

Cost of Enteral Formulae Feed in Critically Ill Patients in a Tertiary Care Centre: An Observational Study from India

Research Article

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Abstract

Introduction: Specialized enteral feeding provided by the use of scientific formula feeds are considered costly and cost is very important factor in Indian ICU. The aim of this study is to evaluate the cost of enteral formulae feeding in critically ill patients in a tertiary care center and to correlate the cost to the severity of illness and LOS of patients in ICU.

Methodology: An Observational study was performed on 2748 patients admitted in ICU of S.L Raheja Hospital over a period of 3 years who were completely fed over formula feeds which was determined by iNutrison Software. The feeding data were extracted from the patient file record and were analyzed.

Result: Overall results indicated that the average cost of scientific feeding formulae was 749 INR (10.77 U.S.Dollars)/day. Average LOS for the entire population during the study period was 4.84 days. If the LOS was greater than 5 days the cost of formulae feeding was 325 INR (4.67 U.S.Dollars)/day and if LOS was less than or equal to 5 days the cost was 826 INR (11.88 U.S.Dollars)/day.

Conclusion: Lesser the number of days the patient stays in the ICU more is the cost of scientific formula feeding. However the cost of feeding per day is much lesser than the cost of many others like antibiotics in the ICU.

Keywords: Enteral nutrition; iNutrison software; Intensive care unit; Formula feeding; Length of stay; APACHE2; Cost of feed

Abbreviations

APACHE: Acute Physiology and Chronic Health Evaluation; ASPEN: American Society of Parenteral and Enteral Nutrition; EN: Enteral Nutrition; GI: Gastro Intestinal; ICU: Intensive Care Unit; LOS: Length of Stay

Introduction

The benefits of enteral nutrition is very well known such as reduced incidence of pneumonia and intra-abdominal infections by reinforcing gut immunocompetence with their direct effect in promoting MALT (Mucosa Associated Lymphoid Tissue) thus producing IgA antibodies, reduced cost by reducing length of stay, lesser chances of infection (associated with parenteral nutrition) and avoidance of central line associated complications [1,2]. In India

and many other Asian countries, specialized enteral feeding can be provided by the use of blenderised kitchen feeds or reconstituted powder based supplemental nutrition also called as scientific formula feeds. Other countries like the United states and European countries have premixed liquid based formula feeding which are generally ready to hang. Scientific feeding formulae have got some advantages over blenderised kitchen diets which include minimization of feed contamination [3], consistency in amount and supply of nutrients, prevention of viscosity related blockage of feeding tubes etc. [4,5]. In an earlier observational intensive care unit study, among the 20 intensive care units studied in a city of Mumbai in India only around 50 % of patients were being fed by scientific formula feeds [6]. This could be due to many reasons which include untrained staff, lack of dietitians, physicians belief of non-superiority of scientific feeding formulae, fear of diarrhea, lack of awareness and above all cost.

As per a systematic review conducted by Pritchard, a wide variation in costs was reported, ranging from 7.8 U.S Dollars per day of Enteral Nutrition (EN) in adults to charges of 46 U.S.Dollars per day for pediatric ICU patients [7]. Another study done in medical and trauma patients in a single centre reported around US\$ 245 per 7 days, or US\$ 35 per day [8]. Cost is a very crucial factor when it comes to Indian Intensive Care Units since most of the payments are out of pocket and less than 10 % of the entire population are covered by medical insurance as per National Family Health Survey-4 for national health insurance [9].

However to the best of our knowledge there is no such study conducted in India that has evaluated the cost of scientific feeding formula in intensive care patients. Hence this observational study was carried out in a tertiary care intensive care unit which provides nutrition by specialized formula feed to 100% of its patients when indicated as per screening criteria with the aim of evaluating the cost of enteral formulae feeding. Secondly we also studied the relation of severity of illness (APACHE 2) and the Length of Stay (LOS) to the cost of scientific enteral feeding.

Materials and Method

A retrospective observational study was performed over consecutive 2748 patients admitted to Intensive Care Unit of SL Raheja Hospital, Mahim, Mumbai, and Maharashtra over period of 3 years from September 2015 to September 2018 after prior approval from ethics committee of the hospital. All of them were included provided they fell into the at risk criteria as suggested by either NRS-2002 or the Nutric score (without the Interleukin-6). All the selected patients were provided with complete powder based formula feeds that was reconstituted under laminar airflow with drinking water. In case of re-admission, only the first admission was considered. Patients were transitioned to kitchen feeds only on the day that the patients were getting shifted out from the intensive care unit.

All the patients received powder based specialized formula feeds that were determined by computer generated sophisticated algorithm called as the iNutrison Software [10]. The iNutrison selected the type of formula feed (among all available formulae in the hospital which included Nestle, Abbott, and Fresenius). The energy and protein requirements were determined as per simple predictive equations as per ASPEN guidelines (total calories at 25 kcal/kg and protein at 1.5 g/kg). The software algorithm showed products or at times combinations of two different formula feeds based on the following criteria in descending order.

1. Best protein match for the water prescribed and that suggested by the formula
2. Best calorie match for the water prescribed and that suggested by the formula

The software suggested the number of scoops to be given with the recommended volume for that particular feed and it also took into account the fluid balance and requirement of the patient.

As per protocol the ICU uses continuous feeding with feeding pumps. In the study, the cost of bags was not included in the data. Also, at times patients were also given scientific feeding formulae

orally in order to “top up” the inadequacy in kitchen based oral diets. When patient had started consuming at least 70 % of kitchen diet orally scientific feeding formula were discontinued. This usually coincided with the last day of stay in the Intensive care unit.

The feeding data were extracted from the patient file record from the Medical Record Departments. The average feed was calculated by sum total of the total number of scoops supplied per admission during the overall length of stay in ICU divided by the number of scoops supplied per tin of formula feed to know the number of tins utilized per patient. Data so obtained were analyzed to get the relationship of average length of stay to average cost of feed per day per patient.

The APACHE 2 score and length of intensive care unit stay of all selected patients were noted by the date of first entry in nutrition planner software considered as date of admission and date of discharge from or death in ICU. In order to obtain the relationship between the cost of feeding, length of stay and severity of illness, the patients were distributed into 4 subgroups based on APACHE 2 scoring system - 3 to 10, 11 to 20, 21 to 30 and more than 31 and the data were analyzed accordingly.

Results

Following Observations were drawn from this study

The inutrimon software probably selected Peptamen (Nestle) (among all the available products as shown in Table 1) often probably in view of specific nutritional requirement for ICU patients which included conservative fluid management, high proteins and moderate calories.

Average length of stay was lesser in patients with APACHE 2 scores between 3 to 10 and 11 to 20 i.e., 3 and 3.84 respectively however the cost of feed per day per patient 751 INR (10.8 U.S.Dollars) and 766.93 INR (11.03 U.S.Dollars) respectively. Whereas average LOS was 20 days and 58 days for subgroups with APACHE 2 scores in the range of 21 to 30 and 31 and above respectively. However average cost per patient was 530 INR (7.62 U.S Dollars) per day and 405 INR (5.82 U.S.Dollars) per day for patients with APACHE 2 scores in the range of 21 to 30 and 31 and above respectively (Table 2).

On comparison between the groups Average LOS was found to be higher in patients in subgroups with apache scores more than 20 when compared with the subgroups with apache scores less than 20. Also, the cost of formulae feed for patients with higher apache score was found to be significantly lower than patients with lesser apache scores.

Overall results indicated that the average cost of scientific feeding formulae was 749 INR/day (10.77 U.S.Dollars) with average length of stay for the entire population during the study period from September 1st 2015 to September 1st 2018 was 4.84 days.

It was also found that if the length of stay was greater than 5 days then cost of formulae feeding was 325 INR (4.67 U.S.Dollars) /day and if length of stay was less than or equal to 5 days the cost was 826 INR (11.88 U.S Dollars) /day (cost of feeding becomes more than double if length of stay goes beyond 5 days - Table 3)

Table 1: Description of total formula feeding in the ICU.

Product name	Total No of scoops	Total no of tins	Total cost (Rs)	Number of patients
Peptamen	136808	3181	4132874 (59,271.13 U.S.Dollars)	1277
Resource high protein	17000	354	316000 (4,527.31 U.S.Dollars)	357
Fresubin D.M	26153	817	513893 (7,368.57 U.S.Dollars)	269
Nephro HP	4530	102	82363 (1,180.98 U.S.Dollars)	56
Kabipro	9593	290	232266 (3,329.00 U.S.Dollars)	235
Resource opti	17306	360	234352 (3,358.90 U.S.Dollars)	186
Resource diabetic	4590	95	66841 (957.752 U.S.Dollars)	61
Resource nutrihep	18770	391	38986 (558.623 U.S.Dollars)	225
Resource dialysis	11939	248	198734 (2,849.55 U.S.Dollars)	62
Resource renal	700	14	10193 (146.153 U.S.Dollars)	15
Kabisure	173	5	3332 (47.71 U.S.Dollars)	5

Table 2: Distribution of patients as per APACHE 2 scoring system and their average length of stay in ICU and average cost per patient per day.

APACHE 2 range	Total no of patient	Total length of stay	Average LOS	Total cost	Average cost per patient	Total cost / day
3 to 10	1724	5398	3	3306110.32 (47,460.82 U.S.Dollars)	751.37 (10.78 U.S.Dollars)	1229912.3 (17,649.01 U.S.Dollars)
11 to 20	876	3204	3.84	1862830.16 (26,742.02 U.S.Dollars)	766.93 (11.00 U.S.Dollars)	638853.31 (9,175.36 U.S.Dollars)
21 to 30	104	1307	20	152074.59 (2,184.1319 U.S.Dollars)	530 (7.61 U.S.Dollars)	33117 (475.624 U.S.Dollars)
31 and above	44	2222	58.47	105162.13 (1,508.44 U.S.Dollars)	405.78 (5.82 U.S.Dollars)	15017 (215.17 U.S.Dollars)

Table 3: Relationship of average length of stay to average cost of feed per day per patient.

Length of stay	Number of patients	Average cost of formula feed per day(in INR)	Total cost for the entire population (in INR)
Less than equal to 5 days	2310	826 (11.85 U.S.Dollars)	4463574 (64069.53 U.S.Dollars)
More than 5 days	438	325 (4.66 U.S.Dollars)	1147613 (16472.01 U.S.Dollars)
Total	2748		

Discussion

Nutrition given early and by the enteral route is well established in the ICU. In modern critical care, the paradigm shift from 'blenderized kitchen feeds' to the 'formulae feed nutrition' has now a lucrative response in terms of health of critically ill patients aiding in their faster recovery and lesser duration of stay in ICU. Choosing the right enteral feeding formula at the right time have number of positive implications. Early enteral nutrition reduces the risk of infection in critically ill patients improves gut immunity and gut function administered to post-operative patients of GI malignancies as they can be subelemental [11-13], offers minimal or no feed contamination as compared to blenderized kitchen feeds [15], lesser chances of intolerance due to permissible osmolality, early weaning off from mechanical ventilator supports reduces the length of stay in ICU and is cheaper than parenteral nutrition [16,17].

Cost factor plays a crucial role in a developing country like India where less than 10% of the population is covered under health insurance schemes, most people have to pay for the cost of treatment

and feeding from their pockets. So, the cost of formula feeds becomes imperative here. The question to answer for which this study was taken up was, whether early initiation of formula feed would affect the length of stay in ICU and will it affect the cost of treatment to critically ill?

In our study, all of the patients were completely fed over formula feeds which was determined by a sophisticated computer generated algorithm by "inutrimon" software that selects the most appropriate scientific feeding formula after taking into account the anthropometry, present illness of the patient, his/her comorbidities and his/her severity of illness.

The results of the present study showed that the average cost of scientific feeding formulae was 749 INR (10.77 U.S.Dollars)/day with average length of stay for the entire population during the study period from September 1st 2015 to September 1st 2018 was 4.84 days. It was also found that cost of feeding becomes more than double if length of stay goes beyond 5 days. This correlation that we found in our observational study has been established in the past by Noseworthy TW [18].

It was established that, average length of stay was lesser in patients with APACHE 2 scores between 3 to 10 and 11 to 20 i.e 3 and 3.84 respectively and the cost of feed per day per patient 751 INR (10.8 U.S Dollars) and 766.93 INR (11.03 U.S.Dollars) respectively. This probably may be because of -

- a) These patient tolerated feeds better
- b) We were able to feed them early in the admission as they probably did not need resuscitation
- c) They probably were unable to finish the formula feed tin supplied in the said days of stay in the ICU and hence the per day cost (in the ICU) increased.

Whereas average LOS was 20 days and 58 days for subgroups with apache scores in the range of 21 to 30 and 31 and above respectively. However average cost per patient was 530 INR (7.62 U.S.Dollars)-per day and 405 INR (5.8 U.S Dollars) per day for patients with apache scores in the range of 21 to 30 and 31 and above respectively. This can be attributed to -

- a) These patients were fed less probably because the initial 48 hours would have gone without feeding in order to ensure reasonable hemodynamic stability.
- b) These patient would have had higher intolerance and hence received lesser feeding
- c) Many of these patients were ventilated and monitored via indirect calorimeter and the measured calories required were found to be much lesser
- d) There were many episodes of iatrogenic underfeeding like visits to CT scans and procedures etc where feeding was held resulting in lesser consumption of feed and hence tins and hence cost.

As in our study average length of stay was lesser in patients with APACHE 2 scores between 3 to 20 which can be supported by some previous studies one among them is by SA Naved which stated that there is an inverse relationship between the high APACHE II score and the length of stay [18]. If the APACHE II score increased beyond 20 in our study the length of stay also increased accordingly which is in accordance to studies by A Agarwal and SJ Theresa [18,19].

As to the best of our knowledge there is no such study taken up in india till date which directly estimated the cost of scientific formula feed, therefore this study could play a pivotal role by supporting the facts that early initiation of feeding will result in lesser overall cost of treatment and will benefit the patient above and better than blenderized kitchen feeds.

Some of The Limitations Of This Study Are

1. This is a single centre observational study where the feed prescription and monitoring is computer driven and hence probably very tightly controlled with respect to achieving target goals of calories and protein.
2. The authors ICU also used continuous feeding via feeding pump. This may not be the cases in other ICU's. Hence the generalizability to all ICUs in INDIA may not be justified.

Concluding Remarks

This is probably the first Indian data on the cost of complete scientific feeding formulae in the ICU. It does appear that lesser the number of days the patient stays in the ICU more is the cost of scientific formula feeding. However the cost of feeding per day is much lesser than the cost of many others like antibiotics in the ICU.

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