Flávia De Conti Cartolano[1], Lúcia Caruso[2], Francisco Garcia Soriano[3]

Enteral nutritional therapy: application of quality indicators

Terapia nutricional enteral: aplicação de indicadores de qualidade

1. Nutritionist, Trainee at Hospital Universitário da Universidade de São Paulo's Nutrition and Dietetics Service – USP – São Paulo (SP), Brazil.
2. Nutritionist, Hospital Universitário da Universidade de São Paulo's Nutrition and Dietetics Service – USP – São Paulo (SP), Brazil.
3. Physician for the Adult Intensive Care Unit - Hospital Universitário da Universidade de São Paulo – USP – São Paulo (SP), Brazil.

From the Nutrition and Dietetics Service - Hospital Universitário da Universidade de São Paulo – USP – São Paulo (SP), Brazil.

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Author for correspondence:
Flávia De Conti Cartolano
Av. Professor Lineu Prestes, 2565 - Cidade Universitária – 1º A
ZIP: 05508-900 - São Paulo (SP), Brazil.
Phone/Fax: (11) 3039-9357
Email: fdeconti@yahoo.com.br / snd@hu.usp.br

ABSTRACT

Objective: Monitor the adequacy of enteral nutritional therapy at the intensive care unit aiming to improve the quality of nutritional assistance.

Methods: Prospective and observational study developed at the adult intensive care unit from 2005 to 2008. Patients over 18 years of age with exclusive enteral nutritional therapy for over 72h participated in the sample. The average values and the percentile adequacy of energy and proteins calculated, prescribed and administered in each year were analyzed. The factors responsible for the non-conformity of the administration planned were classified into intensive care unit extrinsic or intrinsic causes. The quality indicators proposed by the ILSI Brazil were applied, and expressed into percentile goals. In the statistic analyses, confidence interval and the *t Student* e *Mann-Whitney* ($p \leq 0.05$) tests were used, according to the Epi Info program.

Results: One hundred and sixteen patients were followed up. There were statically difference in values of energy and protein administered in 2005 and in 2006, when compared to those in 2008. The adequacy calculated/prescribed remained close to 100% in all the surveys and the adequacy administered/prescribed increased from 74% in 2005, to 89% in 2008. An increase in interruptions of enteral nutritional therapy for external factors and the decrease in interruptions for intensive care unit internal factors were verified. The quality indicators equally reflect the evolution of the patient care.

Conclusion: In the four yearly surveys, a progressive enhancement of nutritional support was verified. Quality indicators allow nutritional care evolution monitoring, the comparison to other services data, and are a new perspective for enteral nutritional therapy assessment.

Keywords: Nutritional therapy; Enteral nutrition; Nutritional assessment

INTRODUCTION

The intensive care quality assurance concept has been increasingly discussed.[1] The nutritional support is currently seen as an additional therapeutic tool for this kind of care, and is fundamental for the patient's management when oral ingestion is not feasible.[2]

Severely ill patients, with a prolonged and complicated course, have intensive metabolic response, generally featuring hypermetabolism, with increased protein catabolism.[3] Thus, these patients have increased nutritional status depletion risk, which can additionally harm their clinical picture.

Currently available literature data suggest that early and appropriate enteral nutritional therapy (ENT) introduction may considerably decrease infections incidence and the hospital stay length.[1,4] However, intensive care patients frequently have nutritional support inadequacies, both for daily energy needs overestimation,[5] and late ENT introduction, and interruption for procedures.[6]

Thus, in the last years several studies were conducted aiming to evaluate non-conformity of the forecasted and administered calories and proteins. Another investigational issue regards the most contributing factors for ENT interruption. These trials showed a low adequacy rate for the administered versus the patients' needs, with the values ranging between 50 and 90%.[1,7,8]

In this context, this study aimed to evaluate the enteral nutritional therapy adequacy among adult patients in an intensive care unit (ICU).

Considering that this trial was conducted yearly since 2005, the 2008 data were compared versus the previous ones,[9-11] with a new analysis perspective, using the International Life Sciences Institute's Nutrition Committee Clinical Nutrition Taskforce nutritional therapy quality indicators.[12]

METHODS

This was prospective observational trial. The project was cleared by the Institution's Ethics Committee (CEP 603/05) and all patients signed an Informed Consent Form.

The data survey was conducted for periods between 53 and 120 days per analyzed year. Only patients receiving at least 72 hours EN (enteral nutrition) were included. Exclusion criteria: concomitant oral and/or parenteral nutrition, non-adherence to the informed consent, and palliative care. The nutritional needs calculations were based on the usual body weight, either adjusted or estimated (ideal age weight, according to standard reference tables).[13-15] The energy-protein recommendations for each clinical status were made according to the unit pre-established protocol.[9] As those were all bed restricted patients in heart or respiratory disease situations, the total energy expenditure was estimated using the Harris-Benedict formula, adding an activity factor of 1.2. For surgical patients, in addition to this factor, an injury factor was also added, ranging according the surgery. In renal or liver insufficiency cases, or sepsis, the calculation was based on the calories per bodyweight (kilograms) recommendation.

All enteral nutrition lines were installed in the post-pyloric region, being the positioning confirmed by X-ray examination. The diets were given using a closed system, with continued infusion during an average 22 hours/day, with the remainder 2 hours reserved for procedures and drugs administration. As per the unit protocol,[16] all patients started ENT with an infusion rate of 25 mL/hour, increasing 10 mL/hour every four hours until reaching 55 mL/hour. After this, each patient progressed to the specific individual target. The available enteral formulas were normocaloric normoproteic, normocaloric hyperproteic or hypercaloric and hyperproteic.

The data collection was started on the first enteral nutrition day, and lasted until the nutritional therapy was discontinued, patient's death or discharge from the unit. The daily collected data included: 24 hours infused volume, number of intestinal movements and, in case of interruption, the event related factors. These causes were differentiated as intrinsic and extrinsic to the unit.

The caloric-protein adequacy by comparison of the calculated and the prescribed, and by the prescribed and the given was estimated as a percent ratio, considering as the standard reference value a figure above 90%.[17,18] For these calculations, data before the patient reached the proposed nutritional target infusion speed were not considered.

The 2008 results were compared to those from 2005, 2006 and 2007.[9-11] For this the Student *t* test was used for analyzing parametrical variables, the Mann-Whitney *U* test was used for non-parametric variables, both with $p \leq 0.05$ significance level and the confidence interval for the proportions. These tests were conducted using the Epi Info version 3.5.1 statistical software.

The quality indicators used are agreed with the issued by ILSI Brazil.[12] The parameters evaluated are shown in table 1.

RESULTS

A total of 116 patients were evaluated, being 33 in 2005, 30 in 2006, 20 in 2007 and 33 in 2008. The Table 2 shows the population and the enteral nutrition therapy characterization, according to the year.

It can be seen that no statistically significant differences were found for 2008 regarding mean age, gender

Table 1 – Quality indicators used

Indicator	Formula	Target
Frequency of energy and protein needs measurement or estimation in NT patients	# patients with energy/protein expenditure measured x 100 / total NT patients #	>80%
Frequency of inappropriate fasting time patients before NT start (>48h)	# patients fasting>48h candidate to NT x 100 / total # of NT candidate patients	<80%
Frequency of inadvertent enteral tube displacement in ENT patients	# of inadvertent enteral tube displacements x 100 / total # of ENT patients x days with enteral tube	<5% in ICUs
Frequency of days with caloric offer given > or <20% of the total prescribed in the total ENT patients days	# of inappropriate caloric offer days x # of patients receiving inappropriate caloric offer x 100 / total number of days in the evaluated period x # of NT patients in the evaluated period	<20%
Frequency of days with insufficient protein offer in the total ENT patients days	# of days with insufficient protein offer x # of patients receiving insufficient protein offer x 100 / total # of days in the evaluated period x # of patients receiving NT in the evaluated period	<10%
Frequency of diarrhea episodes in ENT patients*	# of days with diarrhea x 100 / total # of ENT days	<10%

NT – nutritional therapy; ENT – enteral nutritional therapy; ICU – intensive care unit.
Source: Clinical Nutrition Taskforce (ILSI Brazil, 2008)[12] *Formula adapted.

Table 2- Population and enteral nutritional therapy characterization per year

Characteristics	2005 (N=33)	2006 (N=30)	2007 (N=20)	2008 (N=33)
Follow-up period (days)	53	96	90	120
Average age (years)	57 ± 19(18 - 85)	62 ± 18(31 - 92)	55 ± 18(22 - 87)	59 ± 20(20 - 88)
Gender				
Male	58	60	60	45
Female	42	40	40	55
Distribution per diagnosis				
Respiratory	15	43	15	36
Sepsis	21	23	25	18
Neurology	3	17*	5	0
Cardiology	27	7	25	24
Trauma	12	3	0	3
Neoplasias	6*	3	0	0
Hepatopathy	6	0	0	3
Surgery	0*	0*	10	9
Mixed schock	0	0	10*	0
Others	10	4	10	6
ICU stay (days)	15 ±10.8	13.5 ± 7.9	18.9 ± 12.1	16.5 ± 13.2
Enteral nutritional therapy				
Time to ENT start (hours)	25.3 ± 20	27 ± 20	31 ±19	28.6 ± 21.5
Time to the nutritional target (hours)	32 ± 20.6	30 ± 33.1	29 ± 20.4	24 ± 22.8
ENT time (days)	12.5 ± 11.2	11.8 ± 7.9	17 ±12.0	13.5 ± 11.3

ICU – intensive care unit; ENT – enteral nutritional therapy; Results expressed as % mean ± standard deviation or median (minimum-maximum).
*statistically significant difference ($p<0.05$).

distribution, ENT aspects and ICU stay length, allowing the ENT-related criteria comparison, as shown in tables 3 and 4.

Since the first survey, an increase in the mean time needed to start the ENT was seen, from 25.3 hours in 2005 to 28.6 hours in 2008. A slight drop was seen only when the 2008 data were compared to the 2007 ones, however the differences were not significant.

Regarding the nutritional target, the mean time to reach it has been dropping, as well as the number of patients reaching the target came to its maximal value. It should be stressed that in 2005, 97% of the patients reached the proposed target speed.[10] In the consecutive years, 100% of the patients reached this target. Regarding the persistence with enteral nutrition, the values ranged with the surveys.

The calculated energetic nutritional targets were, in all surveys, about 25 kcal/kg/day, and regarding proteins, the calculations were also very similar with the years. It was also observed that the prescribed target neared the initially calculated in all analyzed periods, except for proteins prescription in 2005, as hyperproteic formulas were only introduced in this unit in 2006.

During the surveys there was a positive approximation between the prescribed nutritional target and the actually administered energy and protein values, with statistical differences between the 2005 and 2006 results, and the 2008 results. This becomes more evident when analyzed under the adequacy rate perspective (Table 4) as, while in the first follow-up year the adequacy rate versus prescribed was 74% both for calories and proteins, in 2008 this was around 89%.

In the figure 1 the percent distribution of causes leading to EN discontinuation is shown. It is noticeable that, concomitant to an increase in the discontinuations for extrinsic issues, there was a decrease in EN discontinuation for intrinsic unit issues.

From all causes (Figures 2 and 3), tracheostomy was the 2008's most contributing external cause for percent inadequacy in EN administration. It can also be seen an increase with the years in the proportion of

Table 3 – Calculated and prescribed nutritional target and administered values (mean per bodyweight kilogram) per year

Specification	2005	2006	2007	2008
Calculated target				
Energy (kcal)	25.80 ± 3.50	24.97 ± 2.73	24.70 ± 2.40	24.88 ± 2.96
Protein (g)	1.10 ±0.10	1.09 ± 0.15	1.13 ± 0.16	1.12 ± 0.16
Prescribe target				
Energy(kcal)	26.1 ± 3.70	24.74 ± 2.77	24.90 ± 2.30	24.98 ± 2.83
Protein (g)	1.04 ± 0.10	1.10 ± 0.16	1.12 ± 0.17	1.13 ± 0.16
Given value				
Energy (kcal)	19.50 ± 5.60*	19.96 ± 3.63*	20.6 ± 3.60	22.26 ± 4.20
Protein (g)	0.77 ± 0.20*	0.84 ± 0.18*	0.90 ± 0.18	1.00 ±0.21

Results expressed as mean ± standard deviation. *Statistically significant difference (p<0.05).

Table 4 – Adequacy rate for the calculated, prescribed and administered per year

Adequacy		2005	2006	2007	2008
Prescribed/Calculated	Energy	100	100.3	100.1	100.5
	Protein	94	99.1	97.9	100.7
Given/Prescribed	Energy	74.4	80.5	83.5	89.0
	Protein	74.1	77.0	83.5	88.9
Given/Calculated	Energy	75.5	79.9	84.5	89.6
	Protein	70.0	77.0	81.2	89.5
Volume		73.90 ± 18.80*	79.90 ± 11.10*	83.50 ± 14.3	88.60 ± 13.7
(Given/Prescribed)		77.60*	82.55*	86.96	91.13
		(17.35-95.05)	(52.64 – 99.70)	(38.57 - 103.00)	(41.34 – 108.04)

Results presented as %, mean ± standard deviation or median (minimal-maximal). *Statistically significant difference (p<0.05).

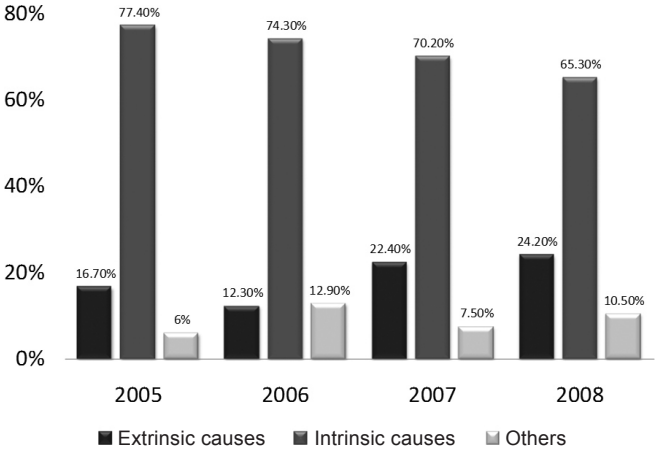


Figure 1 – Percent distribution of enteral nutrition therapy discontinuation per year.

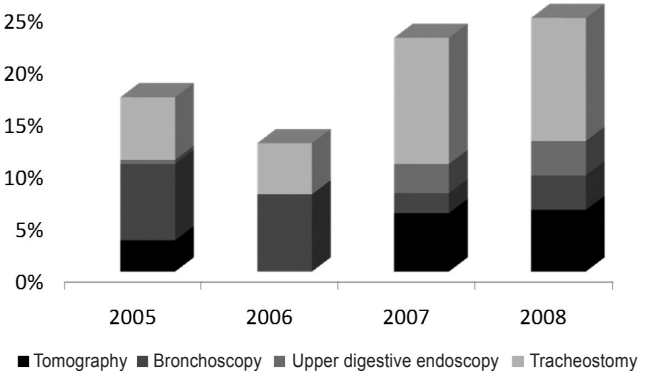
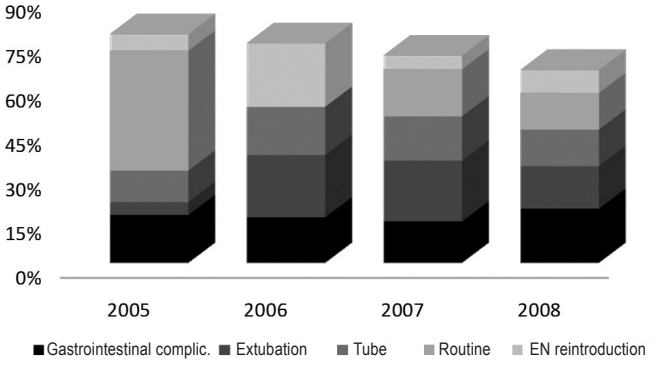


Figure 2 – Percent distribution of extrinsic causes for enteral nutrition therapy interruptions per year.



EN – enteral nutrition; C. - complications.

Figure 3 – Percent distribution of intrinsic causes for enteral nutrition therapy interruptions per year.

EN pauses for procedures. Regarding intrinsic causes, it can be said that these are trending to a balanced distribution, however with an increased participation of interruptions for gastrointestinal complications (18.3%). On the other hand, it has been possible to reduce, since 2006, the fasting time needed for extubation, as well as naso-enteral tube (NET)-related issues.

Regarding the quality indicators used (Table 5), the results show that 100% of the ENT patients had their energy and protein estimated needs attended. The frequency of patients with inappropriate fasting time before ENT ranged with the years from 10 to 20%, the results being within the proposed target. The frequency of inadvertent displacement of enteral tubes was low as well.

Table 5 – Quality indicators

Indicator	Survey				Target
	2005	2006	2007	2008	
Frequency of energy expenditure and protein needs measurement or estimation in NT patients	100	100	100	100	>80
Frequency of patients with inappropriate fasting time before NT start (>48h)	12.1	20.0	10.0	12.1	<80
Frequency of inadvertent enteral tube displacement in ENT patients	0.18	0.14	0.22	0.13	<5 em UTIs
Frequency of days with caloric offer given above or below 20% of the prescribed offer in the total patient ENT days	39.25*	30.30*	25.61*	19.03	<20
Frequency of days with insufficient protein offer in the total patient ENT days	31.24*	30.30*	21.21*	15.61	<10
Frequency of diarrhea episodes in ENT patients	-	-	-	6.76	<10

Results presented as %.
*Statistically significant difference ($p<0.05$). NT – nu¬tritional therapy; ENT – enteral nutritional therapy; ICU – intensive care unit.
Source: Clinical Nutrition Taskforce (ILSI Brazil, 2008)12; Adult ICU – Hospital Universitário.

Initially almost 40% of the total EN days had administered calories inadequacy. For proteins, this percent was lower, about 30%. However, in 2008 these values were approximately 19% and 15%, respectively.

Regarding the indicator quantifying the diarrhea frequency, it was not possible to calculate for all years. It was seen that in 2008 this frequency was 6.76%, i.e., within the proposed target (<10%).

DISCUSSION

Early EN introduction has been associated with lower infection complication rates and reduced ICU stay lengths.[19-21] Although the time to ENT start increased in the studied population, these time averages (from the patient admission until EN start) remained below 48 hours in all years, i.e., within the guidelines' proposed times, which are between 24 and 48 hours.[19-20] In a study by O'Meara et al.,[22] the average time to EN start in critical mechanic ventilation patients was 39.7 hours (±36.3h).

Regarding the nutritional target, the patients have been increasingly reaching it within a shorter average time. This suggests that the unit-adopted protocol favors an appropriate progression of the enteral formula, reducing risks, complications and promoting a rapid and effective course, contributing to minimize the nutritional wastage in this period.[10]

The energetic nutritional targets, calculated based in an average 25 kcal/kg/day agrees with the Intensive Care Nutritional Therapy Guide, which recommends during the acute phase to provide 20 to 25 kcal/kg/day and during the recovery and stabilization phase 25 to 30 kcal/kg/day.[20] Considering the average of what was actually given during the enteral nutrition (Table 3), it can be seen a significant difference for the 2008 results versus those for 2005 and 2006. It becomes then clear that the patients, in average, have being receiving values closer to the recommended.

Considering as conformity percent values above 90%, an improvement could be seen in the nutritional assistance with the years. Looking at the values found regarding ENT administration adequacy in the four surveys, it is clear that the adult ICU practices are increasingly effective, also additionally emphasizing the importance of the previously established enteral nutrition infusion protocol.[16] What can have contributed for the observed quality results, in addition to the protocol, is the work of a continuously educated Multidisciplinary Nutritional Therapy Team.

Different studies have found given/prescribed adequacy rates below the found for 2008. Van den Broek et al.,[8] analyzing just energy adequacy in exclusive EN patients, found an 87% average adequacy. O'Meara et al.,[22] found values close to 50%, ranging according to the hospitalization day. Reid et al.,[5] studying the energy-protein administration adequacy for above 72 hours mechanic ventilation patients observed in average 81% for energy and 76% for protein adequacy. Previous studies found even lower rates. [7,17,23,24]

This picture implies a considerable nutritional deficit, evidencing the difficulty to provide an actual ENT infusion closer to the calculated values. At the same time, it stresses the importance of identifying the causes of the ENT administration interruptions, allowing strategies implementation which can minimize their effects.[10]

EN administration is rendered difficult by directly intensive care-related issues, as hemodynamic instability, fasting for tests and nursing procedures, NET mechanic problems, among others.[9,25] In the literature, the most mentioned causes for EN interruptions involve nursing procedures, gastrointestinal intolerances (vomiting, high gastric residues volume), tube repositioning, tests and surgical interventions.[5,17,18,22] In this trial, the main cause extrinsic to the ICU for EN infusion interruption was the tracheostomy procedure, while, regarding the intrinsic causes, the main reason for ENT pause was gastrointestinal complications. A trial by Rice et al.[7] found that only 9% of the pauses were due to gastrointestinal issues, while O'Leary-Kelley et al.,[18] found it in 36.7%.

The results found with the quality indicators also mirrored improved nutritional assistance. Since the continued system was introduced as the local ICU ENT infusion method, when also the evaluations were started, 100% of the EN patients had their caloric and protein needs calculated.

It can be noticed that the frequency of inadvertent displacement of enteral tube was low. A possible explanation for the low inadvertent NET displacement frequency is that only displacements where the NET had to be replaced, letting out, e.g., tube migrations from post-pyloric to gastric position, as it was not possible collecting these data.

Regarding inappropriate caloric-protein offer days rate, the results observed are consistent in terms of calories (<20%), however a little above for the pro-

teins established target (<10%). Nevertheless, although the insufficient protein days rate didn't reach the aimed value, the yearly percent decline shows that we are moving towards our target. Taking the 2008 results, a significant difference ($p<0.05$) versus previous years (2005, 2006 and 2007) was seen, evidencing a favorable progression towards reaching this quality indicator target.

According to the literature-adopted diarrhea definition, its incidence may range from 16 to 63%.[26] In the paper by Elpern et al.,[25] where the same methodology for diarrhea characterization as this trial was used, diarrhea frequency was of 38% total EN days, while our result for 2008 it was only 6.76%.

Thus, it can be seen that ENT nutritional assistance has shown values compliant to the quality indicators-applied proposed targets. Application of these indicators in ENT is a new evaluation perspective, and allow monitoring the assistance quality and long term data comparisons with other services. However, as this analysis was based on a recent publication, no other results were found that allowed a comparison with other units, what likely will be very soon possible.

CONCLUSION

In the four consecutive yearly surveys performed, we observed an evolution, also with statistically significant differences for the results observed, and this was continuous and reached the scientific literature-recommended values. Thus, patients under nutritional therapy should be routinely monitored. This proposal is of paramount importance, taking into consideration the difficulties involving nutritional evaluation in critically ill patients.

RESUMO

Objetivos: Monitorar a adequação da terapia nutricional enteral na unidade de terapia intensiva visando à melhoria da qualidade da assistência nutricional.

Método: Estudo prospectivo e observacional desenvolvido na unidade de terapia intensiva adulto entre 2005 e 2008. Participaram da amostra pacientes maiores de 18 anos com terapia nutricional enteral exclusiva por mais de 72h. Analisou-se os valores médios e a adequação percentual de energia e proteínas calculados, prescritos e administrados em cada ano. Os fatores responsáveis pela não conformidade na administração planejada foram classificados em causas externas ou internas à unidade de terapia intensiva. Foram aplicados os indicadores de qualidade propostos pelo *International Life Sciences Institute* (ILSI) Brasil, sendo expressos em metas percentuais. Nas análises estatísticas utilizou-se o intervalo de confiança e os testes *t Student* e *Mann-Whitney* ($p\leq0,05$), segundo o programa Epi Info.

Resultados: Foram acompanhados 116 pacientes. Os valores médios de energia e proteínas administrados em 2005 e em 2006 apresentaram diferenças estatísticas quando comparados a 2008. A adequação calculado/prescrito permaneceu próxima a 100% em todos os levantamentos e a adequação administrado/prescrito aumentou de 74% em 2005, para 89% em 2008. Constatou-se o aumento nas interrupções da terapia nutricional enteral por fatores externos e a diminuição das interrupções por fatores internos à unidade. Os indicadores de qualidade igualmente refletem a evolução da assistência prestada.

Conclusão: Nos quatro levantamentos anuais verificou-se a melhora progressiva da oferta nutricional. Os indicadores de qualidade são uma nova perspectiva na avaliação da terapia nutricional enteral, permitindo monitorar a evolução da qualidade da assistência nutricional e a comparação com dados de outros serviços.

Descritores: Terapia nutricional; Nutrição enteral; Avaliação nutricional

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