USE ASSESSMENT AND COST ANALYSIS OF PARENTERAL NUTRITION FOR ADULTS IN A PUBLIC HOSPITAL

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ABSTRACT

The Parenteral Nutrition (PN) is a high-alert medication, with high-cost, indicated for patients in which oral or enteral nutrition is not possible, is insufficient or contraindicated. There are two PN systems currently available, the custom system, prepared in hospital pharmacies or outsourced to specialized clinics, and the standardized compartmentalized bag system. Currently, it is fundamental that the application of financial resources in health be performed efficiently, considering effectiveness, safety and economy. The aim of this study was to evaluate the effectiveness of industrialized NP in the supply of energy and to perform a pharmacoeconomic analysis of cost minimization comparing standardized and custom bags. For this, was determined the total energy expenditure of patient and then determined the adequacy of the prescriptions of PN. For cost analysis was used the values of the standardized bags used for the patient in relation with the hypothetical cost if the same formulation were custom manipulated. 28 patients and 296 PN prescriptions were identified in the study period. The rates of adequacy to the energy expenditure were 39.3% on the 1st day, 34.6% on the 2nd day, 44.65% on the remaining days of treatment, and 33.33% on the last day. As for the analysis cost, the cost of standardized bags was lower in relation to manipulated bags ($p < 0.05$). It was therefore verified that this was a high level of the inadequacy of the prescriptions of industrialized PN bags and that the same is more cost effective for the hospital in question.

Keywords: parenteral nutrition, cost analysis, public hospital.

INTRODUCTION

Parenteral Nutrition (NP) is a potentially dangerous medication,[1] indicated for patients in whom oral or enteral nutrition is not possible, is insufficient or contraindicated. It is a high-cost therapy associated with several complications such as electrolytic disturbances and infectious and mechanical complications. Its main purpose is to provide the patient with a mixture of nutrients directly related to their needs with the maximum possible safety.[2-3]

After nutritional assessment, nutrients and fluids should be indicated for each patient individually. Indirect calorimetry is the gold standard for assessing caloric needs, however, this method is not readily available in daily clinical practice.[4] There are different methods and formulas for determining the energetic need required by the patient, however in prospective studies none of them has a clear advantage.[5] The European Association for Enteral and Parenteral Nutrition (ESPEN) recommends that, in the absence of indirect calorimetry, critical patients should receive 25 kcal/kg/day, gradually increasing until the second or third day of treatment.[5]

NP nutrients are infused directly into the bloodstream through a central or peripheral access and therefore must be available in the form of simple substrates such as glucose, amino acids and lipids, which are called macronutrients, as well as electrolytes and multivitamins and trace elements, called micronutrients.[4]

There are currently two types of NP bags available. The individualized system, manipulated in the hospital's laboratory or outsourced to specialized clinics, and the industrialized compartmentalized bag system, better known as 2:1 (amino acids and glucose) and 3:1 (amino acids, glucose and lipids).[6-7] The industrialized bags contain the macronutrients separated by an inner membrane which is ruptured to the mixture of components prior to administration. Regarding safety, industrialized bags were considered by some studies superior to those handled due to the simplicity of preparation and lower contamination of the product. Regarding effectiveness, studies have shown that both types of bags are similar.[8]

Technological innovation in health made significant advances in the prevention, diagnosis and treatment of many diseases, but this progress was accompanied by an increase in costs, largely related to spending on the purchase of medicines. In this way it is fundamental that the application of the financial resources be carried out efficiently based on evidence of effectiveness and safety and of economic evaluation.[9] It is known that NP is a costly therapy for health institutions, so after the introduction of the industrialized stock markets in the world market, several studies have been conducted to determine which therapy is more cost effective,[3,7,10,11] but in Brazil there are no studies on cost effectiveness of different types of NP formulation.

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In the hospital institutions, the pharmacist plays a fundamental role in the NP utilization process, integrating the multidisciplinary nutritional therapy team (EMTN), promoting pharmacoeconomic and patient safety.[12-13] Thus, the objective of this study was to evaluate the effectiveness of industrialized parenteral nutrition in terms of energy supply and to carry out a pharmacoeconomic study of cost minimization comparing industrialized and manipulated bags.

METHODS

A pharmacoeconomic study of cost minimization with the collection of retrospective data was carried out through a chart review. Adult patients using industrialized parenteral nutrition from September 2014 to June 2015 in a public hospital in western Paraná were included in the sample. Exclusion criteria included absence of patient weight in the medical records and use of manipulated and industrialized parenteral nutrition in the same treatment. The project was approved by the Human Research Ethics Committee of the State University of Western Paraná in March 2016 (CAEE No.: 50067515.0.0000.0107; approval No. 1.545.242) and did not present a conflict of interest.

Data collection was performed through a review of the patient's medical record at the Medical and Statistical Archive Service (SAME) of the hospital, and the electronic medical record, through a computerized system. Social and demographic variables (gender, age), data related to hospitalization (hospitalization unit, clinical evolution, duration of hospitalization) and data related to NP use (indication, type of access, duration of use, prescribed formulations and use of trace elements and multivitamins).

To estimate the total energy expenditure (GET) of each patient, the general formula of 25 kcal/kg/day was used, recommended by ESPEN.[5] In order to analyze the adequacy of NP prescription according to GET, the prescriptions that reached 30 to 50% of GET on the first day, 50 to 70% on the second day, 80 to 120% on the other days were considered appropriate. 40 to 60% on the last day of NP administration. According to the type of bag and quantity of NP prescribed, the total number of calories offered to the patient was determined and this value was compared to the GET to determine the adequacy rate of each prescription. In cases where the patient also used enteral nutrition, the forms of the Nutrition Service were used to determine the amount of calories offered by this route, which were added to the calories offered with NP to calculate adequacy.

COST ANALYSIS

A pharmacoeconomic study of cost minimization was carried out, in which the two alternatives evaluated are equivalent in terms of results obtained, from the perspective of a public hospital as a paying source.

The direct medical costs of the use of NP were analyzed through the acquisition of the two types of formulations, manipulated and industrialized. For industrialized bags, the value of trace elements and polyvinyl alcohol and of the materials necessary for dilution and infusion of the same were added. In the case of handled bags these components are included in the formulation and no parallel administration is required.

The costs of the industrialized NP were obtained from the price record of the 2014 bidding process, whereas for the manipulated formulations, which is an outsourced service to a specialized clinic in the study hospital, were obtained from the process price registration tender for 2015. Due to the time difference between the price registration notices, all values were corrected according to inflation for 2016 (rate 5.36%; IPCA – Fundação Getúlio Vargas). The direct costs of the formulations and materials are presented in table 1. For pharmacoeconomic analysis, the volume of the industrialized pouch prescribed for calculating the value of the manipulated bag of corresponding volume was considered.

STATISTICAL ANALYSIS

The results were expressed in relative and absolute frequencies for qualitative variables and mean and standard deviation for quantitative variables. For the comparison of the quantitative variables that did not present normal distribution, the Wilcoxon non-parametric test (Mann-Whitney) was applied. The correlation test of Spearman was used to evaluate weight and age correlation with the inadequate prescription rate. The significance level adopted was 5% (p-value <0.05). The data were analyzed using statistical software "R" (R CORE TEAM, 2015).[14]

Table 1. Composition and cost of industrialized and manipulated parenteral nutrition formulations.

Type of Bag	Volume (ml)	Amino acids (g)	Glucose (g)	Lipids (g)	Cost (R$)
Industrialized 1	1000	48	165	0	142.00
Industrialized 2	2000	96	330	0	214.33
Industrialized 3	1000	22	80	20	173.33
Industrialized 4	625	35.9	90	25	124.33
Industrialized 5	1250	48	150	50	189.33
Industrialized 6	1875	107.7	270	75	264.33
Industrialized 7	1875	72	225	75	227.33
Manipulated 1	1-600	Prescription *	Prescription	Prescription	236.52
Manipulated 2	600-1200	Prescription	Prescription	Prescription	285.25
Manipulated 3	1200-1800	Prescription	Prescription	Prescription	350.03
Manipulated 4	1800-2200	Prescription	Prescription	Prescription	374.41
Manipulated 5	1050	50	200	20	267.25
Manipulated 6	1110	50	200	32	298.73

* Nutrients handled according to medical prescription within the volume of the respective bag.

RESULTS

In total, 31 patients who used parenteral nutrition during the study period were identified. After submission to the exclusion criteria, one patient was excluded due to the absence of weight in the medical record and two because they had used in the same treatment, manipulated and industrialized NP. Thus, 28 patients with a total of 296 NP prescriptions were analyzed.

The mean age of the patients was 56 years (± 15), the majority being female (54%). The patients remained in the institution on average for 43.39 days (±27.9) and thethe majority had improved clinical discharge (53.57%). Regarding the use of NP, the Intensive Care Unit (ICU) had the highest number of patients undergoing treatment (57.24%), followed by the Clinical and Surgical Clinic (35.71%). The mean time of use was 10.5 days (± 7.81). Most patients had NP administration by central access (96.43%) and 50% of the patients received enteral nutrition associated with NP on at least one day of treatment. The general characteristics of the population are described in table 1.

Table 1. Characteristics of patients who used industrialized parenteral nutrition between September 2014 and June 2015 in a University Hospital.

Characteristics of patients/ hospitalizations	Mean	SD
Age (years)	56.39	±15,3
Length of stay (days)	43.39	±27,9
NP Utilization Time (days)	10.50	± 7.81
Gender	Absolute	Relative
Female	15	53.57%
Male	13	46.43%
Inpatient Unit		
Intensive Care Unit	16	57.14%
Medical and Surgical Clinic	10	35.71%
Emergency Room	2	7.14%
Clinical Evolution of the Patient		
Hospital discharge	15	53.57%
Death	12	42.86%
Transference	1	3.57%
Type of Access		
Central	27	96.43%
Peripheral	1	3.57%
NPT Usage Time		
≤7 days	9	32.14%
8 – 20 days	17	60.71%
> 20 days	2	7.14%
Use of Enteral Nutrition		
Yes	14	50%
No	14	50%

Regarding NP indications (Figure 1), the most frequent reasons for prescription were postoperative ileus (35.71%), pancreatitis (28.57%) and fistulas (10.71%).

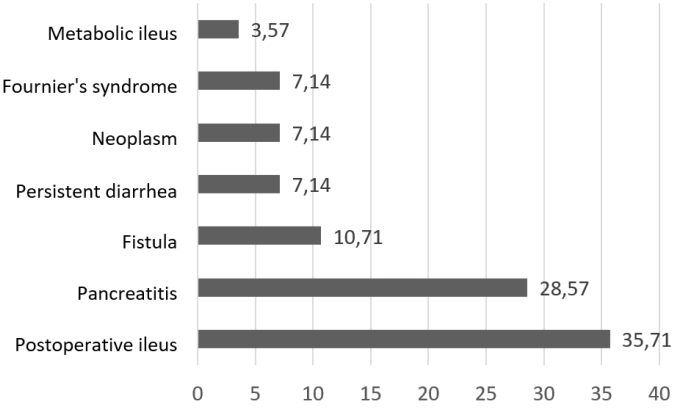

Figure 1. Relative frequency (%) of indications of industrialized Parenteral Nutrition between September 2014 and June 2015 in a University Hospital (n = 28).

Regarding the adequacy of the calories offered (Figure 2), on the first day of NP administration, it was observed that only 39.3% of the patients received between 30 and 50% of the GET. In addition, 50% of the patients received an above-ideal calorie supply for the first day of NP and 10.7% received an offer below 30%. On the second day of NP administration, where the energy supply objective is 50-70% of the GET, most prescriptions were also inadequate (65.3%), 34.6% below the supply of energy necessary for the patient.

The other days of NP use, except the last day, when 80 to 120% of GET should be offered, out of a total of 215 prescriptions, only 96 (44.65%) reached this goal. Among the 119 prescriptions considered inadequate for calorie supply, 80% were below the estimated caloric requirement for the patient. It was also found that during the treatment, seven patients (25%) did not reach the estimated GET on any day of NP administration, and that the other patients reached the GET on average on the 4th day of NP administration. Prescriptions not suitable for GET were not correlated with weight (P: 0.704) or the age (P: 0.137) of the patients.

On the last day of NP administration, when there should be a reduction in the energy supply, a prescription between 40 and 60% of the GET offered exclusively with NP was considered appropriate the previous day. It was verified that only 33.33% of the prescriptions were within the suitability range.

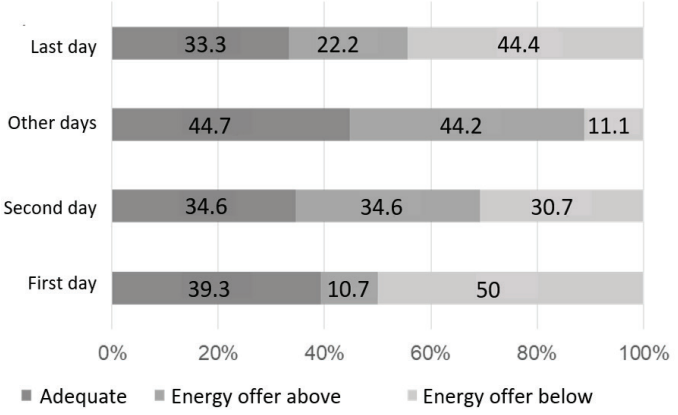

Figure 2. Percentage of Adequacy of Prescribed Parenteral Nutrition Prescriptions between September 2014 and June 2015 in a University Hospital regarding total energy expenditure (n=296).

Regarding the use of trace elements and multivitamins, it was observed that of the 296 prescriptions of NP in the evaluated period only 11.82 and 2.70% contained prescription of trace elements and multivitamins, respectively.

Regarding the cost analysis, it was verified that the hypothetical total cost of the manipulated nutritional products is higher in relation to the industrialized bags, even if these values are increased by the administration of trace elements and multivitamins (P: <0.05) (Table 2).

Table 2. Cost Analysis of Industrialized Parenteral Nutrition X Manipulated in a University Hospital.

Type of Parenteral Nutrition	Industrialized	Manipulated
Average cost per bag (R$)	218.08 ± 37.14	323.89 ± 46.25
Total cost (R$)	64,562.68	95,864.96 *
	Multivitamin	**Trace element**
Cost per day of treatment (R$)	22.71	11.62

*p-value <0.05

Note: Values adjusted according to inflation for 2016.

DISCUSSION

The prescription of parenteral nutrition is complex and associated with significant adverse effects, with appropriate and safe prescriptions being the first step and an essential component in the process of using this therapy.[15] In the present study, high rates of inadequacy of NP prescriptions regarding energy supply were suggested, suggesting that the process of NP use in the study hospital should be reviewed, with prescription protocol insertion and effective participation of the multiprofessional team in nutritional therapy (EMTN) as recommended by Ordinance 272/1998-MS.[2]

Regarding indications for use of postoperative NP ileum, a transient change in gastrointestinal motility after abdominal surgery,[16] was the most frequent cause, a result similar to that found in a study carried out in a public hospital in Fortaleza where the greatest cause of NP indications were gastrointestinal tract surgeries.[17]

The low rate of adequacy of the prescriptions of NP industrialized, regarding the energy supply found in this work differs from some studies described in the literature. Blanchette[10] and co-workers at a Boston hospital in the United States found an energy adequacy rate of 78% with manipulated nutrition and 82% with industrialized, but considering adequate prescriptions with at least 70% of GET in that same study when rates are increased to 90 % the adequacies are of 33 and 30%, for NP manipulated and industrialized respectively. High compliance rates were also found in work performed at a university hospital in Barcelona, Spain, where 87% of the patients received between 85 and 115% of the energy supply with industrialized NP.[18] It should be noted that in the present study a comparison was not made between the two types of formulation regarding energy adequacy, therefore it cannot be said that the low adequacy rate is due to the use of industrialized NP. Berlana and collaborators (2014)[3] analyzed several quality criteria between NP manipulated and industrialized and concluded that the implantation of industrialized bags did not influence the NP quality offered to the patients.

After the introduction of the industrialized bags in the world market several studies were conducted to determine the quality and effectiveness of this type of formulations and there is no conclusive evidence until the moment that this system differs in relation to the pockets manipulated with respect to these criteria. From this, a cost minimization analysis can be performed to determine which NP system is cost advantageous for health institutions. In the present study, a cost analysis was performed for the first time in Brazil between the different NP types. It has been shown that the industrialized system has a lower cost, considering a public hospital as a source of pay. This result is like that described by MAGEE (2014)[19] and TURPIN (2011)[20] in the USA and BERLANA in Spain (2013),[7] who also verified an economy for health institutions with the use of industrialized NP.

When analyzing NP cost studies, the type of NP production in the hospital or outsourced, the types of available bags, 3:1 or 2:1, and the need to add other components such as electrolytes and micronutrients. It should be noted that the present analysis was performed in a hospital that outsources the manipulation service to a specialized clinic and, therefore, does not apply directly to hospitals that have their own manipulation service.

CONCLUSION

The adjustment rates of caloric adjustment with industrialized NP were not satisfactory, but complementary studies are necessary to determine whether this fact is related to industrialized NP or other factors. However, from the pharmacoeconomic point of view, it can be said that the use of industrialized NP is viable in hospitals that outsource this service.

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CONTRIBUTORS

JLT collected, interpreted study data and writing this paper. JCB e DFMO and EAS contributed to analysis of results and critical review of text. MV contributed to study design and interpretation of results. ACCS contributed to study coordination, analysis and interpretation of results and critical review of text. All authors are responsible for the article information and have approved the final version for publication

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CONFLICT OF INTEREST

The authors have no conflicts of interest

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