2012

Selection of Top 10 Quality Indicators for Nutrition Therapy

NUTRITION IN CLINICAL PRACTICE, THOUSAND OAKS, v. 27, n. 2, pp. 261-267, APR, 2012
http://www.producao.usp.br/handle/BDPI/42377

Nutrition in Clinical Practice
http://ncp.sagepub.com/

Selection of Top 10 Quality Indicators for Nutrition Therapy

Cristiane Comeron Gimenez Verotti, Raquel Susana Matos de Miranda Torrinhas, Ivan Cecconello and Dan Linetzky Waitzberg

Nutr Clin Pract 2012 27: 261 originally published online 6 January 2012
DOI: 10.1177/0884533611432317

The online version of this article can be found at:
http://ncp.sagepub.com/content/27/2/261

Published by:
SAGE
http://www.sagepublications.com

On behalf of:
aspen
The American Society for Parenteral & Enteral Nutrition

Nutrition in Clinical Practice
Volume 27 Number 2
April 2012 261-267

DOI: 10.1177/0884533611432317
http://ncp.sagepub.com
hosted at
http://online.sagepub.com

Selection of Top 10 Quality Indicators for Nutrition Therapy

Cristiane Comeron Gimenez Verotti, RD; Raquel Susana Matos de Miranda Torrinhas, MB; Ivan Cecconello, MD, PhD; and Dan Linetzky Waitzberg, MD, PhD

Abstract

Background: The identification of useful quality indicators for nutrition therapy (QINTs) is of great interest and a challenge. This study attempted to identify the 10 QINTs that best suit the practice of quality control in nutrition therapy (NT) by evaluating the opinion of experts in NT with the use of psychometric techniques and statistical tools. *Methods:* Thirty-six QINTs available for clinical application in Brazil were assessed in 2 distinct phases. In phase 1, 26 nutrition experts ranked QINTs by scoring 4 attributes (utility, simplicity, objectivity, low cost) to assess each QINT on a 5-point Likert scale. The top 10 QINTs were identified from the 10 best scores obtained, and the reliability of expert opinion for each indicator was assessed by Cronbach's α. In phase 2, experts provided feedback regarding the selected top 10 QINTs by answering 2 closed questions. *Results:* The top 10 QINTs, in descending order, are the frequency of nutrition screening of hospitalized patients, diarrhea, involuntary withdrawal of enteral feeding tubes, feeding tube obstruction, fasting longer than 24 hours, glycemic dysfunction, estimated energy expenditure and protein needs, central venous catheter infection, compliance of NT indication, and frequency of application of subjective global assessment. Opinions were consistent among the interviewed experts. During feedback, 96% of experts were satisfied with the top 10 QINTs, and 100% had considered them in accordance with their previous opinion. *Conclusion:* The top 10 QINTs were identified according to their usefulness in clinical practice by obtaining adequate agreement and representativeness of opinion of nutrition experts. (*Nutr Clin Pract*. 2012;27:261-267)

Keywords

quality indicators; enteral nutrition; parenteral nutrition; critical illness; quality indicators, health care; outcome assessment; biostatistics

Nutrition therapy (NT) is important to correct protein-energy malnutrition and can help to prevent many adverse outcomes, including increased infection complication rate, impaired wound healing, longer length of hospital stay, higher treatment costs, and increased mortality.[1] However, NT is not without attendant risks and adverse effects and is oriented by procedures that were systematically developed based on important scientific publications in the area and the consensual opinions of experts.[2-5]

One way to control protocol compliance would be through the routine practice of periodic nutrition quality control to identify possible difficulties and failures related to the application of protocols during nutrition care provided to the patient.[6,7] Therefore, in addition to the effort to develop nutrition guidelines, it is also necessary to design quality indicators in nutrition therapy (QINTs) that control the correct application of these guidelines in NT.

The available guidelines comprise an elevated number of recommendations to be followed and could consequently lead to the design of an elevated number of QINTs.[3-5] In 2008, the task force of clinical nutrition of the International Life Science Institute–Brazil (ILSI-Brazil) published a list of 36 QINTs and their respective national goals proposed by consensus by a group of 41 Brazilian NT specialists to attend different issues regarding national and international NT guidelines.[8] However, in addition to the scarcity of available human and material resources, the application of the 36 QINTs to clinical practice has been hindered by the high number of QINTs proposed.[9]

To enable the effective application of QINTs, we believe that ease of application and objectivity must be considered in addition to other factors.[10,11] An excessive number of QINTs must be avoided because they may be difficult to apply

University of São Paulo Medical School, Department of Gastroenterology, Digestive Surgery Discipline (LIM 35), São Paulo, Brazil.

Financial disclosure: none declared.

Corresponding Author: Cristiane Comeron Gimenez Verotti, RD, University of São Paulo, School of Medicine Av. Dr Arnaldo, 455–sala 2108, São Paulo, 1246903 Brazil; e-mail: nutricristiane@me.com.

in clinical practice, whereas the determination of a feasible number of QINTs could be practically applicable and contribute to the success of quality control in NT. Therefore, the identification of the 10 QINTs that are the most effectively useful, easily executed, and cost-effective is of great interest. We aimed to identify the top 10 QINTs, from among those clinically available in Brazil, that could be suited to the practice of quality control in NT. Our proposed method employs psychometric techniques and statistical tools to analyze the opinions of renowned nutrition experts.

Methods

Study Design

This study was approved by the Ethical Committee of Hospital das Clinicas of the University of São Paulo Medical School "CAPPesq—Comissão de Ética para Análise de Projetos de Pesquisa." All 36 QINTs available for clinical application in Brazil (Table 1) were assessed using face-to-face interviews in 2 distinct phases. Phase 1 consisted of a structured interview of 26 nutrition experts to select the top 10 QINTs; during phase 2, the nutrition experts were asked to provide feedback regarding the selected top 10 QINTs by answering 2 closed questions.

Phase 1: Selection of the Top 10 QINTs

The assessment of the top 10 QINTs considered the categories in which the 36 studied QINTs were matched: (A) general aspects; (B) nutrition assessment; (C) indicator of NT; (D) preparation: pharmaceutical assessment, manipulation, quality control, conservation, and transport; (E) administration: ways of access; (F) administration: calories and proteins; (G) clinical and laboratory control; and (H) final assessment.

The evaluation of the 36 QINTs was made by psychometric analysis,[12] recording the opinions of 26 health specialists who are current practitioners of enteral and parenteral NT in different centers of São Paulo city, Brazil (nutritionists, n = 10; physicians, n = 8; nurses, n = 4; pharmacists, n = 4). The opinions of these nutrition specialists were obtained via an individual interview personally applied by only 1 researcher (C.C.G.V.). During the interview, the experts were asked to score 4 attributes with which to assess each QINT (Table 2), following a 5-point Likert scale, to register the manifestation of indifference and of nullity (0 = *very bad*, 1 = *bad*, 2 = *indifferent*, 3 = *good*, and 4 = *very good*). The consistency or reliability of expert opinion for each indicator was assessed by Cronbach's α, considering good consistence in values ≥ 0.5.[13] The top 10 QINTs were initially identified from the top 10 scores (arithmetical average of the 4 assessed attributes for each QINT) obtained by the dependency of adequate reliability.

Phase 2: Feedback From Nutrition Experts

Regarding the 10 QINTs selected, the previous 26 experts were again interviewed to obtain their feedback by answering 2 closed-ended (yes or no) questions about their impressions in relation to the satisfactoriness of the 10 selected QINTs and of the QINT list's concordance with their previous opinion.

Results

Analysis of the structured questions from phase 1 showed consistent opinions among the different specialists interviewed about the attributes of each of the 36 QINTs assessed (Cronbach's $\alpha \geq 0.568$), except for the indicator "frequency of periodic nutrition reassessment in patients with nutrition therapy" (Cronbach's $\alpha = 0.472$), which was the only indicator excluded from the study. Most of the 10 selected QINTs were from categories B (n = 4) and E (n = 3). None of the selected indicators were from category A, D, F, or H. Each QINT's rank, category, description, arithmetical average of 4 assessed attributes, and value for Cronbach's α, as well as the values of concordance for the 10 selected QINTs, are summarized in Table 1. For phase 2, feedback was provided by 25 experts, of whom 96% reported satisfaction with the 10 QINTs selected and 100% considered the list to be in accordance with their previous opinion.

Discussion

This pilot study attempted to select 10 objective and useful QINTs that feature ease of execution (simplicity) and low cost from among the 36 that are currently being used in Brazil, by applying psychometric techniques[12] and statistical tools,[13] with the use of the Likert scale and Cronbach's α. The Likert scale is renowned for its ability to identify opposition between contraries, gradients, and intermediate situations, with an adequate relation between precision and accuracy of measurement. Cronbach's α is efficient to measure the consistency or reliability of scores obtained from psychometric tests.[13] In addition, we made a structured questionnaire for a detailed assessment of the 10 QINTs selected by the nutrition experts.

The detection of nutrition status was of great concern for experts and occupied both 1st place (screening) and 10th place (subjective global analysis [SGA]). The greater value given to nutrition screening is understandable because the detection of nutrition risk allows the healthcare and nutrition support team to take early nutrition initiatives, even in patients with apparently adequate total body weight, whereas SGA is primarily effective to recognize current malnutrition.[15-20] In addition, the use of both nutrition assessment tools can be complementary to better detect malnutrition states.[15] Intestinal motility disorders were of concern

Table 1. Classification of the 36 Quality Indicators for Nutrition Therapy, According to Nutrition Experts, After Structured Questionnaire Results

Rank	Category	Indicator	Average of Attribute Scores	Cronbach's α	Goal
1	B	Frequency of carrying out nutrition screening of hospitalized patients	14.2	0.805	>80%
2	G	Frequency of diarrhea in patients on EN	14.19	0.596	<10%
3	E	Frequency of involuntary withdrawal of enteral feeding tubes	14.08	0.621	ICU: <5% Ward: <10%
4	E	Frequency of tube feeding occlusion in patients on EN	14	0.671	<5%
5	B	Frequency of digestive fasting for more than 24 hours in patients on oral nutrition or EN	13.77	0.597	<12%
6	G	Frequency of patients with glycemic dysfunction on EN and PN	13.46	0.568	Hyperglycemia: Critically ill: 70%–80%; noncritically ill: 20%–30% Hypoglycemia: 5%–7%
7	B	Frequency of measurement or estimation of energy expenditure and protein needs in patients on NT	13.38	0.925	>80%
8	E	Frequency of CVC infection in patients on PN	13.35	0.596	Without bacteremia: <10/1000 catheters or <2.5/1000 catheters (for PIC) With bacteremia <5/1000 catheters
9	C	Frequency of indication compliance of NT	13.08	0.658	<3.5%
10	G	Frequency of application of SGA in patients on NT	12.93	0.634	>75%
11	B	Frequency of episodes of constipation in patients on EN	12.92	0.731	
12	G	Frequency of episodes of abdominal dystension in patients on EN	12.88	0.738	
13	A	Frequency of reduced oral intake in patients on NT	12.65	0.857	
14	D	Frequency of patients with peripheral PN lasting more than 7 days	12.62	0.885	
15	D	Frequency of patients on central PN lasting less than 7 days	12.58	0.879	
16	E	Frequency of phlebitis by PVC in patients on PN	12.54	0.748	
17	B	Frequency of periodic reassessment of patients on NT	12.54	0.472	
18	E	Frequency of induced pneumothorax during catheter insertion	12.42	0.718	
19	H	Frequency of nutrition dietary prescription for patients on NT at discharge	12	0.868	
20	B	Frequency of biochemical essays during early nutrition assessments in patients on NT	11.96	0.803	
21	G	Frequency of electrolyte changes in patients on EN and PN	11.92	0.69	
22	D	Frequency of nonconformities related to preparation time, transportation, and storage in EN	11.69	0.76	
23	G	Frequency of renal dysfunction in patients on EN and PN	11.69	0.614	
24	A	Frequency of approach to patient's nutrition at each level of hospital assistance (first, second, and third levels) in patients on NT	11.58	0.904	

(continued)

Table 1. (continued)

Rank	Category	Indicator	Average of Attribute Scores	Cronbach's α	Goal
25	B	Frequency of measurement of BMI in patients on NT	11.38	0.796	
26	F	Frequency of days of administration with insufficient quantity of protein in the total patient days on NT	11.31	0.735	
27	A	Frequency of recovery of oral intake in patients on NT	11.23	0.742	
28	G	Frequency of patients with high gastric residue on EN	11.19	0.808	
29	F	Frequency of days of administration with caloric intake between 25 and 40 kcal/kg/d in total days in patients on NT	11.15	0.661	
30	F	Frequency of days with calorie supply managed in more or less than 20% of supply prescribed in patients on EN and PN	11.08	0.798	
31	B	Frequency of nutrition anamnesis in patients on NT	10.96	0.906	
32	G	Frequency of hepatic dysfunction among patients on EN and PN	10.69	0.721	
33	H	Frequency of nutrition dietary prescription in ambulatory nutrition monitoring after hospital discharge of patients on NT	9.23	0.927	
34	F	Frequency of days of administration with a protein excess in the total of days in patients on NT	8.92	0.882	
35	G	Frequency of patients with alterations of visceral proteins on NT	8.27	0.748	
36	B	Frequency of protein catabolism in patients on EN and PN	7.65	0.87	

BMI, body mass index; CVC, central venous catheter; EN, enteral nutrition; ICU, intensive care unit; NT, nutrition therapy; PIC, peripheral intravenous catheter; PN, parenteral nutrition; PVC, peripheral venous catheter; SGA, subjective global assessment.

to experts. Frequency of diarrhea in patients on enteral NT was elected to occupy the second position. Different variables of NT, such as rapid infusion of the enteral diet, bacterial contamination, and hyperosmolar formula, can contribute to the incidence of diarrhea. Diarrhea may affect from 2.3%–68% of hospitalized patients and, in addition to contributing to the occurrence of dehydration and hydroelectrolitic changes, can worsen malnutrition.[21,22]

The third and fourth positions of the top 10 QINTs concerned aspects related to enteral gastro/jejunal access and parenteral venous access for NT. The exit or accidental migration of enteral tube feeding can significantly contribute to the rise of infection and mortality rates because of the risk of aspiration, and its incidence can be minimized by systematic assessment of the patient by auscultation and radiography of the abdomen.[23] Small-bore enteral feeding tubes may become clogged in up to 35% of patients.[24] Various factors may contribute to tube occlusions; these include enteral formulation (high-viscosity or intact protein products), feeding tube materials (silicone tubes clog more frequently than polyurethane tubes), insufficient flushing, and incorrect administration of medication.[25,26]

Our fifth elected QINT contemplates fasting, another important aspect to be controlled in NT. Fasting time, especially in the first 24 hours after admission, is associated with increased rates of complications.[27] Enteral nutrition (EN) should be started early (24–48 hours after trauma, surgery, or hospitalization and may even reach 72 hours, depending on the situation of the patient). Frequent interruption of NT during hospitalization may limit the achievement of the goals for which NT was established.[28-33]

The frequency of patients with glycemic dysfunction (sixth selected QINT) reinforces the importance of controlling hyperglycemia, which is the most common complication associated with parenteral NT. However, hyperglycemia could be due to

Table 2. The 4 Attributes and Their Meaning for the Assessment of Individual Quality Indicators for Nutrition Therapy (QINTs)

Attribute	Meaning
Utility	The QINT should be useful, advantageous, and valid.
Simplicity	Is this QINT simple to search, calculate, and analyze? If so, the greater the chances and opportunities for use.
Objectivity	Has this QINT a clear goal, increasing the reliability of what is pursued?
Low cost	Will the cost to do this QINT hamper its routine use?

Modified from Bittar.[14]

other causes, as when it is associated with metabolic stress in critically ill patients. A recent examination of critically ill patients has shown that the maintenance of glycemic levels above the reference values and up to 180 mg/dL can contribute to a higher survival rate.[34]

The frequency of measurement or estimation of energy expenditure and protein requirements in patients undergoing NT (seventh selected QINT) may guide nutrition prescription and can prevent complications associated with overfeeding, underfeeding, and some important metabolic disorders.[27] Contamination of the central venous catheter (eighth selected QINT) is one of the most feared complications of parenteral nutrition (PN) therapy; catheter contamination reaches levels of up to 30% and provides a potential source of infection.[35,36] The National Nosocomial Infections Surveillance (NNIS) system of the Centers for Disease Control and Prevention (CDC) reports a median rate of catheter-related bloodstream infection in intensive care units (ICUs) of all types ranging from 1.8–5.2 per 1000 catheter-days.[37]

"Frequency of indication compliance of EN" occupied the ninth position on the top 10 list. Favorable results of compliance should follow the recommendations of available protocols and guidelines.[38-40]

The prevalence of QINTs from categories B and E in the list of the top 10 selected QINTs indicates a major concern among professional NT specialists regarding nutrition status assessment and aspects related to enteral gastro/jejunal access and parenteral venous access in NT. In fact, in-hospital malnutrition is common. Over 10 years, the Brazilian National Survey of Nutrition[41] has identified malnutrition, which is associated with higher rates of morbidity and mortality, in 48.1% of hospitalized patients. The rates of malnutrition among hospitalized patients currently found in Brazil are similar to those reported globally.[42] The selection and monitoring of the routes to nutrition access are also important to guarantee adequate energy-protein offerings in adequate time and volume and to avoid complications directly related to access type.[43]

We should note that our top 10 QINTs have been chosen based on the opinions of experts in São Paulo, the most affluent city in South America, and may not be suitable for universal use. Therefore, it would be advisable that each country should develop its own QINTs contemplating their own goals based on its internal nutrition guidelines and adapted for local characteristics of healthcare and public health policy. Regarding the goals of our selected top 10 QINT, those proposed by ILSI for Brazilian clinical application are described in Table 2.

Our top 10 list includes QINTs that are potentially useful for clinical practice performed by a health professional without the use of any expensive or technological resources. In addition, the brevity of this list increases its applicability. The agreement of 96% and the representativeness of opinion of 100% of interviewed experts for these 10 selected QINTs demonstrate that the methodology of selecting quality indicators currently developed by us is efficient, which may contribute to the design of quality indicators from different areas by other groups who want to attend to the emerging importance attributed to quality indicators.

In conclusion, we suggest the clinical application of the selected top 10 list of quality indicators is likely to improve and/or enable the quality of NT and therefore contribute to lower NT-associated complication rates, which negatively influence the incidence of morbidity and mortality. Achievement of this goal will support the importance that is being attributed to QINTs, and its verification is the next step to be approached by our team.

Acknowledgments

The authors acknowledge the significant contribution of the Clinical Nutrition Task Force, ILSI-Brazil, as well as all participating Brazilian nutrition experts and thank Julio C. Pereira, MD, PhD, for statistical supervision.

References

1. Barker LA, Gout BS, Crowe TC. Hospital malnutrition: prevalence, identification and impact on patients and the healthcare system. *Int J Environ Res Public Health*. 2011;8:514-527.
2. Lochs H, Allison SP, Meier R, et al. Introductory to the ESPEN Guidelines on Enteral Nutrition: terminology, definitions and general topics. *Clin Nutr*. 2006;25(2):180-186.
3. Guenter P. Safe practices for enteral nutrition in critically ill patients. *Crit Care Nurs Clin North Am*. 2010;22(2):197-208.

4. Singer P, Berger MM, Van den Berghe G, et al. ESPEN Guidelines on Parenteral Nutrition: intensive care. *Clin Nutr*. 2009;28(4):387-400.
5. Heyland DK, Dhaliwal R, Day A, Jain M, Drover J. Validation of the Canadian clinical practice guidelines for nutrition support in mechanically ventilated, critically ill adult patients: results of a prospective observational study. *Crit Care Med*. 2004;32(11):2260-2266.
6. 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(6):675-684.
7. Waitzberg DL. A difference must make a difference. *JPEN J Parenter Enteral Nutr*. 2010;34(6):604-605.
8. Waitzberg DL. *Indicadores de qualidade em terapia nutricional*. São Paulo: ILSI Brasil; 2008.
9. Martins JR, Horie LM, Shiroma GM, et al. Quality control indicators in enteral nutrition: the compliance rates in a general hospital in Brazil. *Clin Nutr Suppl*. 2009;4(suppl 2)iii-iv:111.
10. Waitzberg DL, Castro M. *Planejamento da terapia nutricional in Nutrição oral, enteral e parenteral na prática clínica*. 4th ed. São Paulo, Brazil: Editora Atheneu; 2009. 501-09.
11. Martins JR, Verotti CC, Shiroma GM, Waitzberg DL. Re: development and implementation of an audit tool for quality control of parenteral nutrition. *Nutr Clin Pract*. 2010;25(2):221-222.
12. Braga CG, da Cruz Dde A. Psychometric contributions to the assessment of psychosocial responses in nursing. *Rev Esc Enferm USP*. 2006;40(1):98-104.
13. Bland JM, Altman DG. Cronbach's alpha. *BMJ*. 1997;314 (7080):572.
14. Bittar OJNV. Indicadores de qualidade e quantidade em saúde. *Re Adm em Saúde*. 2001;12(3):21-28.
15. Raslan M, Gonzalez MC, Dias MC, et al. Comparison of nutritional risk screening tools for predicting clinical outcomes in hospitalized patients. *Nutrition*. 2010;26(7-8):721-726.
16. Barbosa Silva MCG, Barros AJD. Avaliação nutricional subjetiva parte 1—Revisão de sua validade após duas décadas de uso. *Arq Gastroenterologia*. 2002;39(3):181-187.
17. Elia M, Zellipour L, Stratton RJ. To screen or not to screen malnutrition? *Clin Nutr*. 2005;24(6):867-884.
18. García de Lorenzo A, Alvarez J, Calvo MV, et al. Conclusions of the II SENPE discussion forum on: hospital malnutrition. *Nutr Hosp*. 2005;20(2):82-87.
19. Mueller C, Compher C, Ellen DM; the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) Board of Directors. A.S.P.E.N. Clinical Guidelines: nutrition screening, assessment, and intervention in adults. *JPEN J Parenter Enteral Nutr*. 2011;35(1):16-24.
20. Leandro-Merhi VA, de Aquino JL, Sales Chagas JF. Nutrition status and risk factors associated with length of hospital stay for surgical patients. *JPEN J Parenter Enteral Nutr*. 2011;35(2):241-248.
21. Reese JL, Means ME, Hanrahan K, Clearman B, Colwill M, Dawson C. Diarrhea associated with nasogastric feedings. *Oncol Nurs Forum*. 1996;23(1):59-66.
22. Jack L, Coyer F, Courtney M, Venkatesh B. Diarrhea risk factors in enterally tube fed critically ill patients: a retrospective audit. *Intensive Crit Care Nurs*. 2010;26(6):327-334.
23. de Aguilar-Nascimento JE, Kudsk KA. Use of small-bore feeding tubes: successes and failures. *Curr Opin Clin Nutr Metab Care*. 2007;10(3):291-296.
24. Marcuard SP, Stegall KS. Unclogging feeding tubes with pancreatic enzyme. *JPEN J Parenter Enteral Nutr*. 1990;14: 198-200.
25. A.S.P.E.N. Board of Directors and the Clinical Guidelines Task Force. Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. *JPEN J Parenter Enteral Nutr*. 2002;26(suppl 1):1SA-138SA.
26. Lord LM. Restoring and maintaining patency of enteral feeding tubes. *Nutr Clin Pract*. 2003;18:422-426.
27. Villet S, Chiolero RL, Bollmann MD, et al. Negative impact of hypocaloric feeding and energy balance on clinical outcome in ICU patients. *Clin Nutr*. 2005;24(4):502-509.
28. Andersen HK, Lewis SJ, Thomas S. Early enteral nutrition within 24h of colorectal surgery versus later commencement of feeding for postoperative complications. *Cochrane Database Syst Rev*. 2006;(4):CD004080.
29. Lewis SJ, Andersen HK, Thomas S. Early enteral nutrition within 24 hours of intestinal surgery versus later commencement of feeding: a systematic review and meta-analysis. *J Gastrointest Surg*. 2009;13(3):569-575.
30. Peter JV, Moran JL, Phillips-Hughes J. A metanalysis of treatment outcomes of early enteral versus early parenteral nutrition in hospitalized patients. *Crit Care Med*. 2005;33(1):213-220.
31. Heyland DK, Dhaliwal R, Drover JW, Gramlich L, Dodek P; Canadian Critical Care Clinical Practice Guidelines Committee. Canadian clinical practice guidelines for nutrition support in mechanically ventilated, critically ill adult patients. *JPEN J Parenter Enteral Nutr*. 2003;27(5):355-373.
32. Kreymann KG. Early nutrition support in critical care: a European perspective [review]. *Curr Opin Clin Nutr Metab Care*. 2008;11(2):156-159.
33. Kreymann KG, Berger MM, Deutz NE, et al. ESPEN guideline on enteral nutrition: intensive care. *Clin Nutr*. 2006;25(2):210-223.
34. The NICE-SUGAR Study Investigators. Intensive versus conventional glucose control in critically ill patients. *N Engl J Med*. 2009;360:1283-1297.
35. Lebeaux D, Zarrouk V, Leflon-Guibout V, Lefort A, Fantin B. Totally implanted access port-related infections: features and management. *Rev Med Interne*. 2010;31(12):819-827.
36. Rosenthal VD, Maki DG, Rodrigues C, et al. Impact of International Nosocomial Infection Control Consortium (INICC) strategy on central line–associated bloodstream infection rates in the intensive care units of 15 developing countries. *Infect Control Hosp Epidemiol*. 2010;31(12):1264-1272.
37. O'Grady NP, Alexander M, Burns LA, et al. Healthcare Infection Control Practices Advisory Committee. Guidelines for the prevention of intravascular catheter-related infections. *Am J Infect Control*. 2011;39(4)(suppl 1):S1-S34.
38. Arabi Y, Haddad S, Sakkijha M, Shimemeri AA. The impact of implementing an enteral tube feeding protocol on caloric and protein delivery in intensive care unit patients. *Nutr Clin Pract*. 2004;19:523-530.
39. Barr J, Hecht M, Flavin KE, Khorana A, Gould MK. Outcomes in critically ill patients before and after the implementation of an evidence-based nutritional management protocol. *Chest*. 2004;125:1446-1457.

40. Mckenzie SL, Zygun DA, Whitmore BL, Doig CJ, Hameed SM. Implementation of a nutrition support protocol increases the proportion of mechanically ventilated patients reaching enteral nutrition targets in the adult intensive care unit. *JPEN J Parenter Enteral Nutr*. 2005;29:74-80.
41. Waitzberg DL, Caiaffa WT, Correia MI. Hospital malnutrition: the Brazilian national survey (IBRANUTRI): a study of 4000 patients. *Nutrition*. 2001;17(7-8):573-580.
42. Vanderwee K, Clays E, Bocquaert I, et al. Malnutrition and nutrition care practices in hospital wards for older people. *J Adv Nurs*. 2011;67(4):736-746.
43. A.S.P.E.N. Board of Directors and Clinical Guidelines Task Force. Guidelines for the use of parenteral and enteral nutrition in adult and pediatric patients. *JPEN J Parenter Enteral Nutr.* 2002;26(suppl 1):1SA-138SA.