Masterclass Critical Care Nutrition 2019

Hoe bepaal ik de energiebehoefte bij IC-opname en in het IC-beloop?

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Prevention of Protein & Energy deficit essential for (functional) outcomes

Average ICU intake (not in Ede):

1000 kcal/day

0.7 g proteins/kg per day

Should be (80 kg pat):

2000 kcal/day

1.5 g proteins/kg per day

25 kcal/ kg per day

What formula?

Equation	Bias (all)	Accuracy (all)	Accuracy among subgroups by age and body mass index			
			Younger nonobese	Younger obese	Older nonobese	Older obese
ACCP	213 to 386	35	44	34	50	12
ACCP (MAW)	–162 to –62	46	44	47	50	43
HBE	–323 to –223	34	31	45	27	35
HBE x 1.25	102 to 216	46	50	45	56	33
Faisy	72 to 149	53	65	72	37	39
Penn State	–43 to –29	67	69	70	77	53
Penn State modified	–87 to –4	–	–	–	–	74

Penn State or modified Penn State if >60 recommended by experts*

Patient Population	Predictive Equation
PSU equation for patients ≤60 years old	RMR (kcal/d) = MSJ(0.96) + Tmax(167) + VE(31) – 6212
PSU equation for patients >60 years old	RMR (kcal/d) = MSJ(0.71) + Tmax(85) + VE(64) – 3085
MSJ equation for men	RMR = 5 + (10 × Weight[kg]) + (6.25 × Height[cm]) – (5 × Age[y])
MSJ equation for women	RMR = –161 + (10 × Weight[kg]) + (6.25 × Height[cm]) – (5 × Age[y])

MSJ, Mifflin–St Jeor; PSU, Penn State University; RMR, resting metabolic rate; Tmax, maximum temperature in the past 24 hours; VE, minute ventilation (L/min).

Curr Opin Crit Care 2012, 18:174–177

*Choban JPEN 2013

X

What makes Penn State University equation superior?

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MSJ, Mifflin–St Jeor; PSU, Penn State University; RMR, resting metabolic rate; Tmax, maximum temperature in the past 24 hours; VE, minute ventilation (L/min).

$\dot{V}E$ = minute volume (in L/min)

Penn State or modified Penn State if >60 recommended by experts*

MINUTE VOLUME IS A REFLECTION OF THE CO_2 PRODUCTION

Curr Opin Crit Care 2012, 18:174–177

*Choban JPEN 2013

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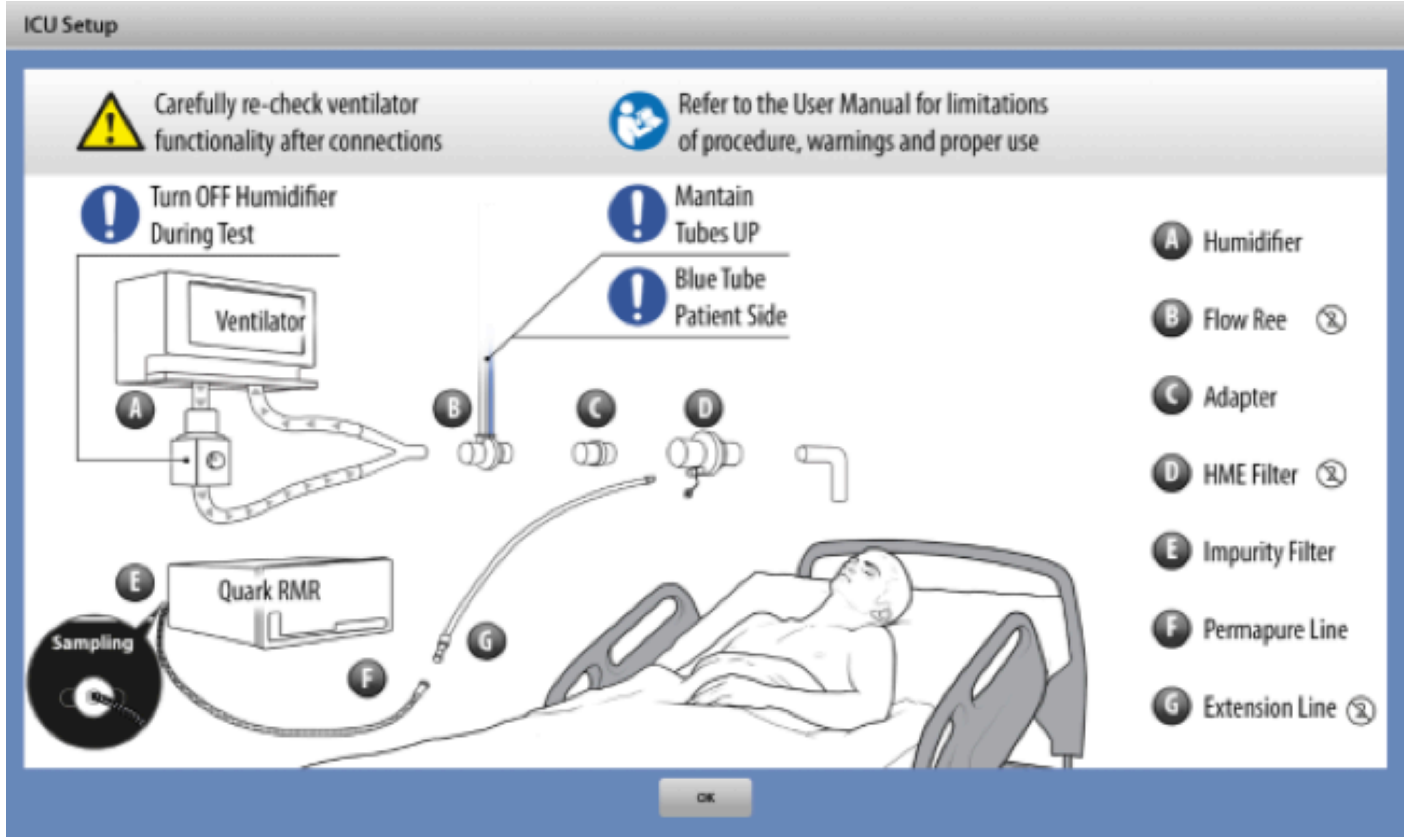
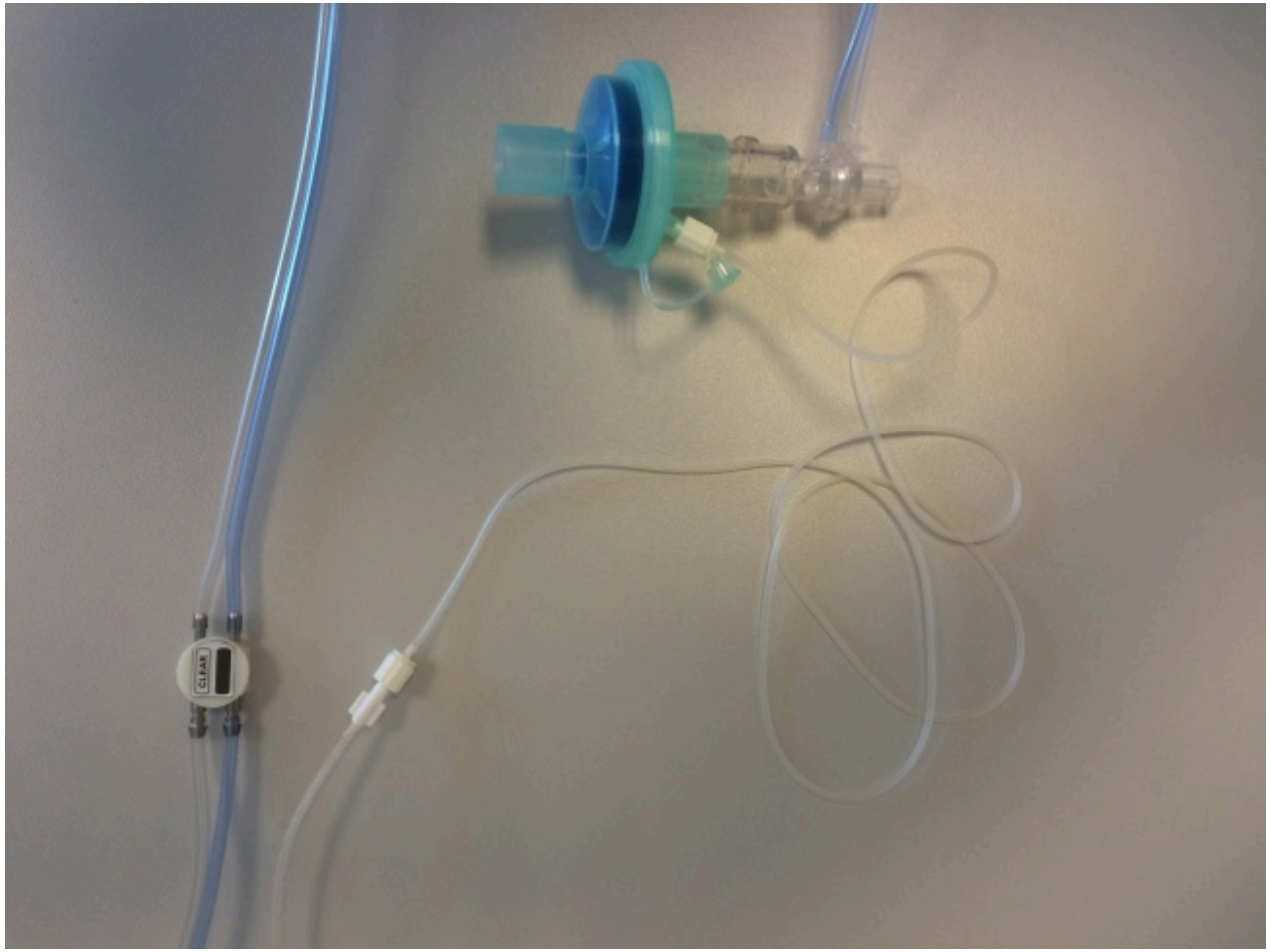
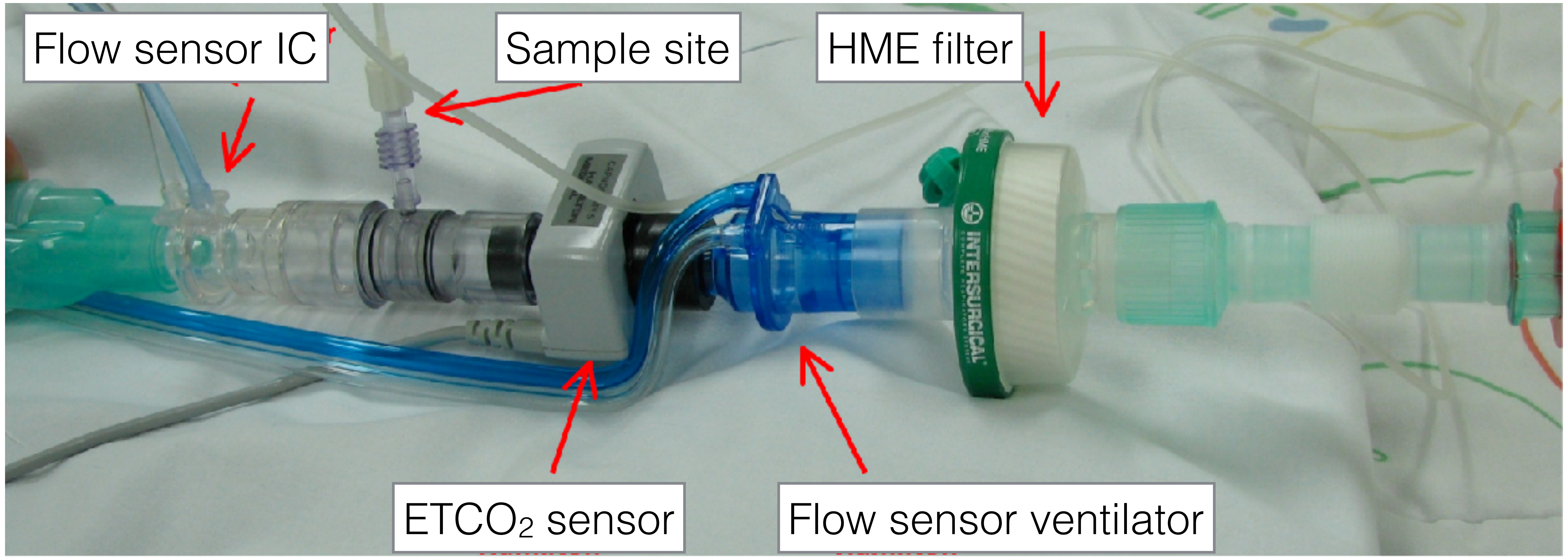

ICU Setup
Carefully re-check ventilator functionality after connections
Refer to the User Manual for limitations of procedure, warnings and proper use
Turn OFF Humidifier During Test
Mantain Tubes UP
Blue Tube Patient Side
Ventilator
Quark RMR
Sampling
A Humidifier
B Flow Ree
C Adapter
D HME Filter
E Impurity Filter
F Permapure Line
G Extension Line
OK



Indirect Calorimetry



$$REE\ (kcal/\ min) = 3.9 * VO_2\ (l\ /\ min) + 1.1 * VCO_2\ (l/\ min)$$

$$\Big\downarrow *1440$$

Energy Expenditure per 24 hours

Weir Equation

- In 1949, Weir introduced an equation to facilitate the calculation of Resting Energy Expenditure, as follows:

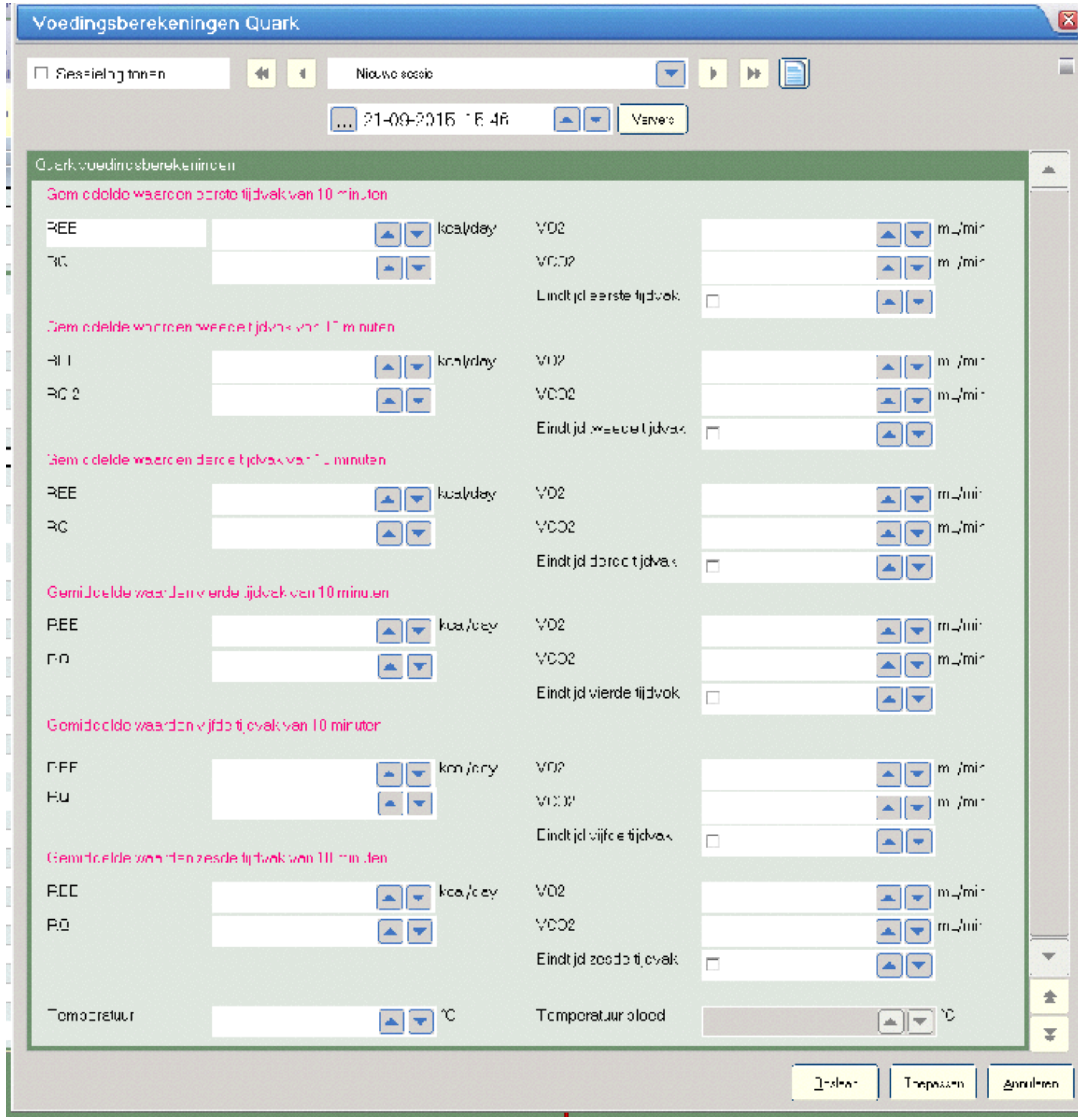
$$REE(kcal) = [VO_2\ (3.941) + VCO_2\ (1.11)]$$

- VO_2 = oxygen uptake (L/min)
- VCO_2 = carbon dioxide output (L/min)

Ziekenhuis Gelderse Vallei

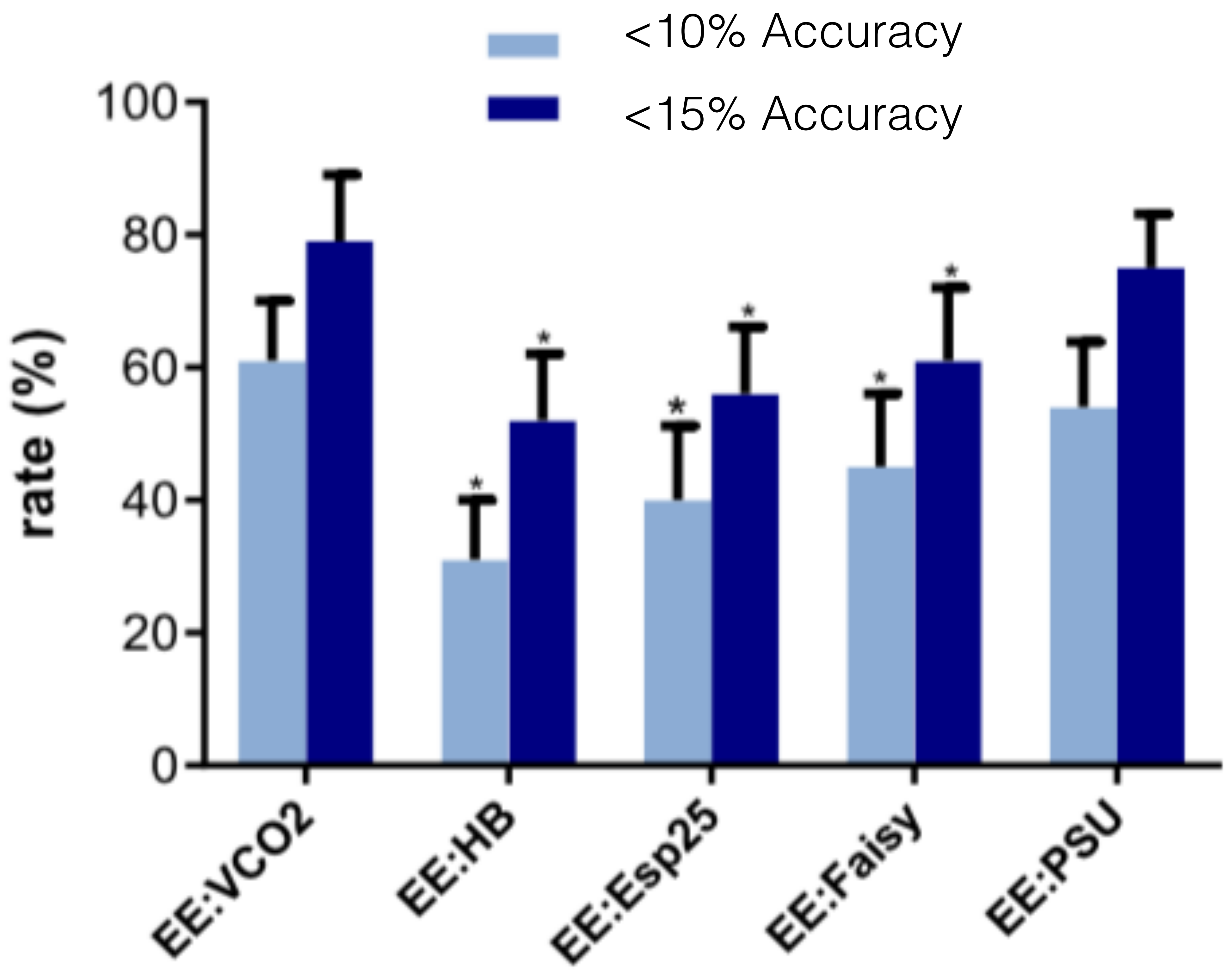
Insert into PDMS system

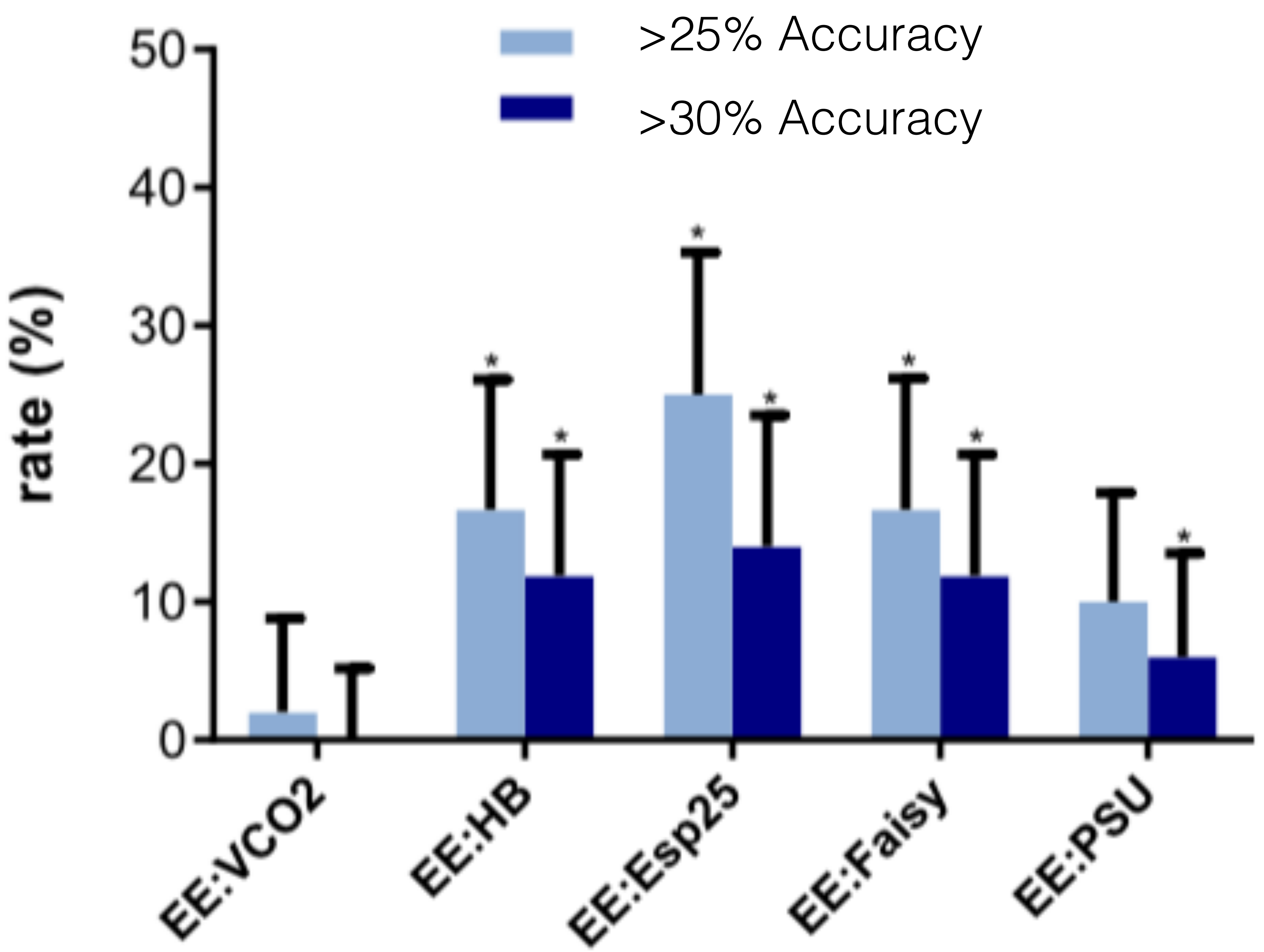
- **REE**
- **RQ**
- **VO_2**
- **VCO_2**



Ventilator VCO_2 to predict Energy Expenditure

$EE = VCO_2 * 8{,}19$ in kcal/24 h





EE:Esp25, Energy expenditure calculated with the European Society for Clinical Nutrition and Metabolism guideline equation of 25 kcal/kg/day; EE:Faisy, Energy expenditure calculated with the Faisy equation; EE:HB, Energy expenditure calculated with the Harris–Benedict equation; EE:PSU, Energy expenditure calculated with the Penn State University 2003b equation; EE:VCO2, Energy expenditure from ventilator-derived volume of carbon dioxide and nutritional respiratory quotient

Stapel et al. Critical Care (2015) 19:370

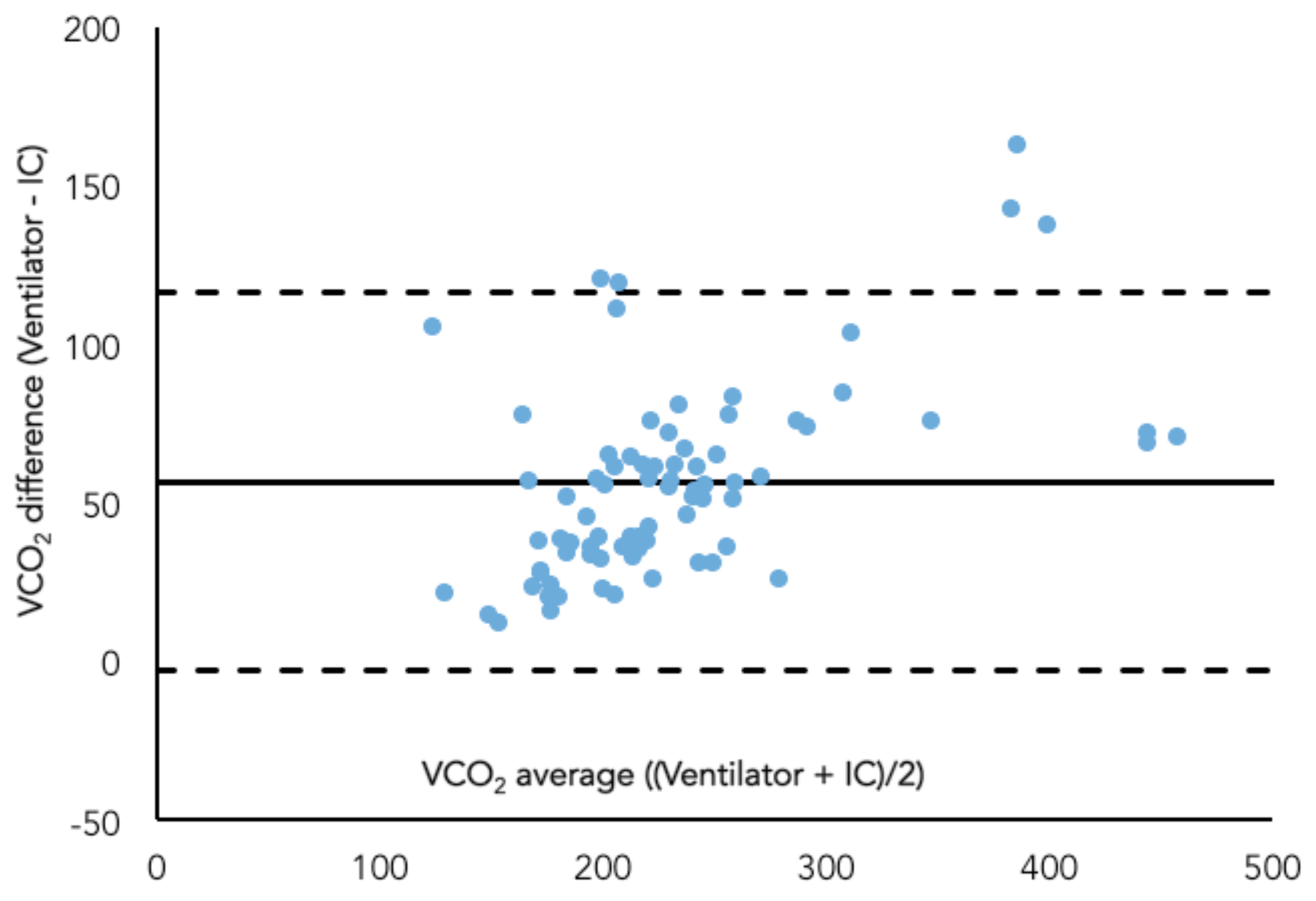
DREAM-VCO_2 Study

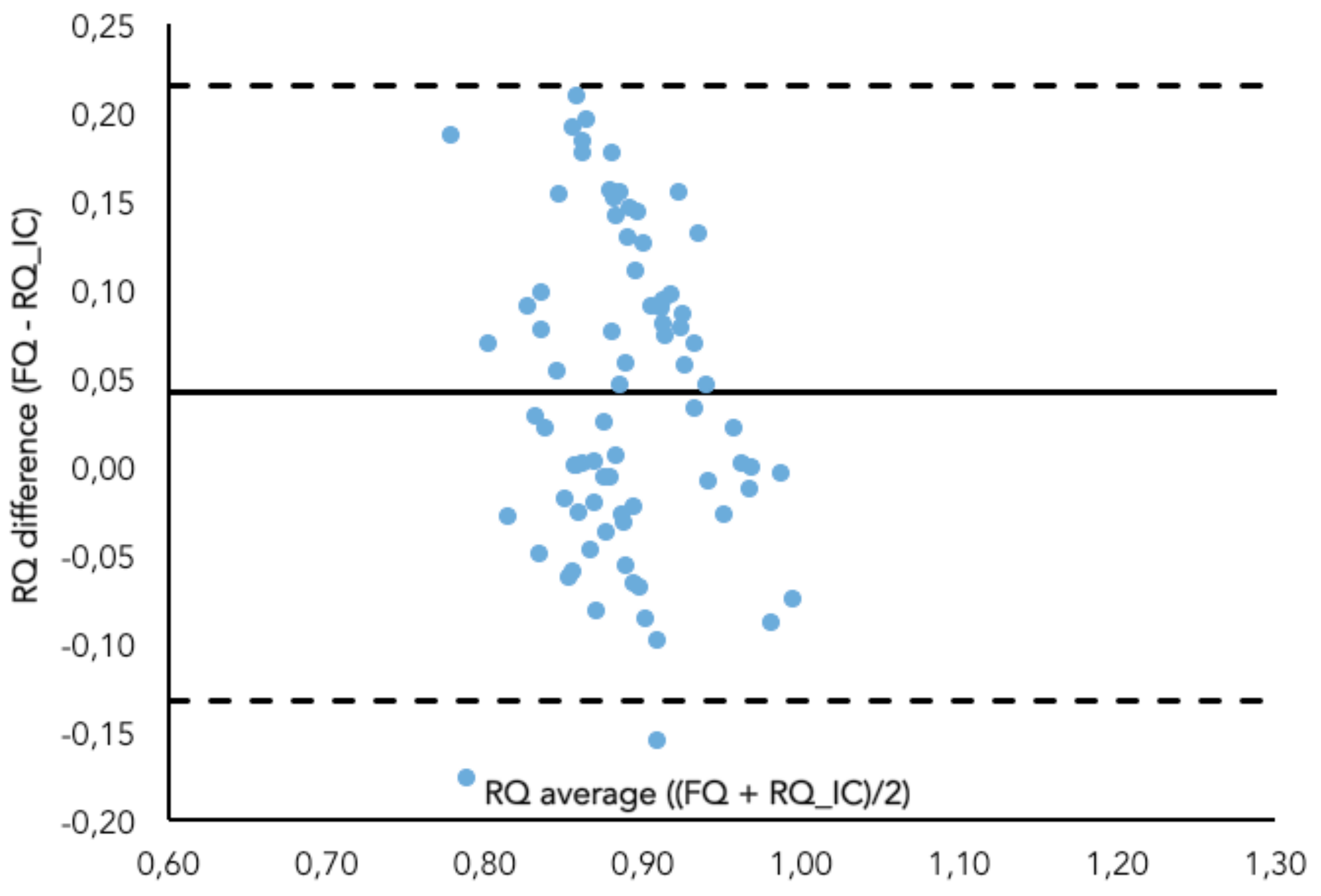
Direct Resting Energy Expenditure Assessment with the Metabolic Cart Compared with the VCO_2 from the Ventilator in Critically Ill Patients: A Prospective Cohort Study

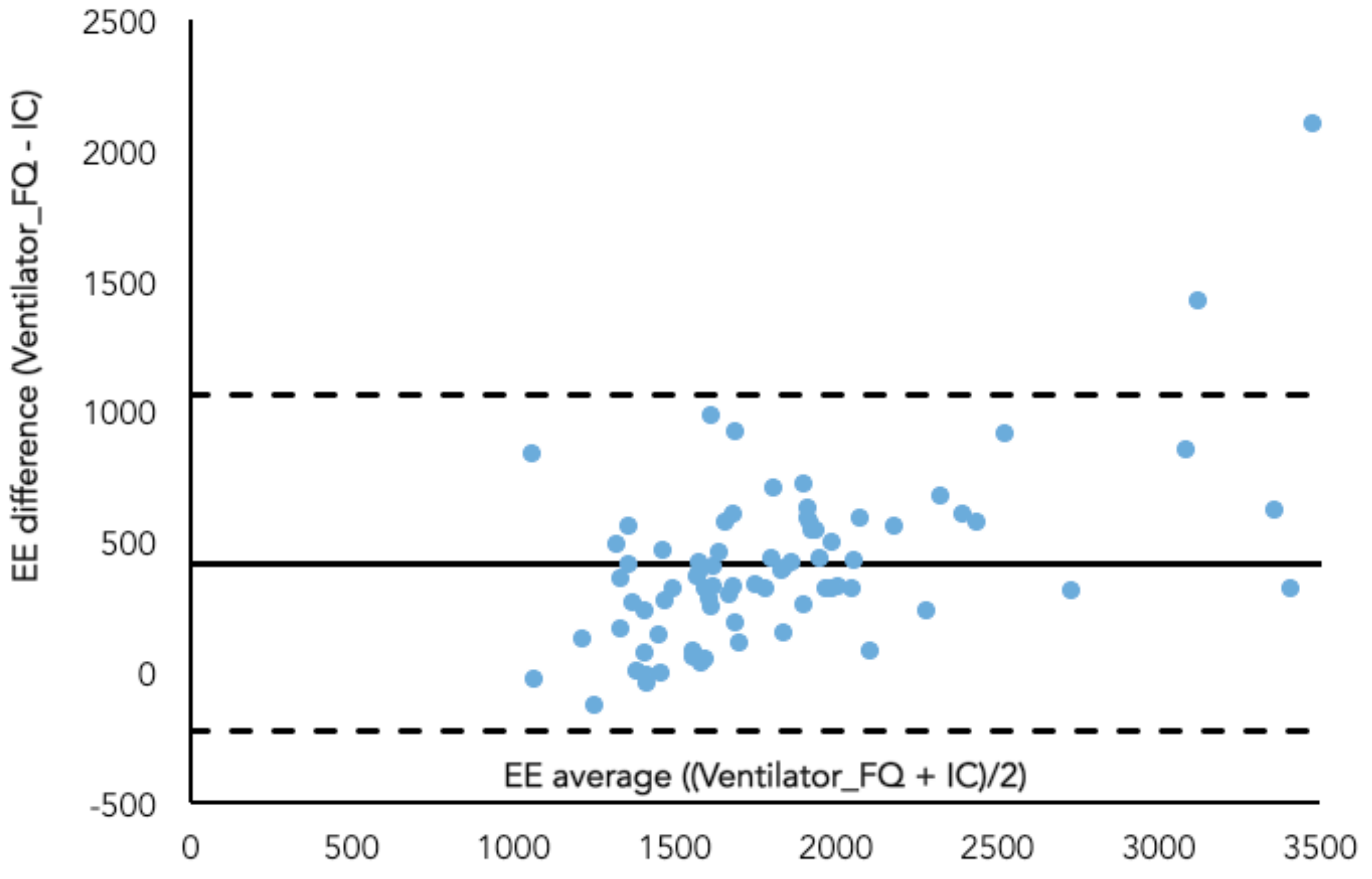
- Indirect Calorimetry

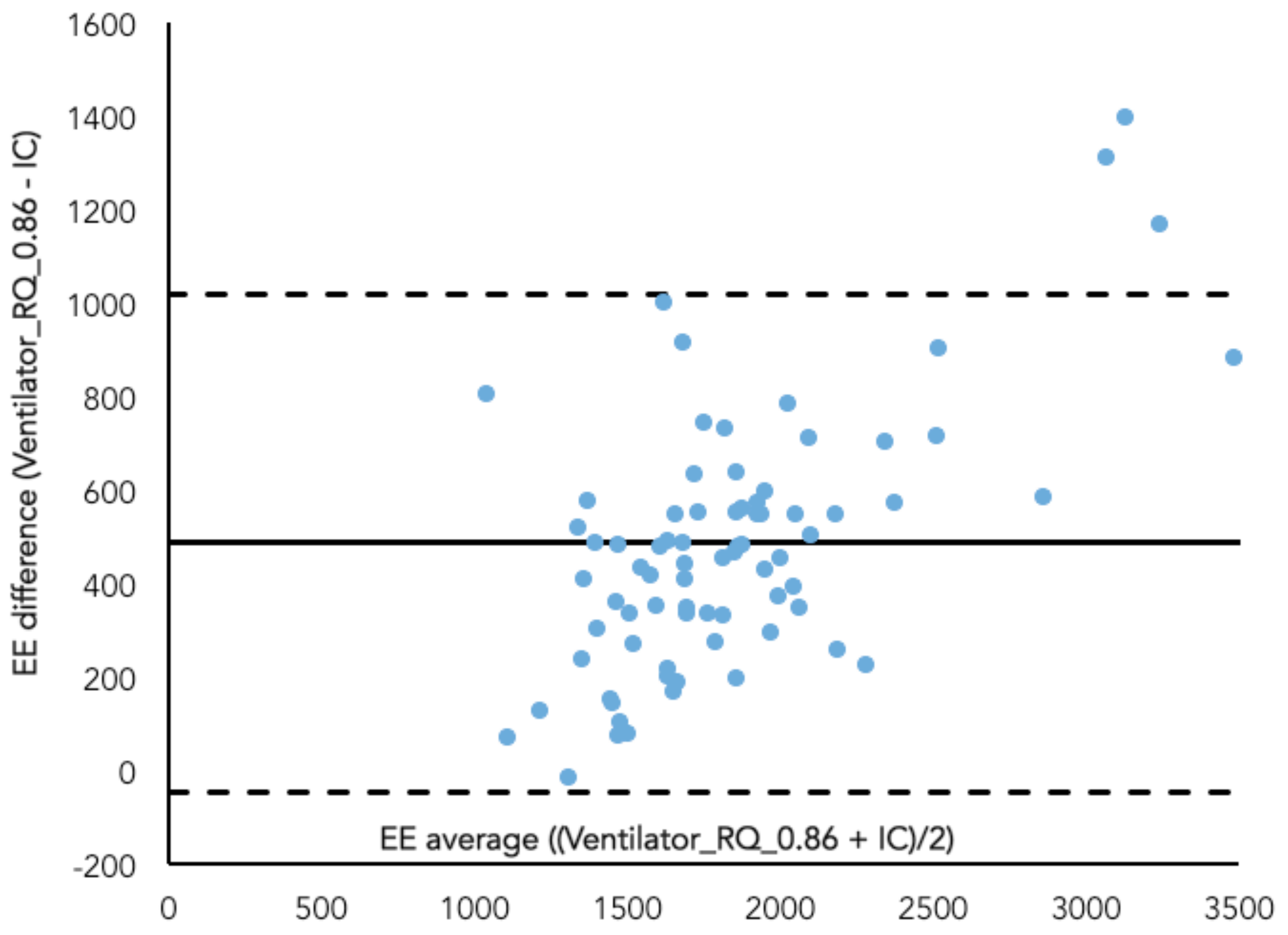
X

Dream VCO_2 Study

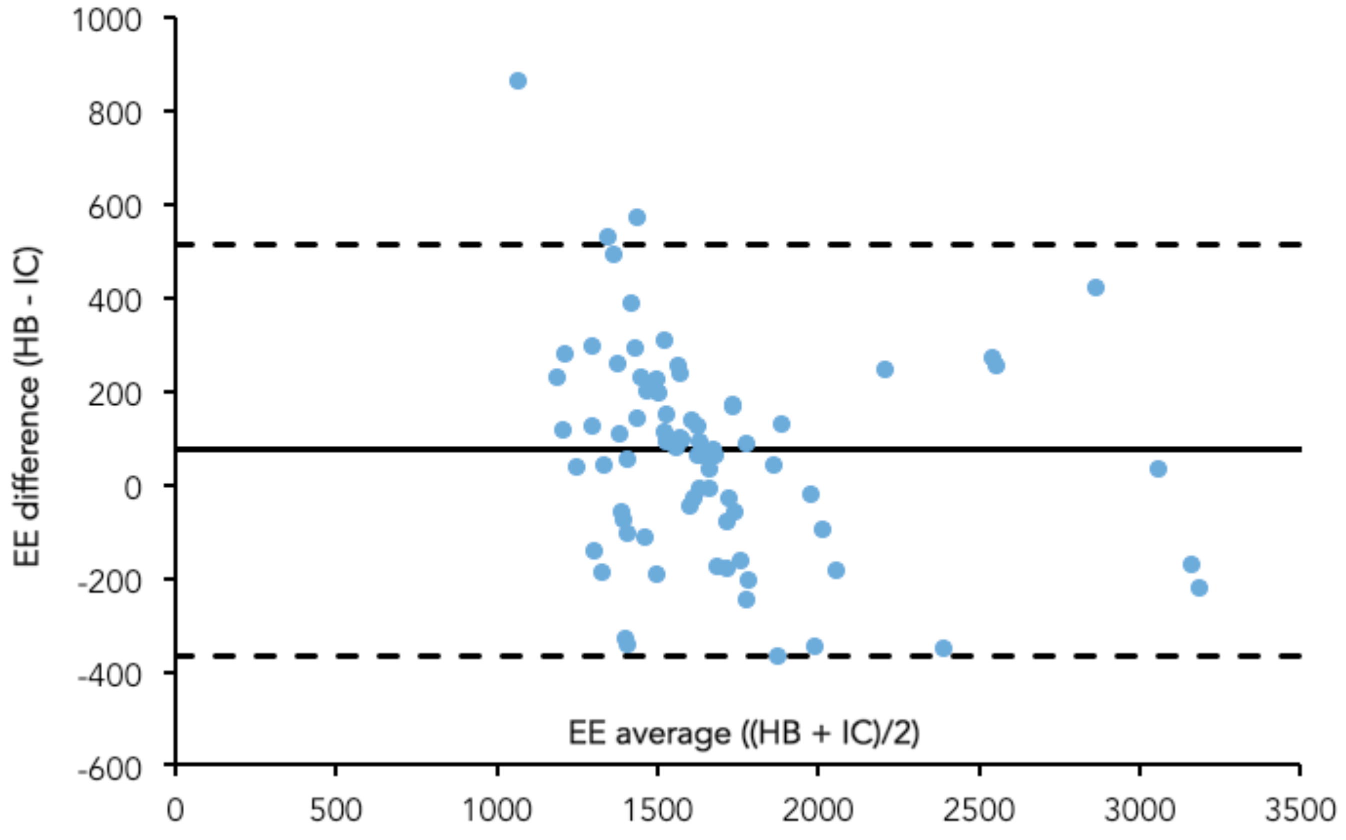








All ventilator derived VCO_2 and calculated food driven (RQ) variables show unacceptable high variations compared to indirect calorimetry

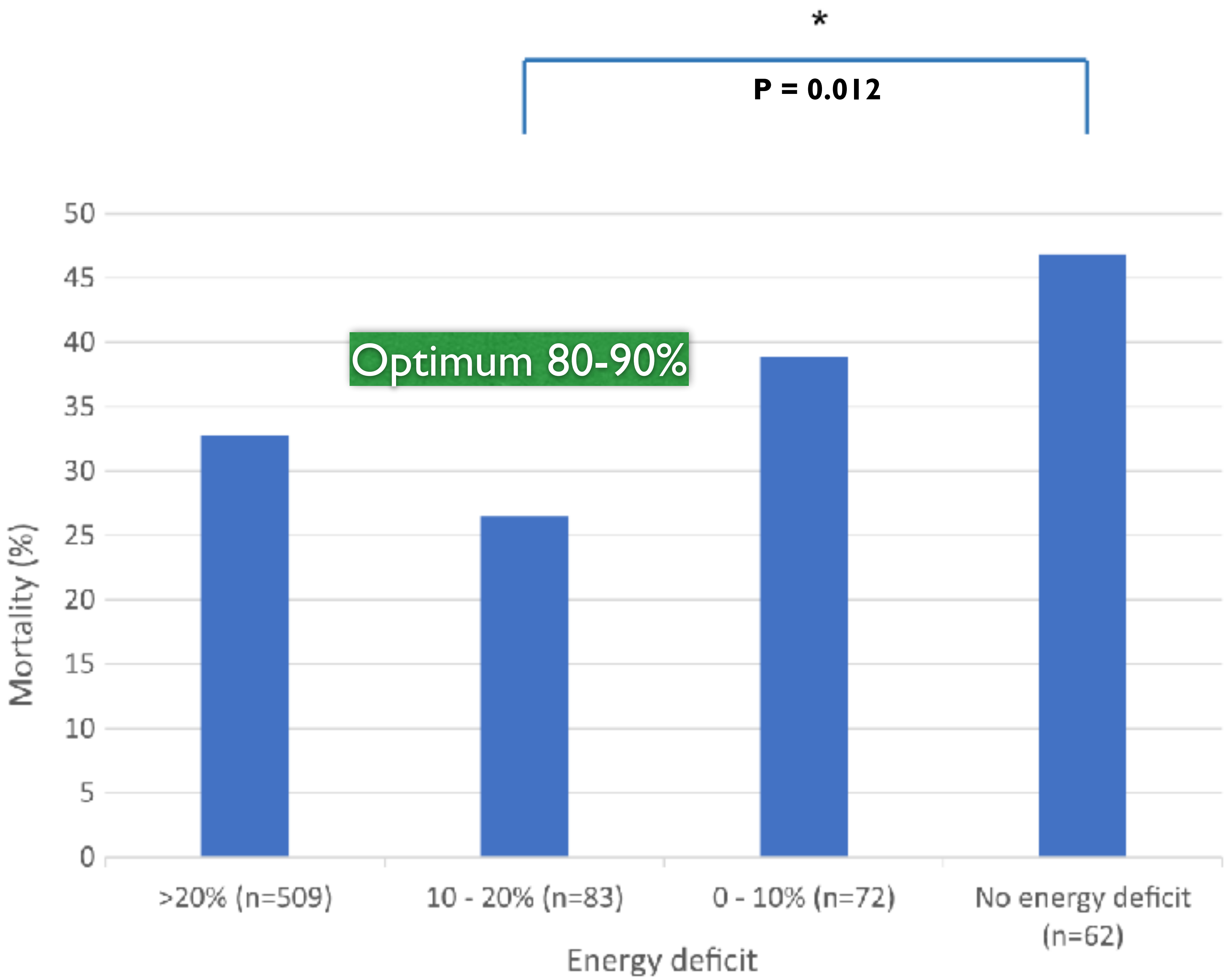


Koekkoek K, Xiaochen Q, Van Zanten AR et al. Submitted (2018)

Hospital mortality and cumulative energy deficit in ICU patients

during first 4 days of ICU stay for 726 non-septic ICU patients

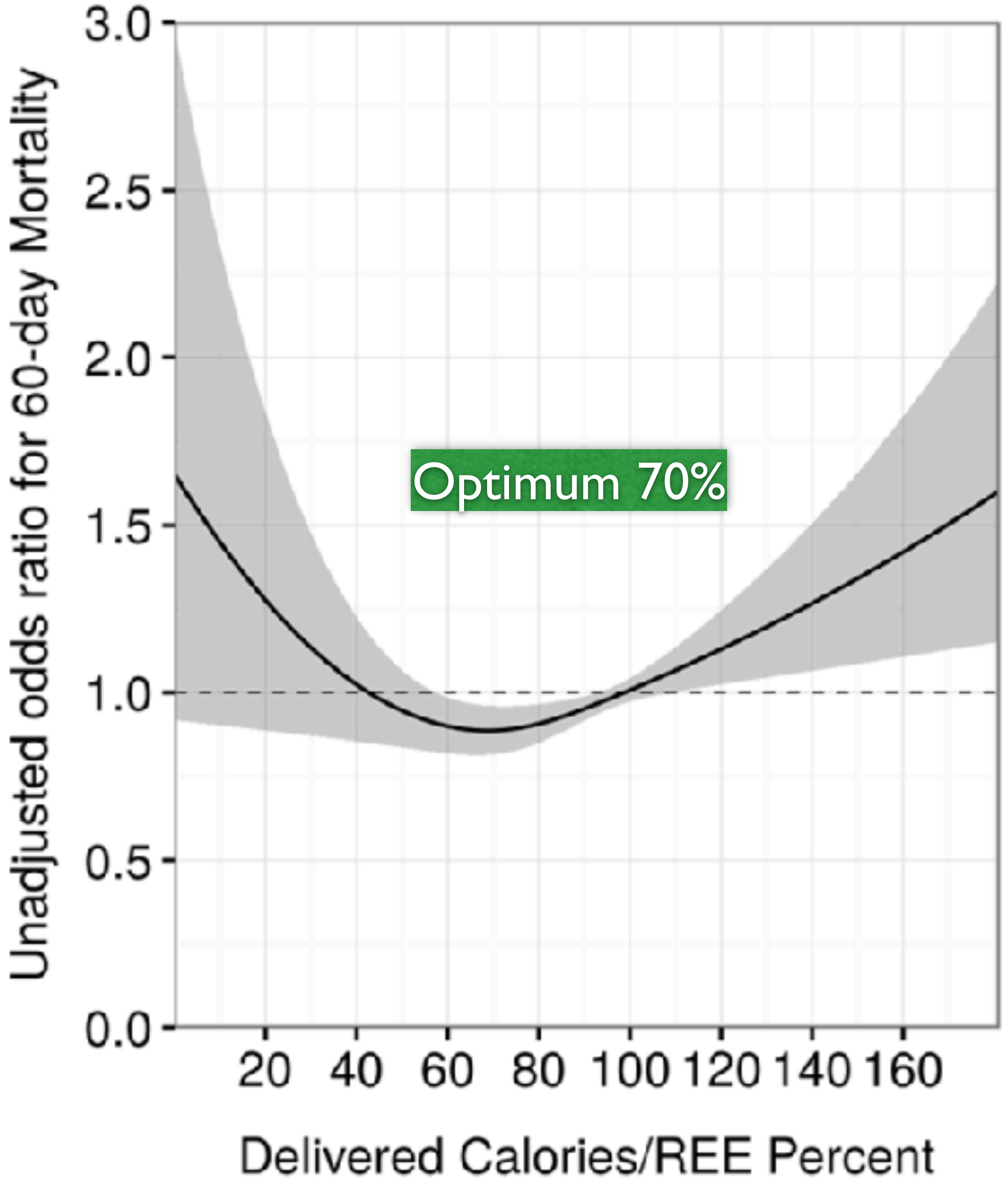
Reference is the measured resting energy expenditure of the patient



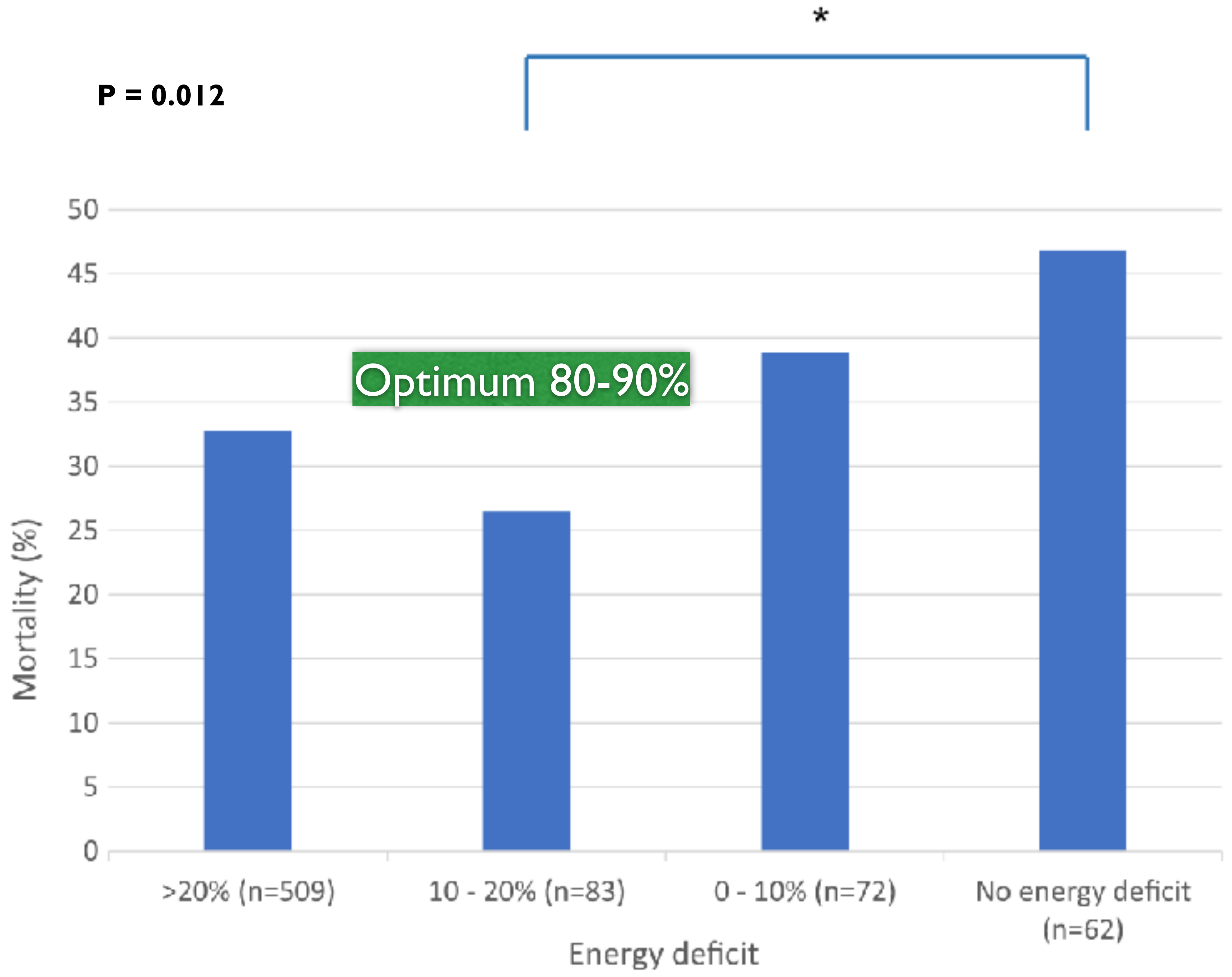
During EN with 100% target, target achieved is typically 80-85% due to feeding interruptions

Weijs P. Crit Care 2014;18:701

Hospital mortality and cumulative energy deficit in ICU patients based on measured energy expenditure



during first 4 days of ICU stay for 726 non-septic ICU patients



During EN with 100% target, target achieved is typically 80-85% due to feeding interruptions

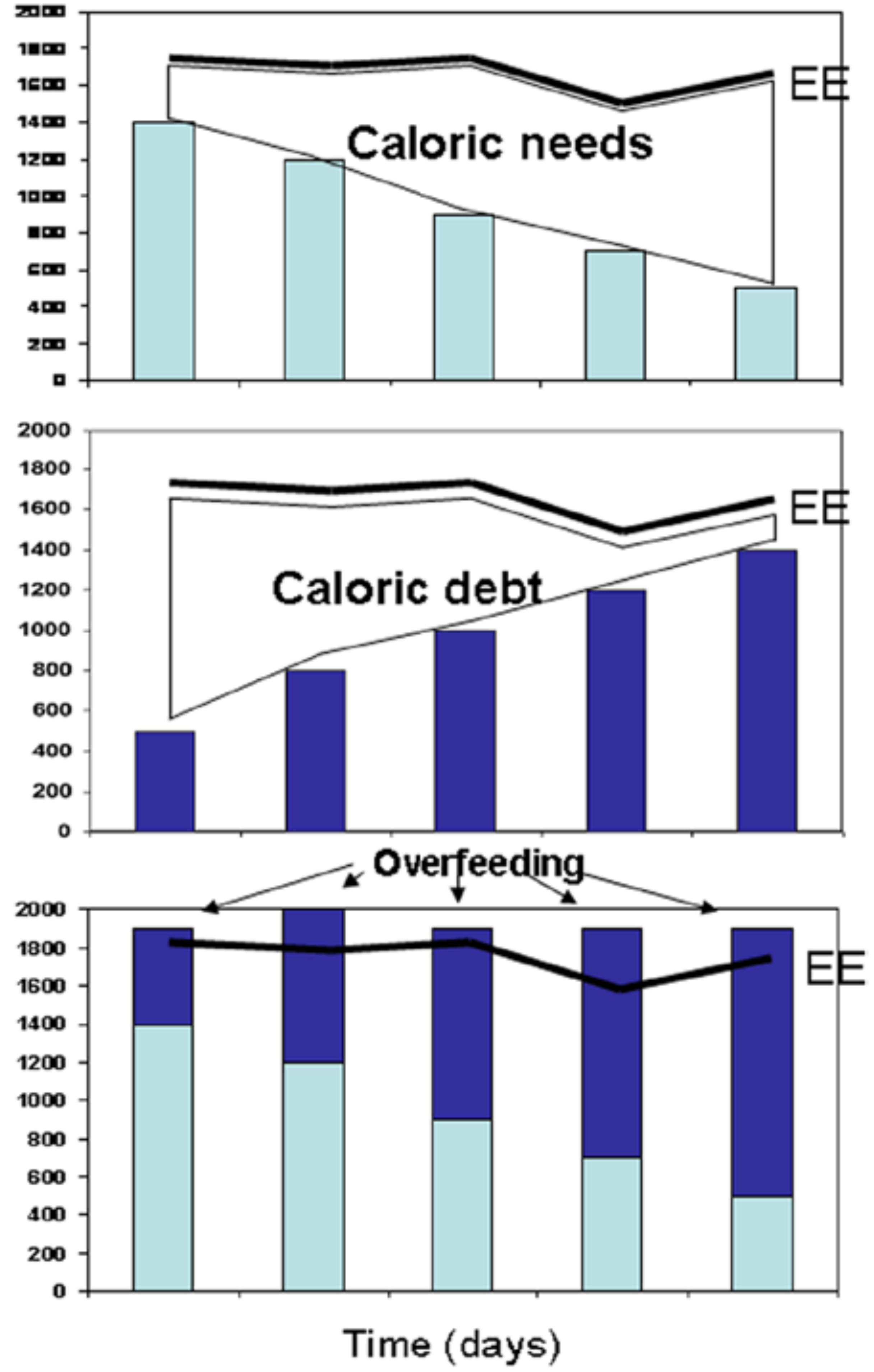
Zusman et al. Crit Care 2016;20:367, Weijs P. Crit Care 2014;18:701

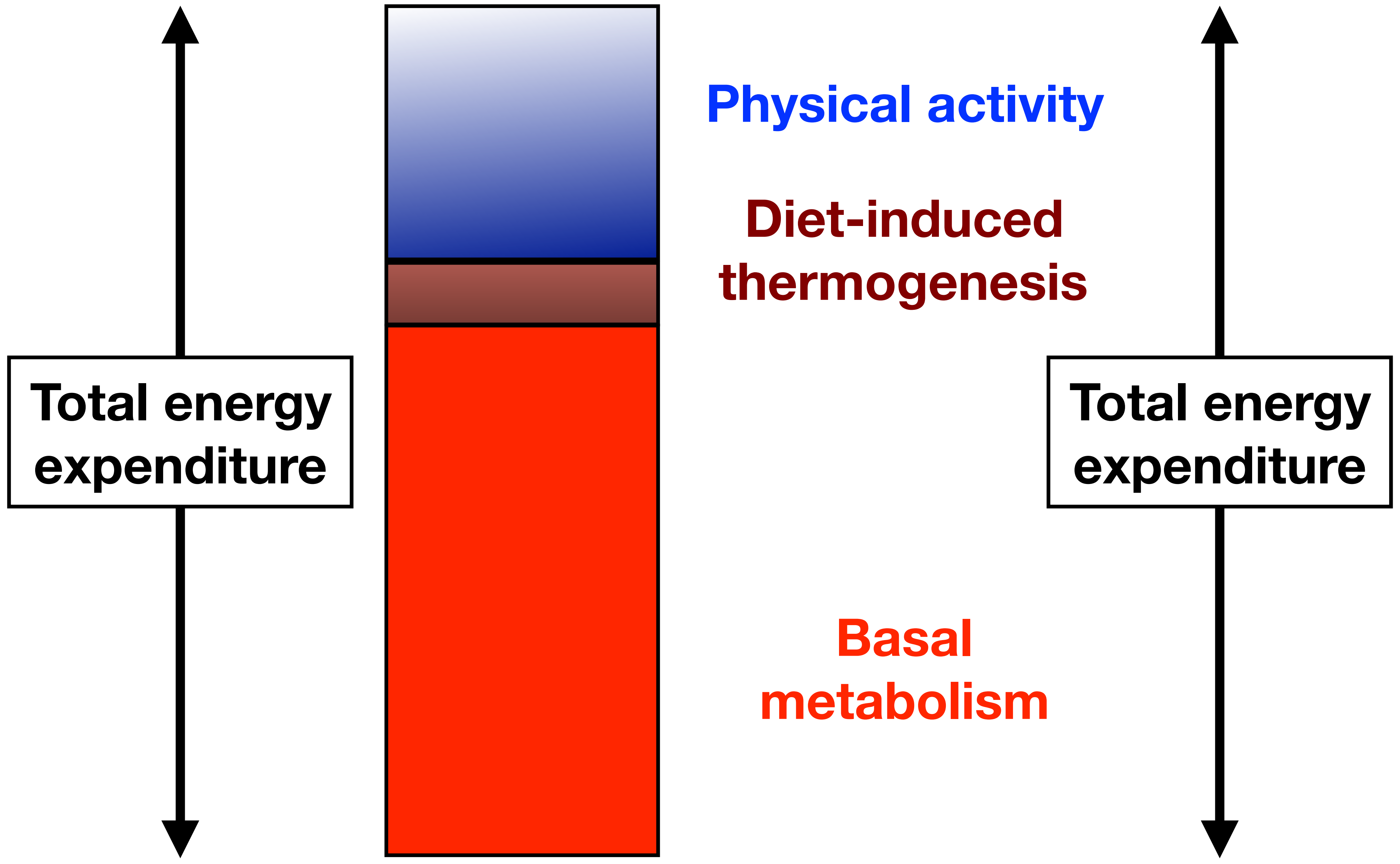
Consequences of early non-inhibitable endogenous energy production and overfeeding risk in critical illness

endogenous production

nutritional intake

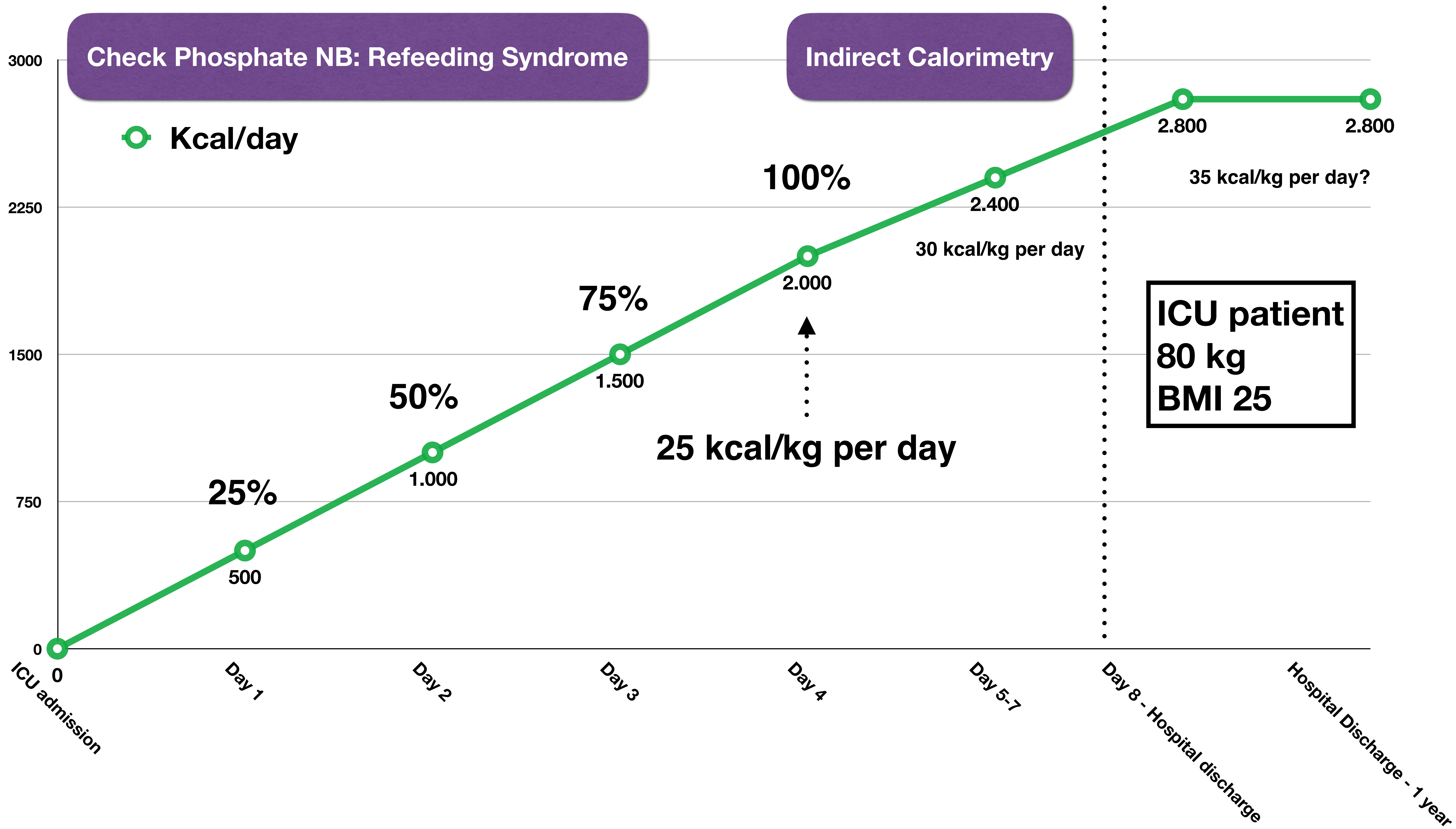
total intake





Fraipont V, Preiser JC. JPEN J Parenter Enteral Nutr. 2013;37(6):705-13.

Energy targets in ICU patients



Koekkoek KWAC, van Zanten ARH. Curr Opin Anaesthesiol. 2018

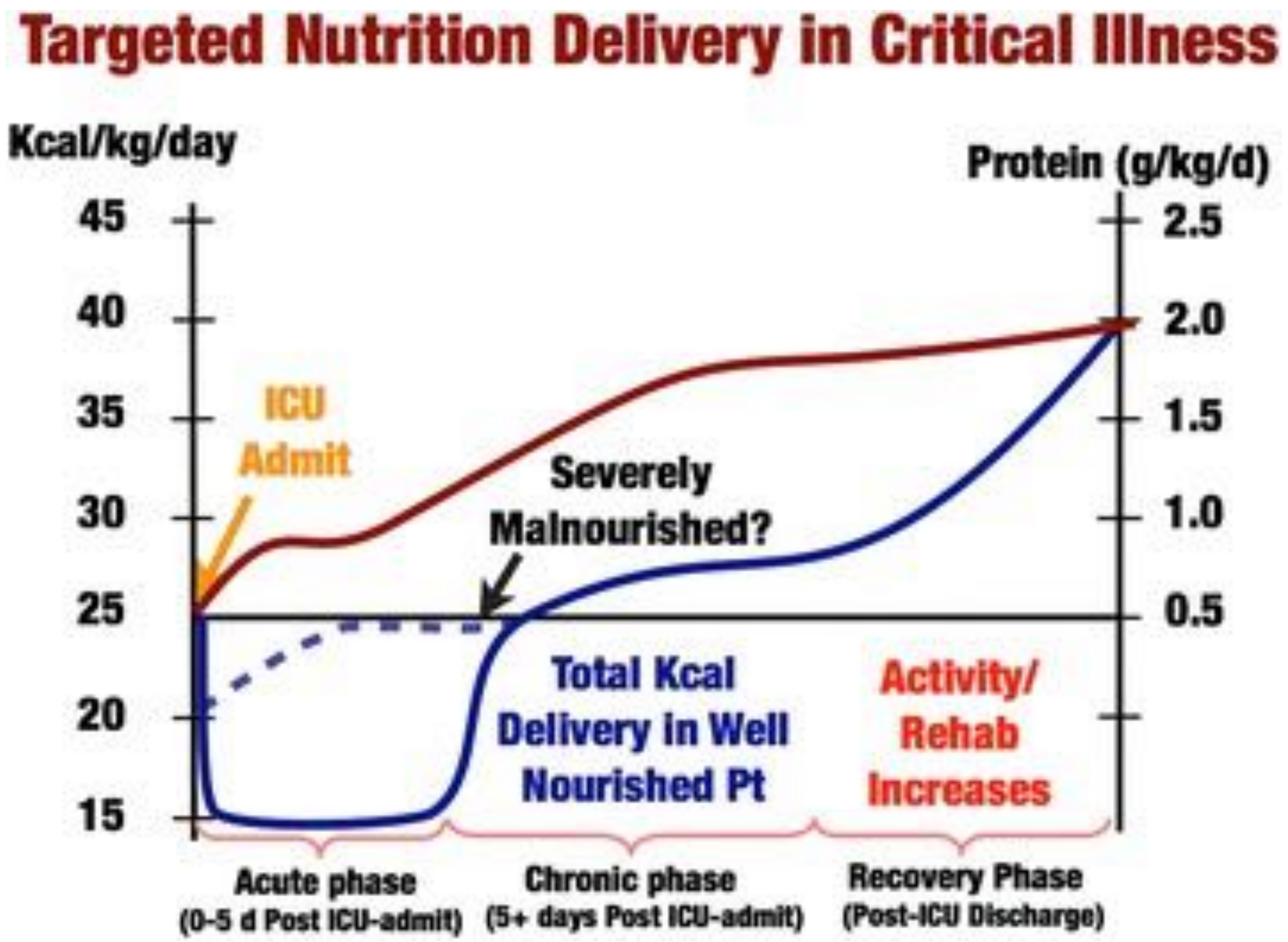
Tailoring nutrition therapy to illness and recovery

Protein intake:

- Day 1-5: increasing up to 1.2 g/kg bw
- Day 5 =>: increasing from 1.2 to 2.0 g/kg/day

Energy intake

- Day 1-5: 15 kcal/kg bw (malnourished (20 – 25)
- Day 5 till discharge: increasing to 27.5 kcal/kg bw
- Post ICU discharge: increasing 27.5 to 40 kcal/kg bw



Do we have the enteral feeds to meet the protein targets without overfeeding the patient in the ICU?

Wischmeyer Critical Care 2017, 21(Suppl 3):316

Ziekenhuis Gelderse Vallei

Tight calorie balance control

The tight calorie control study (TICACOS)

	Study group (n= 56)	Control group (n=56)	P value
Caloric requirements	Defined as resting energy expenditure, (REE), measured by indirect calorimetry every 48 h	Based on expert group recommendations of 25kcal/kg/day	
REE (kcal)	1976 +/- 468	1838 +/- 469	P=0.606
Planned/prescribed (kcal)	1976 +/- 468	1865 +/- 323	P=0.575
Total energy delivered (kcal)	2096	1480	P<0.05
Total energy delivered from enteral nutrition(kcal)	1552	1261	P<0.05
Total energy delivered from parenteral nutrition (kcal)	479	139	P<0.05
Total protein delivered (g)	76	53	P<0.05
Mean daily energy balance (kcal)	+180	-367	P<0.001
Cumulative energy balance (kcal)	+1920	-3486	P<0.001

P Singer Intensive Care Med. Apr 2011;37(4):601-9.

Tight calorie balance control

The tight calorie control study (TICACOS)

Clinical outcomes	Study group (n= 56)	Control group (n= 56)	P value
ICU mortality	12 (20.4%)	15 (26.8%)	P=0.508
Hospital mortality	28%	50.9%	P=0.031
Ventilation (days)	17.4 +/- 14.5	12.0 +/- 8.0	P=0.015
ICU LOS (days)	18.6 +/- 14.4	13.3 +/- 7.9	P=0.017
HLOS (days)	36.7 +/- 22.8	34.6 +/-28.2	P=0.28
VAP	17 (30%)	9 (16%)	P=0.073
Bacteraemia	13 (23%)	8 (14%)	P=0.226
Wound infection	5 (9%)	2 (4%)	P=0.206
Other complications	Not significant	Not significant	Not significant

P Singer Intensive Care Med. Apr 2011;37(4):601-9.

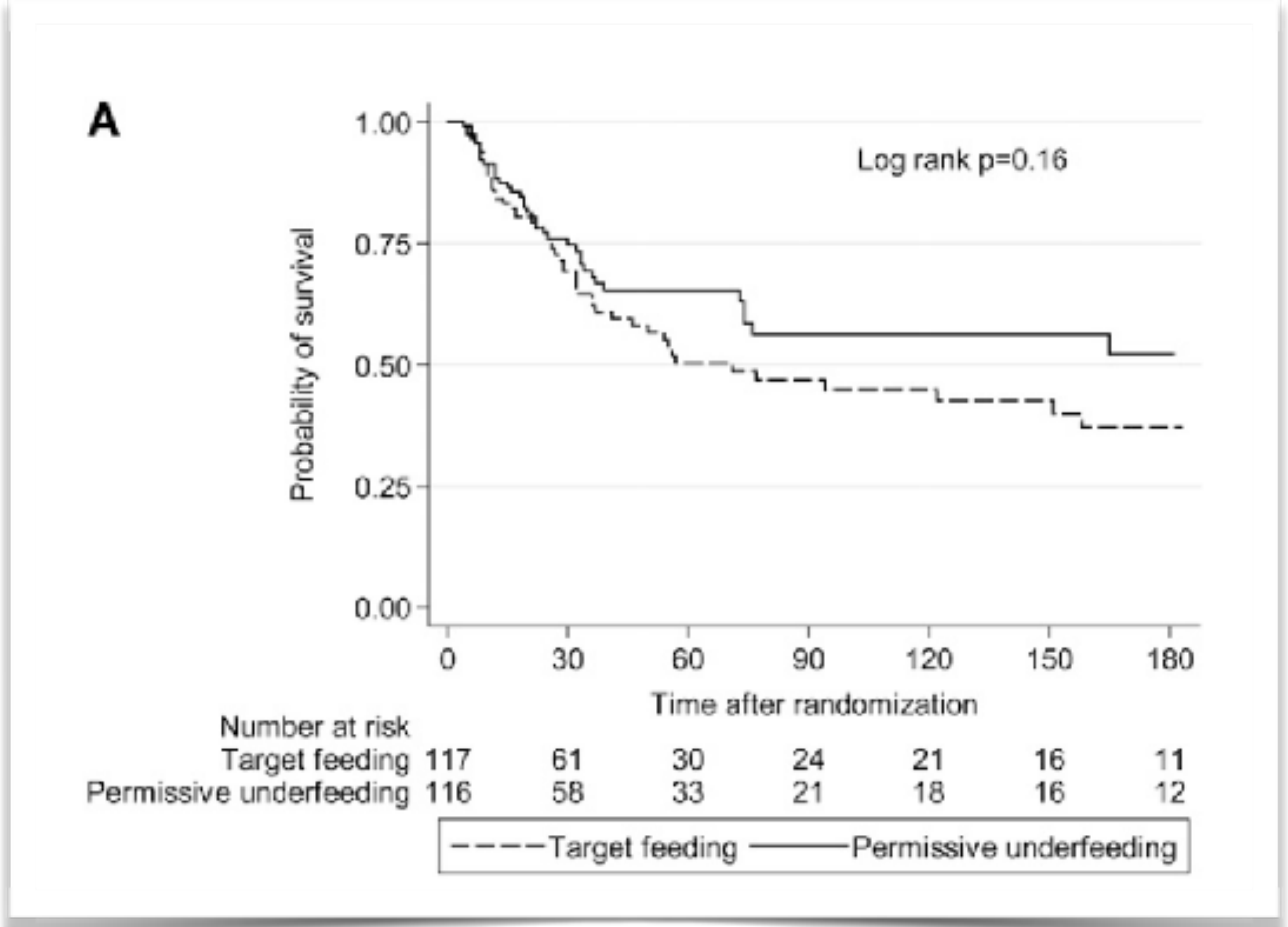
Trophic vs. Full EN in ICU The Arabi I RCT

- **28-day all-cause mortality:**
- **18.3% in the permissive underfeeding group vs. 23.3% in the target feeding group.**

(RR: 0.79; 95% CI: 0.48, 1.29; P = 0.34).

- **Lower hospital mortality: 30.0% vs. 42.5%;**

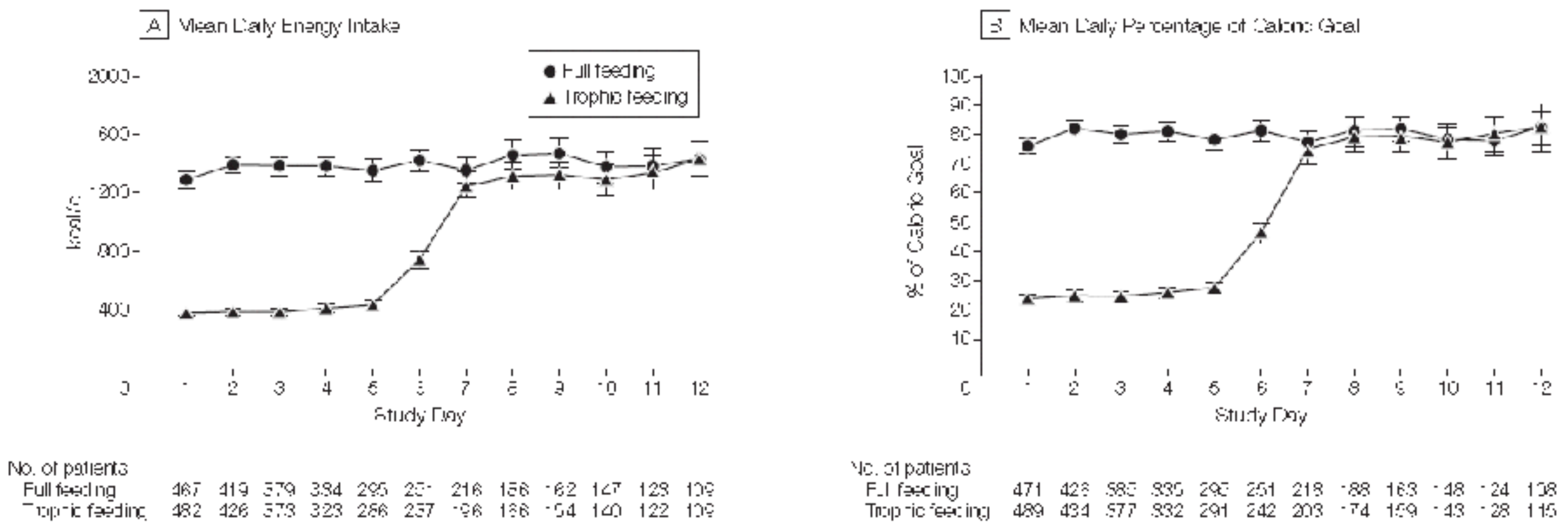
relative risk: 0.71; 95% CI: 0.50, 0.99; P = 0.04).



Target group: 1200 kcal/d and 43 g/d of protein
Permissive undernutrition group1099 kcal/d and 47 g/d.
It should be highlighted that this study compares two levels of undernutrition.

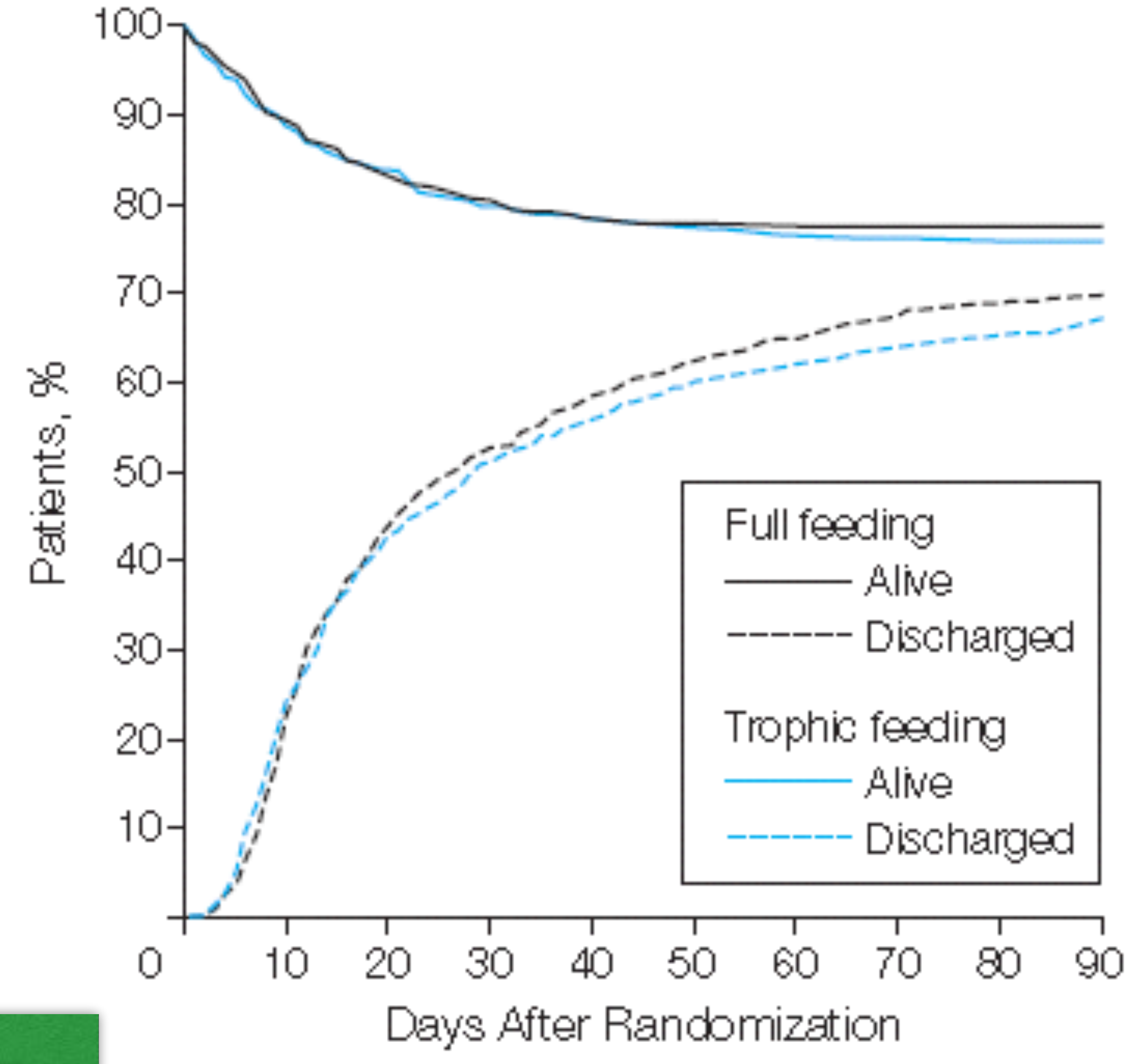
Arabi YM, et al. Am J Clin Nutr 2011;93:569e77.

Trophic vs. Full EN in ALI: The EDEN randomized trial



Outcome	Trophic Feeding (n = 508)	Full Feeding (n = 492)	*P* Value
Ventilator-free days, No. (95% CI)	14.9 (13.9-15.8)	15.0 (14.1-15.9)	.89
Failure-free days, No. (95% CI)			
Cardiovascular	19.1 (18.2-20.0)	18.9 (18.1-19.8)	.75
Renal	20.0 (19.0-20/9)	19.4 (18.4-20.5)	.43
Hepatic	22.0 (21.2-22.9)	22.6 (21.8-23.5)	.37
Coagulation	22.3 (21.4-23.1)	23.1 (22.3-23.9)	.16
ICU-free days, No. (95% CI)	14.4 (13.5-15.3)	14.7 (13.8-15.6)	.67
60-d mortality, No. (%) [95% CI]	118 (23.2) [19.6-26.9]	109 (22.2) [18.5-25.8]	.77
Development of infections, No. (%) [95% CI]			
VAP	37 (7.3) [5.0-9.5]	33 (6.7) [4.5-8.9]	.72
Clostridium difficile colitis	15 (3.0) [1.5-4.4]	13 (2.6) [1.2-4.1]	.77
Bacteremia, No. (%)	59 (11.6) [8.8-14.4]	46 (9.3) [6.8-11.9]	.24

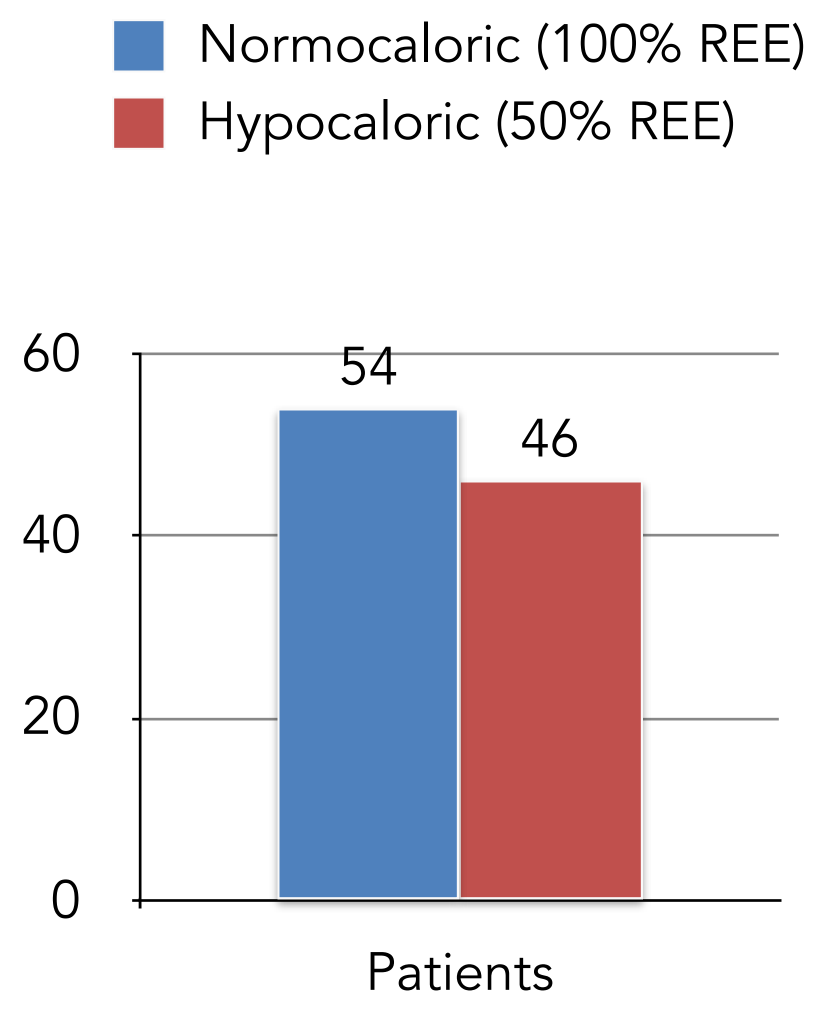
Abbreviations: ICU, intensive care unit; VAP, ventilator-associated pneumonia.

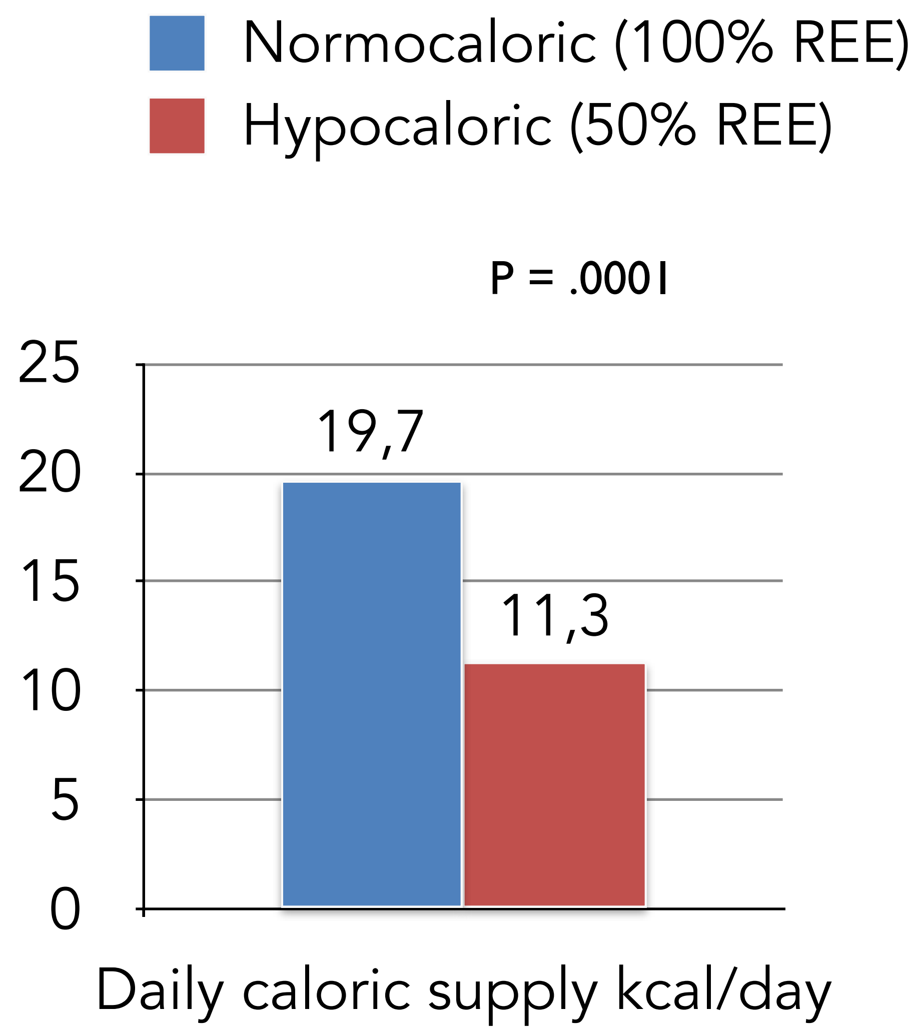


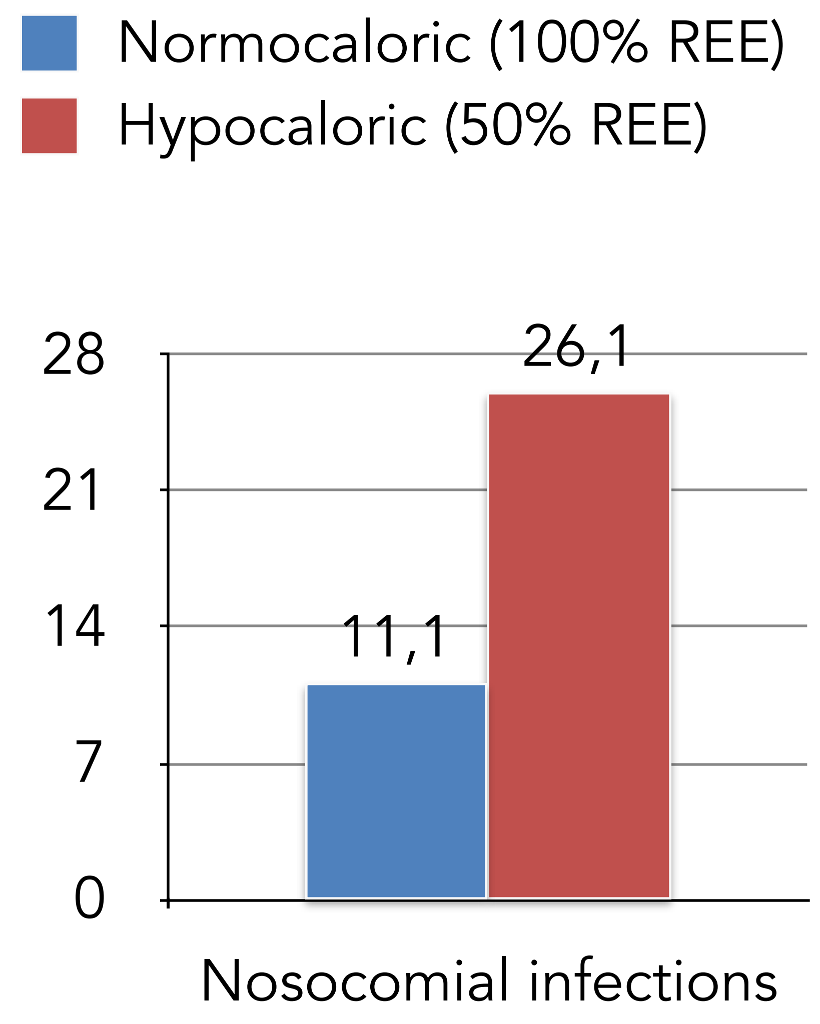
In patients with acute lung injury, compared with full EN, a strategy of initial trophic EN for up to 6 days did not improve ventilator-free days, 60-day mortality, or infectious complications.

Rice et al. JAMA 2012;307

Normocaloric vs Hypocaloric feeding in critically ill patients







66 male / 34 female
mean age of 65.8 ± 11.6 years
during 7 days

Insulin demand was significantly higher and gastrointestinal intolerance more frequent in normocaloric group than in hypocaloric group

ICU mortality: 22.2% (normocaloric) vs. 21.7% (hypocaloric) (NS).
Hospital mortality: 31.5% (normocaloric) vs. 37.0% (hypocaloric) P = 0.67)

Hypocaloric group more infections

Petros S et al. JPEN J Parenter Enteral Nutr. 2014 Apr 3

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Permissive Underfeeding or Standard Enteral Feeding in Critically Ill Adults

Yaseen M. Arabi, M.D., Abdulaziz S. Aldawood, M.D., Samir H. Haddad, M.D., Hasan M. Al-Dorzi, M.D., Hani M. Tamim, M.P.H., Ph.D., Gwynne Jones, M.D., Sangeeta Mehta, M.D., Lauralyn McIntyre, M.D., Othman Solaiman, M.D., Maram H. Sakkijha, R.D., Musharaf Sadat, M.B., B.S., and Lara Afesh, M.S.N., for the PermiT Trial Group*

Arabi et al. New Engl J Med 2015

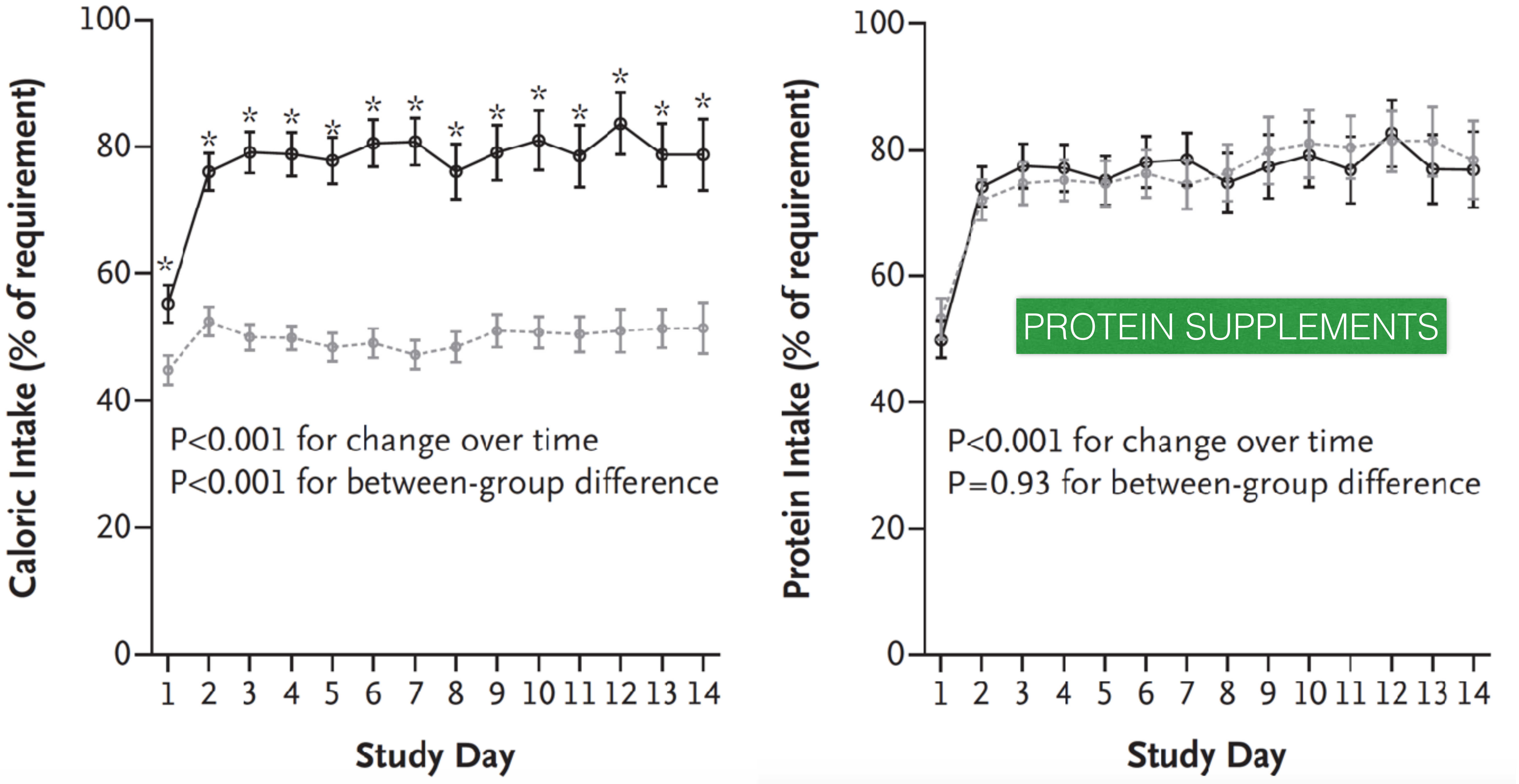
X

Young patients, high BMI, severely ill ICU patients

Variable	Permissive Underfeeding (N=448)	Standard Feeding (N=446)
Age — yr	50.2±19.5	50.9±19.4
Female sex — no. (%)	156 (34.8)	164 (36.8)
Body-mass index†	29.0±8.2	29.7±8.8
Diabetes — no. (%)	159 (35.5)	153 (34.3)
Admission category — no. (%)		
Medical	336 (75.0)	335 (75.1)
Surgical	19 (4.2)	12 (2.7)
Nonoperative trauma	93 (20.8)	99 (22.2)
Severe sepsis at admission — no. (%)	159 (35.5)	133 (29.8)
Traumatic brain injury — no. (%)	55 (12.3)	63 (14.1)
APACHE II score‡	21.0±7.9	21.0±8.2
SOFA score§	9.9±3.5	9.8±3.5
Mechanical ventilation — no. (%)	436 (97.3)	429 (96.2)

Arabi et al. New Engl J Med 2015

Caloric and Protein Intake



Arabi et al. New Engl J Med 2015

Permissive Underfeeding

Comments:
- Pseudomulticentric 70% from one site
- No indirect calorimetry
- Most medical
- Young (mean age 51)
- Well nourished (BMI 29)
- Long-term functional outcomes not studied

The NEW ENGLAND JOURNAL of MEDICINE

Extrapolation of the permissive underfeeding concept to high-risk patients cannot be recommended.

Recommended calorie intake 25-30 kcal/kg per day

Permissive underfeeding group 11 kcal/kg per day

Full nutrition group 16 kcal/kg per day

Both groups meet criteria for hypocaloric feeding not meeting targets

Recommended protein intake 1.2-2.0 g/kg per day

Permissive underfeeding group 0.7 g/kg per day

Full nutrition group 0.7 g/kg per day

Both groups meet criteria for very low protein intake not meeting targets

Is less really more?

Study	Year	Patients	BMI	Nutritional risk	Indirect Calorimetry	Mean Daily Calories (kcal)	Mean Daily Proteins (g/day)
Author		Trophic vs. full	Trophic vs. full	Mean Estimated Nutric score	yes/no	Trophic vs. full	Trophic vs. full
Arabi I	2011	120/120	28.5±7.4/28.5±8.4	4-5	no	1066.6±306.1/1251.7 ±432.5	47.5±21.2/ 43.6±18.9
Rice	2012	508/492	29.9±7.8/30.4±8.2	4-5	no	400/1300	0.3-0.4/1.0-1.2
Petros	2014	46/54	28.6±6.5/27.1±6.8	5-6	yes	11.3±3.1/19.7±5.7	0.4/0.8
Charles	2015	41/42	32.9±2.0/28.1±0.9	3-4	no	982±61/1338±92	86±6/83±6
Arabi II	2015	448/446	29.0±8.2/29.7±8.8	4-5	no	835±297/1299±467	57±24/59±25

High BMI

Low risk

Van Zanten AR. J Thorac Dis. 2015;7(7):1086-91

Ziekenhuis Gelderse Vallei

Is less really more?

Study	Year	Infections	Mortality	Other Outcomes
Author		Trophic vs. full	Trophic vs. full	Trophic vs. full
Arabi I	2011	Sepsis episodes:44.2/46.7% (P=0.70)	28-day mortality: 18.3/23.3%; (P=0.34) Hospital mortality: 30.0%/42.5%; (P=0.04).	
Rice	2012	Bacteremia: 11.6/9.3 (P=0.24)	60-day Mortality: 23.2/22.2 (P=0.77)	Ventilator free days (28d): 14.9/ 15.0 (P=0.89)
Petros	2014	Infections: 26.1/11.1% (P=0.046)	ICU mortality rate: 21.7%/ 22.2% (NS) Hospital mortality: 37.0/31.5% (P=0.67)	
Charles	2015	Infections:70.7/76.2% (P=0.57)	Hospital mortality 7.3/9.5% (P=0.72)	
Arabi II	2015	Infections: 35.9/37.9 (P=0.54)	90-day mortality: 27.2/28.9% (P=0.58)	

Van Zanten AR. J Thorac Dis. 2015;7(7):1086-91

Big scientific debate on this study

2014 Harry M. Vars Award

Journal of Parenteral and Enteral Nutrition
Volume 39 Number 1
January 2015 13–20

DOI: 10.1177/0148607114528541
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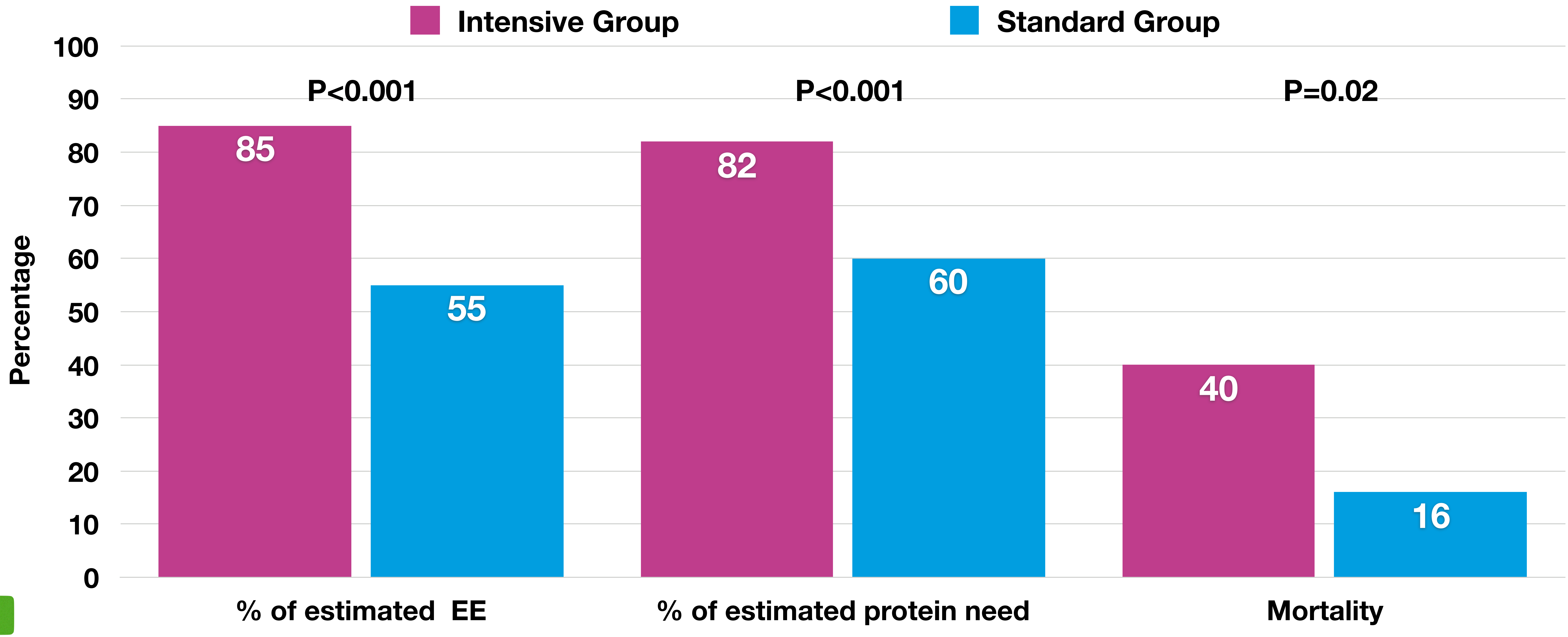
online.sagepub.com

Intensive Nutrition in Acute Lung Injury: A Clinical Trial (INTACT)

Carol A. Braunschweig, PhD, RD[1]; Patricia M. Sheean, PhD, RD[2]; Sarah J. Peterson, MS, RD[3]; Sandra Gomez Perez, MS, RD[4]; Sally Freels, PhD[5]; Omar Lateef, DO[6]; David Gurka, MD, PhD[6]; and Giamila Fantuzzi, PhD[1]

INTACT trial, stopped early (n = 78)

Intensive medical nutrition therapy (IMNT; 30 kcal/kg/day) from acute lung injury diagnosis to hospital discharge



Braunschweig CA, et al. JPEN J Parenter Enteral Nutr. 2015;39:13–20.

Post-hoc analysis INTACT trial

- Higher overall energy intake, higher mortality (OR: 1.14, 95% CI: 1.02, 1.27).

- Patients enrolled for at least 8 days (n = 66), higher early energy intake significantly increased the HR for mortality (HR: 1.17, 95% CI: 1.07, 1.28), higher late energy intake was significantly protective (HR: 0.91, 95% CI: 0.83, 1.0).

- Results were similar for early but not late protein (g/kg) exposure (early-exposure HR: 8.9, 95% CI: 2.3, 34.3; late-exposure HR: 0.15, 95% CI: 0.02, 1.1).

- Threshold analyses indicated early mean intakes >18 kcal/kg significantly increased subsequent mortality.

Braunschweig CA, et al. Am J Clin Nutr 2017;105:411–6.

Intensive Care Med (2017) 43:1637–1647
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SEVEN-DAY PROFILE PUBLICATION

Early goal-directed nutrition versus standard of care in adult intensive care patients: the single-centre, randomised, outcome assessor-blinded EAT-ICU trial

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Methods EAT-ICU study

- Acutely admitted, mechanically ventilated ICU patients expected to stay longer than 3 days in the ICU.
- Early goal-directed nutrition (EGDN) group
  - indirect calorimetry
  - 24-h urinary urea aiming at covering 100% of requirements from the first full trial day using enteral and parenteral nutrition.
- Standard of care group
  - 25 kcal/kg/day by enteral nutrition.
  - If not met by day 7, supplemented with parenteral nutrition.
- Primary outcome: physical component summary (PCS) score of SF-36 at 6 months.

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Baseline characteristics

Variable	Early goal-directed nutrition ($N = 100$)	Standard of care ($N = 99$)
Age, years	63 (51–72)	68 (52–75)
Male sex, no. (%)	65 (65%)	59 (60%)
Actual body weight, kg	78 (67–90)	80 (70–90)
BMI[a], kg/m^2	22 (20–26)	22 (20–25)
Source of ICU admission, no. (%)		
Emergency department	31 (31%)	30 (30%)
General ward	45 (45%)	38 (38%)
Operating or recovery room	6 (6%)	12 (12%)
Other ICU[b]	10 (10%)	11 (11%)
Other hospital	8 (8%)	8 (8%)
Admission type, no. (%)		
Medical	52 (52%)	43 (43%)
Emergency surgery	43 (43%)	53 (54%)
Elective surgery	5 (5%)	3 (3%)
Diagnoses and procedures, no. (%)		
Haematologic malignancy[c]	13 (13%)	12 (12%)
Multiple trauma	8 (8%)	10 (10%)
Severe sepsis	47 (47%)	47 (47%)
Dialysis on admission	6 (6%)	5 (5%)
Mechanical ventilation	100 (100%)	99 (100%)
Days in hospital before ICU admission, days	0.9 (0.2–4.1)	1.1 (0.2–4.8)
Time from ICU admission to randomisation, h	14 (10–20)	13 (7–20)
Nutrition given in ICU prior to randomisation		
Energy, kcal/day	140 (24–260)	122 (30–275)
Protein, g/day	0 (0–0)	0 (0–0)
SAPS II[d]	47 (37–54)	48 (39–59)
SOFA score[e]	8 (6–11)	8 (5–10)

- 5 years age difference
- low BMI
- 11% other ICU
- otherwise well balanced

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Nutrition characteristics in ICU after randomisation

Variable	Early goal-directed nutrition ($N = 100$)	Standard of care ($N = 99$)
Measured[a] energy requirement, kcal/day	2069 (1816–2380)	1887 (1674–2244)
Calculated[b] energy requirement, kcal/day	1950 (1750–2125)	1875 (1650–2100)
Energy intake, kcal/day	1877 (1567–2254)	1061 (745–1470)
Energy balance[c], kcal/day	−66 (−157 to −6)	−787 (−1223 to −333)
Measured[d] protein requirement, g/kg/day	1.63 (1.36–2.05)	1.16 (0.89–1.62)
Protein intake, g/kg/day	1.47 (1.13–1.69)	0.50 (0.29–0.69)
Protein balance[c], g/kg/day	−0.28 (−0.76 to 0.11)	−0.69 (−1.02 to −0.38)
Plasma urea, mmol/l	13.5 (8.7–21.9)	9.0 (5.6–14.4)
24-h urinary urea, mmol/day	516 (368–760)	320 (175–482)

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Primary and secondary outcomes

Primary outcome measure	Early goal-directed nutrition ($N = 100$)	Standard of care ($N = 99$)	Adjusted mean difference (95% CI)	p value
PCS score at 6 months adjusted for presence of haematologic malignancy, mean (SD)	22.9 (21.8)	23.0 (22.3)	−0.0[a] (−5.9 to 5.8)	0.99

Secondary outcome measures	Early goal-directed nutrition ($N = 100$)	Standard of care ($N = 99$)	Relative risk or mean difference (95% CI)	p value
Vital status, no. (%)				
Dead at day 28	20 (20%)	21 (21%)	0.94 (0.55–1.63)	0.83
Dead at day 90	30 (30%)	32 (32%)	0.93 (0.61–1.40)	0.72
Dead at 6 months	37 (37%)	34 (34%)	1.08 (0.74–1.57)	0.70
Length of stay among 6-month survivors, median days (IQR)				
ICU	7 (5–22)	7 (4–11)	NA	0.21
Hospital	30 (12–53)	34 (14–53)	NA	1.00
Percentage of days alive without life support at day 90, median (IQR)				
RRT	100% (97–100)	100% (97–100)	NA	0.64
Mechanical ventilation	86% (39–96)	92% (56–96)	NA	0.27
Inotrope/vasopressor support	96% (82–98)	96% (84–98)	NA	0.67
Time to new organ failure, mean days (SD)	5.4 (0.4)	5.9 (0.5)	NA	0.33[b]
New organ failure in ICU, no. (%)	81 (81%)	77 (78%)	1.04 (0.90–1.20)	0.57
Time to death, mean days (SD)	60 (13)	91 (24)	NA	0.51[c]
New use of RRT in ICU, no. (%)	22 (22%)	17 (17%)	1.28 (0.73–2.26)	0.39
Time to any infection, mean days (SD)	20 (1)	51 (9)	NA	0.80[b]
Nosocomial infections, no. (%)				
Any	19 (19%)	12 (12%)	1.57 (0.80–3.05)	0.18[d]

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EGDN induces more hyperglycemia and insulin use

Secondary outcome measures	Early goal-directed nutrition ($N = 100$)	Standard of care ($N = 99$)	Relative risk or mean difference (95% CI)	p value
Cumulative insulin dose in ICU, median IU (IQR)[g]	86 (2–530)	0 (0–39)	262 (71–453)	0.008
No. of patients (%) with at least one episode of				
Blood glucose ≤2.2 mmol/l	2 (2%)	1 (1%)	NA	–[e]
Blood glucose ≥15 mmol/l	52 (52%)	25 (25%)	2.06 (1.40–3.03)	0.0001

- **Protein balance improved from –0.69 to –0.28 in the EGDN group, i.e. by 0.41 g/kg/day.**
- **Plasma urea also increased, (assuming Vd of 60% of weight), increase in plasma urea nitrogen matches the apparent increase in protein balance**
- **This indicates that no net protein gain was obtained with the extra supply of protein.**
- **Reduction of protein load at a plasma urea above 20 mmol/l may explain why no increased in RRT was observed.**

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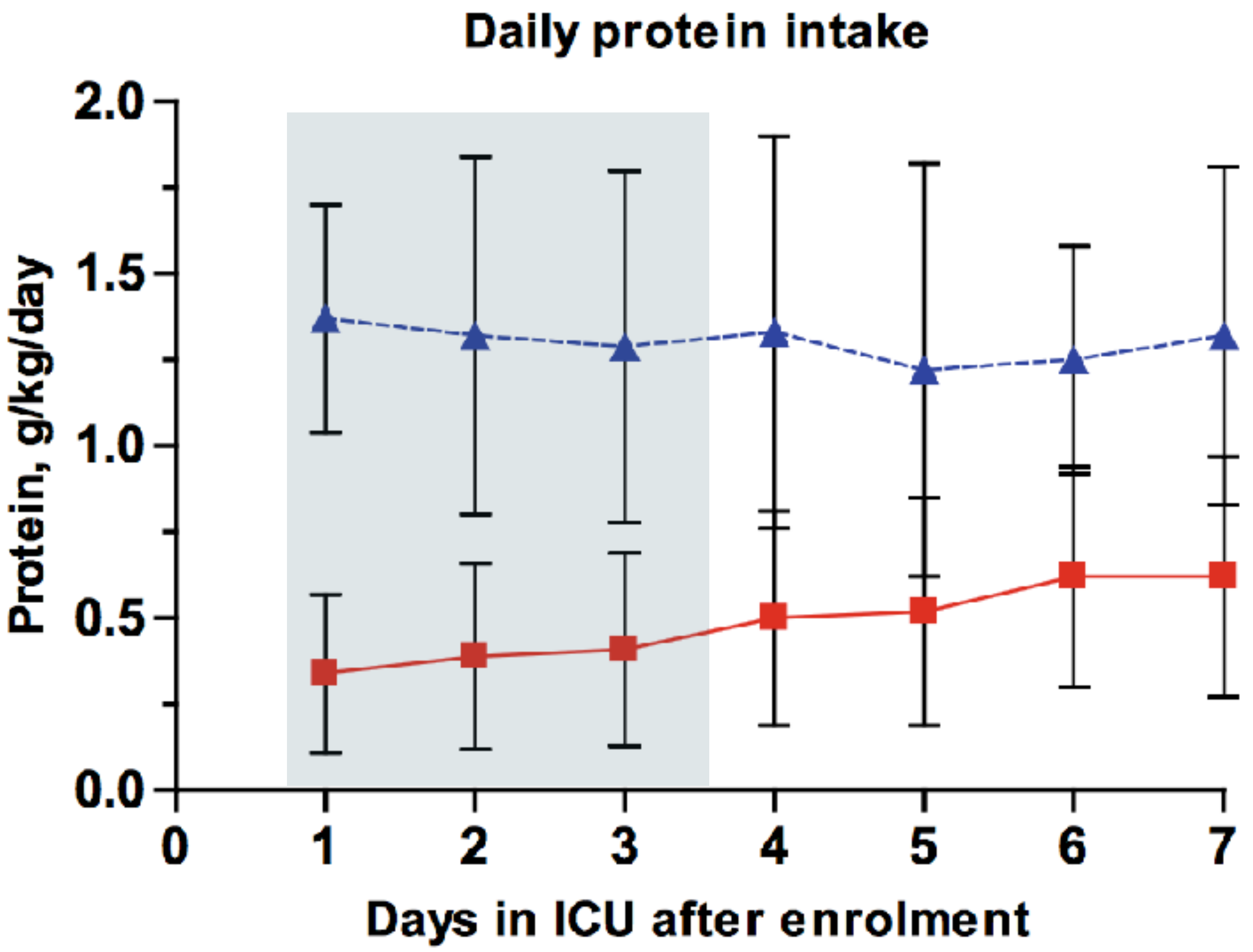
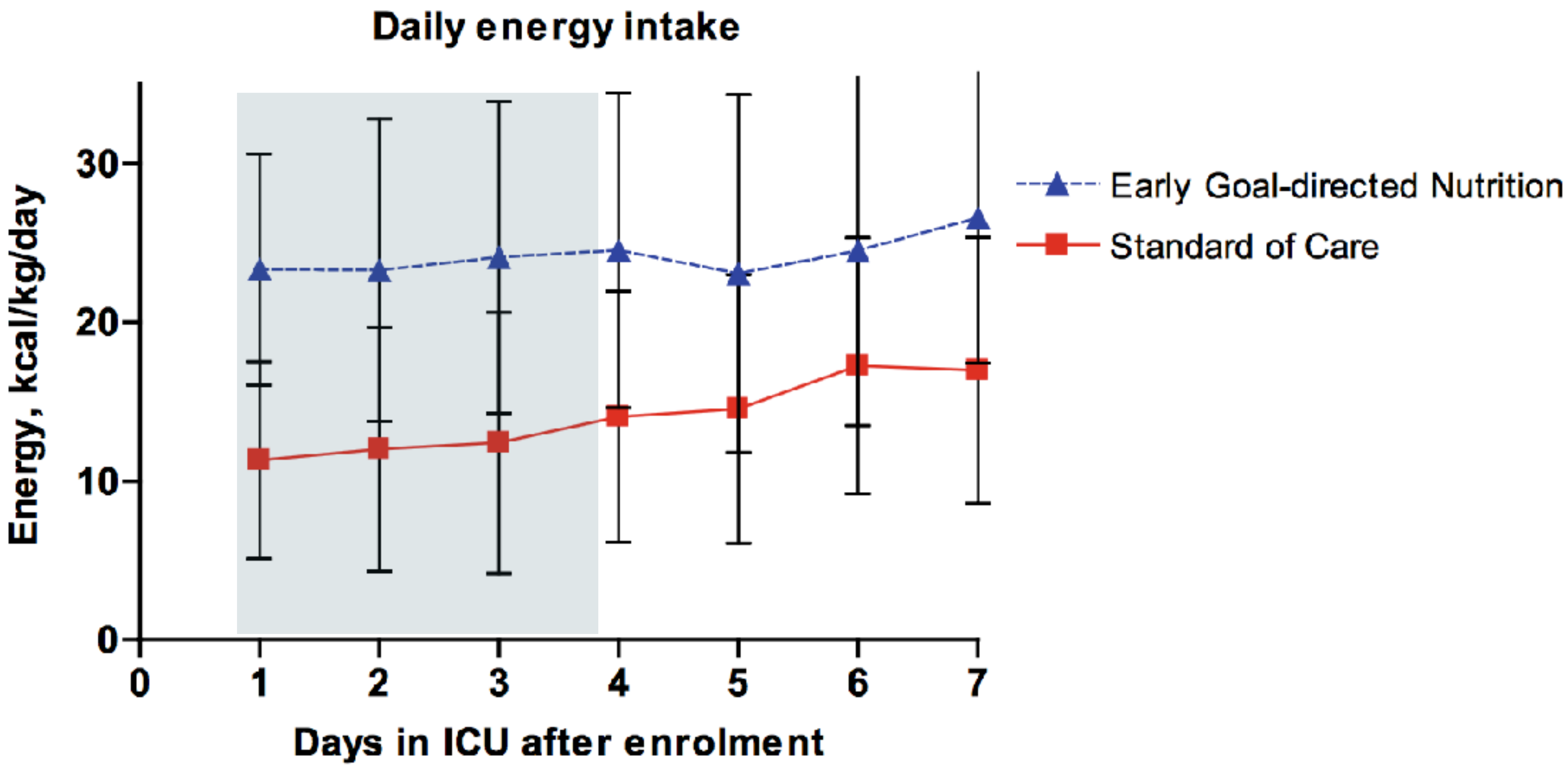
Additional protein and energy by SPN





Period of autophagy suppression

Period of endogenous energy production

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ESPEN ICU guidelines 2018

- **Recommendation 18:** After day 3, caloric delivery can be increased up to 80-100% of measured EE.

- Grade of recommendation: 0 – strong consensus (95 % agreement)

- **Recommendation 19:** If predictive equations are used to estimate the energy need, hypocaloric nutrition (below 70 % estimated needs) should be preferred over isocaloric nutrition for the first week of ICU stay.

- Grade of recommendation B – strong consensus (95 % agreement)

ESPEN ICU guidelines 2018

- Recommendation 15: In critically ill mechanically ventilated patients, EE should be determined by using indirect calorimetry.
- Grade of recommendation: B – strong consensus (95 % agreement)
- Recommendation 16: If indirect calorimetry is used, isocaloric nutrition rather than hypocaloric nutrition can be progressively implemented after the early phase of acute illness
- Grade of recommendation: 0 – strong consensus (95 % agreement)
- Recommendation 17: Hypocaloric nutrition (not exceeding 70% of EE) should be administered in the early phase of acute illness.
- Grade of recommendation: B – strong consensus (100 % agreement)

Conclusions

- By measuring VCO_2 and VO_2, REE and RQ can be calculated
- Best estimate of actual Energy Expenditure
- In low risk ICU patients trophic versus full nutrition in first week no difference
- Demonstration of ICU Indirect Calorimetry device
- One RCT showed benefits of REE drive nutrition strategy in ICU patients