Learning objectives

- To understand the principles of hospital economics as it relates to clinical nutrition;
- To identify the costs of malnutrition in your hospital;
- To demonstrate how an adequate nutritional support team has cost benefit and cost efficacy;
- To learn how modern approaches in clinical nutrition, like immunonutrition and home care nutrition, have an impact on cost benefit.

Contents

1. Introduction
2. Aspects of costs
   2.1 The onus of malnutrition: a hospital reality
   2.2 Costs arising from “non-prescription of nutritional therapy”
   2.3 Multidisciplinary team work: an expense or economy
   2.4 Old models, new approaches
      2.4.1 Conventional care: intra-hospital model
      2.4.2 Home-care
      2.4.3 Integrated hospital-home model
      2.4.4 Brazilian experience with integrated hospital-home model
      2.4.5 Considerations regarding the care models
   2.5 Nutritional therapy reduces complications and costs
3. Glossary: analysis of costs
4. Short summary of the module
5. References

Key messages

- Hospital malnutrition is not only a significant clinical problem but also imposes a financial burden by provoking a higher rate of surgical complications, mortality and longer hospital stays. Investment in nutritional therapy provides economic returns;
- The cost of the creation and maintenance of the nutritional support team is easily offset by the resources and savings generated by the team itself;
- Nutritional therapy in home-care is cost effective;
- The adoption of preoperative immunomodulatory nutritional therapy in patients undergoing elective surgery, mainly for GI cancer, as a prophylactic against postoperative surgical complications caused a 2.24 times reduction in the total treatment cost;
- The search for the ideal model of nutritional therapy is based on the binomial of quality and cost. The prescription of nutritional therapy has a favorable impact on financial and resource generating aspects of the institution, when practiced by properly trained groups.
1. Introduction

Using the techniques of health economics it is possible to analyze our clinical practice in terms of its costs and consequences. It can help to answer questions, like: Are you satisfied with the available financial resources? Are these resources being well applied? Would a new method of care economize on resources?

It is also important to consider the opportunity cost when evaluated a given program. Could you gain more value applying your own resources in an alternative way?

2. Aspects of Costs (1)

Costing of healthcare involves a review of therapeutic procedures, documented in the medical records of the patient, which are then analyzed and reimbursed by public and private sources of funding. Fund providers (medical health systems or medical insurance companies) observe this process according to their own interests. The health care authorities seeks to analyze investment and results, with a view to certifying that the monetary resources transferred are being allocated in a safe, efficient and effective manner in the appropriate amount and without waste. The manager of health services or hospital administrator receives the funds and has the responsibility for optimizing the use of these resources (2). He or she, on behalf of the institution receiving these resources, must therefore determine a balance between the duration of the hospital stay and the benefits for the patient, and also whether the services rendered by the hospital are compatible with its financial stability (3).

The interests of the manager of health services and the direct provider of health services are often conflicting. The former wants to spend the least amount possible, whereas the latter’s priority is to maximize patient benefit and to use leading-edge technology to treat patients. The health service provider who manages to demonstrate the value of the service rendered can receive reimbursements for that service that are increasingly close to the real costs of the procedures performed. For example, in the USA the reimbursement for nutritional treatment (NT) represented 30% of the expenses effectively involved in the service, whereas after the elaboration of a series of economic studies, reimbursement began to cover up to 80% of the real costs (4, 5, 6). It is therefore in the clinicians’ interests to keep careful records which allow him or her to accumulate and provide evidence of the cost effectiveness of the service provided.

To apply the principles of economics in healthcare practice does not necessarily mean that one should spend less, but, on the contrary, that the resources should be used in a more efficient manner (7). Spending excessive resources to obtain minimal increments in terms of outcome is not worthwhile, is not good clinical practice, and is unlikely to elicit the support of managers or funding authorities.

2.1 The Onus of Malnutrition: A Hospital Reality

It is difficult to establish a monetary value for the physical and psychological manifestations of malnutrition, especially because these are affected by age, severity of malnutrition, and severity and type of underlying disease (8).

Malnutrition often coexists with disease and, because each can be a cause or a consequence of the other, it is reasonable to consider the cost of malnutrition and associated disease together (disease-related malnutrition) (8).

The Brazilian Inquiry into Hospital Nutrition Evaluation (IBRANUTRI), investigated 4000 patients from 12 states and the federal districts of the country, and found a malnutrition rate of 48.1% in patients Brazilian public hospitals, 12.6% being severely malnourished and 35.5% being moderately malnourished (9).

Hospital malnutrition is directly responsible for higher mortality and morbidity indexes [slower healing of wounds, increased rate of hospital infection, longer hospital stay, mainly among patients in intensive care units (ICUs), and higher frequency of re-admission (10, 11), resulting in higher costs for the health system (12, 13). One must also consider avoidable deaths, the additional costs for the retirement system, and the greater social burden (caused by the inability of these patients to continue with their work and the continuing costs of their care in the community).

This creates a vicious circle. The longer the patient stays in hospital, the greater the chance of becoming undernourished, which then results in more prolonged hospitalization. In a country with an insufficient number of hospital beds, such malnutrition among hospitalized patients reduces the turnover of the hospital and reduces still further the beds available for new patients.
IBRANUTRI demonstrated that malnutrition worsens the length of the hospital stay: within the first 48 h of hospitalization 31.8% of patients are already undernourished. This number increases to 44.5% after 3-7 days of admission, 51.2% after 8-15 days, jumping to 61% after 15 days (9). Prolonged hospitalization and clinical complications generate increased costs. These costs place an even greater burden on the public health care, which already works close to its limit. This problem can be resolved, in the case of undernourished patients, using the tools and resources that are currently available within the hospitals themselves, e.g. by screening patients for malnutrition and treating appropriately with nutritional support (10).

2.2 Costs Arising from “Non-Prescription of Nutritional Therapy”
Failure to identify and treat the problem of undernutrition in elective surgical patients, results in a higher incidence of general and infectious complications, as well as greater mortality, when compared with those in good nutritional state at the time of surgery (12, 14, 15). Few observations disagree with these results (16, 17). Even in non gastrointestinal disease, there is an association between preoperative malnutrition and a complicated postoperative course (18, 19). Undernourished patients remain hospitalized for a longer period than well-nourished patients and have a greater chance of developing minor and major complications, thereby significantly increasing hospital expenses (20). Their mortality rate is also greater than that of malnourished patients (21, 22 - 26).
Correia and Waitzberg (27) found that the presence of malnutrition was correlated with a 1.5 times greater chance of infection compared with non-undernourished patients. The chances of developing malnutrition were increased by a number of factors: age over 60 years increased the chance of malnutrition by 1.8 times; admission for more than 8 days increased the risk 2.7 fold; the presence of cancer increased the chance of malnutrition by 8.1 times; and localization of the disease in the upper digestive tract was associated with a 15.7 times greater chance of malnutrition.
The early identification of malnutrition followed by immediate nutritional intervention is the best way to minimize the harmful effects of protein-calorie malnutrition (10, 28, 29). The failure to provide early NT for undernourished surgical patients increases hospital costs to a significant degree (23, 25, 26).
In the United Kingdom, it was found that malnourished patients had more general practitioners visits, more hospital admissions (e.g., 65% and 82% more, respectively, for those ≥65 y old), >30% longer hospital stays, and greater likelihood of admission to care homes than did well-nourished individuals. The overall cost of treating malnutrition was estimated to be in excess of £7.3 billion per year, with disproportionately large expenditure on older individuals (≥65 y) who account for about 50% of the population in hospitals and >90% of the population in long-term care facilities. About 50% is expended on the care of malnourished patients in hospitals and most of the remainder on managing them in long-term care facilities (8).
On the other hand the active search for hospital malnutrition, using screening tools, has been proved cost effective. According to Kruizenga et al (30), the recognition of malnutrition improved from 50% to 80% with the use of the SNAQ malnutrition screening tool during admission to the hospital. The standardized nutritional care protocol added approximately 600 kcal and 12 g protein to the daily intake of malnourished patients. Early screening and treatment of malnourished patients reduced the length of hospital stay in those with low handgrip strength (e.g. frail patients). To shorten the mean length of hospital stay by one day for all malnourished patients, a mean investment of EURO 76 (US $91) in nutritional screening and treatment was needed.

2.3 Multidisciplinary Team Work: An Expense or Economy? (1)
Multidisciplinary nutritional support team (MNTT) work can be responsible for a reduction in treatment costs when certain procedures are adopted, with a view to guaranteeing better clinical results and a significant reduction in the costs.
The University of Michigan (USA) showed an impressive reduction in the cost of patient treatment after the creation of a MNTT and the establishment of work methodology and specific training. Among other positive results, there was most notably a significant decrease in the incidence of sepsis as a result of catheterization (from 24.0 to 3.5%). The reduction in the general costs of hospitalization varied from US$14 680 to US$35 286 a month, amounting to an economy of approximately US$25 000 a month, considering the lower expenses of laboratory examinations, antibiotic therapy and the infusion of intravenous fluids. It is undeniable that such a team is an expensive asset. The fees involved in the creation and maintenance of this specialized team reach...
Another study, carried out with the same objective (32), showed that the MNTT resulted in a significant reduction in the mortality rate (23%), duration of hospitalization (11.6%) and readmission rate (43%). The cost-benefit analysis showed that for each US$1.00 spent by the MNTT, a return of US$4.20 was obtained on this investment (59).

A systematic review of studies was done to better appreciate the impact of multidisciplinary TPN teams. Naylor et al (33) identified 11 studies, 4 with concurrent controls and 7 with historical controls, eligible for inclusion in the review. Results of the studies indicate that the incidence of total mechanical complications is reduced in patients managed by the TPN team; however, it is unclear if there is a reduction in catheter-related sepsis and metabolic and electrolyte complications. The available evidence, although limited, suggests financial benefits from the introduction of multidisciplinary TPN teams in the hospital setting.

Recently Kennedy et al (34) have demonstrated the cost savings and quality benefits of a MNTT in a British hospital. The primary aim of this study was to determine whether a MNTT could show tangible cost savings (equipment, investigations, and medication costs) from managing patients considered for parenteral nutrition (PN). Secondary aims related to the quality issues of placement of PN catheters, catheter-related sepsis (CRS), duration of parenteral nutrition, and mortality. Although the number of PN days increased with a MNTT, tangible cost savings of £50715 were demonstrated within the MNTT year by avoidance of unnecessary PN and a decreased incidence of CRS. These savings justify the salaries of a nutrition nurse specialist and a senior dietitian.

In three countries of Europe, MNTTs were analyzed, by Shang et al (35) according to their structure and organization. From a total of 3071 hospitals in Germany, Austria and Switzerland NSTs have been established at 98 hospitals (3.2%). Their main activities were creating nutritional regimes (100%), education (87%) and monitoring nutrition therapy (92%). In general, the MNTTs were not independently operating units but were affiliated to a special discipline. Seventy-one per cent of the physicians, 40% of the nurses and 69% of the dieticians in the MNTT held a nutrition-specific additional qualification. A total of 12% of the physicians, 37% of the nurses and 46% of the dieticians were exclusively responsible for the MNTT. A reduction of complications (88%) and cost saving (98%) has occurred since their establishment. In 32% of hospitals the MNTT received specific funding support.

The creation and maintenance of a good multidisciplinary team, specialized in nutritional support, can more than offset its cost through the resources it generates: however standards of practice, development of guidelines in clinical nutrition and better documentation by MNTTs are necessary. Special efforts should be directed towards education of MNTT members and and the financing of teams.

2.4 Old Models, New Approaches (1)

In the past hospital nutrition support programs have not usually been continued into the community setting. On the other hand, hospital discharge does not always coincide with the ending of the need for nutritional care. There is a need therefore to integrate pre and post discharge care into a single program, continuing nutritional support until normal intake is sufficient. Curtailment of the program prematurely may diminish its effectiveness and lead to disappointing results.

Braunschweig et al. (60), at the University of Illinois, Chicago, USA, followed the changes in the nutritional state of 404 patients during their hospitalization. The prevalence of moderate and serious malnutrition increased from 54% at admission to 59% by hospital discharge. The greatest risk of complications was seen among those who, during their hospital stay, passed from a state of normal nutrition to one of severe undernutrition (3.8 times greater than the reference group), and among those who were malnourished prior to admission and who deteriorated further during their stay (3.1 times more than the reference group). The costs were also proportionally greater.

Mughal and Meguid (36) showed the falsity of the assumption that patients, undergoing abdominal surgery, recovered their habitual food intake by the second postoperative week. Indeed, it took an average of 36 days for this to be achieved.

This leads us to the need for back-up home-based NT in the care of hospitalized patients.

2.4.1 Conventional Care: Intra-Hospital Model

Keeping a patient in a hospital bed for longer than it is absolutely necessary results in proportionally higher direct and indirect expenses (37) due to the cost of the use of physical space, increased staff time, and the inappropriate use of basic and high tech facilities. Other additional costs of prolonged
hospital stay may be caused by the increased risk of acquiring hospital based infections, thus
generating costs in medicines, laboratory examinations and prolonging still further the duration of
the hospitalization (38). Furthermore, lengthy hospitalization causes delays in attending to new
patients, which can result in irremediable damage to the waiting patients’ health.
The trend in the health sector is increasingly to treat patients outside the hospital environment,
hence the rather inelegant expression ‘dehospitalization’ (37, 39, 40).
In the USA, for example, there was a significant decrease in the use of active hospital beds between
1994 and 1999 (from 1.2 million to 425 000).

2.4.2 Home-Care
There are economies to be gained by maintaining the patient at home, considering the high cost of
hospitalization compared with that of home-based treatment (41 - 46).
At a teaching hospital in Spain, it was observed that the mean value of attending patients at home
was 4.17 times less than the expenditure in the same conditions when hospitalized (42).
The Government Medical Health Care System in the USA (Medicare) has created a financial incentive
for hospitals that discharge hospitalized patients earlier (47).

2.4.3 Integrated Hospital-Home Model
The care model termed ‘integrated hospital-home model’ ensures that the patient, at times
hospitalized and at other times at home, suffers no interruption in their nutritional care. There is,
therefore a seamless continuation of care and exchange of information between the hospital and
the community. The costs of nutritional care can also be integrated between the two. This model
allows the standardization of the nutritional service, using the same nutritional service protocols,
and the same selection criteria for nutritional support by whatever route. This model also improves
the confidence of the patient and family in the quality and safety of the service provided.
A service model similar to this was implemented in the New England Medical Center (Boston, USA),
where it maximized the efficiency of the patient, diagnostic and treatment services (48).

2.4.4 Brazilian Experience with Integrated Hospital-Home Model
The purpose of this model in Brazil was to optimize the use of surgical beds and to provide a
nutritional service throughout the perioperative period. The objective of NT was to prepare the
patient nutritionally preoperatively and to optimize nutrition in the postoperative period (49, 50).
Our study involved patients given EN or PN treatment before and after upper gastrointestinal
surgery. One of the following two models was adopted for NT: the integrated hospital-home model
(study group) and the conventional intra-hospital model (control group). These two models were
compared in terms of effectiveness and cost. The protocols are outlined in Figure 1.
The study group, which was submitted to home-based NT in the preoperative and post-hospital discharge periods, incurred 2.6 times lower costs compared with the conventional intra hospital group (R$3,343.76 versus R$9,716.47 respectively; \( P<0.001 \) ) (50) (Fig. 2).

![Figure 2 Total Cost of the Treatment (median). Study versus Control Group](image)

The program also allowed a better rate of surgical bed occupation (2.9 times greater) and generated cost savings for the institution of the order of R$9132.83 for each patient treated using the integrated hospital-home model (50) (Fig. 3).

![Figure 3 Rate of Occupancy of Hospital bed. Study versus Control Group](image)

2.4.5 Considerations Regarding the Care Models
Preoperative nutritional support has already been the object of economic studies. Flynn and Leighty (51) reported a reduction in postoperative complications and in the duration and cost of hospitalization when 61 undernourished patients were submitted to home-based EN treatment in the preoperative period for head and neck surgery. The benefits of postoperative home nutritional supplementation were studied by Beattie et al. (52) in 101 undernourished surgical patients who were randomly selected and controlled every 2 weeks.
for a 10-week period pre and post discharge. The authors observed that the group with nutritional supplementation had less weight loss, improved muscle strength and more favorable quality of life measurements. Furthermore, fewer patients needed antibiotic therapy. On the basis of these results, the authors suggested that, in undernourished patients undergoing moderate to major surgical procedures, it was cost effective to give NT in hospital and to prolong it after discharge until full recovery. Surgical patients can benefit from nutritional intervention in both the preoperative and postoperative periods without being hospitalized. Surprisingly, it is not common practice to initiate NT in surgical patients as part of the preoperative preparation, even in countries where the reimbursement of home NT is already accepted. (15)

2.5 Nutritional Therapy Reduces Complications and costs
NT, when properly managed and given appropriately, contributes significantly to reducing morbidity and mortality rates and consequently to reducing costs. There is evidence that EN, given early in the postoperative period, reduces the rate of postoperative complications (53). Enteral formulas with added immunomodulatory nutrients reduce the rates of surgical morbidity and treatment costs when compared with control formulas (28, 54, 55, 56). Similar results were observed when the use of immunostimulatory enteral formulas were compared with PN in patients who were seriously ill or were suffering from post-abdominal trauma (53, 57), although the conclusions of these studies are less well accepted than those of the studies involving elective surgery.

Gianotti et al. (29) conducted a study to evaluate the economics of adopting immunomodulatory NT as a prophylactic agent against postoperative surgical complications. The authors confirmed that although the specialized immunomodulatory formula is more expensive, economic analysis revealed a 2.24 times reduction in the total cost of treatment (113.778 versus 254.450 Euros in the study and control groups, respectively), as a result of a lower incidence of complications and shorter hospital stays. More recently Braga and Gianotti (58) confirmed the previous results, analyzing the costs of a preoperative protocol of immunonutrition in surgery. Total cost of nutrition was 3407 euros in the conventional group and 14.729 euros in the preoperatively fed group. In patients without complications, the cost of in-hospital routine care was similar in both groups. The mean cost per patient of complications was EURO 6178 in the conventional group and EURO 4639 in the preoperative group (p = .05). The total cost of patients with complications was EURO 535,236 in the conventional group and EURO 334,148 in the preoperative group. These total costs consumed 93% of the diagnosis-related-group (DRG) reimbursement rate in the conventional group and 78% in the preoperative group. Cost-effectiveness was EURO 6245 for the conventional group and EURO 2985 for the preoperative group. Conclusions: The costs of postoperative morbidity consumed a large proportion of the DRG reimbursement rate. Preoperative immunonutrition was cost-effective in this series and reduced the proportion of total costs consumed by postoperative morbidity.

3. Glossary: Analysis of Costs
It is very common practice to perform a comparative cost analysis between two programs or services, for which the following technical terms are used:

Analysis of cost-effectiveness: This is used when two programs are studied whose objectives are the same, but the results obtained are different, as well as the costs involved. This becomes necessary because it is not always correct automatically to select the program with the lowest cost without considering the results. In an analysis of cost-effectiveness, one should study the results and compare these with the cost per unit of result/effect obtained with the program. This can be compared in terms of either the cost/unit of effect or effect/unit of cost. This allows one to assess whether any additional cost is worthwhile because outcome is improved to a significant degree, or whether any benefit is only marginal and resources would be better allocated elsewhere.

Analysis of cost increment: A comparative study to determine what are the additional costs of a program or service against another, considering the benefits or effects of each alternative produces.

Analysis of cost reduction or cost minimization: When in the evaluation of two programs with similar results, one seeks to identify what is the cost difference between the two. It should be
assumed that the results of any of the alternatives are identical or the difference between them is not important.

**Cost-benefit analysis:** It is frequently not possible to assume that the results obtained by two programs are identical. In addition, the results obtained with two programs and the respective costs are not always comparable, because of differences in the measurements. In cost-benefit analysis a common unit of measurement is sought, which is the monetary value. The data are presented in monetary terms, both for the numerator and the denominator. The results of this analysis are expressed as: how much does each monetary value of benefit cost or what is the benefit worth for the monetary value? It is a measure of financial return on investment and measures the degree to which expenditure in one direction results in financial savings or gain directly or indirectly.

Cost-benefit ratio = cost (R$)/benefit (R$)
Benefit-cost ratio = benefit (R$)/cost (R$)

**Cost effectiveness:** Monetary value per unit of benefit.

**Direct costs:** These are those costs easily identifiable in the product or services. For example: raw materials, packaging, direct labor, wages, benefits, materials, physical space, traveling, training, laboratory tests, publicity, and other operational costs. The direct costs can also have a different focus. In economics everything has a value; nothing is free. Time is money, even volunteers have a cost as do care givers, medicines and foods.

**Indirect costs:** These relate to costs not identified in the product or services, and require care in their apportionment. They are costs indirectly involved in the production of goods or in services rendered.

**Opportunity cost:** The opportunity cost is the value that would be gained if the resource was used in a better alternative way for treatment or services.

**4. Short Summary of the Module**

Hospital malnutrition burdens the system financially by provoking a higher rate of surgical complications, mortality and longer hospital stays. The early identification of nutritional risk, followed by prompt nutritional intervention is the best way to minimize the adverse clinical and economical effects of protein-calorie malnutrition. Failure to provide early NT for undernourished surgical patients increases the hospital costs to a significant degree. Nutritional screening and treatment are cost-effective.

Multidisciplinary nutritional support team (MNTT) work can be responsible for a reduction in treatment costs by reducing unnecessary treatment and carrying out nutritional support in a more cost effective manner with fewer complications. The creation and maintenance of a good MNTT, accompanied by the setting of standards, guidelines and good documentation, can more than offset its cost through the resources it generates or saves.

Conventionally NT has usually been confined to the period of hospital admission without any home-based follow-up after hospital discharge. There are many cases of interruption in nutritional care because there is no integrated model to ensure continuity. The care model termed ‘integrated hospital-home model’ involves a seamless and continuous program between hospital and home until recovery is complete. The nutritional preparation of patients for surgery and their nutritional support postoperatively can also be carried out in the home environment just as effectively and at lower cost.

Well managed nutritional therapy, given for the appropriate indications, contributes significantly to reducing the morbidity and mortality of hospital patients to a reduction in costs. The adoption of preoperative immunomodulatory nutritional therapy in some groups of patients undergoing elective surgery (mainly those with upper GI cancer) resulted in a 2.24 times reduction in the total treatment costs.

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