Nutrition in the critically-ill child

Basics and Beyond

Heraklion 2007

G. Briassoulis

Reduced nutritional reserves

- 43% - 88% of ICU patients
  - *Giner et al, 1996; Barr et al, 2004*
- 16% - 20% of critically ill children
  - *Pollack et al, JPEN 1982*
- Negative impact of hypocaloric feeding and energy balance on clinical outcome in ICU patients
  - *Villet S, Chiolero RL, et al. Clin Nutr 2005*

Consensus conferences for nutrition of critically ill patients

- Accurate assessment of the REE is required in patients receiving nutritional support
  - to ensure that their energy needs are **met**
  - to avoid the complications associated with **over- or underfeeding**

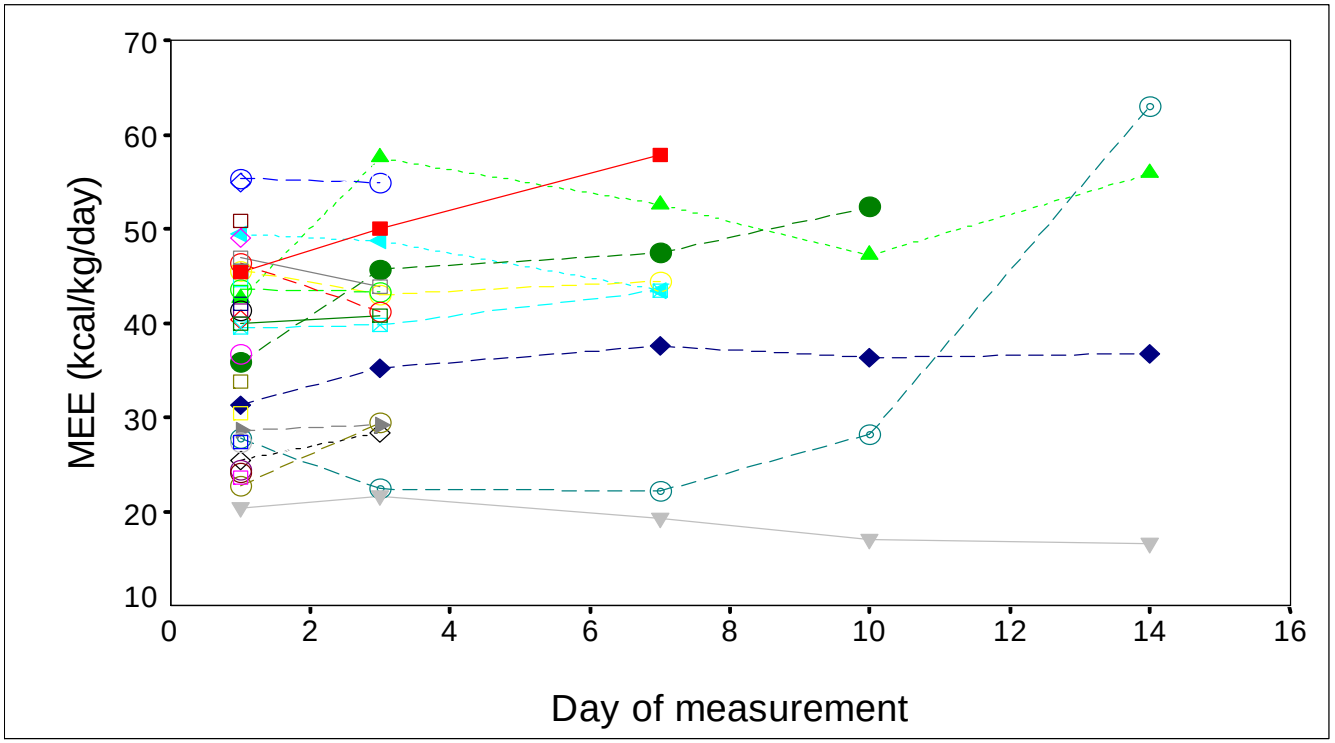
Indirect calorimetry

1. Indirect calorimetry and other more **sophisticated techniques** (i.e. double labelled water) are
    1. **rarely available** to centres
    2. outside of research due to **cost, time limitations, availability** of designated staff
2. Efforts to measure caloric requirements are **meaningless** unless an equal effort is made to actually **provide enough calories to match** those requirements

Using IC studies have failed to show a rise in energy expenditure during the early postinjury period in infants or older children

- *Shanbhogue RLK, Lloyd DA: Absence de hypermetabolism after operation in the newborn infant. JPEN 1992; 16: 333–336*
- *Powis MR, Smith K, Rennie M, et al: Effect of major abdominal operations on energy and protein metabolism in infants and children. J Pediatr Surg 1998; 33: 49–53*

Individual patients data of repeat REE measurements



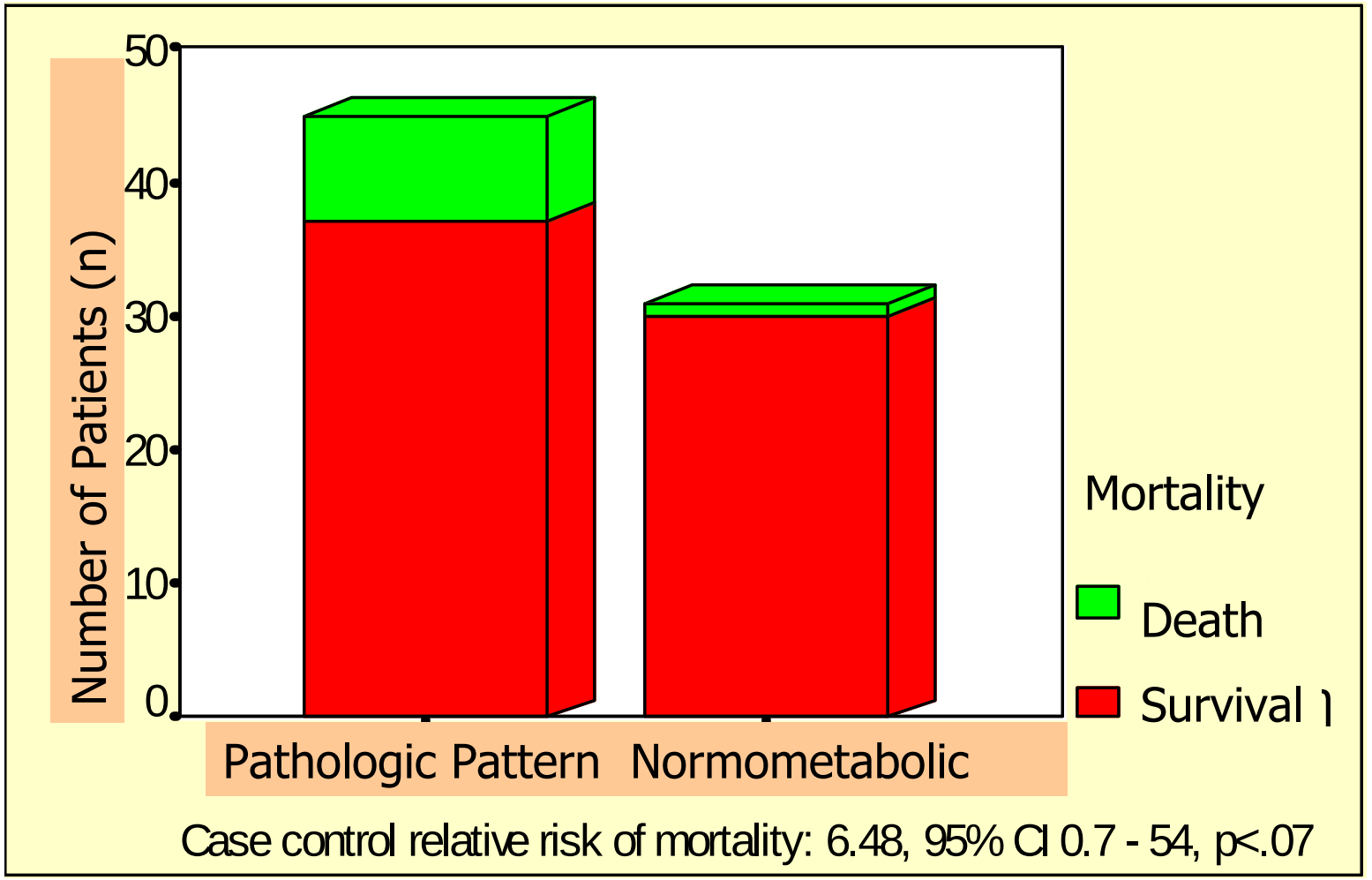
Briassoulis G, Venkataraman S, Thompson AE. Energy expenditure in critically ill children. Crit Care Med 2000 28:1166-72

Compact modular metabolic monitors

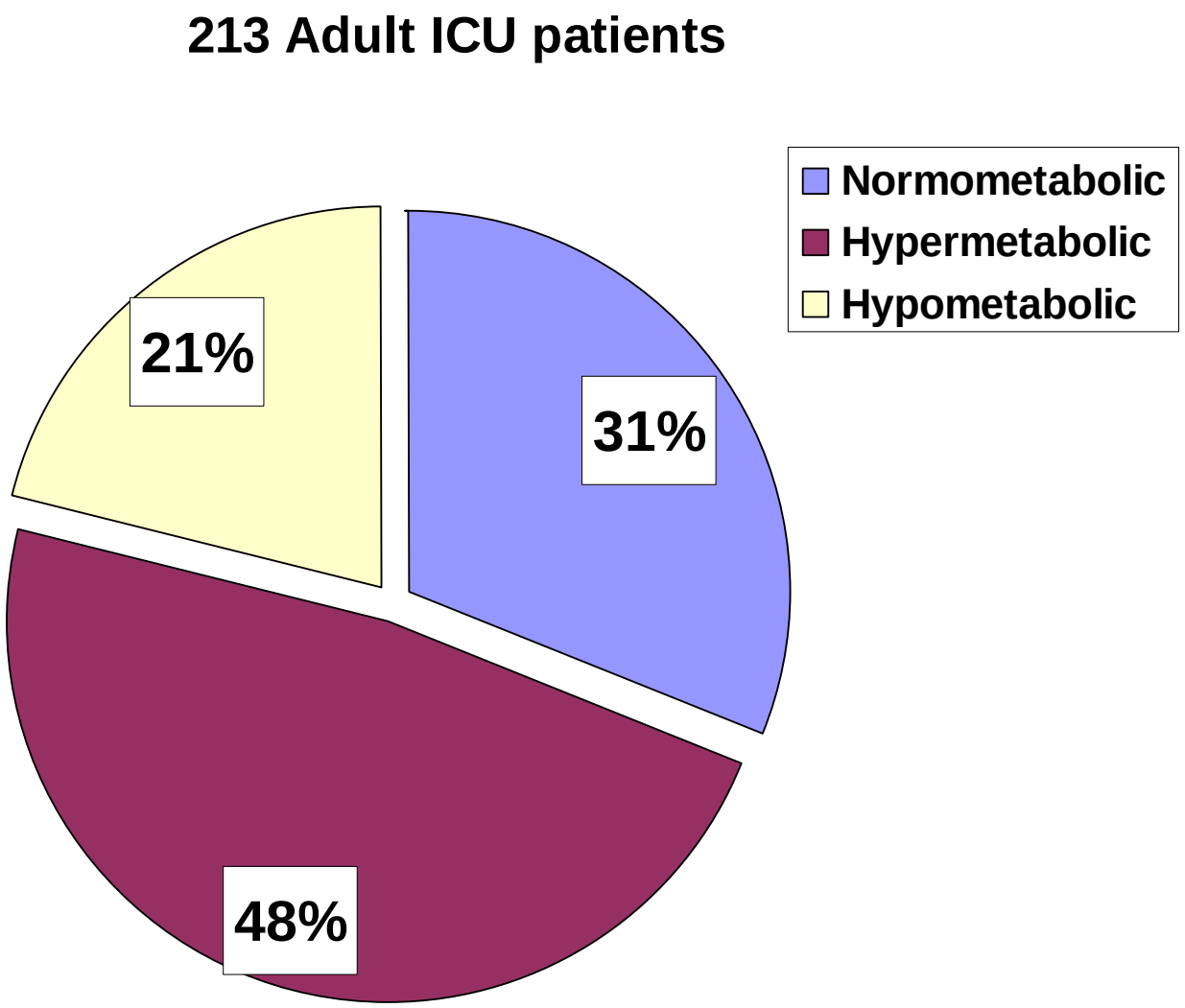
- May overcome many of previously encountered problems
- Validation studies have indicated that it can be easily used in the clinical setting with adequate reproducibility and accuracy in ventilated critically ill adult patients
- Accuracy in children?

Mclellan S, et al. Intensive Care Med 2001:1680-5, 2002: 870 - 6
Donaldson L, et al. Anaesthesia 2003:455-60
Singer P et al, Nutrition 2006: 22; 1077-86

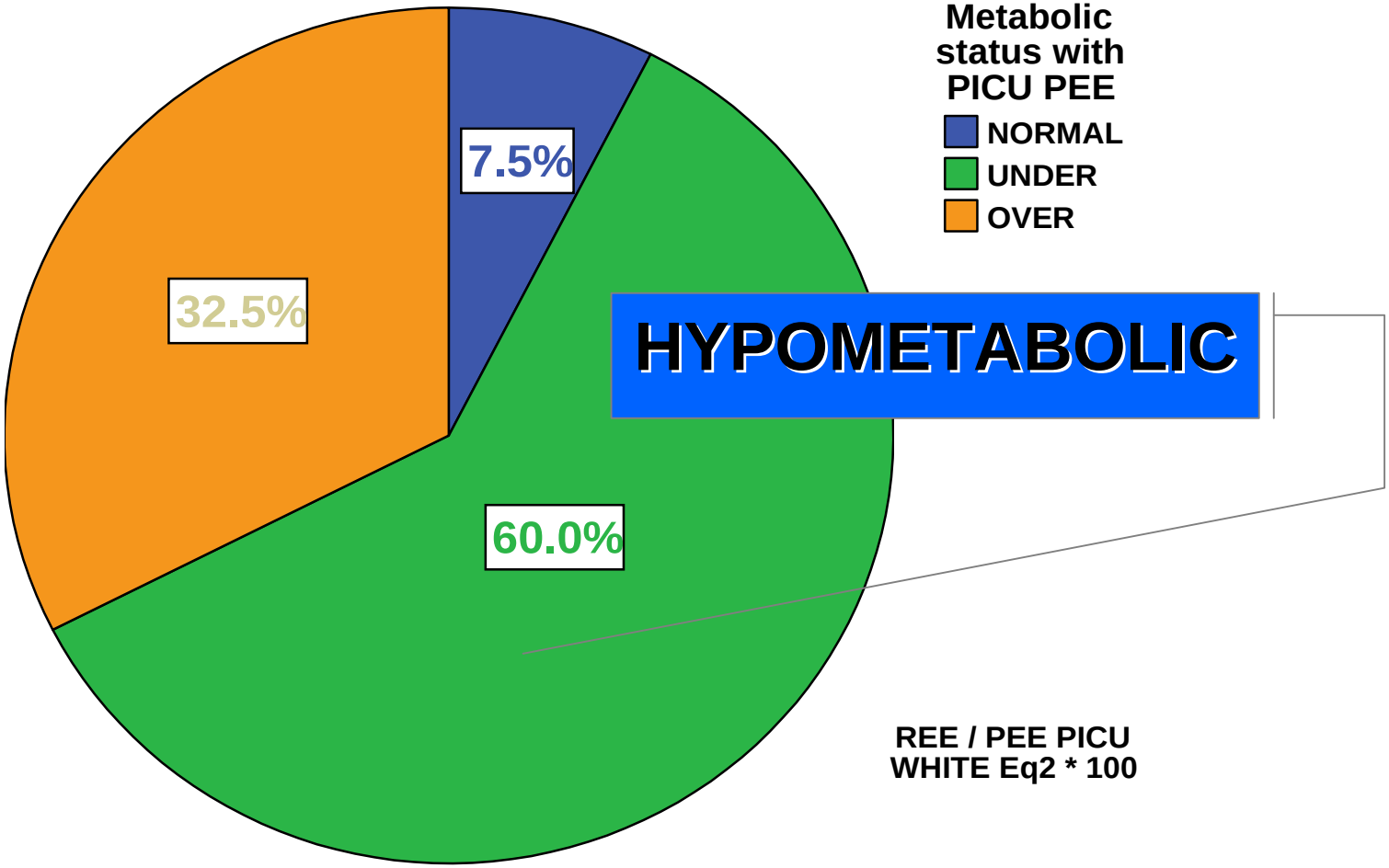
Relation between normal and abnormal metabolic patterns and mortality



McClave SA, *et al*. JPEN 1998; 22:375–381



Metabolic status in critically ill children using PICU specific White equation



Guidelines

- In the last few years, three sets of clinical practice guidelines have been published by various bodies interested in the optimal practice of nutrition support in ICU patients
  - Have used evidence-based approaches
  - Several controversies remain
  - Practical aspects warrant further discussion

Guidelines 1st

- Heyland DK, Dhaliwal R, Drover JW, *et al*
- Canadian clinical practice guidelines for nutrition support in mechanically ventilated, critically ill adult patients
- J Parenter Enteral Nutr 2003; 27:355–373

Guidelines 2nd

- Doig GS, Simpson F, the Australian and New Zealand Intensive Care Society Clinical Trials Group
- Evidence-based guidelines for nutritional support of the critically ill: results of a bi-national guideline development conference
- Carlton: Australian and New Zealand Intensive Care Society; 2005

Guidelines 3rd

- Kreymann KG, Berger MM, Deutz NE, *et al*
- ESPEN Guidelines on enteral nutrition: intensive care
- Clin Nutr 2006; 25:210–223

Davies AR. Practicalities of nutrition support in the intensive care unit. Curr Opin Clin Nutr Metab Care. 2007; 10: 284-90

- Enteral nutrition is preferred to parenteral nutrition unless there is a major gut condition which will delay commencement of enteral nutrition
- Nasogastric feeding should begin within 24 h, but if intolerance develops, promotility drugs (erythromycin or metoclopramide) or small bowel feeding should be attempted before resorting to supplementary parenteral nutrition

Enteral Nutrition

- **Use EN** in patients who can be fed via the enteral route
- **Avoid additional parenteral** nutrition in patients who tolerate EN and can be fed approximately to the target values
- There is **no significant difference in the efficacy** of jejunal versus gastric feeding

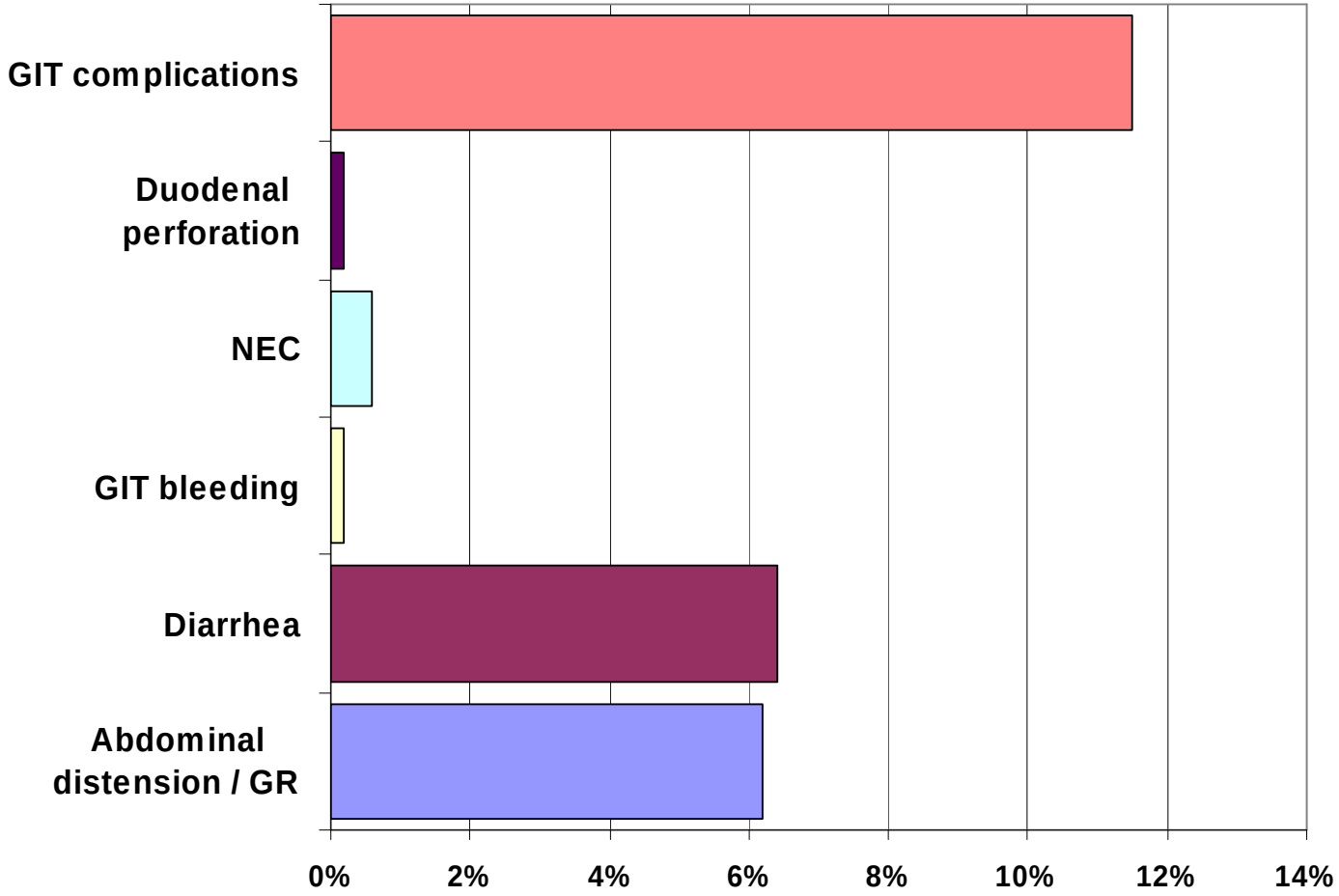
Grade A

2006 ESPEN guidelines on enteral nutrition in intensive care:

- Small bowel feeding tubes
  - are more expensive
  - appear to block more commonly
  - are not uncommonly inadvertently removed
  - can be difficult to place, delay in EN

Nguyen N, et al. World J Gastroenterol 2006; 12:4383–4388

Gastrointestinal complications in critically ill children with transpyloric enteral nutrition

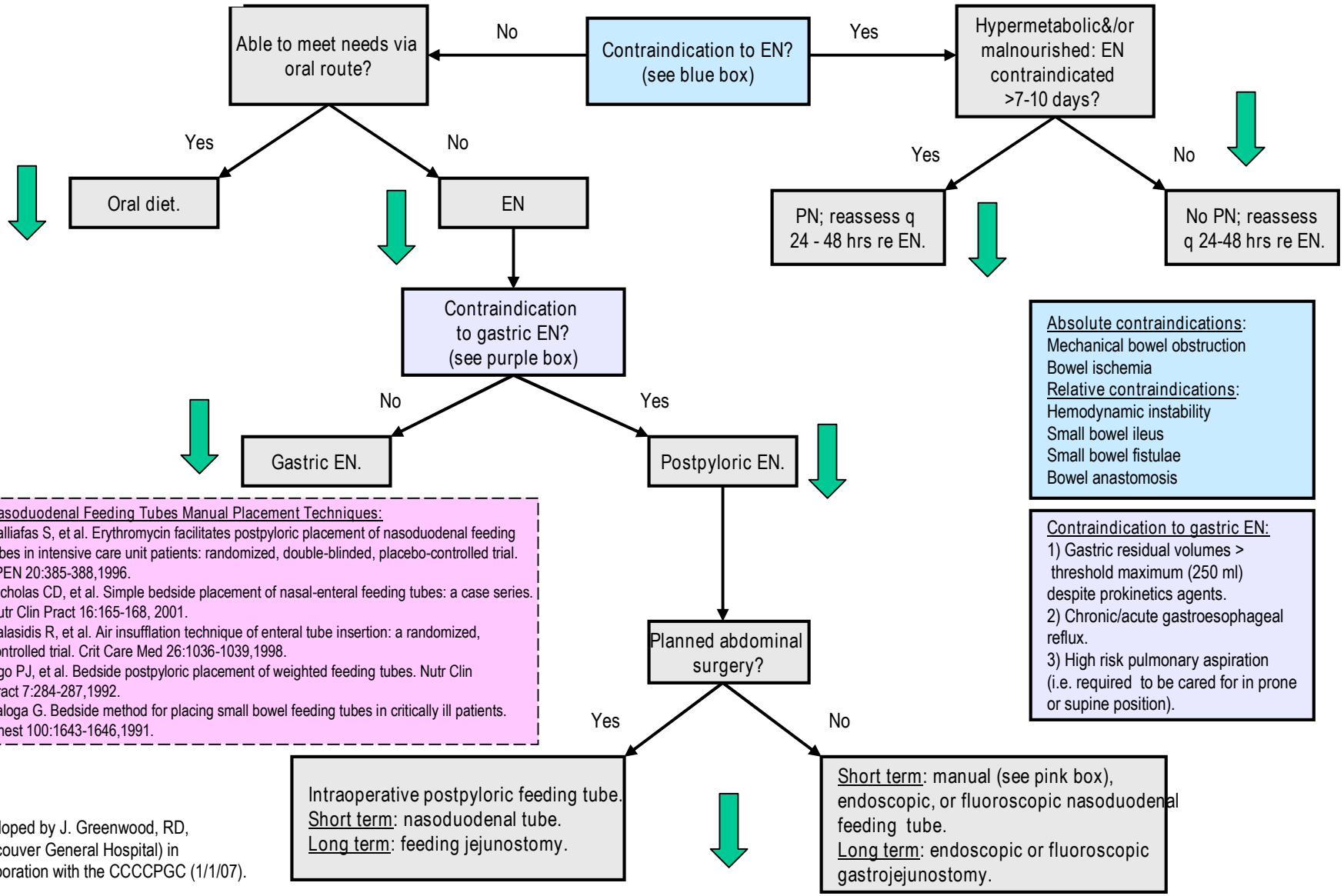


Lopez-Herce J, et al. Eur J Clin Nutr. 2007 Feb 28

Critical Care Nutrition

www.criticalcarenutrition.com

ROUTES OF NUTRITION SUPPORT GUIDELINE



Absolute contraindications:
Mechanical bowel obstruction
Bowel ischemia
Relative contraindications:
Hemodynamic instability
Small bowel ileus
Small bowel fistulae
Bowel anastomosis

Contraindication to gastric EN:
1) Gastric residual volumes > threshold maximum (250 ml) despite prokinetics agents.
2) Chronic/acute gastroesophageal reflux.
3) High risk pulmonary aspiration (i.e. required to be cared for in prone or supine position).

Nasoduodenal Feeding Tubes Manual Placement Techniques:

Kalliafas S, et al. Erythromycin facilitates postpyloric placement of nasoduodenal feeding tubes in intensive care unit patients: randomized, double-blinded, placebo-controlled trial. JPEN 20:385-388,1996.

Nicholas CD, et al. Simple bedside placement of nasal-enteral feeding tubes: a case series. Nutr Clin Pract 16:165-168, 2001.

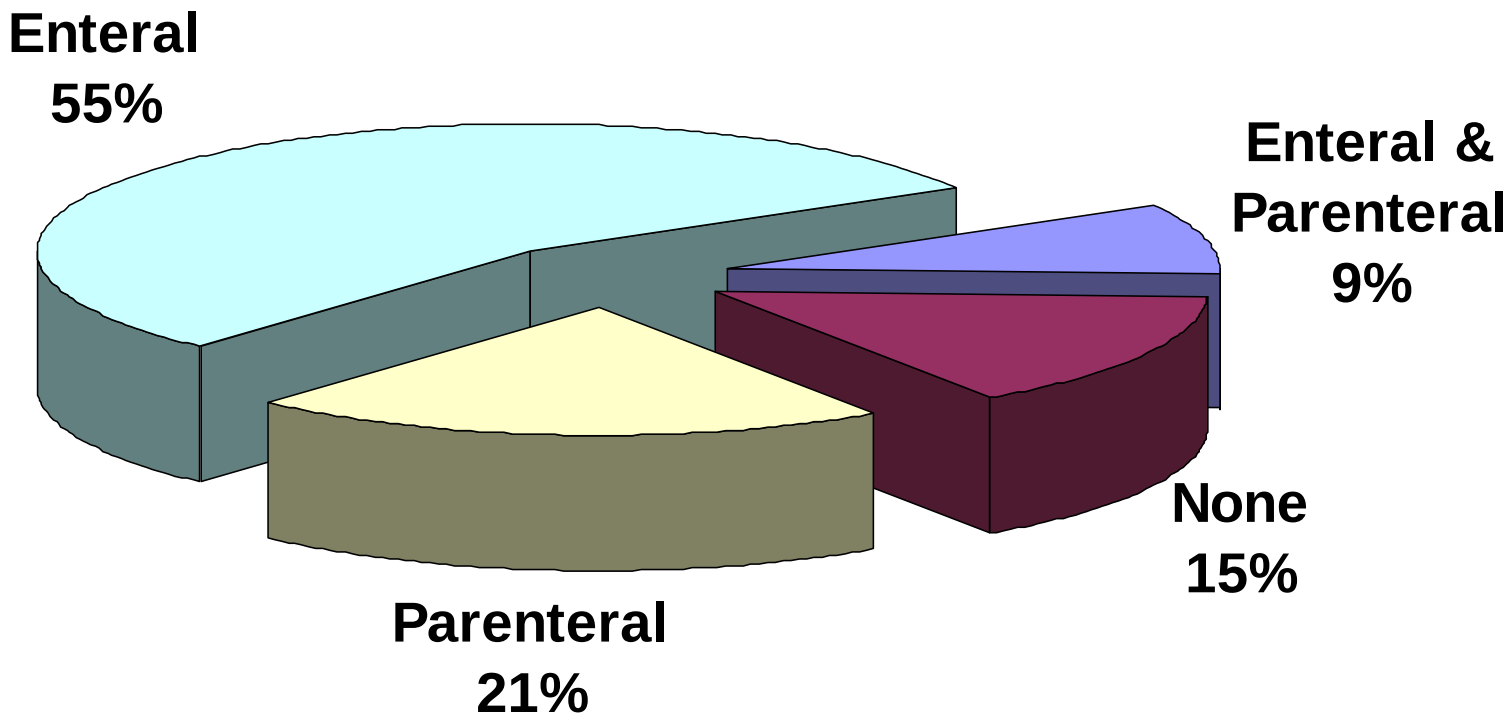
Salasidis R, et al. Air insufflation technique of enteral tube insertion: a randomized, controlled trial. Crit Care Med 26:1036-1039,1998.

Ugo PJ, et al. Bedside postpyloric placement of weighted feeding tubes. Nutr Clin Pract 7:284-287,1992.

Zaloga G. Bedside method for placing small bowel feeding tubes in critically ill patients. Chest 100:1643-1646,1991.

Developed by J. Greenwood, RD, (Vancouver General Hospital) in collaboration with the CCCCPGC (1/1/07).

Type of nutritional support delivered



Taylor: Pediatr Crit Care Med, Volume 4(2) April 2003.176-180

Death by parenteral nutrition

- *Marik PE, Pinsky M*
- *Intensive Care Med. 2003; 29:867-9*

Is parenteral nutrition guilty?

- *Varga P, Griffiths R, Chiolero R, Nitenberg G, Leverve X, Pertkiewicz M, Roth E, Wernerman J, Pichard C, Preiser C*
- *Intensive Care Med. 2003; 29: 1861-4*

Is PN really that risky in ICU?
Can it all be done by EN?

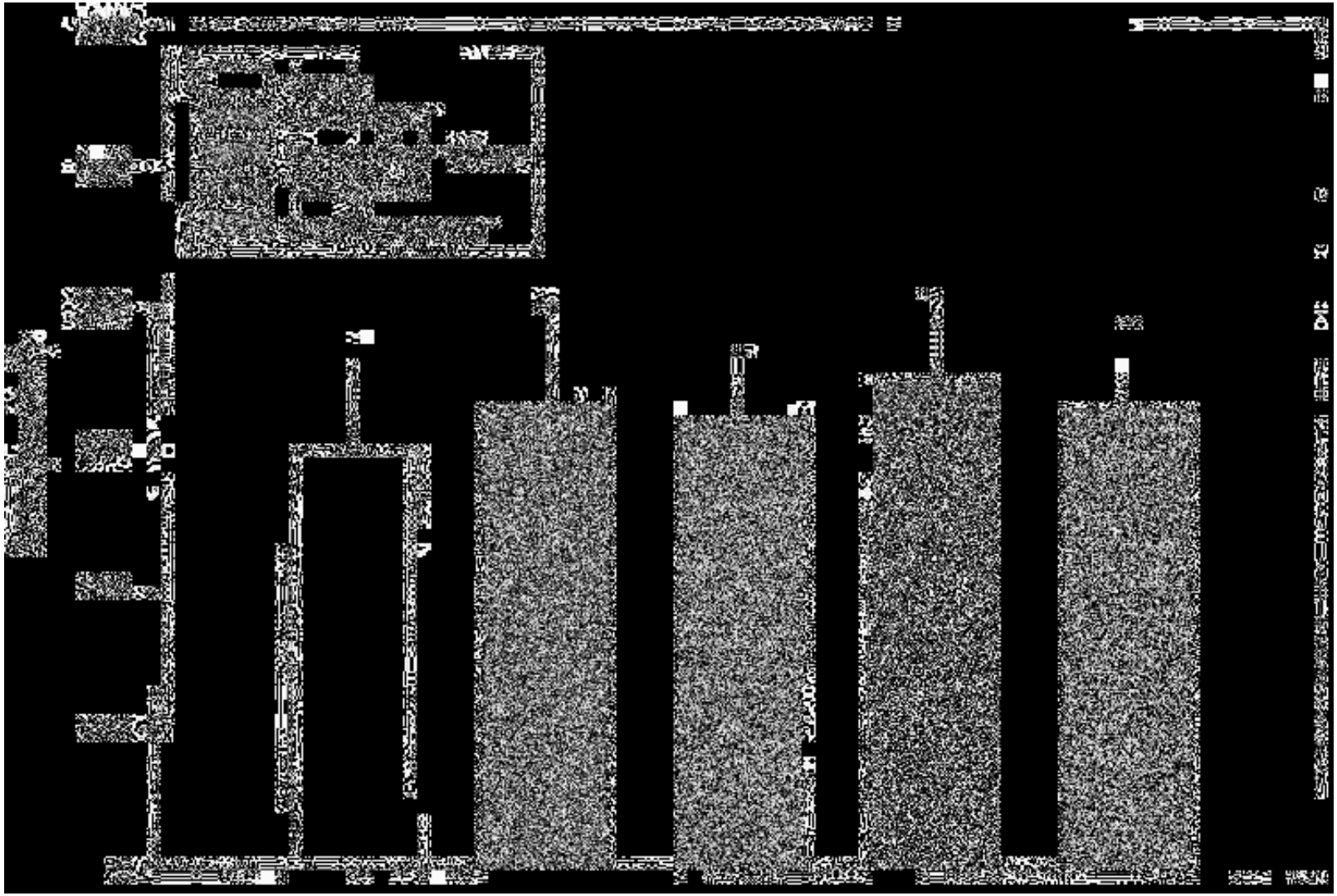
- PN remains a valuable yet challenging weapon in the presence of gastrointestinal feed intolerance or failure

- Real life in biology and in ICU is neither black nor white

Forte G, et al. Nutritional Therapy & Metabolism 2006; 24: 86-98

2006 ESPEN guidelines on enteral nutrition in intensive care: Grade C

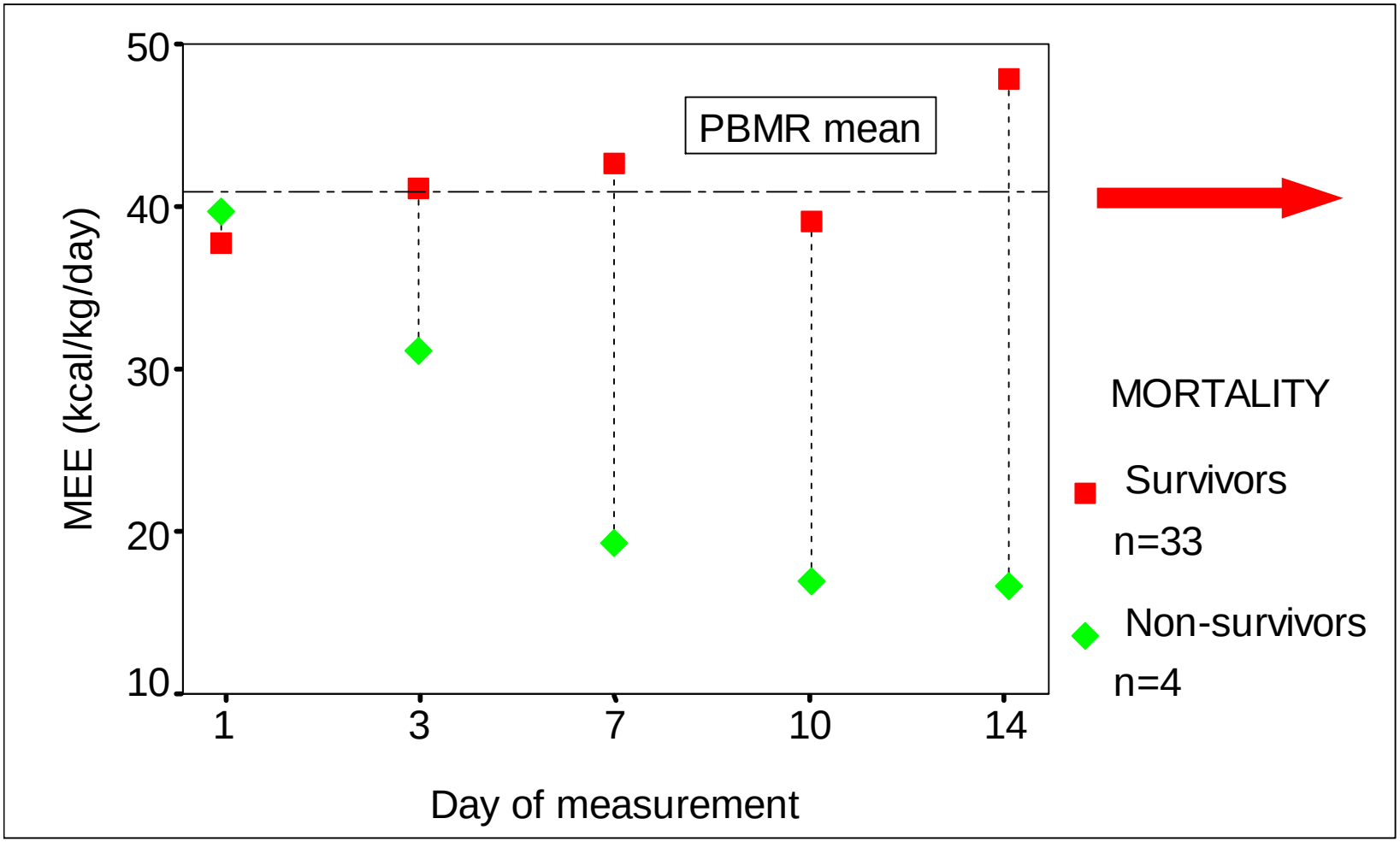
- **No general amount can be recommended as EN therapy has to be adjusted to the progression/ course of the disease and to gut tolerance**



No significant difference in REE between diagnostic groups

Briassoulis G, Venkataraman S, Thompson AE. Energy expenditure in critically ill children. Crit Care Med 2000 28:1166-72

Regarding the short-term mortality, REE showed opposite trends between survivor and non-survivors. Reference line represents mean PBMR



Exogenous energy supply: REE: same target?

- During the **acute and initial phase of critical illness**: in excess of **20–25 kcal/kg BW/day** may be associated with a less favourable outcome
- During the **anabolic recovery phase**, the aim should be to provide **25–30 kcal/kg BW/day** to support the anabolic reconstitution

2006 ESPEN guidelines on enteral nutrition in intensive care: Grade C

If target not reached?

- **If these target values are not reached supplementary parenteral nutrition** should be given
- In patients with **severe undernutrition—or a chronic catabolic disease** — target values should be met fully using **supplementary PN if necessary**

2006 ESPEN guidelines on enteral nutrition in intensive care: Grade C

A large proportion of feeding delays are attributable to avoidable causes

- **Adequate nutritional support remains an elusive goal for many patients**
- **Intakes of between 50 and 70% of target are commonplace**

McClave 1999, De Jonghe 2001, Krishnan 2003, Rubinson 2004, Heyland 2003, Barr 2004, Binnekade 2005

Underfeeding 50.3% of days Reasons

1. Failing to start feeding (43.3%)
2. Failing to increase feeds according to the protocol (31.8%)
3. Stopping feeds for prolonged periods (24.8%)
   - Fasting for airway management procedures (21%)
   - Gastrointestinal intolerance (14%)

Reid C. Journal of Human Nutrition & Dietetics 2006; 19: 13

Intolerance in adult ICUs

- Lower cut-off values (150–250 mL) have often been criticized because they can result in premature cessation of feeds and significant underfeeding

- When protocols using 200 mL or 400 mL to define intolerance were compared, there was no difference in the frequency of regurgitation or aspiration

Lin & Van Citters, 1997, McClave et al., 2005

Critical Care Nutrition

ELEVATED GASTRIC RESIDUAL VOLUMES (residual > 250 ml)

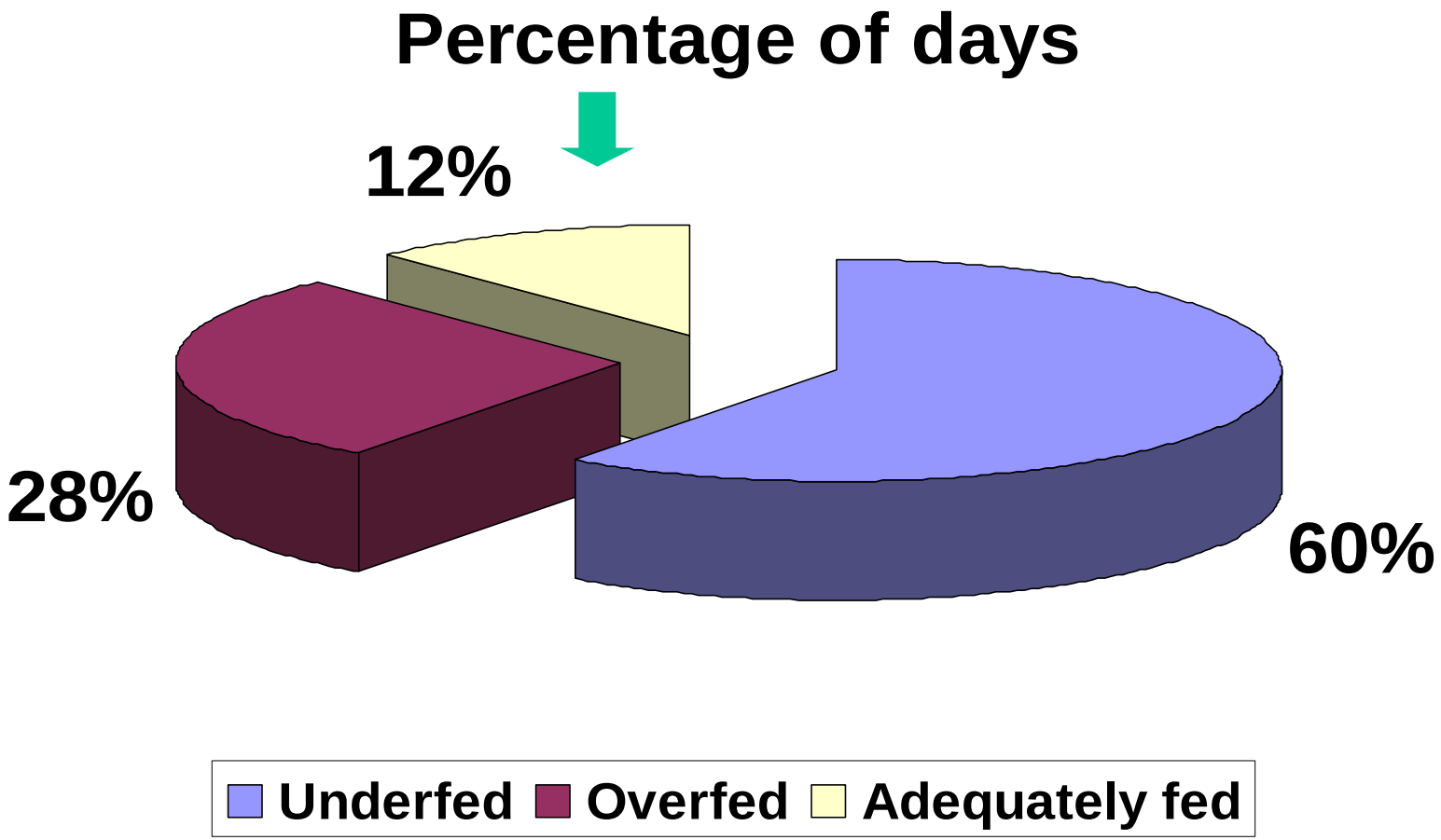
- Narcotic agents
  - Reassess and reduce to minimal effective dose
- Hypokalemia
  - Correct in timely manner
- General intervention: Do not stop feeds; follow enteral feeding guideline
- Initiate IV metoclopramide (0.15 mg/kg)
- If no response after 4 doses, place a nasoduodenal feeding tube

ICU patients receiving NG feeding in whom GI intolerance develops should have a small bowel feeding tube placed

- CONCURRENT GASTRIC DECOMPRESSION: If gastric stasis is present, place a decompression tube to allow for gastric decompression
- PATIENT POSITIONING: Unless contraindicated, elevate the head of bed 45º.
- EARLY TEN is better than late, not increased complications, achieved earlier nutrition 24-48 h (0.5-1 ml/kg/hr and every 4h)

Sánchez C. Nutrition 2007; 23: 16-22

Energy intake in PICU

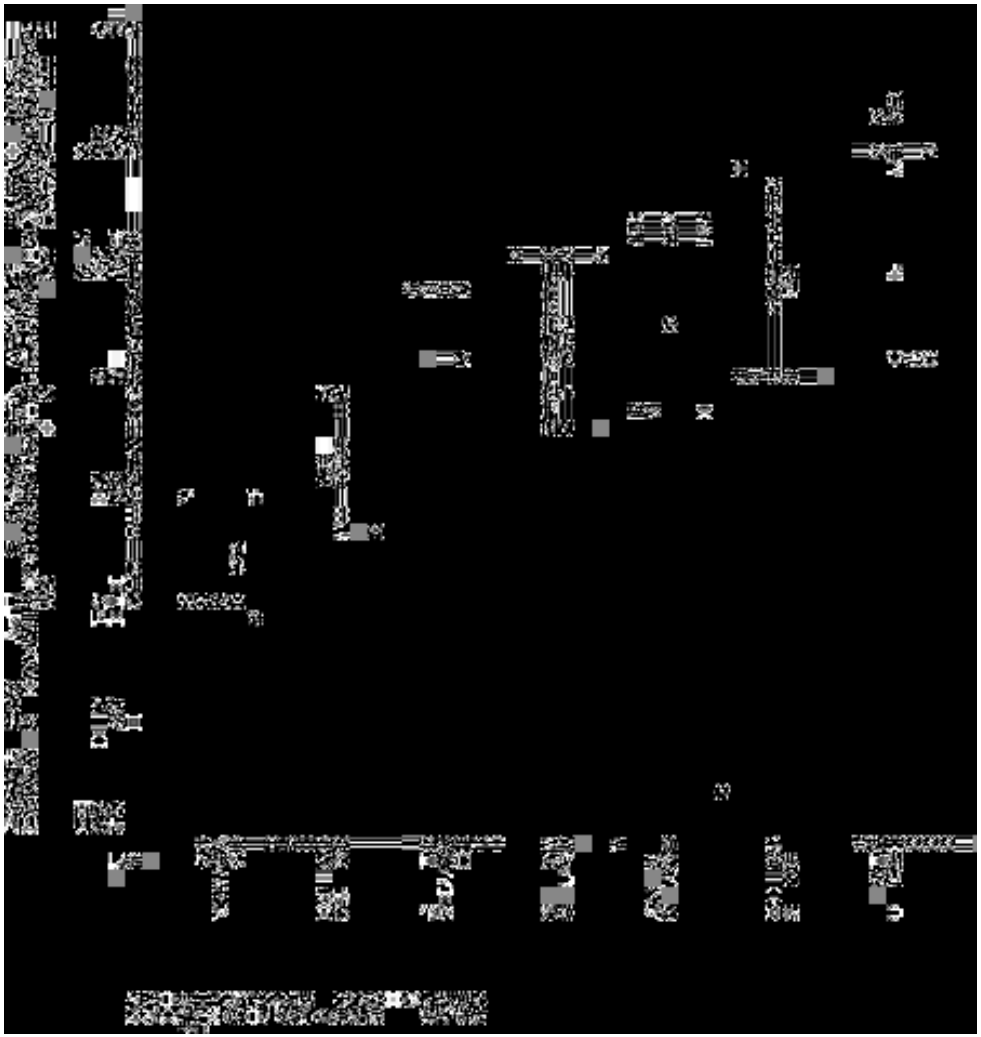


Oosterveld: Pediatr Crit Care Med, 2006; 7: 147-53

Studies in critically ill patients

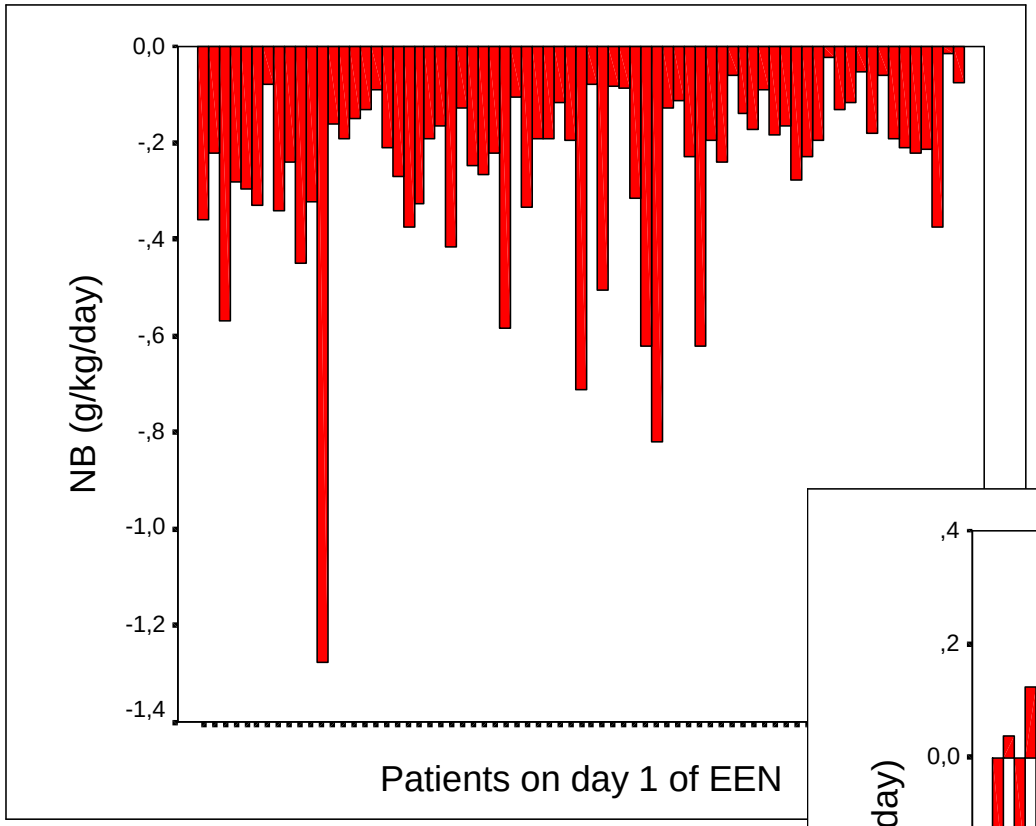
- Short enteral fasting (7 days), causes gut mucosal atrophy, expressed as a decrease in villus height and crypt depth, when compared to controls
  - *Hernandez G, et al. Crit care 1999; 14: 73-7*
- Loss of gastrointestinal mucosal integrity is reversed by the institution of EN
  - *RJ Hadfield, et al. AJRCCM 1995; 152: 1545-8*

The ratio of energy intake to energy expenditure per admission day over the course of the study period

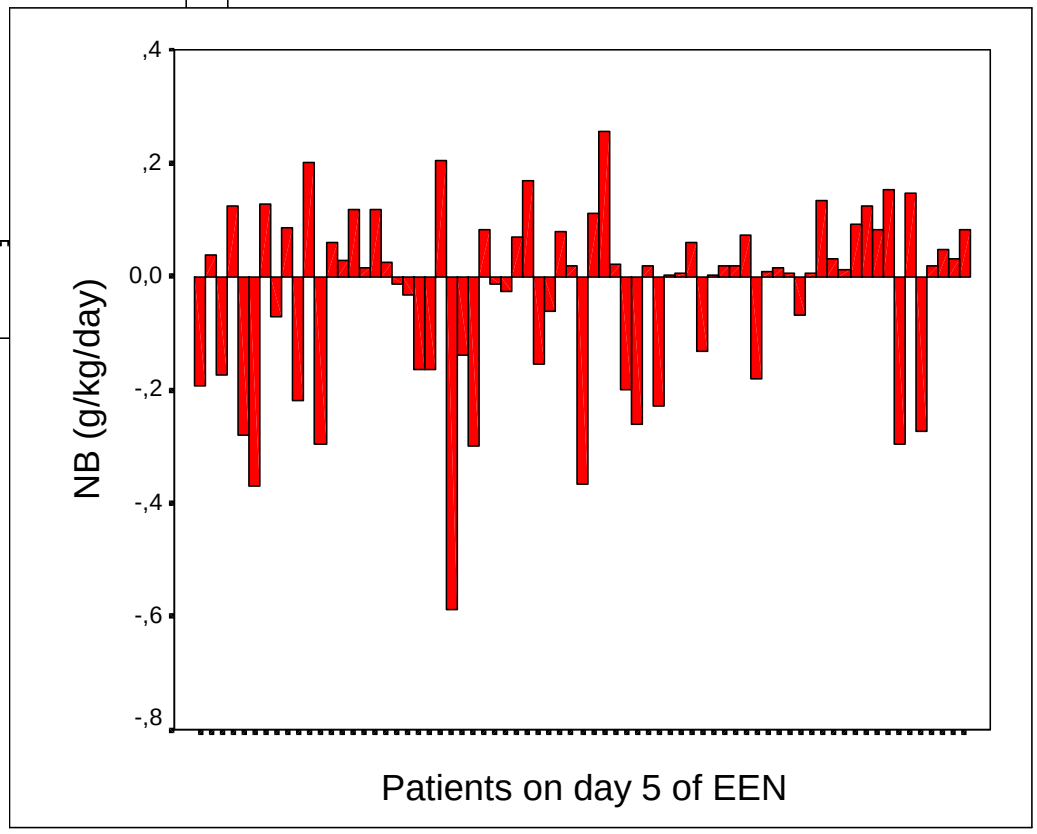


*$p < .001$

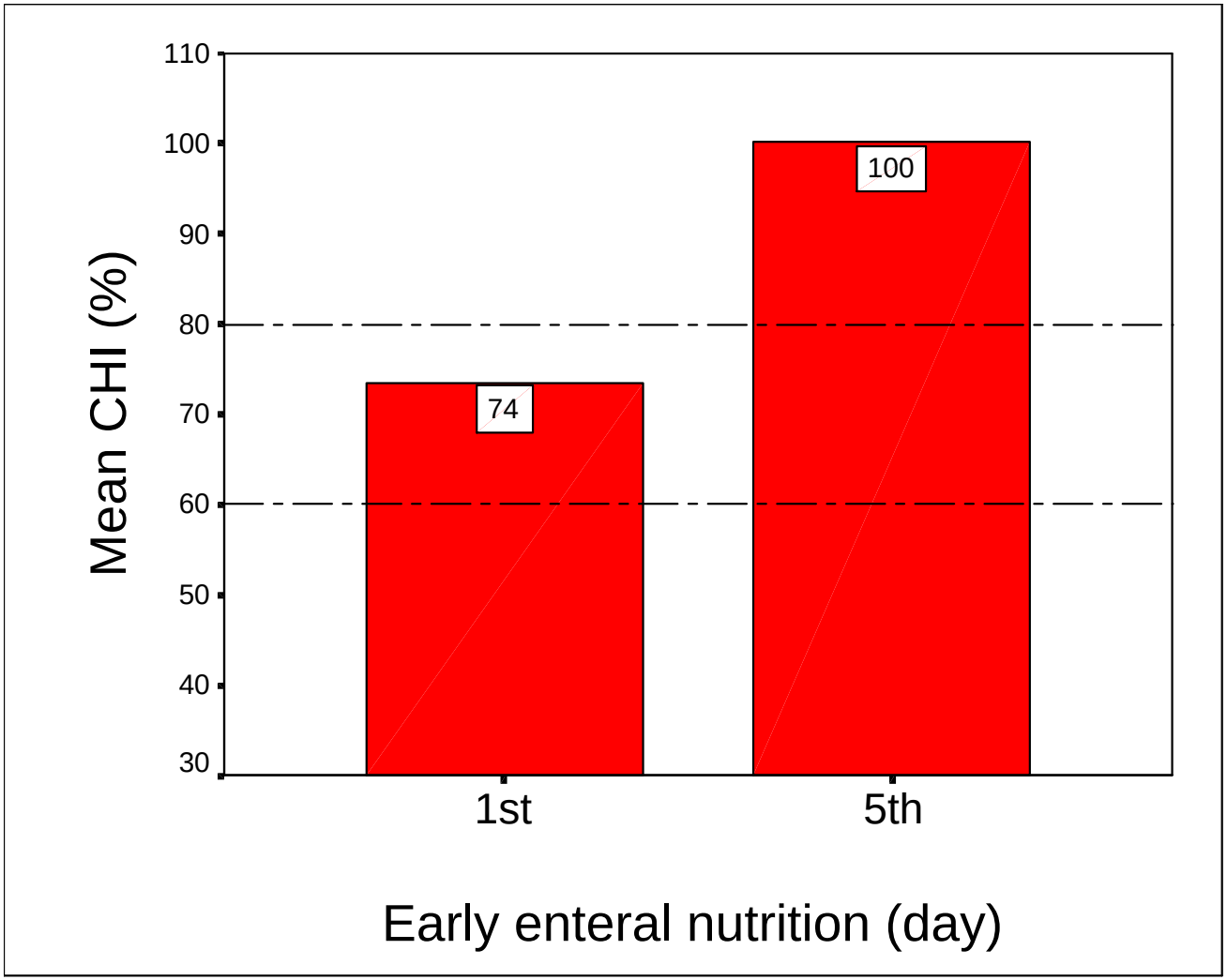
Oosterveld: Pediatr Crit Care Med 2006; 7: 147-53



- Nitrogen balances on days 1 and 5 of a protocol of early enteral nutrition in 71 critically ill children



Briassoulis G, Zavras N, Hatzis T. Nutrition. 2001 J;17:548-57



Mean CHI, indicative of somatic protein status at the beginning and the end of a protocol of early enteral nutrition in critically ill children

2006 ESPEN guidelines on enteral nutrition in intensive care: grade C

- **Whole protein formulae are appropriate in most patients because no clinical advantage of peptide based formulae could be**

Major methodological problems in studies **in intensive care patients**

1. **Type of immune-modulating** nutrition implies a formula enriched with several ‘‘functional’’ substrates

- Glutamine, arginine, nucleotides, antioxidants and ω-3 fatty acids
- The observed effects cannot, therefore be ascribed to one single substrate

2. They do not refer to homogenous populations

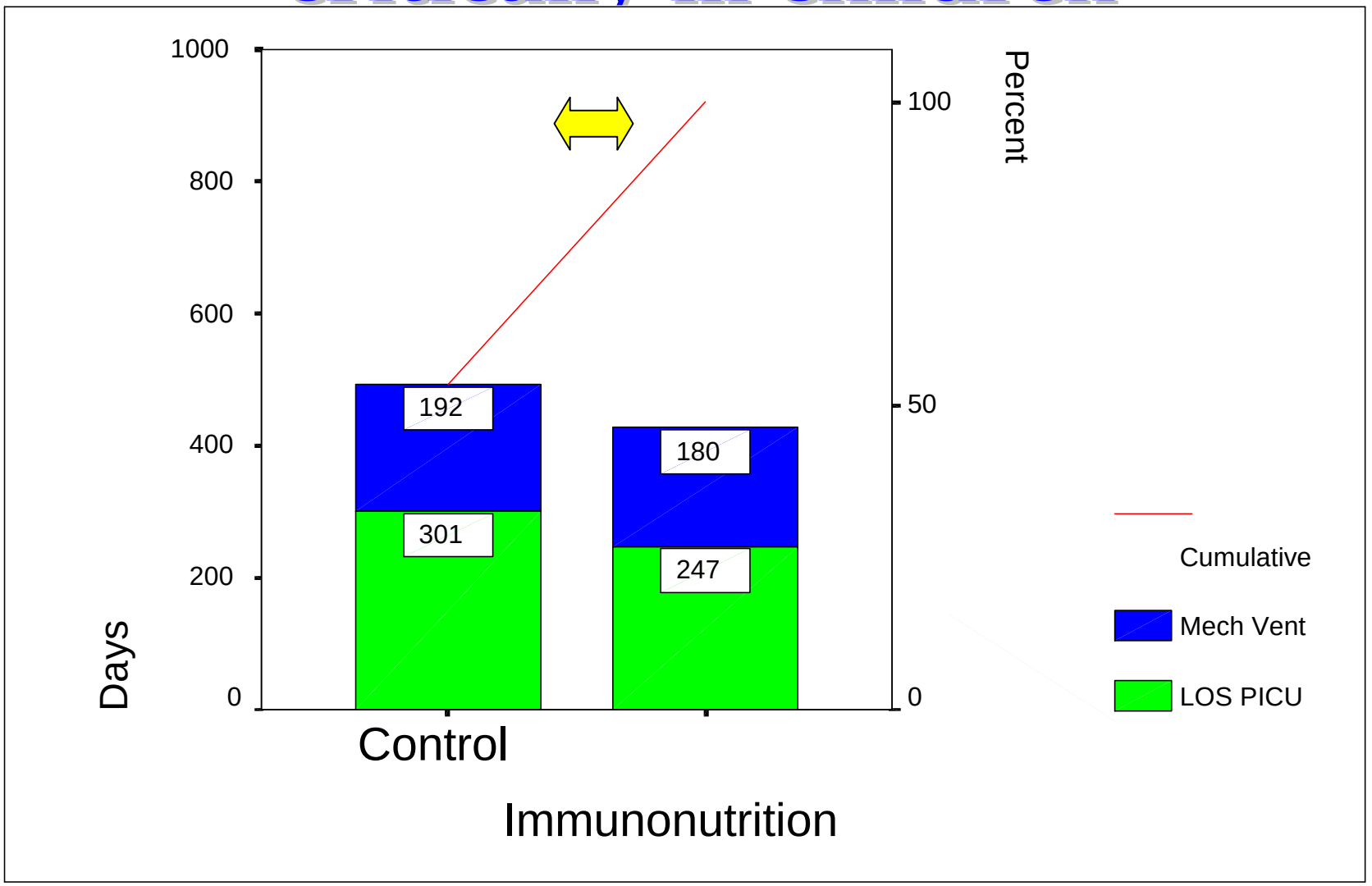
- Vary widely in terms of:
  - Diagnosis
  - Severity of disease
  - Metabolic derangements
  - Therapeutic procedures
  - Gastrointestinal function
- **Which concentrations, doses, groups?**

Immune-modulating formulae are superior to standard enteral formulae

- in elective upper GI **surgical patients**
- in patients with a **mild sepsis** (APACHE II<15)
- in patients with **trauma**
- in patients with **ARDS** (formulae containing ω-3 fatty acids and antioxidants)

2006 ESPEN guidelines on enteral nutrition in intensive care: Grade A & B

Mortality, LOS and LOMV in critically ill children



WHEN THE ENTERAL

ROUTE IS AVAILABLE

USE IT !