Using the gut in acute care patients

Permissive underfeeding in practice

J.-C. Preiser (BE)
PERMISSIVE UNDERFEEDING IN PRACTICE

ESPEN congress
Jean-Charles Preiser, M.D., Ph.D.
Dept Intensive Care, Erasme University Hospital
Brussels, Belgium
CONFLICTS OF INTEREST

- Aguettant
- Baxter
- B Braun
- Fresenius
- Nestlé
- Nutricia
Learning objectives

- Know the definition of permissive underfeeding and the rationale behind it
- Know the evidence for permissive underfeeding
- Know the indications and application of permissive underfeeding
Learning objectives

- Know the definition of permissive underfeeding and the rationale behind it
- Know the evidence for permissive underfeeding
- Know the indications and application of permissive underfeeding
Be early for enteral, no rush for calories!

Jean-Charles Preiser
Yaseen M. Arabi

Percentage of energy expenditure vs. Time

0 50 100

Normocaloric / full feeding
Hypocaloric / permissive underfeeding
Trickle / trophic feeding
The 3 post-injury phases

[Diagram showing energy expenditure (kcal/day) for early, late, and recovery phases with different contributions of proteins, lipids, and carbohydrates]
Be early for enteral, no rush for calories!

Percentage of energy expenditure

Time

Hypocaloric / permissive underfeeding

Trickle / trophic feeding
Permissive underfeeding is no longer abusive nor insulting!
# Updated recommendations

## Intentional Underfeeding: Trophic Feeds vs Full Feeds

<table>
<thead>
<tr>
<th></th>
<th>Topic</th>
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<th>Recommendation compared to 2013</th>
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Provision of Nutrients to the Acutely Ill
Introducing the “Baby Stomach” Concept

Am J Respir Crit Care Med. 2017 Jun 8.
doi: 10.1164/rccm.201705-0919ED

Jean-Charles Preiser, M.D., Ph.D.
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Karolinska University Hospital Huddinge
Stockholm, Sweden
The “Baby lung”

- ARDS Lung has “normal” & unaerated / partially aerated alveoli
- “Normal” segments inflate easily
- Unaerated segments distend poorly
  - High pressure
  - Slow response
- Normal lung segments may be over-inflated when ventilated with traditional tidal volumes
Figure 1. Probability of Survival and of Being Discharged Home and Breathing without Assistance during the First 180 Days after Randomization in Patients with Acute Lung Injury and the Acute Respiratory Distress Syndrome.

ARDSnet, NEJM 2000
Rationale:
DURING THE ACUTE PHASE

THE CALORIC NEEDS ARE LOWER THAN ENERGY EXPENDITURE
WHY COULD HIGH CALORIC INTAKE BE DETRIMENTAL DURING THE ACUTE / EARLY PHASE?

- Overfeeding
- Autophagy
- Refeeding
Activators of autophagy?

- Fasting
- Cellular stress
- Hypoxia

M.P.C., K.U.Leuven
Suppressors of autophagy?

Nutrients

Growth Factors

Insulin

M.P.C., K.U.Leuven
Restricted versus continued standard caloric intake during the management of refeeding syndrome in critically ill adults: a randomised, parallel-group, multicentre, single-blind controlled trial

Gordon S Doig, Fiona Simpson, Philippa T Heighes, Rinaldo Bellomo, Douglas Cheser, Ian D Caterson, Michael C Reade, Peter W J Harrigan, for the Refeeding Syndrome Trial Investigators Group*
WHAT ABOUT PROTEIN INTAKES?
A reappraisal of nitrogen requirements for patients with critical illness and trauma

Dickerson et al. 2012
IV aminoacid therapy for kidney function
Doig Intensive Care Med 2015;41:1197

- **Objective:**
  - To determine whether IV AA therapy preserves kidney function in patients at risk of AKI

- **Intervention:**
  - Random allocation to receive a daily supplement up to 100g AA or standard

- **Main outcome:**
  - Duration of renal dysfunction

- **Results:**
  - 474 patients (235 standard, 239 AA) – no difference in duration of renal dysfunction / transient improvement in GFR
Elevated glucagon availability during critical illness increases hepatic amino acid catabolism, explaining the illness-induced hypoaminoacidemia, without affecting muscle wasting and without a sustained impact on blood glucose.

Furthermore, amino acid infusion likely results in a further breakdown of amino acids in the liver, mediated by increased glucagon, without preventing muscle wasting.
Learning objectives

• Know the definition of permissive underfeeding and the rationale behind it
• Know the evidence for permissive underfeeding
• Know the indications and application of permissive underfeeding
Observed/expected mortality and caloric intake
Hiesmayr et al NutritionDay 2007-2013, n= 9870

O/E-ratios in different feeding groups units with > 75% outcome

D1-D7

> D7
Permissive underfeeding and intensive insulin therapy in critically ill patients: a randomized controlled trial¹⁻³

Yaseen M Arabi, Hani M Tamim, Gousia S Dhar, Abdulaziz Al-Dawood, Muhammad Al-Sultan, Maram H Sakkijha, Salim H Kahoul, and Riette Brits

Design: This study had a 2 × 2 factorial, randomized, controlled design. Eligible patients were randomly assigned to permissive underfeeding or target feeding groups (caloric goal: 60–70% compared with 90–100% of calculated requirement, respectively) with either IIT or CIT (target blood glucose: 4.4–6.1 compared with 10–11.1 mmol/L, respectively).

Results: Twenty-eight-day all-cause mortality was 18.3% in the permissive underfeeding group compared with 23.3% in the target feeding group (relative risk: 0.79; 95% CI: 0.48, 1.29; P = 0.34). Hospital mortality was lower in the permissive underfeeding group than in the target group (30.0% compared with 42.5%, respectively; relative risk: 0.71; 95% CI: 0.50, 0.99; P = 0.04). No significant differences in outcomes were observed between the IIT and CIT groups.
Early versus Late Parenteral Nutrition in Critically Ill Adults

Figure 1: Consort diagram

- Assessed for eligibility (N=8703)
  - Randomized (N=4640)
  - Excluded (N=4063)
    - Not eligible (N=3605)
      - Age < 18 year (N=1344)
      - Moribund or DNR coded (N=214)
      - Other trial (N=50)
      - Short bowel syndrome (N=13)
      - Re-admission to ICU (N=361)
      - BMI < 17 (N=106)
      - Referred with nutrition (N=181)
      - Nutritional risk score < 3 (N=299)
      - Other (N=144)
    - No consent (N=458)

- Randomized to 'Early PN' (N=2312)
  - Received intervention (N=2312)
  - Discontinued intervention (N=0)
    * Patient/surrogate request (N=0)
    * Protocol violation (N=0)
  - Lost to follow-up (N=0)
  - Analyzed in 'Early PN' arm (N=2312)

- Randomized to 'Late PN' (N=2328)
  - Received intervention (N=2313)
  - Discontinued intervention (N=15)
    * Patient/surrogate request (N=0)
    * Protocol violation (N=15)
  - Lost to follow-up (N=0)
  - Analyzed in 'Late PN' arm (N=2328)
Caloric intake in the EPaNIC trial

Figure 2: Nutrition

- **Enteral nutrition**
  - Late PN: Red bars
  - Early PN: Blue bars
  - Median (p25-p75)

- **Parenteral nutrition**
  - Late PN: Red bars
  - Early PN: Blue bars

- **Total nutrition**
  - Late PN: Red bars
  - Early PN: Blue bars

<table>
<thead>
<tr>
<th>Day</th>
<th>Late PN Energy</th>
<th>Early PN Energy</th>
<th>Late PN % of target</th>
<th>Early PN % of target</th>
</tr>
</thead>
<tbody>
<tr>
<td>d1</td>
<td>2328</td>
<td>2312</td>
<td>328</td>
<td>517</td>
</tr>
<tr>
<td>d3</td>
<td>1399</td>
<td>1438</td>
<td>139</td>
<td>736</td>
</tr>
<tr>
<td>d5</td>
<td>913</td>
<td>975</td>
<td>910</td>
<td>736</td>
</tr>
<tr>
<td>d7</td>
<td>655</td>
<td>975</td>
<td>655</td>
<td>736</td>
</tr>
<tr>
<td>d9</td>
<td>436</td>
<td>517</td>
<td>436</td>
<td>517</td>
</tr>
<tr>
<td>d11</td>
<td>313</td>
<td>371</td>
<td>313</td>
<td>371</td>
</tr>
<tr>
<td>d13</td>
<td>2328</td>
<td>2312</td>
<td>2328</td>
<td>2312</td>
</tr>
<tr>
<td>d15</td>
<td>1399</td>
<td>1438</td>
<td>1399</td>
<td>1438</td>
</tr>
</tbody>
</table>

Note: N Late PN and N Early PN are not explicitly stated in the figure.
Outcomes – EPaNIC trial
Casaer et al NEJM 2011

Primary outcome

Hosp LOS  ICU LOS  New inf  MV >2d  RRT  CRP
Early versus Late Parenteral Nutrition in Critically Ill Children

Tom Fivez, M.D., Dorian Kerklaan, M.D., Dieter Mesotten, M.D., Ph.D.,

This article was published on March 15, 2016, at NEJM.org.

DOI: 10.1056/NEJMoa1514762

METHODS

We conducted a multicenter, randomized, controlled trial involving 1440 critically ill children to investigate whether withholding parenteral nutrition for 1 week (i.e., providing late parenteral nutrition) in the pediatric intensive care unit (ICU) is clinically superior to providing early parenteral nutrition. Fluid loading was similar in the two groups. The two primary end points were new infection acquired during the ICU stay and the adjusted duration of ICU dependency, as assessed by the number of days in the ICU and as time to discharge alive from ICU. For the 723 patients receiving early parenteral nutrition, parenteral nutrition was initiated within 24 hours after ICU admission, whereas for the 717 patients receiving late parenteral nutrition, parenteral nutrition was not provided until the morning of the 8th day in the ICU. In both groups, enteral nutrition was attempted early and intravenous micronutrients were provided.
Outcomes – PEPaNIC trial
Fivez et al NEJM 2016

Primary outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Early</th>
<th>Late</th>
</tr>
</thead>
<tbody>
<tr>
<td>New infection</td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>LOS</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Mortality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration MV</td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>
Recent large nutrition RCT’s

Nutrition in critically ill patients: where do we stand?

Jean-Charles PREISER *, Fabio Silvio TACCONE

**TABLE I.—A summary of the most important studies on nutrition on the critically ill patient.**

<table>
<thead>
<tr>
<th>Study</th>
<th>Inclusion criteria</th>
<th>Number of patients (CTRL/intervention)</th>
<th>Type of intervention</th>
<th>Primary outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPaNIC 7</td>
<td>ICU admission, Nutrition risk score &gt;3</td>
<td>2312/2328</td>
<td>Early PN vs. late PN</td>
<td>Duration of ICU dependency: 4 [2-9] vs. 3 [2-7] P=0.02</td>
</tr>
<tr>
<td>EDEN 6</td>
<td>Acute lung injury, mechanical ventilation</td>
<td>508/492</td>
<td>Trophic vs. full feeding</td>
<td>Ventilator-free days 14.9 [13.9-15.8] vs. 15.0 [14.1-15.9] NS</td>
</tr>
<tr>
<td>SPN 8</td>
<td>Patients in the ICU at day 3, expected ICU stay ≥5 days, Less than 60% of target energy by EN</td>
<td>153/152</td>
<td>Supplemental PN vs. EN alone</td>
<td>Number of infections: * 100 vs. 114 NS</td>
</tr>
<tr>
<td>EarlyPN 9</td>
<td>ICU patients ineligible for EN</td>
<td>686/686</td>
<td>Standard vs. early PN</td>
<td>60-day mortality: 22.6% vs. 21.5% P=0.6</td>
</tr>
<tr>
<td>CALORIES 10</td>
<td>Expected nutrition support &gt;2 days, Expected ICU stay &gt;3 days</td>
<td>1191/1197</td>
<td>Early PN vs. early EN</td>
<td>30-day mortality: 33.1% vs. 34.2% P=0.57</td>
</tr>
<tr>
<td>PermiT 11</td>
<td>EN within 48 hours from admission</td>
<td>445/440</td>
<td>Permissive vs. full EN</td>
<td>90-day mortality: 27.2% vs. 28.9% P=0.58</td>
</tr>
</tbody>
</table>
Normocaloric versus hypocaloric feeding on the outcomes of ICU patients: a systematic review and meta-analysis

Fig. 2 Comparison of the risk of hospital mortality during study period for patients receiving standard feeds as compared to hypocaloric feeds grouped by trophic feeds and underfeeding.

Weight is the relative contribution of each study to the overall treatment effect (odds risk ratio and 95% confidence interval) on a log scale assuming a random effects model.
Enetral versus parenteral nutrition in critically ill patients: an updated systematic review and meta-analysis of randomized controlled trials

Gunnar Elke¹, Arthur R. H. van Zanten², Margot Lemieux³, Michele McCall⁴, Khursheed N. Jeejeebhoy⁵, Matthias Kott¹, Xuran Jiang⁵, Andrew G. Day³ and Daren K. Heyland*
Enteral versus parenteral nutrition in critically ill patients: an updated systematic review and meta-analysis of randomized controlled trials

Infectious complications
Learning objectives

- Know the definition of permissive underfeeding and the rationale behind it
- Know the evidence for permissive underfeeding
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# Updated recommendations

## 3.3a Intentional Underfeeding: Trophic Feeds vs Full Feeds

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## Components of the NUTRIC score

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<tr>
<th>Variable</th>
<th>Range</th>
<th>Points</th>
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</thead>
<tbody>
<tr>
<td>Age</td>
<td>&lt;50</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>50 - &lt;75</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>≥75</td>
<td>2</td>
</tr>
<tr>
<td>APACHE II</td>
<td>&lt;15</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>15 - &lt;20</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>20-28</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>≥28</td>
<td>3</td>
</tr>
<tr>
<td>SOFA</td>
<td>&lt;6</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>6 - &lt;10</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>≥10</td>
<td>2</td>
</tr>
<tr>
<td>Number of Co-morbidities</td>
<td>0-1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>&gt;2</td>
<td>1</td>
</tr>
<tr>
<td>Days from hospital to ICU admission</td>
<td>0 - &lt;1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>≥1</td>
<td>1</td>
</tr>
<tr>
<td>IL-6</td>
<td>0 - &lt;400</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>≥400</td>
<td>1</td>
</tr>
</tbody>
</table>
Permissive Underfeeding or Standard Enteral Feeding in High- and Low-Nutritional-Risk Critically Ill Adults

Post Hoc Analysis of the PermiT Trial

Yaseen M. Arabi¹, Abdulaziz S. Aldawood¹, Hasan M. Al-Dorzi¹, Hani M. Tamim¹,², Samir H. Haddad¹, Gwynne Jones³, Lauralyn McIntyre⁴, Othman Solaiman⁴, Maram H. Sakkijha¹, Musharaf Sadat¹, Shihab Mundekkadan¹, Anand Kumar⁵, Sean M. Bagshaw⁶, and Sangeeta Mehta⁷,⁸; for the PermiT trial group

American Journal of Respiratory and Critical Care Medicine Volume 195 Number 5 | March 1 2017

Figure 2. Kaplan-Meier survival curves for patients in the permissive underfeeding and standard feeding groups stratified by NUTRIC score (high nutritional risk, NUTRIC score 5-9; low nutritional risk, NUTRIC score 0-4) and by prealbumin. NUTRIC = NUTritional Risk in the Critically Ill.
Back to bedside...
Ability to match > 50% REE within 3 days?

- **YES**
- **NO**

Contra-indication to EN?

- **YES**
  - Wait

- **NO**
  - Start EN
    - Gradual increase of infusion rate (target 25 kcal/kg.d) and optimise delivery (pro-motility agents, post-pyloric tube)

Day 5-7

- **EN still contra-indicated**
  - Parenteral nutrition

- **< 80% of prescription delivered by enteral route**
  - Consider complementary PN (to match caloric debt)
From unintentional to intentional permissive underfeeding

Percentage of energy expenditure

Hypocaloric / permissive underfeeding

Trickle / trophic feeding
## A J-shaped relationship between caloric intake and survival in critically ill patients

Isabel Carolina Reis Crosara¹, Christian Mélot² and Jean-Charles Preiser¹*

<table>
<thead>
<tr>
<th></th>
<th>q1 (N=251)</th>
<th>q2 (N=251)</th>
<th>q3 (N=251)</th>
<th>q4 (N=251)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Daily caloric expenditure (25 kcal*kg/day)</strong></td>
<td>1923 ± 437</td>
<td>1915 ± 370</td>
<td>1995 ± 443</td>
<td>1800 ± 337</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td><strong>Average total Caloric intake (kcal*kg/day)</strong></td>
<td>185 ± 456</td>
<td>230 ± 62</td>
<td>940 ± 471</td>
<td>1653 ± 615</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td><strong>Total percentage of energy intake/requirement (%)</strong></td>
<td>9.9 ± 2.5</td>
<td>12.2 ± 3.2</td>
<td>47.3 ± 22.9</td>
<td>93.4 ± 35.1</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>calories given enterally (kcal/kg/day)</td>
<td>0.62 ± 2.93</td>
<td>0.04 ± 0.36</td>
<td>6.73 ± 6.67</td>
<td>11.19 ± 9.66</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>calories given parenterally (kcal/kg/day)</td>
<td>1.27 ± 4.24</td>
<td>0</td>
<td>2.74 ± 5.64</td>
<td>9.83 ± 10.38</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>IV glucose in non-nutrition solutions (gm)</td>
<td>11.60 ± 22.09</td>
<td>56.72 ± 14.81</td>
<td>43.70 ± 34.28</td>
<td>40.64 ± 41.52</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Average blood glucose concentrations (in mg/dL)</td>
<td>134 ± 32</td>
<td>134 ± 24</td>
<td>138 ± 32</td>
<td>138 ± 30</td>
<td>0.1773</td>
</tr>
</tbody>
</table>
NutritionDay ICU: A 7 year worldwide prevalence study of nutrition practice in intensive care

Itai Bendavid a, Pierre Singer a,*, Miriam Theilla a, Michael Themessl-Huber b, Isabella Sulz b, Mohamed Mouhieddine c, Christian Schuh b, Bruno Mora c, Michael Hiesmayr c


Fig. 4. Total energy delivery in kcal/24 h according to days of hospitalization. (Boxes represent interquartile range and the line in the box the median) Alternative with extreme values is included for information.
What is the best achievable practice?
Cahill Crit Care Med 2010;38:395

The amount of calories received by enteral nutrition and parenteral nutrition as a percentage of the maximum calories prescribed at baseline assessment in all patients across the 12 days of observation.
Relevance of non-nutritional calories in mechanically ventilated critically ill patients

E Bousie¹, D van Blokland¹, HJW Lammers² and ARH van Zanten¹


![Bar charts showing calorie intake over days for different groups of patients.](image-url)
Early enteral nutrition in critically ill patients: ESICM clinical practice guidelines

Annika Reintam Blaser¹,², Joel Starkopf³, Waleed Alhazzani⁴,⁵, Mette M. Berger⁶, Michael P. Casaer⁷, Adam M. Deane⁸, Sonja Fruhwald⁹, Michael Hiesmayr¹⁰, Carole Ichai¹¹, Stephan M. Jakob¹², Cecilia I. Loudet¹³, Manu L. N. G. Malbrain¹⁴, Juan C. Montejo González¹⁵, Catherine Paugam-Burtz¹⁶, Martijn Poeze¹⁷, Jean-Charles Preiser¹⁸, Pierre Singer¹⁹,²⁰, Arthur R.H. van Zanten²¹, Jan De Waele²², Julia Wendon²³, Jan Wernerman²⁴, Tony Whitehouse²⁵, Alexander Wilmer²⁶, Heleen M. Oudemans-van Straaten²⁷ and ESICM Working Group on Gastrointestinal Function

Results: We formulated 17 recommendations favouring initiation of EEN and seven recommendations favouring delaying EN. We performed five meta-analyses: in unselected critically ill patients, and specifically in traumatic brain injury, severe acute pancreatitis, gastrointestinal (GI) surgery and abdominal trauma. EEN reduced infectious complications in unselected critically ill patients, in patients with severe acute pancreatitis, and after GI surgery. We did not detect any evidence of superiority for early PN or delayed EN over EEN. All recommendations are weak because of the low quality of evidence, with several based only on expert opinion.
Early enteral nutrition in critically ill patients: ESICM clinical practice guidelines

Annika Reintam Blaser\textsuperscript{1,2*}, Joel Starkopf\textsuperscript{1,3}, Waleed Alhazzani\textsuperscript{4,5}, Mette M. Berger\textsuperscript{6}, Michael P. Casaer\textsuperscript{7}, Adam M. Deane\textsuperscript{8}, Sonja Fruhwald\textsuperscript{9}, Michael Hiesmayr\textsuperscript{10}, Carole Ichai\textsuperscript{11}, Stephan M. Jakob\textsuperscript{12}, Cecilia I. Loudet\textsuperscript{13}, Manu L. N. G. Malbrain\textsuperscript{14}, Juan C. Montejo González\textsuperscript{15}, Catherine Paugam-Burtz\textsuperscript{16}, Martijn Poeze\textsuperscript{17}, Jean-Charles Preiser\textsuperscript{18}, Pierre Singer\textsuperscript{19,20}, Arthur R.H. van Zanten\textsuperscript{21}, Jan De Waele\textsuperscript{22}, Julia Wendon\textsuperscript{23}, Jan Wernerman\textsuperscript{24}, Tony Whitehouse\textsuperscript{25}, Alexander Wilmer\textsuperscript{26}, Heleen M. Oudemans-van Straaten\textsuperscript{27} and ESICM Working Group on Gastrointestinal Function

Starting and continuing EEN
- Start EN at a slow rate (10–20 ml/h) while carefully monitoring abdominal/gastrointestinal symptoms
- Increase EN slowly once previous symptoms are resolving and no new symptoms occur
- Do not increase EN in cases of intolerance or new symptoms, such as pain, abdominal distension or increasing intra-abdominal pressure. In these circumstances EN should be either continued at a slow rate or ceased depending on the severity of symptoms and suspected underlying sinister pathology (e.g. mesenteric ischaemia)

Energy target during EEN
- Do not aim to cover full energy target with EEN. The optimal energy and protein target in the early phase of acute critical illness is not known. EEN that exceeds actual energy expenditure appears harmful and should be avoided [4, 5], whereas hypocaloric EEN may be safe [6–8]

Monitoring and protocolised management of GI dysfunction during EEN
- In case of gastric retention without other new abdominal symptoms use prokinetics and/or postpyloric feeding in a protocolised way [9]
- During introduction and increasing the rate of EN, measurement of intra-abdominal pressure (IAP) provides an additional numeric value to detect negative dynamics of IAP during EN in patients with severe abdominal pathology, hypoperfusion or fluid overload

Individualized approach
- For patients with diminished consciousness and inadequate swallowing, precautions to prevent aspiration of gastric contents may be useful, including considering postpyloric feeding
- Premorbid health and course of the acute illness may differ between patients with similar diagnose; therefore an individual approach should always be applied
Early enteral nutrition in critically ill patients: ESICM clinical practice guidelines

Delay EN
- if shock is uncontrolled and hemodynamic and tissue perfusion goals are not reached
- In case of uncontrolled life-threatening hypoxaemia, Hypercapnia or acidosis
Early enteral nutrition in critically ill patients: ESICM clinical practice guidelines

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14. We suggest using EEN in critically ill adult patients with abdominal trauma after the continuity of the GI tract is confirmed/restored (conditional recommendation based on expert opinion = Grade 2D)

15. We suggest delaying EN in critically ill adult patients with overt bowel ischaemia (conditional recommendation based on expert opinion = Grade 2D)

16. We suggest delaying EN in critically ill adult patients with high-output intestinal fistula if reliable feeding access distal to the fistula is not achievable (conditional recommendation based on expert opinion = Grade 2D)

17. We suggest using EEN in critically ill adult patients with an open abdomen (conditional recommendation based on expert opinion = Grade 2D)

18a. We suggest using EEN in patients with intra-abdominal hypertension without intraperitoneal hypertension, abdominal compartment syndrome, but consider temporary reduction or discontinuation of EN when intra-abdominal pressure is >12 mmHg, and tolerance of EN is essential (conditional recommendation based on expert opinion = Grade 2D)

18b. We suggest delaying EN in critically ill adult patients with abdominal compartment syndrome (conditional recommendation based on expert opinion = Grade 2D)

19. We suggest delaying EN in patients with active upper GI bleeding, and starting EN when the bleeding has stopped and no signs of rebounding are observed (conditional recommendation based on expert opinion = Grade 2D)

20. We suggest starting low dose enteral nutrition when acute, immediately life-threatening metabolic derangements are controlled with or without liver support strategies, independent on grade of encephalopathy (conditional recommendation based on expert opinion = Grade 2D)

21. We suggest delaying EN in critically ill adult patients if gastric aspirate volume is above 500 ml/h (conditional recommendation based on expert opinion = Grade 2D)

22. We suggest using EEN in critically ill adult patients regardless of the presence of bowel sounds unless bowel ischaemia or obstruction is suspected (conditional recommendation based on expert opinion = Grade 2D)

23. We suggest using EEN in critically ill adult patients presenting with diarrhoea (conditional recommendation based on expert opinion = Grade 2D)

24. We suggest using EEN in critically ill adult patients with overt bowel ischaemia / high-output intestinal fistula, abdominal compartment syndrome, active upper GI bleeding. If gastric aspirate volume is above 500 ml/h
Why protocols for enteral nutrition in ICU?

JC Preiser D Ledoux Crit Care Med 2004

• Interest of early enteral nutrition
• Systematic gastrointestinal dysfunction during critical illness
• Frequent complications
  • High gastric residues, pulmonary aspiration
  • Diarrhoea - constipation
  • Gut ischemia - non occlusive bowel necrosis
• Multidisciplinary (doctors, nurses, dieticians)
• Cost-effectiveness
Influence of the Canadian algorithm on nutritional support

Martin CMAJ 2004;170:197

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Fig. 3: Cluster-specific mean proportions, and 95% confidence intervals, of patients receiving nutritional support in the appropriately randomized control and intervention hospitals on each study day. Day 1 is the day of ICU admission. The p values were obtained from a t test of cluster-specific means.
1- Prescribe a nutrition goal (ml/h)
2- Let the nurse apply the protocol:

Gastric Residual Vol /6h

< 250 ml
- Keep perfusion rate or increase it by a factor 2 to reach the goal

> 250 ml
- Decrease the infusion rate by half
- Consider pro-motility agents

Gastric residual volume

< 250 ml
- Keep perfusion rate or increase it by a factor 2 to reach the goal

> 250 ml
- Decrease infusion rate by half
- Consider pro-motility agents
Impact of the use of the implementation of a enteral feeding protocol
M De Ryckere et al Nutr Clin Metab 2013;27:5

Difference between recommended prescription (25 kcal/kg/d) and actual prescription
Impact of the use of the implementation of a enteral feeding protocol
M De Ryckere et al Nutr Clin Metab 2013;27:5

Difference between target caloric intake and actual caloric delivery

![Graph showing the difference between target caloric intake and actual caloric delivery.](image)
Impact of the use of the implementation of a enteral feeding protocol
M De Ryckere et al Nutr Clin Metab 2013;27:5

Time needed to reach the target

Graph showing:
- Time (Temp[H]) on the y-axis from 0 to 70
- Two bars representing 'PRE' and 'POST'
- 'PRE' has a time of 32.825 hours
- 'POST' has a time of 11.85 hours
- The difference is statistically significant (p = 0.001)
The 3 post-injury phases

Energy expenditure (kcal/day)

Preiser, Ichai, Orban, Groeneveld

Metabolic response to the stress of critical illness
Take-home messages

• Permissive underfeeding should be considered during the early phase of critical illness ONLY
• Implies caloric and protein restriction
• Similar policy regardless of the severity of disease and related « nutrition risk »?
Hippocrates (470-377 BC)
“Let food be your cure, and let your cure be your food”

*Primum non nocere*… with an inappropriate nutrition, ie avoid high caloric intakes during the acute phase, low caloric intakes during the late phase
Grading quality of evidence and strength of recommendations
GRADE Working Group

**High** = Further research is very unlikely to change our confidence in the estimate of effect.

**Moderate** = Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.

**Low** = Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.

**Very low** = Any estimate of effect is very uncertain.
Final recommendation (grade A++)

- Stay tuned and keep your mind open!