



Original article

Individualized measurement of disease-related malnutrition's costs

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SUMMARY

Background & aims: Disease-related malnutrition has a significant economic impact in hospitals, but accurate measurements of these costs have rarely been reported. The aim of this study is to calculate the actual costs of disease-related malnutrition in hospitals, taking into account every cost that patients generate during their hospital stay.

Methods: Patients admitted to medical wards were included in this study. Nutritional evaluation was carried out by two methods (Nutritional Risk Screening 2002 and Short Nutritional Assessment Questionnaire) at admission and/or at discharge. Hospitalization costs were measured for each patient individually, considering the cost of the bed, the Intensive Care Unit, the physicians' services, the laboratory tests and diagnostic procedures, and the drug costs. Differences in costs between malnourished patients and non-malnourished patients were calculated.

Results: Malnourished patients incurred higher costs than non-malnourished ones. The cost increase for malnourished patients ranged between 45% and 102%. The nutritional status accounted for most of this increase. The most outstanding difference in patients' costs was between those patients who maintained their nutritional status, either well or malnourished, during their hospital stay.

Conclusions: Disease-related malnutrition clearly has an impact on the cost of hospital care provision, particularly in malnourished patients who do not improve their nutritional status during their hospital stays. Individualized cost analyses are needed to identify the real costs of malnutrition.

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1. Introduction

Malnutrition is a condition caused by the insufficient or imbalanced consumption of nutrients in comparison with nutritional requirements. It is a common disease in hospitals all over the world, and elderly people are especially at risk of developing it. There is a mutual influence of disease and malnutrition, and three different malnutrition syndromes have been defined according to the degree of systemic inflammation. The term “disease-related malnutrition” (DRM) has been proposed to reflect this interaction between nutritional status and medical conditions [1–6].

Many studies have reported the association of DRM with complications that patients suffer from during their hospital stays. In turn, they imply longer periods of hospitalization and further use of resources [7,8]. The economic consequences of DRM have been analysed from different perspectives, such as resource utilization

(for example, antibiotics or readmission rates) or as monetary outcomes [7,9]. In relation to these economic terms, it is estimated that DRM originates an important increase of the total hospitalization costs of malnourished patients [10,11].

DRM costs have already been measured by several groups of researchers [12–14]. By and large, they have been calculated based on estimations of general costs of the hospital stays, such as by hospital bed costs per day, or disease costs, for example, obtained from the Diagnosis-Related Group (DRG) database [15,16]. Other authors have used a more thorough procedure, also taking into account drug and diagnostic procedures costs. [17,18].

The goal of this study is to calculate the costs associated with DRM based on an individualized analysis of costs per patient, including ward and Intensive Care Unit (ICU) stays, laboratory tests, diagnostic procedures, drugs and nutrition supplements' costs.

2. Material and methods

Demographic, nutritional, and economic data were collected from patients admitted between March 2011 and May 2013 to four

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units of the Department of Internal Medicine, Hospital 12 de Octubre, Madrid, a third level hospital with 1365 beds. Any patient admitted to these wards was eligible to be included in the study if he or she was able to collaborate in the study, was 18 or older, and had an estimated stay in the hospital of longer than two days. Exclusion criteria were (1) length of stay shorter than seven days, (2) rejection of participation or continuation in the study, or (3) pregnancy. Furthermore, all patients had to give their consent to participate in the study.

All data were collected by the same researcher, who was not involved in these patients' care. Collected information included age, gender, comorbidity (measured by Charlson Index [19]), weight, height (measured at admission and discharge), duration of hospital stay, nutritional status, and hospital costs.

Nutritional status was estimated by two methods, the Nutritional Risk Screening 2002 (NRS-2002[®]) and the Short Nutritional Assessment Questionnaire (SNAQ[®]), which were applied within 48 h of admission or at discharge. NRS-2002[®] measures patients' nutritional status in two phases, taking into account comorbidity and degree of malnutrition [20]. If patients have three or more points, they are considered malnourished or at risk of malnutrition. SNAQ[®] is based on the occurrence of weight loss, decrease of appetite, and use of supplemental drinks or tube feeding over the past month [21]. If patients have a score of two or more, they are considered malnourished. In this study, a patient was classified as malnourished when he or she was considered malnourished or at risk of malnutrition by either of these methods.

Hospitalization costs were calculated using the following variables: daily costs of stay either in wards or in the ICU, costs of every laboratory parameter measured for each patient, costs of every non-laboratory diagnostic procedure carried out for each patient, costs of medical consultations to any medical specialist other than the physicians taking care of the patient in the ward, costs of administered drugs, and costs of nutritional support, when applicable. The costs of drugs and nutritional supplements were obtained from the Pharmacy service. All other expenses were provided by the Economic Management Unit of Hospital 12 de Octubre and adjusted for the year of the study. Daily costs (ward and ICU stay) were multiplied by the number of days each patient stayed in the unit. All costs were individually measured for each patient, with the exception of the daily costs of the hospital stays. All costs were calculated in euros (€).

The study was conducted in agreement with the standards of the Declaration of Helsinki. The study protocol was approved by the Ethics Committee of Clinical Investigation of Hospital 12 de Octubre before the beginning of the study. Patients were informed about the objectives and procedures of the study, as well as about their right to refuse or leave the study at any moment.

Statistical analysis was carried out with SPSS[®] 18 version for Windows (SPSS Inc., Illinois, United States). The results were expressed as arithmetic mean \pm standard deviation for quantitative variables, and as frequencies and percentages of patients for qualitative variables. To compare categorical variables, the chi-square test was chosen, and for continual variables the student-*t* test was selected. In order to analyse which variable had a major impact on hospitalization costs, a multivariate linear regression analysis was applied to the main parameters (nutritional status, age, gender, and comorbidity). The statistically significant level that was established to detect significant differences was 0.05.

3. Results

A total number of 260 potential candidates were evaluated for inclusion in the study, but 50 of them were left out for different reasons, such as for meeting exclusion criteria or for having

expressed their desire not to take part in the study or even for leaving it. Therefore, 210 patients were interviewed and analysed. The nutrition status was assessed in 126 patients within the first 48 h of admission, and 148 patients were nutritionally evaluated at discharge. Nutritional data of 64 patients were available both at admission and at discharge (Fig. 1). Patients were split into two classes, malnourished or well-nourished, and the different costs incurred during hospitalization were individually calculated per patient. Demographic characteristics (age, gender, and comorbidity) were compared between both groups, but no significant differences were observed (Table 1).

3.1. Cost of malnourished patients at admission

Among the 126 patients evaluated at admission, 33.33% of them were classified as malnourished. There was not any significant difference between them and the well-nourished patients regarding gender, age, or comorbidity.

Taking into consideration all of the economic variables assessed in the study, the total cost of hospitalization of malnourished patients (4158.90 € \pm 4148.51) significantly exceeded, by 45.2%, the cost of non-malnourished patients (2864.21 € \pm 1747.95) ($p = 0.015$) (Fig. 2).

As most patients were old and suffered from multiple diseases, we also studied the possible influences of age, gender, and comorbidity on costs. Interestingly, we found that these characteristics had no influence on costs. However, nutritional status did explain the differences between the groups, as it was further supported by the multivariate linear regression analysis ($p = 0.029$) (Table 2).

3.2. Cost of malnourished patients at discharge

A total of 148 patients were nutritionally screened at discharge. Among them, 45 were considered malnourished (30.5%). The main demographic characteristics were similar in malnourished and well-nourished individuals.

The mean cost of malnourished patients (6329.33 € \pm 6460.65) went over the mean cost of non-malnourished patients by 80.1% ($p = 0.000$) (Fig. 2).

Nutritional status was the main reason for these costs differences, without a significant impact of other variables such as age, gender, or comorbidity ($p = 0.000$) (Table 2).

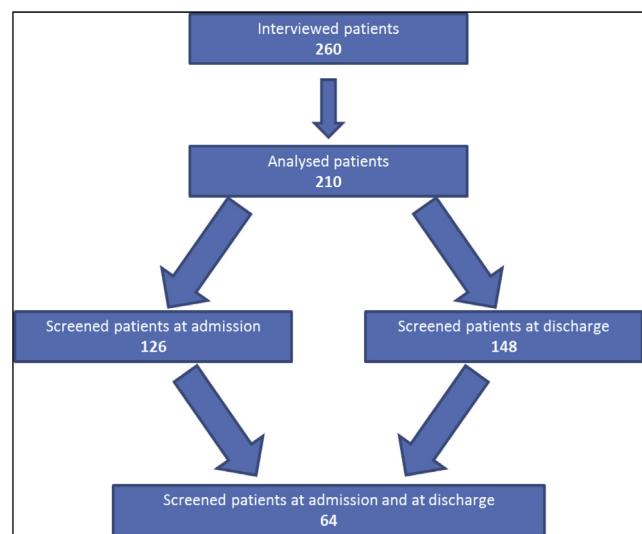


Fig. 1. Patients recruitment flow-chart.

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