Recipe for optimal nutrition therapy in the critically ill child

Lee Jan Hau, MBBS, MRCPCH, MCI
Children’s Intensive Care Unit
24th September 2015
Some of the work presented in this talk were supported with funding from Nestle Nutrition Institute
Outline

• Establish the impact of malnutrition in the pediatric intensive care unit

• What would we need to consider in implementing an ideal recipe for optimal nutrition for the critically ill child?

• Is there such a recipe?
Nutritional Status Based on Body Mass Index Is Associated With Morbidity and Mortality in Mechanically Ventilated Critically Ill Children in the PICU

<table>
<thead>
<tr>
<th>Outcomes</th>
<th>OR</th>
<th>95% CI</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>1.53</td>
<td>1.24–1.89</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Overweight</td>
<td>1.44</td>
<td>0.94–2.19</td>
<td>0.09</td>
</tr>
<tr>
<td>Obese</td>
<td>1.35</td>
<td>0.87–2.10</td>
<td>0.14</td>
</tr>
<tr>
<td>Infections</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight</td>
<td>1.88</td>
<td>1.18–3.01</td>
<td>0.008</td>
</tr>
<tr>
<td>Overweight</td>
<td>1.42</td>
<td>0.99–2.06</td>
<td>0.06</td>
</tr>
<tr>
<td>Obese</td>
<td>1.64</td>
<td>1.38–2.03</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

- N = 1622
- Looking at the association between admission BMI with mortality and hospital acquired infections
- Weight and height measured in 91% and 72% of children respectively

Caloric Intake Impacts on Mortality

- Prospective observational study
- 31 centers from 8 countries (n = 500)
- An association between energy adequacy and 60-day hospital mortality
- Children who received > 66.7% of caloric requirement had an adjusted OR of 0.14 (95% CI: 0.03 – 0.61) of dying

Protein intake is also important

- Prospective observational study
- 59 PICUs from 15 countries
- After adjusting for severity of illness, PICU days and energy intake, enteral protein intake was associated with mortality


N = 1245
Nutrition Delivery Affects Outcomes in Pediatric Acute Respiratory Distress Syndrome

Judith Ju-Ming Wong, MBChB AAO, MRCPCH1; Wee Meng Han, Ph D2; Rehena Sultana, MSc3; Tsee Foong Loh, MBBS, MRCPCH4; and Jan Hau Lee, MBBS, MRCPCH, MCI4,5

- Nutritional data over the first 7 days of ARDS
- Adequate calories: ≥ 80% of resting energy expenditure by day 3 of ARDS
- Adequate protein: ≥ 1.5 g/kg/day of protein by day 3 of ARDS
- Primary clinical outcomes: PICU mortality
- Secondary outcomes: Ventilator-free days and PICU-free days, multi-organ dysfunction and need for ECMO
Wong et al. *JPEN* 2016
After adjusting for severity illness scores, oxygenation index, presence of comorbidities, inadequate protein intake was associated with mortality

Wong et al. *JPEN* 2016
Outline

• Establish the impact of malnutrition in the pediatric intensive care unit

• What would we need to consider in implementing an ideal recipe for optimal nutrition for the critically ill child?

• Is there such a recipe?
Recipe = Protocol?

• Initiation and advancement of enteral nutrition (EN)
  – Bolus feeding
  – Continuous feeding

• Definitions for EN intolerance
  – gastric residual volume (threshold differs)
  – Clinical examination findings

• When to start one of the EN adjuncts
  – Prokinetics
  – Nasojejunal feeding

• What are the contraindications for the protocol

• What are your nutritional goals

• When to start total parenteral nutrition
Improvement in time of initiation and achievement of goal feeds

Reduction in infective and gastrointestinal complications
Are We Ready?

Perceptions of Pediatric Critical Care Nurses on the Initiation of a Nursing-Led Feeding Protocol

Angela Hui Ping Kirk¹* • Brenda Sok Peng Ng² • Ang Noi Lee³ • Bixia Ang⁴ • Jan Hau Lee⁵

• 64/74 (86%) was keen to implement a feeding protocol

• There was no association between readiness to adopt a feeding protocol with years of PICU experience and educational level

Impact of a nurse-led feeding protocol in a pediatric intensive care unit

Bixia Ang¹, Wee Meng Han¹, Judith Ju-Ming Wong², Ang Noi Lee³, Yoke Hwee Chan⁴ and Jan Hau Lee⁴,⁵

• Observational descriptive study
• 40 patients were recruited across both periods
• There was no difference in median duration taken to initiate feeds [20.0 (IQR 17.0, 37.5 vs. 21.5 (IQR 10.5, 27.0) hours, p = 0.516)
Nurse-led Feeding Protocol: A Longitudinal Study

<table>
<thead>
<tr>
<th>Medians (25th, 75th centiles)</th>
<th>Pre-protocol</th>
<th>Post-protocol</th>
<th>p value</th>
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<td>Percentage caloric intake over seven days</td>
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<th>Pre-protocol</th>
<th>Post-protocol</th>
<th>Both groups combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory distress</td>
<td>12.0 (7.5, 17.3)</td>
<td>10.0 (5.8, 16.0)</td>
<td>12.0 (6.0, 17.8)</td>
</tr>
<tr>
<td>Extubation/Intubation</td>
<td>10.0 (8.0, 10.0)</td>
<td>9.0 (8.0, 11.3)</td>
<td>10.0 (8.0, 11.0)</td>
</tr>
<tr>
<td>Radiological procedures</td>
<td>9.5 (8.0, 11.0)</td>
<td>7.0 (6.3, 7.8)</td>
<td>8.0 (7.0, 11.0)</td>
</tr>
</tbody>
</table>

Protocol Version 2

- Underwent revision of the original protocol
- Faster rate of increase
- Introduce the concept of caloric requirements and move away from fluid requirements
- Feeding calculator
Outline

• Establish the impact of malnutrition in the pediatric intensive care unit

• What would we need to consider in implementing an ideal recipe for optimal nutrition for the critically ill child?

• Is there such a recipe?
What does Cochrane Library say?

- A systematic review was performed because of lack of clear guidelines to the best form or timing of nutrition in critically ill infants and children.

- Only one trial as relevant.
  - 77 children with burns > 25% of the total body surface area.
  - Randomized to either enteral nutrition within 24 hours or after at least 48 hours.
  - No statistically significant differences were observed for mortality, sepsis, ventilator days, and length of stay.

- Research is urgently needed to identify best practices regarding the timing and forms of nutrition for critically ill infants and children.

Joffe et al. *Cochrane Database Syst Rev. 2016*
Does the ideal recipe exist?

- Heterogeneity exists among patients we encounter in the PICU
- Setup and logistics considerations differ among PICUs

Leong et al. *Ped Crit Care Med* 2014
Wong et al. *Asia Pac J Clin Nutr* 2016
Stratified Approach to Our Patients

- Medical patients
- Surgical patients
- Cardiothoracic patients in the PICU
- Children on ECMO
Pre-operative nutrition algorithm

Post-operative nutrition algorithm

• Weight and height should be measured in all children on admission to the PICU
• Indirect calorimetry remains the gold standard for estimating resting energy requirement
• Enteral nutrition is the preferred mode of nutritional support in critically ill children with functional gastrointestinal tract and no absolute contraindications
• Total parenteral nutrition should be considered when EN is contraindicated
• Nutrition should be emphasized as part of everyday patient management in the PICU
Conclusion

• We need to be mindful of caloric and protein provision in critically ill children

• A “one-size-fits-all” recipe probably does not exist

• There is a pressing need for more research in pediatric critical care nutrition within the region to identify unique gaps and solutions
Thank you

lee.jan.hau@singhealth.com.sg
A Canadian Survey of Perceived Barriers to Initiation and Continuation of Enteral Feeding in PICUs

Amanda Y. Leong, BSc¹; Kristina R. Cartwright¹; Gonzalo Garcia Guerra, MD, MSc²; Ari R. Joffe, MD, FRCPC²; Vera C. Mazurak, PhD¹; Bodil M. K. Larsen, PhD, RD³

Leong et al.  Ped Crit Care Med 2014
Nutritional practices and their relationship to clinical outcomes in critically ill children—An international multicenter cohort study*

Nilesh M. Mehta, MD; Lori J. Bechard, MEd, RD, LDN; Naomi Cahill, RD, MSc; Miao Wang, MSc; Andrew Day, MSc; Christopher P. Duggan, MD, MPH; Daren K. Heyland, MD, MSc

- 29/31 (93%) sites had dedicated intensive care unit dietician
- 10/31 (32%) units had guidelines/protocols for initiating and advancing enteral nutrition intake
- Timing of initiation of enteral nutrition
- Use of motility agents

Metha et al. *Crit Care Med* 2012
Survey of contemporary feeding practices in critically ill children in the Asia-Pacific and the Middle East

Judith JM Wong MBBC, MRCPCCH, Chengsi Ong BS, MS, Wee Meng Han PhD, Nilesh M Mehta MD, Jan Hau Lee MBBS, MRCPCCH, MCI

- 35 centers from 18 countries
- Dedicated dietitian in 13 (37%) center
- 11 (31%) centers utilized feeding protocols
- Lack of consensus on when to start feeding and when to use feeding adjuncts
- 156 PICUs from 52 countries
- 52% have nutrition protocols
- 57% have nutrition support teams
- < 15% have indirect calorimetry
- 60% aim to start enteral nutrition within 24 hours of PICU admission

All had elements for initiation and advancement of EN

All had definitions for EN intolerance
- 7/9 used gastric residual volume (threshold differs)

All had recommendations for one of the EN adjuncts

6/7 had contraindications stated

7/9 had nutritional goals
  - All are diversely defined

Objectives

• Establish the impact of malnutrition in the PICU

• Challenges in nutrition therapy in the PICU

• Current recommendations on optimal nutrition in the PICU
The 1st Asia Pacific – Middle East Consensus Working Group on Nutrition Therapy in the Paediatric Critical Care Environment
Early versus Late Parenteral Nutrition in Critically Ill Children

Tom Fivez, M.D., Dorian Kerklaan, M.D., Dieter Mesotten, M.D., Ph.D., Sascha Verbruggen, M.D., Ph.D., Pieter J. Wouters, M.Sc., Ilse Vanhorebeek, Ph.D., Yves Debaveye, M.D., Ph.D., Dirk Vlasselaers, M.D., Ph.D., Lars Desmet, M.D., Michael P. Casaer, M.D., Ph.D., Gonzalo Garcia Guerra, M.D., Jan Hanot, M.D., Ari Joffe, M.D., Dick Tibboel, M.D., Ph.D., Koen Joosten, M.D., Ph.D., and Greet Van den Berghe, M.D., Ph.D.

- 1440 patients randomized at 3 centers
- Early (within 24 hours) vs. late (Day 8) parenteral nutrition
- Nosocomial PICU infections and length of PICU stay
Limitations

• 55% of patients in early PN group discharged by day 4
• 77% of patients in late PN group were discharged by day 8 without received any PN
• Caloric requirement calculation differed across all 3 centers
• Assessment of malnutrition used in the study has not been validated in critically ill children

Metha et al. NEJM 2016
A minimum intake of **57 kcal/kg/day** and **1.5 g protein/kg/day** associated with positive protein balance

Bechard et al. *J Peds* 2012
Worldwide Survey of Nutritional Practices in PICUs*

Dorian Kerklaan, MD¹; Tom Fivelz, MD²; Nilesh M. Mehta, MD³; Dieter Mesotten, MD, PhD⁴; Joost van Rosmalen, PhD⁴; Jessie M. Hulst, MD, PhD⁵; Greet Van den Berghe, MD, PhD⁵; Koen F. M. Joosten, MD, PhD⁶; Sascha C. A. T. Verbruggen, MD, PhD¹

Objective: To assess current nutritional practices in critically ill children worldwide.

Design: A two-part online, international survey. The first part, "the survey," was composed of 59 questions regarding nutritional strategies and protocols (July–November 2013). The second part surveyed the "point prevalence" of nutritional data of patients present in a subgroup of the responding PICUs (May–September 2014).

Setting: Members of the World Federation of Pediatric Intensive and Critical Care Societies were asked to complete the survey.

Subjects: Pediatric critical care providers.

Interventions: Survey.

*See also p. 85.

¹Intensive Care Unit, Department of Paediatrics and Pediatric Surgery, Erasmus Medical Centre, Sophia Children's Hospital, Rotterdam, The Netherlands.

²Clinical Division and Laboratory of Intensive Care Medicine, Department Cellular and Molecular Medicine, KU Leuven University, Leuven, Belgium.

³Critical Care Medicine, Department of Anesthesiology, Perioperative and Pain Medicine, and Center for Nutrition, Division of Gastroenterology, Hepatology and Nutrition, Boston Children's Hospital, Harvard Medical School, Boston, MA.

⁴Department of Biostatistics, Erasmus MC, Rotterdam, The Netherlands.

⁵Department of Pediatric Gastroenterology, Erasmus MC-Sophia Children's Hospital, Rotterdam, The Netherlands.

Drs. Kerklaan and Fivelz contributed equally.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF.

Measurements and Main Results: We analyzed 189 responses from 156 PICUs in 52 countries (survey). We received nutritional data on 295 patients from 41 of these 156 responding PICUs in 27 countries (point prevalence). According to the "survey", nutritional protocols and support teams were available in 52% and 57% of the PICUs, respectively. Various equations were used to estimate energy requirements; only in 14% of PICUs, indirect calorimetry was used. Nutritional targets for macronutrients, corrected for age/weight, varied widely. Enteral nutrition would be started early (within 24 hr of admission) in 60% of PICUs, preferably by the gastric route (88%). In patients intolerant to enteral nutrition, parenteral nutrition would be started within 48 hours in 55% of PICUs. Overall, in 72% of PICUs supplemental parenteral nutrition would be used if enteral nutrition failed to meet at least 50% of energy delivery goal. Several differences between the intended (survey) and the actual (point prevalence) nutritional practices were found in the responding PICUs, predominantly overestimating the ability to adequately feed patients.

Conclusion: Nutritional practices vary widely between PICUs worldwide. There are significant differences in macronutrient goals, estimating energy requirements, timing of nutrient delivery, and threshold for supplemental parenteral nutrition. Uniform consensus-based nutrition practices, preferably guided by evidence, are desirable in the PICU. (Pediatr Crit Care Med 2016; 17:10–18)

Key Words: enteral nutrition; intensive care units; nutritional support; parenteral nutrition; pediatric; questionnaires
<table>
<thead>
<tr>
<th>Characteristics of protocols</th>
<th>Briassoulis et al\textsuperscript{27}</th>
<th>Petrillo-Albarame et al\textsuperscript{24}</th>
<th>Braudis et al\textsuperscript{21}</th>
<th>Tume et al</th>
<th>del Castillo et al\textsuperscript{21}</th>
<th>Geukers et al\textsuperscript{21}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusion/exclusion criteria</td>
<td>NS</td>
<td>Clear exclusion criteria given</td>
<td>NS</td>
<td>NS</td>
<td>Clear exclusion criteria given</td>
<td>Clear exclusion criteria given</td>
</tr>
<tr>
<td>Indication for PN</td>
<td>NS</td>
<td>If EN not tolerated</td>
<td>IF EN contraindicated</td>
<td>IF EN</td>
<td>Persistent high GRVs</td>
<td>Persistent high GRVs</td>
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<tr>
<td>Anthropometric monitoring</td>
<td>Weight, height</td>
<td>Weight</td>
<td>Weight</td>
<td>Weight</td>
<td>Weight, length, head circumference,</td>
<td>Weight</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>abdominal girth</td>
<td></td>
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<tr>
<td>Method of estimating energy</td>
<td>Schofield equation</td>
<td>White equation</td>
<td>Estimated average requirements</td>
<td>NS</td>
<td>WHO equation</td>
<td>WHO equation</td>
</tr>
<tr>
<td>requirements</td>
<td></td>
<td></td>
<td>(Department of Health 1991)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Type of formula</td>
<td>Nutrisond Pediatric (&lt;10 years)</td>
<td>Kindercal or Pediasure</td>
<td>Either Pedialyte (if never fed previously) or EBM/formula</td>
<td>NS</td>
<td>Start with Pedialyte and progress to EBM or formula (EBM or elemental formula if heme+ stools)</td>
<td>Commercially available ready-made solutions based on age</td>
</tr>
<tr>
<td>Standard formulas (&lt;10 years)</td>
<td></td>
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</tr>
<tr>
<td>Dose at initiation</td>
<td>Started as 50% predicted PBMR on D1</td>
<td>10 ml/hr</td>
<td>1 ml/hr for 4 hrs (&lt;2.5 kg), or 25 ml/hr for 4 hrs (&gt;2.5 kg)</td>
<td>Full target feeds initiated at 2 hourly boluses</td>
<td>Start at 25% of target volume</td>
<td>Start at 25% of target volume</td>
</tr>
<tr>
<td>Target time of initiation</td>
<td>&lt;12 hr</td>
<td>&lt;6 hr</td>
<td>&lt;6 hr</td>
<td>NS</td>
<td>&lt;24 hr</td>
<td>&lt;24 hr</td>
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<tr>
<td>from ICU admission</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Dose advancement</td>
<td>100% PBMR at D2</td>
<td>Increase by 5 ml/hr every 2 hr</td>
<td>Increase by 1 ml/hr (&lt;2.5 kg) or 25 ml/hr every 4 hr if tolerated</td>
<td>Full target feeds progressed to 3 hourly or 4 hourly boluses</td>
<td>Increase by 3 ml/hr every 4 hours if tolerated</td>
<td>Increase by 25% every 4 hours if tolerated</td>
</tr>
<tr>
<td></td>
<td>125% PBMR at D3</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td></td>
<td>150% PBMR at D4 and D5</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>GRV monitoring</td>
<td>Checked GRV every 4 hr (&lt;25% of the feed volume given accepted)</td>
<td>No routine measurement of GRV once feeding started</td>
<td>Checked GRV every 4 hr (&lt;50% of feed volume given accepted)</td>
<td>Checked GRV every 4 hr (&lt;50% of feed volume given accepted)</td>
<td>Checked GRV every 4 hr (&lt;50% of feed volume given accepted)</td>
<td>Checked GRV every 4 hr (&lt;50% of feed volume given accepted)</td>
</tr>
<tr>
<td>Continuous or bolus/interval</td>
<td>All started with continuous feeds</td>
<td>All started with continuous feeds</td>
<td>All started with continuous feeds</td>
<td>Continuous feeds considered if persistently high GRV</td>
<td>All started with continuous feeds</td>
<td>All started with continuous feeds</td>
</tr>
<tr>
<td>feeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motility agents</td>
<td>Cisapride started if there were high GRVs</td>
<td>Metochlorpromide started if there were high GRVs</td>
<td>Metochlorpromide started if there were high GRVs</td>
<td>Erythromycin started if there were high GRVs</td>
<td>Metochlorpromide started if there were high GRVs</td>
<td>NS</td>
</tr>
<tr>
<td>Acid suppressants</td>
<td>NS</td>
<td>NS</td>
<td>Ranitidine if NBM</td>
<td>NS</td>
<td>Ranitidine or lansoprazole for all patients</td>
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<tr>
<td>Gastric or small bowel</td>
<td>All had intragastric feeding</td>
<td>NS</td>
<td>Small bowel feeding if patients not tolerating intragastric feeding</td>
<td>Small bowel feeding if persistent high GRVs</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>feeding</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Signs of intolerance</td>
<td>NS</td>
<td>Clearly stated</td>
<td>Clearly stated</td>
<td>Clearly stated</td>
<td>Clearly stated</td>
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<tr>
<td>Nurse driven</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Only 6 of 9 studies had description of the protocol in their published study: D1-5, day 1-5; EBM, expressed breast milk; EN, enteral nutrition; GRV, gastric residual volume; ICU, intensive care unit; NBM, nil by mouth; NS, not specified; PBMR, predicted basal metabolic rate; PN, parenteral nutrition; WHO, World Health Organization.
Nurse-led Feeding Protocol: A Longitudinal Study

- Observational descriptive study
- 40 patients were recruited across both periods
- There was no difference in mean duration taken to initiate feeds (20.0 vs. 21.5 hours, \( p = 0.516 \))

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Mean (5th, 95th percentiles)

Lee et al. *Ped Crit Care Med* 2014
Review

Nutrition biomarkers and clinical outcomes in critically ill children: A critical appraisal of the literature

Chengsi Ong, Wee Meng Han, Judith Ju-Ming Wong, Jan Hau Lee

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SUMMARY
Background & aims: Malnutrition can significantly affect clinical outcomes in critically ill children. In view of the limitations of anthropometry, nutrition-related serum biomarkers have been used to assess the degree of malnutrition in the pediatric intensive care unit. The aim of this review is to critically appraise the use of nutrition-related serum biomarkers in predicting clinical outcomes in critically ill children.

Methods: We searched major databases (MEDLINE, EMBASE, CINAHL, Cochrane Library) using MeSH terms and key words related to “biomarkers”, “nutrition” and “critically ill children”. All studies that explored the relationship between any nutrition-related serum biomarker and clinical outcomes in critically ill children (1 day–18 years) were included. The clinical outcomes of interest were duration of intensive care unit or hospital stay, duration of mechanical ventilation and mortality.

Results: We found one randomized controlled trial and 15 observational studies involving 2068 children. In these 16 studies, 16 different nutritional biomarkers and two nutrition indices were examined. Albumin (n = 7), magnesium (n = 4), transferrin, prealbumin and calcium (n = 3 respectively) were the most commonly studied biomarkers. Seven biomarkers (25-hydroxyvitamin D, albumin, calcium, magnesium, total protein, transferrin, triglycerides) and two indices (modified nutritional index and Ondera’s prognostic nutritional index) had positive associations with clinical outcomes. However, no biomarkers or nutrition indices consistently predicted clinical outcomes.

Conclusions: Current medical literature does not provide convincing data to demonstrate any association between nutrition-related serum biomarkers and clinical outcomes in critically ill children. Further research is required to identify novel and clinically robust nutrition-related biomarkers.

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<table>
<thead>
<tr>
<th>Serum biomarkers</th>
<th>Positive correlations with clinical outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-Hydroxyvitamin D Albumin</td>
<td>PICU LOS</td>
</tr>
<tr>
<td></td>
<td>Hospital LOS</td>
</tr>
<tr>
<td></td>
<td>PICU LOS</td>
</tr>
<tr>
<td></td>
<td>Mortality</td>
</tr>
<tr>
<td></td>
<td>Post-operative infections</td>
</tr>
<tr>
<td></td>
<td>Duration of mechanical ventilation</td>
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<tr>
<td>Calcium</td>
<td>PICU LOS</td>
</tr>
<tr>
<td></td>
<td>Mortality</td>
</tr>
<tr>
<td>Magnesium</td>
<td>PICU LOS</td>
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<td></td>
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<tr>
<td>Modified nutritional index</td>
<td>Mortality</td>
</tr>
<tr>
<td>Onodera’s prognostic nutritional index</td>
<td>Mortality</td>
</tr>
<tr>
<td></td>
<td>Hospital LOS</td>
</tr>
<tr>
<td>Total protein</td>
<td>PICU LOS</td>
</tr>
<tr>
<td>Transferrin</td>
<td>Mortality</td>
</tr>
<tr>
<td></td>
<td>Mortality</td>
</tr>
<tr>
<td>Triglycerides</td>
<td>PICU LOS</td>
</tr>
<tr>
<td></td>
<td>Duration of mechanical ventilation</td>
</tr>
</tbody>
</table>

LOS: length of stay; PICU: pediatric intensive care unit.

Ong et al. Clinical Nutrition 2014