Original Article

Survey of contemporary feeding practices in critically ill children in the Asia-Pacific and the Middle East

Judith JM Wong MBBCh BAO, MRCPCH[1], Chengsi Ong BS, MS[2], Wee Meng Han PhD[2], Nilesh M Mehta MD[3], Jan Hau Lee MBBS, MRCPCH, MCI[4,5]

[1]*Department of Paediatric Medicine, KK Women's and Children's Hospital, Singapore*
[2]*Department of Dietetics and Nutrition, KK Women's and Children's Hospital, Singapore*
[3]*Critical Care Medicine, Boston Children's Hospital, Boston, United States of America*
[4]*Children's Intensive Care Unit, Department of Paediatric Subspecialties, KK Women's and Children's Hospital, Singapore*
[5]*Office of Clinical Sciences, Duke-NUS School of Medicine, Singapore*

Background and Objectives: Nutrition is a fundamental component of care of critically ill children. Determining variation in nutritional practices within paediatric intensive care units (PICUs) allows for review and improvement of nutrition practices. **Methods and Study Design:** The aim was to survey the nutrition practices and perspectives of paediatric intensivists and dieticians in Asia-Pacific and the Middle East. A questionnaire was developed to collect data on (1) the respondent's and institution's characteristics, (2) nutritional assessments and nutrient delivery practices, and (3) the perceived importance and barriers to optimal enteral feeding in the PICU. **Results:** We analysed 47 responses from 35 centres in 18 different countries. Dedicated dietetic services were only present in 13 (37%) centres and regular nutrition assessments were conducted in only 12 (34%) centres. In centres with dedicated dieticians, we found greater use of carbohydrate, fat additives and special formulas. Two thirds [31 (66%)] of respondents used total fluids to estimate energy requirements. Only 11 (31%) centres utilized feeding protocols. These centres had higher use of small bowel feeding, acid suppressants, laxatives and gastric residual volume thresholds. When dealing with feed intolerance, they were also more likely to start a motility agent. There was also a lack of consensus on when feeding should start and the use of adjuncts. **Conclusions:** Nutrition practices and barriers are unique in Asia-Pacific and the Middle East and strongly reflect a lack of dietetic services. Future effort should focus on developing a uniform approach on nutrition practices to drive paediatric critical care nutrition research in these regions.

Key Words: children, feeding, nutrition, paediatrics, survey

INTRODUCTION

Nutrition is a fundamental component of patient care and yet malnutrition is present in over 30% of paediatric intensive care unit (PICU) admissions.[1-3] Nutrition delivery is generally inadequate in mechanically ventilated children with overall energy and protein intake compared to prescribed goals of only 38% and 43% respectively.[1] On average, cumulative enteral energy intake reached just over 50% of the prescribed goal by day 6 of PICU admission. To compound this issue further, a large majority of feed interruptions in the PICU may be avoidable.[4]

Enteral nutrition (EN) in critically ill patients is associated with improvements in gut blood flow and mass, gut immunity, protein synthesis and wound healing, and overall survival after critical illness.[5,6] Recent studies have shown emerging consensus on bedside nutritional practices such as: (1) preference for enteral over parenteral route to feed critically ill children unless there are absolute contraindications, (2) comprehensive nutritional assessment at admission and accurate determination of energy requirements to avoid over or underfeeding, and (3) the use of enteral nutrition protocols to improve nutrient delivery and clinical outcomes.[1,7-13] However, many other nutritional practices are not supported by strong evidence and result in variation in practice.

Documenting actual practices surrounding EN and establishing reasons for these variations are important first steps to allow intensive care teams to review and potentially revise practices. Previous reports that have examined bedside practices were mainly conducted in Europe and North America.[14,15] The aim of this study is to determine paediatric critical care nutrition practices and perspectives in Asia-Pacific and the Middle East. Due to different socio-economic status and culture, we hypothesized that perceptions, practices and barriers related to nutrient delivery in the PICU in Asia-Pacific and the

Corresponding Author: Jan Hau Lee, KK Women's and Children's Hospital, 100 Bukit Timah Road, Singapore 229899.
Tel: +65 63941778; Fax: +65 6291 7923
Email: lee.jan.hau@kkh.com.sg
Manuscript received 17 November 2014. Initial review completed 31 December 2014. Revision accepted 10 January 2015.
doi: 10.6133/apjcn.2016.25.1.07

Middle East would be different from those previously reported in the literature.

MATERIALS AND METHODS

Development of the survey

This study was approved by our hospital's institutional review board and a waiver of consent was granted. The survey questionnaire comprised the main themes extracted from a recently published nutrition survey in the United Kingdom - this was modified based on current literature.[14] The pilot questionnaire had three main sections: (1) participant's level of experience and institution characteristics; (2) issues on nutritional assessment and different aspects of enteral and parenteral nutrition (e.g. initiation, volume adaptation, system of administration, types of solutions, prevention and treatment of complications); and (3) barriers to optimal enteral feeding and perspectives of intensive care providers about the importance of enteral feeding in the PICU. All questions were single-item questions without overlap and none of the questions permitted sum-scores. There were three types of closed ended questions. The first type of question had "yes", "no" or "don't know" type of response options. The second type asked for ranked answers. The third type of question utilised a five-point Likert scale ("strongly agree", "agree", "neutral", "disagree" or "strongly disagree"). For some of the questions, limited free comments could be added.

Because of the limited number of paediatric intensivists in Singapore, we ran a qualitative pilot test of the questionnaire on 7 adult and neonatal intensivists. The aim of the validation process was to assess the face (does the questionnaire "look like" it is going to measure what it is supposed to measure?) and content validity (do the questions reflect areas that are essential/useful to clarify the purpose of the study?). We also accepted comments and suggestions on the clarity of language to ensure ease of understand. No quantitative validation was done as most questions in this survey were factual and not subjective.

The main survey

The main survey was then uploaded onto Survey Monkey® (www.surveymonkey.com) and an invitation to participate was sent to potential respondents. The survey was only available in the English language. The target population were paediatric intensive care physicians and dieticians in Asia Pacific and the Middle East. The goal was to obtain responses to our questionnaire from representatives of most centres in the region. We therefore attempted to contact at least one representative from each country and asked them to secondarily invite dieticians in their respective regions to participate. We identified the representatives by several means - collaborative intensive care societies of the Society of Intensive Care Medicine (SICM), Singapore were identified and the survey invitation was sent by email to their presidents. Written invitations were handed out to paediatric intensivists from regions of interest at the 7th World Congress of Paediatric Intensive and Critical Care Congress 2014 at Istanbul, Turkey. Members of the Asia Pacific-Middle East Consensus Working Group on Nutrition Therapy in the Paediatric Critical Care Environment were also invited to participate. Intensivists from neonatal ICUs and adult ICUs were not eligible.

The study was conducted over April to August 2014. As a token of appreciation, each centre that participated received an academic textbook. No payments or other modes of gratuity were provided for completion of the study questionnaire.

Data analysis

Complete and partially complete surveys were included in the analysis. If a question was skipped, we analysed it as "don't know". If there was more than one response from a single centre, the responses were handled as follows:

For yes or no questions – if >60% answered "yes", response for the centre was analysed as "yes". This was to ensure results were conservative and not overestimate responses.

For ranking questions – analysed as frequency of ranking 1 or 2 (i.e. the two most important factors). These responses were analysed individually and not pooled according to centres.

For Likert scale questions – these questions mainly addressed perceptions of the respondents therefore each answer was analysed individually.

Categorical data was presented as counts and percentages. Continuous data was presented as medians and interquartile ranges. Differences between categorical variables were analyzed using the chi-square test or Fisher's exact test, whichever was appropriate. Statistical analysis was performed using SPSS version 19 (IBM, United States). All statistical tests were two-tailed, and the significance level was taken as $p<0.05$.

RESULTS

A total of 205 invitations were sent out. We received 62 (30%) responses, of which 47 responses from 35 centres in 18 different countries were included in the analyses (Table 1). Respondents included physicians (n=38) and dieticians (n=9).

Dietetic services and nutritional assessments

Only 13 (37%) centres reported presence of a dedicated dietician in their PICU. Centres that had a dedicated dietician were able to make regular assessments of their patients compared to centres that did not have a dedicated dietician (12/13 vs 0/22; $p<0.001$). The most common nutritional screening tool utilized was anthropometry [31 (66%)], followed by serum biomarkers [27 (57%)]. Dieticians preferred to use anthropometry (9/9 vs 22/38; $p=0.019$).

Daily energy delivery goals were most commonly based on total fluid requirement (e.g., 100 mL/kg for the first 10 kg, 50 mL/kg for the next 10 kg and 25 mL/kg for each subsequent kg) which was used by 31 (66%) of respondents. Energy goals were estimated using the Dietary Reference Index [15 (32%)] and Schofield equation [14 (30%)]. Three (9%) centres reported access to indirect calorimetry. Dieticians preferred to use the Schofield equation (7/9 vs 7/38; $p=0.001$) and physicians preferred to use total fluid requirement to estimate energy goals (30/38 vs 1/9; $p<0.001$).

Enteral and parenteral nutrition

Fifteen (32%) respondents aimed to initiate enteral nutrition by 24 hours. However, 11 (23%) had no specific time target for initiating enteral nutrition (Figure 1). More than three quarter [41 (87%)] of respondents used carbohydrate or fat additives (e.g. glucose polymers, medium chain triglycerides) to increase caloric content in their patients and 31 (66%) respondents used protein supplements to increase protein intake. Respondents from centres with a dedicated dietician were more likely to use additives compared to centres that did not have a dedicated dietician (14/14 vs 13/19; p=0.027). These respondents were also more likely to use special formulas like semi-elemental (12/14 vs 8/19; p=0.015) and elemental formulas 12/14 vs 7/19; p=0.011). Only 2 respondents used immune-modulating diets (e.g. eicosapentanoic acid, gamma-linoleic acid, arginine and glutamine). Indications for the use of these diets were severe gastrointestinal dysfunction, immunosuppression or for the neurosurgical patient.

Parenteral nutrition was used by 45 (96%) respondents to supplement caloric intake. Most respondents [30 (64%)] had no specific guidelines and timing for initiating parenteral nutrition (PN) (Figure 1). One centre did not have PN available. Soybean based lipid (e.g. intralipid, lipoven) was the most common lipid infusion used [28 (60%)], followed by SMOF (soybean, medium chain triglyceride, olive oil, fish oil) lipid [17 (36%)]. Feeding protocols did not influence the target time to start enteral or parenteral nutrition in this study.

EN delivery and the use of adjuncts

Thirty-nine (83%) respondents used gastric feeding as first line route of feeding. 34 (72%) were able to provide small bowel feeding when indicated, but 8 (17%) did not have this therapy available. Enteral nutrition delivery was reportedly preferred as bolus/interval or as continuous feeding by 32 (68%) and 8 (17%) respondents respectively.

Forty (85%) of respondents used motility agents to decrease gastro-intestinal transit time. The most common motility agents used were domperidone [30 (64%)], metoclorpromide [22 (47%)] and erythromycin [17 (36%)]. Respondents from centres with feeding protocols preferred to add a motility agent when encountering feed intolerance 7/19 vs 2/27 ranked 1 or 2; p=0.022). 39 (83%)

Table 1. Characteristics of respondents and centres

Respondent characteristics		Number of respondents (n=47) n (%)
Country of origin	Singapore	7 (15)
	Malaysia	5 (11)
	Australia	5 (11)
	China	5 (11)
	Philippines	4 (9)
	United Arab Emirates	3 (6)
	Thailand	3 (6)
	Japan	2 (4)
	Indonesia	2 (4)
	Bangladesh	2 (4)
	New Zealand	2 (4)
	India	1 (2)
	Vietnam	1 (2)
	Taiwan	1 (2)
	Saudi Arabia	1 (2)
	Oman	1 (2)
	Egypt	1 (2)
	Azerbaijan	1 (2)
Years of experience working in a PICU	<2 years	1 (2)
	2-5 years	8 (17)
	>5 years	35 (74)
PICU characteristics		**Number of centres (n=35) n (%)**
Type of patients	Medical (including oncology)	34 (97)
	Surgical	31 (89)
	Trauma	24 (69)
	Neurosurgical	23 (66)
	Cardiac	19 (54)
	Burns	17 (49)
Number of beds	<10	14 (40)
	10-20	14 (40)
	>20	6 (17)
Teaching center		26 (74)
Closed PICU		24 (69)
Dietetic services	Dedicated dietician	13 (37)
	Daily coverage (including weekends)	5 (14)
	Regular assessments	12 (34)
	Nutritional support team	9 (26)

respondents used acid suppressants with proton pump inhibitors being the most common. Forty-one (87%) respondents used laxatives either to treat or to prevent constipation, with osmotic agents being the most common laxative used. Probiotics were used by 24 (51%) respondents. Head of bed elevation was reportedly implemented routinely by 22 (47%) and only when indicated by 15 (32%) respondents. Use of small bowel feeding, acid suppressants, laxatives and gastric residual volumes (GRV) thresholds were also more prevalent in centres with feeding protocols.

Thirty-six (77%) respondents measured GRV. However, 27 (75%) were not able to comment on a specific cut off for GRV. Others considered GRV in excess of 50% of the last feed volume or >5 mL/kg as significant. Nevertheless, a majority of the respondents stated that the most important sign of gastro-intestinal intolerance was a high GRV (Figure 2). The most common action taken in the face of feed intolerance was to stop feeds, reduce the amount of feed volume, or switch a patient from bolus to continuous feeds.

Feeding protocol

Eleven (31%) centres used feeding protocols. There was no statistical significance in the frequency of use of motility agents, continuous feeds or small bowel feeds between centres that used a feeding protocol versus centres that did not (Figure 3). Most feeding protocols had specific instructions on feed initiation [10 (91%)], advancement [11 (100%)] and a monitoring regime for feed intolerance [10 (91%)]. Less than half of them [3-4 (27-36%)] had specifications on nutritional assessments and withholding of feeds for procedures.

Barriers to optimal nutrition

In order of frequency, the most commonly cited reasons for sub-optimal nutrition in the PICU were fluid restriction, gastro-intestinal intolerance and hemodynamic instability. Respondents from centres with feeding protocols were more likely to cite fasting for procedure as a reason for suboptimal nutrition (10/19 vs 5/27 ranked 1 or 2; p=0.025). Feeds were most often stopped for surgical procedures, intubation/extubation procedures and gastro-intestinal intolerance. Median fasting times for solids were 6 (IQR: 4, 8) hours for surgical procedures and 4 (IQR: 4, 6) hours for intubation/extubation and radiological procedures. There was no difference in fasting times with the use of feeding protocols. Common signs and symptoms of feed intolerance cited were high GRV, vomiting and abdominal distension (Figure 2). Respondents from centres with feeding protocol placed more emphasis on vomiting as a sign of feed intolerance (13/19 vs 6/27 ranked 1 or 2; p=0.003).

The 3 most commonly identified institutional challenges to optimal nutrition were inadequate education regarding the importance of nutrition in PICU [19 (40%)], non-ICU clinicians requesting for nil by mouth [18 (38%)] and manpower shortage [18 (38%)]. Many centres sought to address this problem by educational sessions, mainly in the form of bedside teaching, lectures and invited speakers. These challenges and solutions were similar across centres with and without feeding protocols.

Thirty-nine (83%) respondents stated that nutrition is an important issue in the PICU and 38 (81%) reported that nutrition can improve clinical outcomes. Thirty six respondents (77%) expressed that a feeding protocol is important to improve nutrient delivery. However, only 17 (36%) respondents felt that nutrition provided in their ICU was adequate.

DISCUSSION

To our knowledge this is the first survey of current nutritional practices and perceptions in the PICU and perceptions in the Asia Pacific and Middle East region. This survey identified practices and barriers unique to the region. There was a relative lack of dietetic services and inadequate nutrition assessments in PICU patients. We also found that many physicians use total fluids to estimate energy requirements which is an inaccurate method and frequently leads to overfeeding. Parenteral nutrition and small bowel feeding are not available in some centres reflecting limitation of resources in the region. There was also a lack of consensus on optimal time to initiate and the use of adjuncts to promote feeding in critically ill

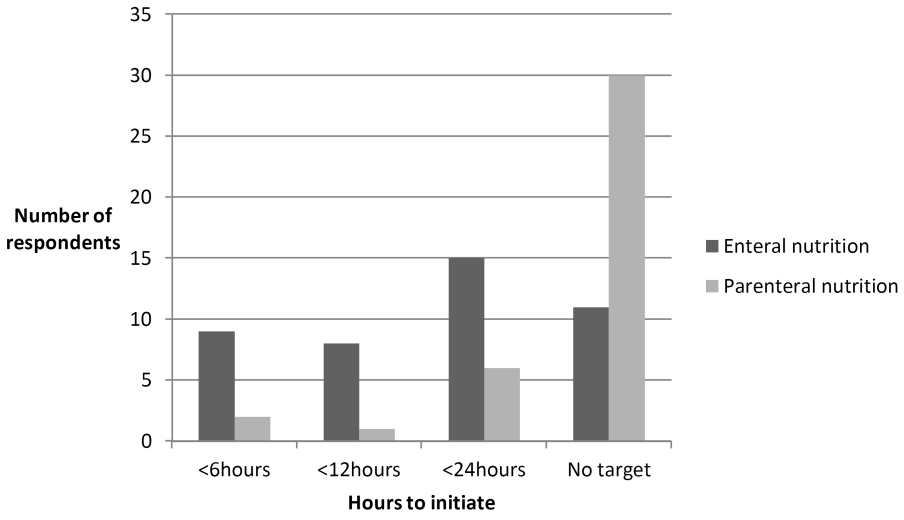

Figure 1. Target time to initiate enteral and parenteral nutrition.

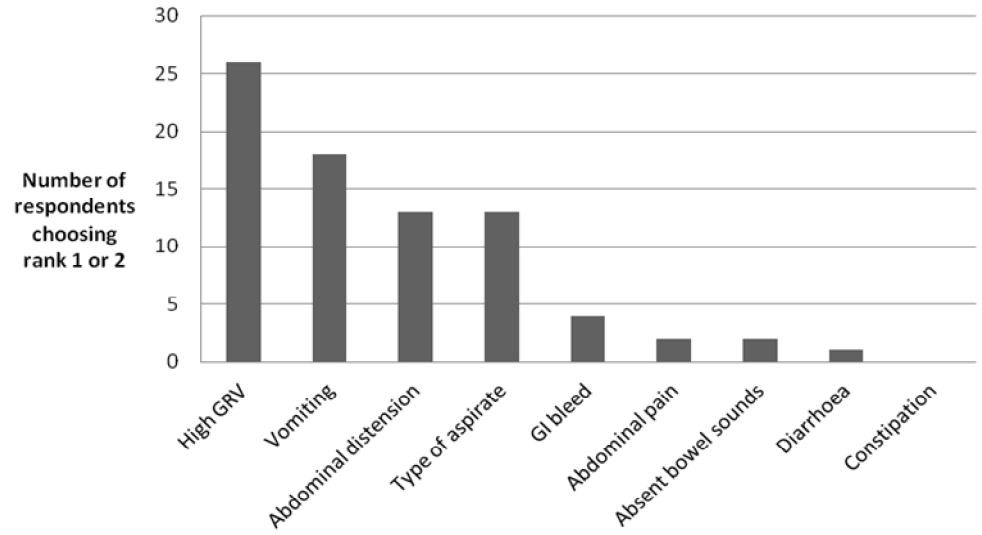

Figure 2. Signs of feed intolerance. GI: Gastrointestinal; GRV: Gastric residual volume.

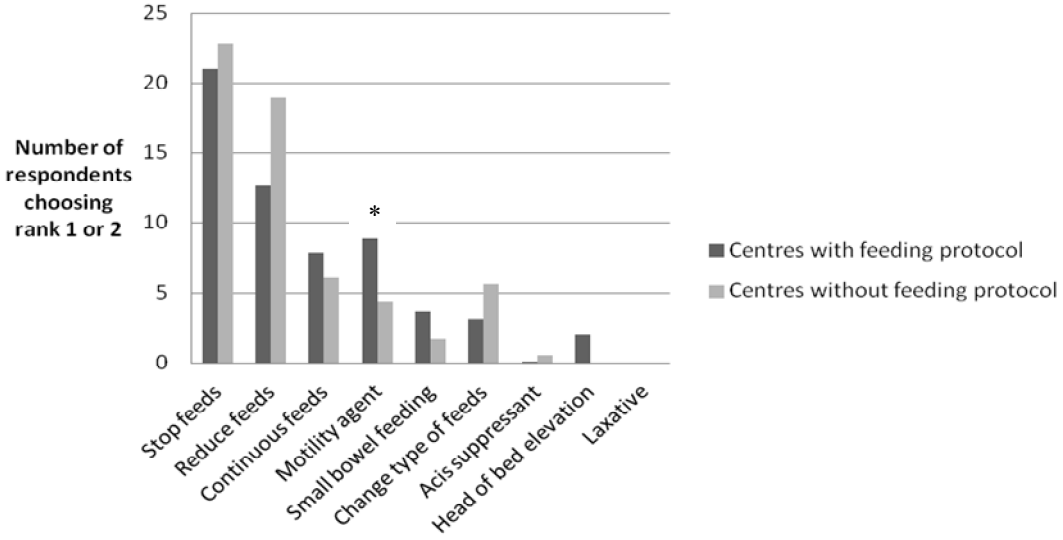

Figure 3. Comparison of methods for troubleshooting feed intolerance between centres with and without feeding protocols. *p=0.022.

children.

This nutrition survey involving countries in Asia-Pacific and the Middle East demonstrated a number of similarities as well as differences when compared with surveys done in North America and Europe, likely reflecting cultural differences and resource limitation. A multicentre cohort study involving 8 countries (mostly in America, Canada and Europe) reported that majority (93%) of centres had a dedicated intensive care dietician present, whereas from our survey, only 13 (37%) had this resource.[1] A nutrition support team was present in 9 (26%) of our centres. Feeding protocols were present in 11 (31%) centres from Asia-Pacific and the Middle East compared to 96% in United Kingdom and Ireland.[14] Almost all (91-100%) feeding protocols used in centres from our study included specific instructions on feed initiation, advancement and monitoring of feed intolerance as with other reports.[16] However, guidelines for nutrition assessment and energy goals are only included in 3 (27%) of them likely reflecting the lack of dietetic expertise. Although universal nutrition screening and subsequent regular nutrition assessments have been recommended, only 12 (34%) of centres in our study were able to conduct regular nutrition assessments.[16]

Most respondents used total fluids (the Holliday-Segar method) to estimate calorie requirements in their patients.[17] This practice likely reflects the fact that most of our respondents were physicians. In contrast, respondents who were dieticians never used total fluids to estimate calorie requirements. Estimating energy requirements by total fluid may lead to overfeeding.[18] Excess nutritional delivery during a period of critical illness can further increase the metabolic demands of acute injury and place an added burden on the lungs and liver.[9,19] This current practice further highlights the urgent need for provision of dietetics support in PICUs and the need for education tools in energy estimation for medical practitioners in our region.

As with PICUs worldwide, the use of GRV to discern feed tolerance was common.[14] Threshold GRVs are usually related to the previous volume of feed given, a volume per kilogram weight or an absolute amount.[20-22] A high

GRV has been associated with increased risk of finding pepsin-positive tracheal secretions in critically ill adult patients, but this association is not uniformly consistent and it is unclear if this surrogate marker actually leads to clinical aspiration.[23-25] In the paediatric population there are no studies that relate high GRV to clinical outcomes. There are also no studies that indicate a threshold value.[26] As a result, responding to an arbitrary GRV may cause unnecessary withholding of feeds and decreased nutrient delivery. Our respondents regard signs and symptoms like high GRVs, vomiting and abdominal distension as feed intolerance. This is given in the same sequence of importance as respondents from other studies.[14] As with previous published work, we found the main contraindications for enteral feeding were gastrointestinal concerns and hemodynamic instability and the main cause for overall suboptimal nutrition was fluid restriction.[14,27] 85% of our respondents used motility agents either routinely or as indicated; with domperidone being the most common agent used. This proportion is surprisingly high in comparison to previous studies reporting the usage of motility agents of only 16%.[27] In contrast, in most European and American centres, the use of metoclopramide and erythromycin are preferred compared to domperidone.[20-22,28] This variation in practice is likely due to the lack of efficacy studies of motility agents in children, with all available studies being limited to preterm neonates.[29-31]

Differences in findings between this survey and previous ones include the lack of dietetic resources in our region. This has led to ramifications especially with regards to the ability to conduct comprehensive nutrition assessments, monitor and estimate nutritional needs accurately. Lack of resources in the region is also evident from our finding that there are centres that do not have parenteral nutrition or the available equipment or expertise to provide small bowel feeding.

This survey has several limitations. We acknowledge that the response rate for this survey (30%) and total number of respondents were low; and this may have led to response bias and nonresponse error. We attempted several methods to increase representation at the various countries in the region but had to depend on these representatives to contact and secondarily invite eligible individuals. Our respondents were also more likely to come from tertiary/larger hospitals. All these factors could have resulted in respondents probably having an interest in PICU nutrition and therefore our findings may not be totally reflective of actual perceptions and practices on the floor, indicating selection bias. To mitigate this, we grouped multiple responses from a single centre and counted "yes/no" questions as "yes" only if >60% from that group agreed to ensure results were conservative and not overestimate responses. Another possible reason for the low response rate was that the survey was only available in English which is not the first language in many countries in the region. This study was also not designed to explore the actual caloric and macronutrient intake prescribed and received by patients. This information will be complimentary to the information ascertained from this study in order to determine the extent of discrepancy between current practice and our targets. Future studies should try to focus on determination of the actual caloric and macronutrient intake prescribed and received by patients. The role of GRVs in critically ill paediatric patients and the efficacy of motility agents are also areas for future investigations.

Conclusion

Nutrition practices in Asia Pacific – Middle East are different compared to other parts of the world. We found that dietetic services, the use of feeding protocols and nutrition education were limited in this region. We also identified practices that lack evidence-base, such as the use of gastric residual volumes and the use of total fluids to estimate energy requirements. Future effort should focus on developing a regional consensus statement that provides guidance on optimal nutrition practices for critically ill children. This will help direct future research efforts in paediatric critical care nutrition in these regions.

ACKNOWLEDGEMENT

We would like to thank the members of the Asia Pacific-Middle East Consensus Working Group on Nutrition Therapy in the Paediatric Critical Care Environment: Dr Ali Ibrahim Al-Mehaidib, King Faisal Specialist Hospital & Research Centre, Kingdom of Saudi Arabia; Dr Yer Kee Chor, Sarawak General Hospital, Malaysia; Dr Pei Lin Koh, National University Hospital, Singapore; Dr Mohamad Miqdady, Sheikh Khalifa Medical City, United Arab Emirates; Dr Antonius Pudjiadi, Cipto Mangunkusumo Hospital, Indonesia; Ms. Elizabeth Rogers, Royal Children's Hospital, Australia; Dr Rujipat Samransamruajkit, Chulalongkorn Hospital, Thailand and Dr Sunit Singhi, Post Graduate Institute of Medical Education & Research, India. We would also like to thank Nestle Health Science for their kind sponsorship of the paediatric critical care nutrition textbooks, the online survey and the publication fees; as well as Ms. Sylvaine Barbier from the Centre for Quantitative Medicine of Duke-NUS Graduate Medical School Singapore for statistical support.

AUTHOR DISCLOSURES

All the authors have no disclosures.

REFERENCES

1. Mehta NM, Bechard LJ, Cahill N, Wang M, Day A, Duggan CP et al. Nutritional practices and their relationship to clinical outcomes in critically ill children: an international multicenter cohort study. Crit Care Med. 2012;40:2204-11. doi: 10.1097/CCM.0b013e31824e18a8.
2. Hulst J, Joosten K, Zimmermann L, Hop W, van Buuren S, Buller H et al. Malnutrition in critically ill children: from admission to 6 months after discharge. Clin Nutr. 2004;23: 223-32. doi: 10.1016/S0261-5614(03)00130-4.
3. Pollack MM, Wiley JS, Kanter R, Holbrook PR. Malnutrition in critically ill infants and children. JPEN J Parenter Enteral Nutr. 1982;6:20-4. doi: 10.1177/01486071 8200600120.
4. Mehta NM, McAleer D, Hamilton S, Naples E, Leavitt K, Mitchell P et al. Challenges to optimal enteral nutrition in a multidisciplinary pediatric intensive care unit. JPEN J Parenter Enteral Nutr. 2010;34:38-45. doi: 10.1177/014860 7109348065.
5. Prieto MB, Cid JLH. Malnutrition in the critically Ill child: the importance of enteral nutrition. Int J Environ Res Public Health. 2011;8:4353-66. doi: 10.3390/ijerph8114353.
6. de Souza Menezes F, Leite HP, Koch Nogueira PC. Malnutrition as an independent predictor of clinical outcome

in critically ill children. Nutrition. 2012;28:267-70. doi: 10.1016/j.nut.2011.05.015.
7. Botran M, Lopez-Herce J, Mencia S, Urbano J, Solana MJ, Garcia A et al. Relationship between energy expenditure, nutritional status and clinical severity before starting enteral nutrition in critically ill children. Br J Nutr. 2011;105:731-7. doi: 10.1017/S0007114510004162.
8. Briassoulis G, Venkataraman S, Thompson AE. Energy expenditure in critically ill children. Crit Care Med. 2000;28:1166-72.
9. Mehta NM, Bechard LJ, Dolan M, Ariagno K, Jiang H, Duggan C. Energy imbalance and the risk of overfeeding in critically ill children. Pediatric Crit Care Med. 2011;12:398-405. doi: 10.1097/PCC.0b013e3181fe279c.
10. Oosterveld MJ, Van Der Kuip M, De Meer K, De Greef HJ, Gemke RJ. Energy expenditure and balance following pediatric intensive care unit admission: a longitudinal study of critically ill children. Pediatric Crit Care Med. 2006;7:147-53. doi: 10.1097/01.PCC.0000194011.18898.90.
11. Hamilton S, McAleer DM, Ariagno K, Barrett M, Stenquist N, Duggan CP et al. A stepwise enteral nutrition algorithm for critically Ill children helps achieve nutrient delivery goals. Pediatric Crit Care Med. 2014;1:583-9. doi: 10.1097/PCC.0000000000000179.
12. Meyer R, Harrison S, Sargent S, Ramnarayan P, Habibi P, Labadarios D. The impact of enteral feeding protocols on nutritional support in critically ill children. J Hum Nut Diet. 2009;22:428-36. doi: 10.1111/j.1365-277X.2009.00994.x.
13. Wong JJ, Ong C, Han WM, Lee JH. Protocol-driven enteral nutrition in critically ill children: a systematic review. JPEN J Parenter Enteral Nutr. 2014;38:29-39. doi: 10.1177/0148607113502811.
14. Tume L, Carter B, Latten L. A UK and Irish survey of enteral nutrition practices in paediatric intensive care units. Br J Nutr. 2013;109:1304-22. doi: 10.1017/S0007114512003042.
15. Heyland DK, Schroter-Noppe D, Drover JW, Jain M, Keefe L, Dhaliwal R et al. Nutrition support in the critical care setting: current practice in canadian ICUs--opportunities for improvement? JPEN J Parenter Enteral Nutr. 2003;27:74-83. doi: 10.1177/014860710302700174.
16. Martinez EE, Bechard LJ, Mehta NM. Nutrition algorithms and bedside nutrient delivery practices in pediatric intensive care units: an international multicenter cohort study. Nutr Clin Pract. 2014;29:360-7. doi: 10.1177/0884533614530762.
17. Meyers RS. Pediatric fluid and electrolyte therapy. J Pediatr Pharmacol Ther. 2009;14:204-11. doi: 10.5863/1551-6776-14.4.204.
18. Blinman T, Cook R. Allometric prediction of energy expenditure in infants and children. Infant Child Adolesc Nutr. 2011;3:216-24. doi: 10.1177/1941406411414416.
19. Chwals WJ. Overfeeding the critically ill child: fact or fantasy? New Horiz. 1994;2:147-55.
20. Briassoulis GC, Zavras NJ, Hatzis MT. Effectiveness and safety of a protocol for promotion of early intragastric feeding in critically ill children. Pediatr Crit Care Med. 2001;2:113-21. doi: 10.1097/00130478-200104000-00004.
21. Braudis NJ, Curley MA, Beaupre K, Thomas KC, Hardiman G, Laussen P et al. Enteral feeding algorithm for infants with hypoplastic left heart syndrome poststage I palliation. Pediatr Crit Care Med. 2009;10:460-6. doi: 10.1097/PCC.0b013e318198b167.
22. del Castillo SL, McCulley ME, Khemani RG, Jeffries HE, Thomas DW, Peregrine J et al. Reducing the incidence of necrotizing enterocolitis in neonates with hypoplastic left heart syndrome with the introduction of an enteral feed protocol. Pediatr Crit Care Med. 2010;11:373-7. doi: 10.1097/PCC.0b013e3181c01475.
23. McClave SA, Lukan JK, Stefater JA, Lowen CC, Looney SW, Matheson PJ et al. Poor validity of residual volumes as a marker for risk of aspiration in critically ill patients. Crit Care Med. 2005;33:324-30. doi: 10.1097/01.CCM.0000153413.46627.3A.
24. McClave SA, Snider HL. Clinical use of gastric residual volumes as a monitor for patients on enteral tube feeding. JPEN J Parenter Enteral Nutr. 2002;26(6 Suppl):S43-8; discussion S9-50. doi: 10.1177/014860710202600607.
25. Metheny NA, Schallom L, Oliver DA, Clouse RE. Gastric residual volume and aspiration in critically ill patients receiving gastric feedings. Am J Crit Care. 2008;17:512-9; quiz520.
26. Horn D, Chaboyer W, Schluter PJ. Gastric residual volumes in critically ill paediatric patients: a comparison of feeding regimens. Aust Crit Care. 2004;17:98-100, 102-3. doi: 10.1016/S1036-7314(04)80011-0.
27. Heyland DK, Cahill NE, Dhaliwal R, Sun X, Day AG, McClave SA. Impact of enteral feeding protocols on enteral nutrition delivery: results of a multicenter observational study. JPEN J Parenter Enteral Nutr. 2010;34:675-84. doi: 10.1177/0148607110364843.
28. Petrillo-Albarano T, Pettignano R, Asfaw M, Easley K. Use of a feeding protocol to improve nutritional support through early, aggressive, enteral nutrition in the pediatric intensive care unit. Pediatr Crit Care Med. 2006;7:340-4. doi: 10.1097/00130478-200607000-00033.
29. Reddy PS, Deorari AK, Bal CS, Paul VK, Singh M. A double-blind placebo-controlled study on prophylactic use of cisapride on feed intolerance and gastric emptying in preterm neonates. Indian Pediatr. 2000;37:837-44.
30. Sekteera W, Nuntnarumit P, Supapannachart S. Oral erythromycin for treatment of feeding intolerance in preterm infants: a preliminary report. J Med Assoc Thai. 2002;85(Suppl 4):S1177-82.
31. Mansi Y, Abdelaziz N, Ezzeldin Z, Ibrahim R. Randomized controlled trial of a high dose of oral erythromycin for the treatment of feeding intolerance in preterm infants. Neonatology. 2011;100:290-4. doi: 10.1159/000327536.

Original Article

Survey of contemporary feeding practices in critically ill children in the Asia-Pacific and the Middle East

Judith JM Wong, MBBCh BAO, MRCPCH[1], Chengsi Ong BS, MS[2], Wee Meng Han PhD[2], Nilesh M Mehta MD[3], Jan Hau Lee MBBS, MRCPCH, MCI[4,5]

[1]*Department of Paediatric Medicine, KK Women's and Children's Hospital, Singapore*
[2]*Department of Dietetics and Nutrition, KK Women's and Children's Hospital, Singapore*
[3]*Critical Care Medicine, Boston Children's Hospital, Boston, United States of America*
[4]*Children's Intensive Care Unit, Department of Paediatric Subspecialties, KK Women's and Children's Hospital, Singapore*
[5]*Office of Clinical Sciences, Duke-NUS School of Medicine, Singapore*

亚太和中东地区危重患儿的现代喂养实践调查

背景与目的：营养是危重患儿护理的一个基本组成部分。确定儿科重症监护病房内的营养实践变化（PICUS），从而评估和改善营养实践。**方法与研究设计**:目的是调查亚太和中东地区的营养实践和儿科重症监护室及营养师的观点。设计调查问卷，收集以下数据：（1）受访者及机构的特点；（2）营养评估和营养输送的方法；（3）PICU 最佳喂养的重要性和障碍。**结果**：分析了来自 18 个国家， 35 个中心的 47 名受访者的资料。只有 13（37%）个中心有专门的饮食服务，12（34%）个中心有正规的营养评估。在有专门营养师的中心，我们发现更多使用碳水化合物、脂肪添加剂和特殊配方。2/3（31，66%）的被调查者使用全流体来估算能量需求。只有 11（31%）个中心使用喂养计划。这些中心常使用小肠喂养、酸抑制剂、泻药和胃残留量阈值。在处理食物不耐受时，他们更可能一开始就使用蠕动剂。关于什么时候开始喂养以及添加什么辅食方面缺乏共识。**结论**：亚太和中东地区独特的营养行为和障碍，强烈反映了饮食服务的缺乏。未来的努力应该集中在发展统一的营养实践方法，推动这些地区儿科重症监护的营养学研究。

关键词：儿童、喂养、营养、儿科、调查