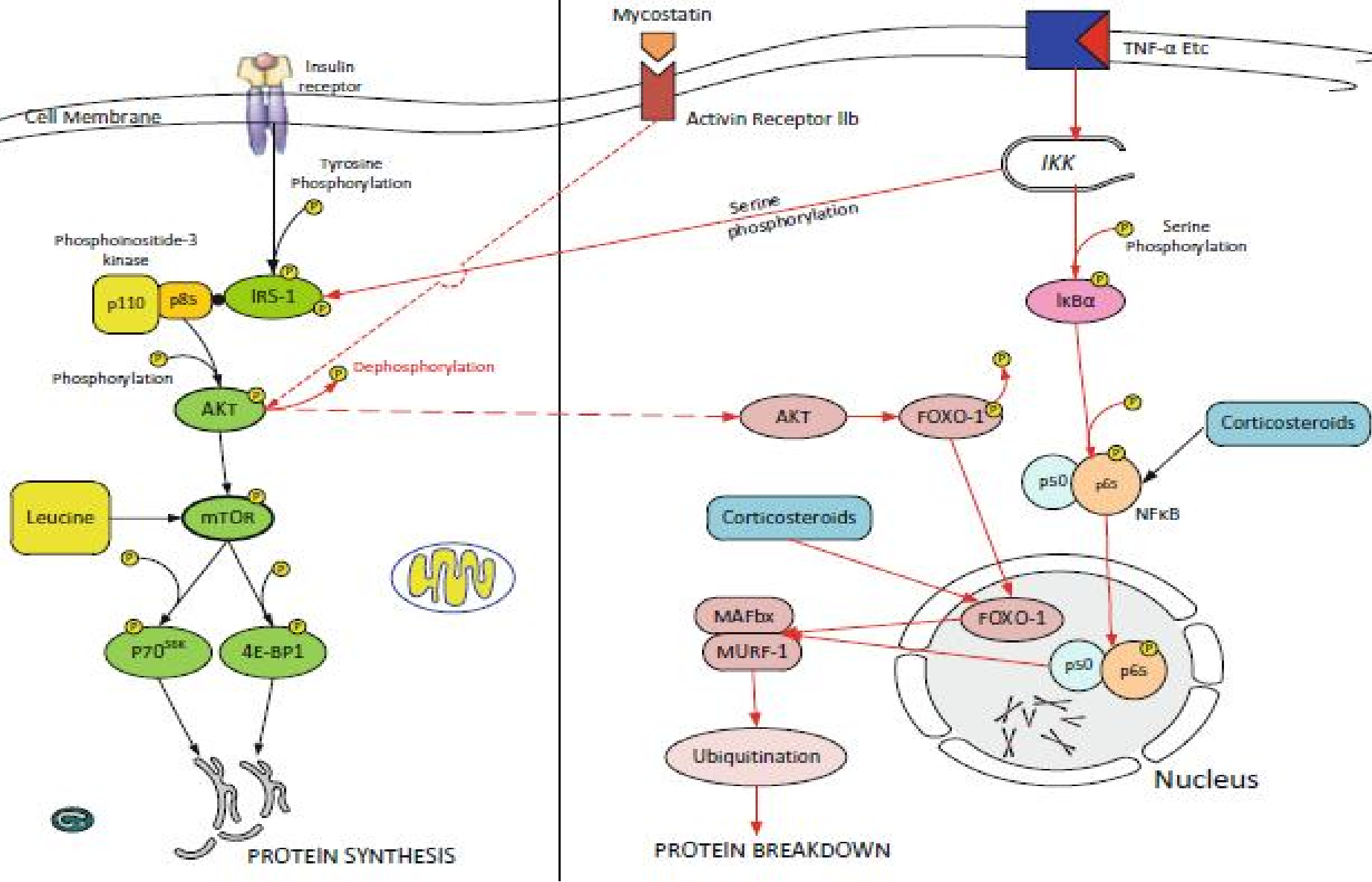
- Whole-body
- Muscle

Net protein balance



ANABOLIC PATHWAY

CATABOLIC PATHWAY



—————▶ Black arrow- Increased protein synthesis  
 - - - - -▶ Dashed arrow - dephosphorylation

—————▶ Red arrow - Decreased protein synthesis

# Bolus vs continuous feeding ?

## Kontinuální nutrice

- Pokles svalové proteosyntézy MPS
- Pokles sekrece GIT hormonů : GIP, CCK, GLP-1.
- → Omezený efekt na motilitu GIT, kontrakce žlučníku, fci pancreatu, absorpci živin
- Pokles sekrece inzulínu
- Inzulínorezistence, hyperglykemie
- Steatóza jater
- Zvětšený, špatně kontraktilní žlučník
- Atrofie sliznice tenkého střeva

## Bolusová nutrice

- **je fyziologická**
- **MPS proteosyntéza následuje po bolusovém podání stravy → bolusově vyplavený inzulín**
- BCAA + inzulín, kombinace účinku
- Za 30min po stravě, přetrvává 2 hod, po té pokles
- Kont- setrvale nízké hladina jak BCAA i Inzulínu
- I při vysokých kont dávkách AMK → mTOR off → paradoxně inhibice MPS
- Stimulace produkce GIT hormonů po jídle

# Bolus vs continuous feeding



REVIEW

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Feeding critically ill patients the right 'whey': thinking outside of the box. A personal view



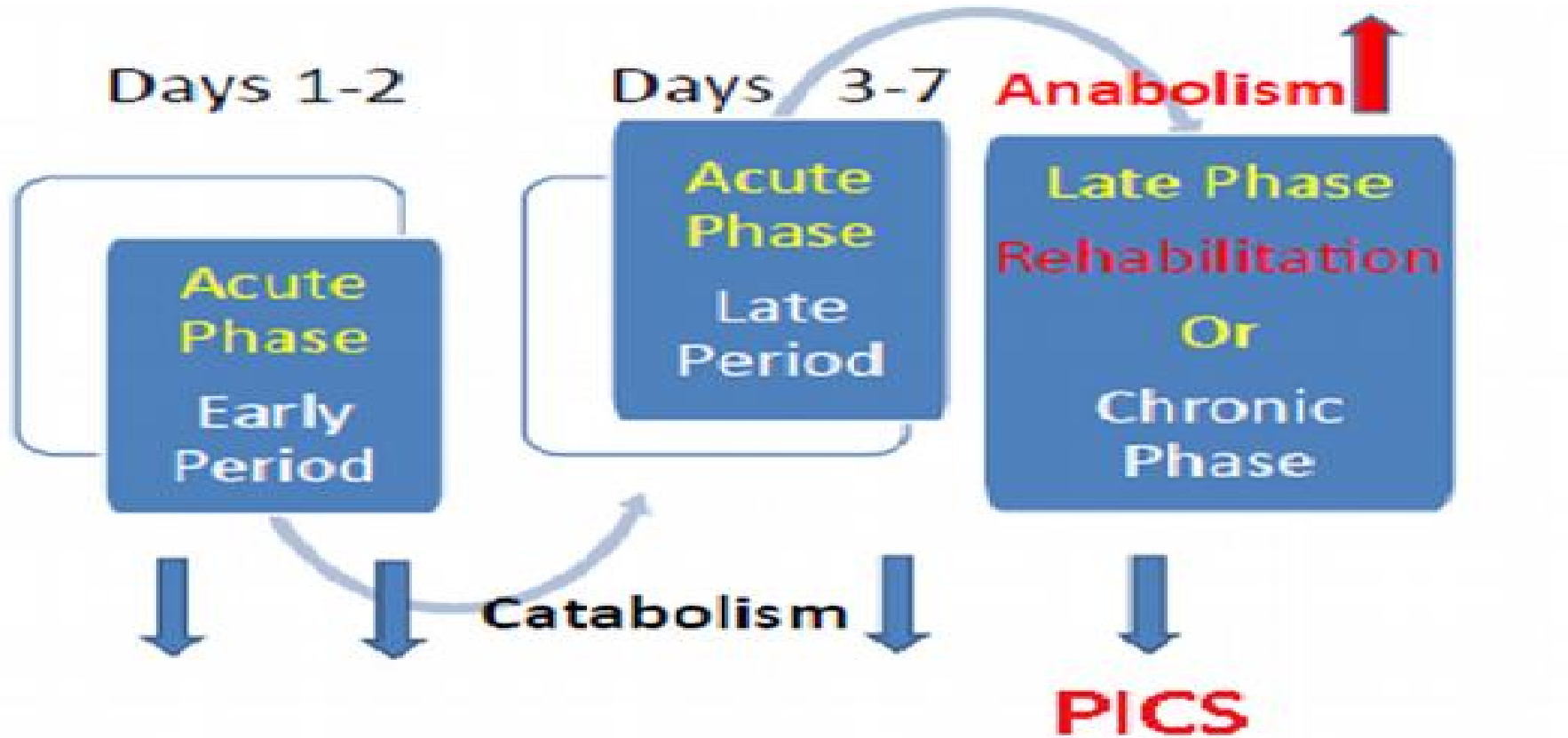
Paul E. Marik

- Bolusy podávat 30-60min ( sníží se intolerance)
- Zlepší se glykemická kontrola ! (entero-hormonální odpověď, vyplavení inzulínu)
- Brání se svalové atrofii
- **Nejlépe bolusy syrovátkové bílkoviny, HMB + MCT + vitamín D + rehabilitace**

*The traditional method of continuous tube feeding is illogical, stupid and quite likely harmful*

Paul Marik MD, Intensivist, 1958—∞

# summary



Energy 15 20-25 25-30 kcal/kg/d

Protein < 0,8 0,8- 1,2 > 1,2 g/kg/d



## CONFERENCE REPORTS AND EXPERT PANEL



# Early enteral nutrition in critically ill patients: ESICM clinical practice guidelines

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1. Set nutrition target (kcal+prot)
2. Start EN when possible
3. Calculate caloric and protein balances
4. Complementary PN on day 4-5-8

# Srovnání HP formulí

100ml	Diben 1,5 HP	Jevity plus HP	Peptamen AF	Fresubin Intensive	Peptamen Intense
E kcal	150	130	120	120	<b>100</b>
Protein	7,5 (20%)	8,13	7,6	10 (33%)	<b>9,2 (37%)</b>
Cukry	13,1 (35%)	14,15	10,7	12,9 (42%)	<b>7,6 (29%)</b>
Tuky	7 (42%)	4,33	5,5	3,2 (24%)	<b>3,8 (34%)</b>



**..Různé metabolické pochody v různých fázích onemocnění.. Neplatí jedna dávka a jeden lék pro všechny..**

**Děkuji za pozornost**