Nutrición Hospitalaria

Artículo especial

INFORNUT® Process; improves accessibility to diagnosis and nutritional support for the malnourished hospitalized patient; impact on management indicators; two-year assessment

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Abstract

Introduction: The high prevalence of disease-related hospital malnutrition justifies the need for screening tools and early detection in patients at risk for malnutrition, followed by an assessment targeted towards diagnosis and treatment. At the same time there is clear undercoding of malnutrition diagnoses and the procedures to correct it

Objectives: To describe the INFORNUT program/process and its development as an information system. To quantify performance in its different phases. To cite other tools used as a coding source. To calculate the coding rates for malnutrition diagnoses and related procedures. To show the relationship to Mean Stay, Mortality Rate and Urgent Readmission; as well as to quantify its impact on the hospital Complexity Index and its effect on the justification of Hospitalization Costs.

Material and methods: The INFORNUT® process is based on an automated screening program of systematic detection and early identification of malnourished patients on hospital admission, as well as their assessment, diagnoses, documentation and reporting. Of total readmissions with stays longer than three days incurred in 2008 and 2010, we recorded patients who underwent analytical screening with an alert for a medium or high risk of malnutrition, as well as the subgroup of patients in whom we were able to administer the complete INFORNUT® process, generating a report for each.

PROCESO INFORNUT®; MEJORA DE LA ACCESIBILIDAD DEL PACIENTE HOSPITALIZADO DESNUTRIDO A SU DIAGNÓSTICO Y SOPORTE NUTRICIONAL; REPERCUSIÓN EN INDICADORES DE GESTIÓN; DOS AÑOS DE EVALUACIÓN

Resumen

Introducción: La alta prevalencia de desnutrición hospitalaria relacionada con la enfermedad justifica la necesidad de herramientas de cribado y detección precoz de los pacientes en riesgo de desnutrición, seguido de una valoración encaminada a su diagnóstico y tratamiento. Existe asimismo una manifiesta infracodificación de los diagnósticos de desnutrición y los procedimientos para revertirla.

Objetivos: Describir el programa/proceso INFOR-NUT® y su desarrollo como sistema de información. Cuantificar el rendimiento en sus diferentes fases. Citar otras herramientas utilizadas como fuente de codificación. Calcular las tasas de codificación de diagnósticos de desnutrición y procedimientos relacionados. Mostrar su relación con Estancia Media, Tasas de Mortalidad y Reingreso urgente; así como cuantificar su impacto en el Índice de Complejidad hospitalario y su efecto en justificación de Costes de Hospitalización.

Material y métodos: El proceso INFORNUT® se basa en un programa de cribado automatizado de detección sistemática e identificación precoz de pacientes desnutridos al ingreso hospitalario, así como de su valoración, diagnóstico, documentación e informe. Sobre el total de ingresos con estancias mayores de tres días habidos en los años 2008 y 2010, se contabilizaron pacientes objeto de cribado analítico con alerta de riesgo medio o alto de desnutrición, así como el subgrupo de pacientes a los que se les pudo completar en su totalidad el proceso INFORNUT® llegando al informe por paciente. Se citan otras fuentes documentales de codificación. Del Conjunto Mínimo de la Ba-

Other documentary coding sources are cited. From the Minimum Basic Data Set, codes defined in the SEDOM-SENPE consensus were analyzed. The data were processed with the Alcor-DRG program. Rates in ‰ of discharges for 2009 and 2010 of diagnoses of malnutrition, procedure and procedures-related diagnoses were calculated. These rates were compared with the mean rates in Andalusia. The contribution of these codes to the Complexity Index was estimated and, from the cost accounting data, the fraction of the hospitalization cost seen as justified by this activity was estimated.

Results: Results are summarized for both study years. With respect to process performance, more than 3,600 patients per year (30% of admissions with a stay > 3 days) underwent analytical screening. Half of these patients were at medium or high risk and a nutritional assessment using INFORNUT® was completed for 55% of them, generating approximately 1,000 reports/year. Our coding rates exceeded the mean rates in Andalusia, being 3.5 times higher for diagnoses (35‰); 2.5 times higher for procedures (50‰) and five times the rate of procedure-related diagnoses in the same patient (25‰). The Mean Stay of patients coded with malnutrition at discharge was 31.7 days, compared to 9.5 for the overall hospital stay. The Mortality Rate for the same patients (21.8%) was almost five times higher than the mean and Urgent Readmissions (5.5%) were 1.9 times higher. The impact of this coding on the hospital Complexity Index was four hundredths (from 2.08 to 2.12 in 2009 and 2.15 to 2.19 in 2010). This translates into a hospitalization cost justification of 2,000,000€; five to six times the cost of artificial nutrition.

Conclusions: The process facilitated access to the diagnosis of malnutrition and to understanding the risk of developing it, as well as to the prescription of procedures and/or supplements to correct it. The interdisciplinary team coordination, the participatory process and the tools used improved coding rates to give results far above the Andalusian mean. These results help to upwardly adjust the hospital Complexity Index or Case Mix-, as well as to explain hospitalization costs.

se de Datos se analizaron los códigos definidos en consenso SENPE-SEDOM. Los datos se procesaron con el programa Alcor-GRD. Se calcularon las tasas en ‰ altas dadas para los años 2009 y 2010 de diagnósticos de desnutrición, procedimientos y diagnósticos asociados a procedimientos. Se compararon dichas tasas con las tasas medias de la comunidad andaluza. Se estimó la contribución de dichos códigos en el Índice de Complejidad y, a partir de los datos de contabilidad analítica, se estimó la fracción del coste de hospitalización que se ve justificada por esta actividad.

Resultados: Resumimos aquí un resultado para ambos años estudiados. En cuanto al *rendimiento del proceso,* más de 3.600 pacientes por año (30% de los ingresos con estancia > 3 días) fueron objeto de cribado analítico. La mitad de ellos resultaron de riesgo medio o alto, de los cuales al 55 % se les completó una valoración nutricional mediante INFORNUT®, obteniéndose unos 1.000 informes/año. Nuestras *tasas de codificación* superaron a las tasas medias de Andalucía, siendo 3,5 veces superior en diagnósticos (35 ‰); 2,5 veces en procedimientos (50 ‰) y quintuplicando la tasa de diagnósticos asociados a procedimientos en el mismo paciente (25 ‰). La *Estancia Media* de los pacientes codificados al alta de desnutrición fue de 31,7 días, frente a los 9,5 de global hospitalaria. La *Tasa de Mortalidad* para los mismos (21,8 %) fue casi cinco veces superior a la media y la de *Reingresos "urgentes"* (5,5 %) resultó 1,9 veces superior. El *impacto* de dicha codificación en el *Índice de Complejidad* hospitalario fue de cuatro centésimas (de 2,08 a 2,12 en 2009 y de 2,15 a 2,19 en 2010). Esto se traduce en una *justificación de costes* de hospitalización por 2.000.000 €; cinco a seis veces el coste de la nutrición artificial.

Conclusiones: El proceso ha facilitado el acceso al diagnóstico de la desnutrición o al conocimiento del riesgo de padecerla, así como a la prescripción de los procedimientos y/o suplementos para remediarla. La coordinación interdisciplinar del equipo, lo participativo del proceso y las herramientas utilizadas mejoran las tasas de codificación hasta resultados muy por encima de la media andaluza. Estos resultados contribuyen a ajustar al alza el IC hospitalario, así como a la justificación de costes de hospitalización.

Introduction

Hospital malnutrition is a common problem in patients admitted to hospital. Values of hospital malnutrition range between 10% and 85% depending on the type of patients studied (elderly, children, medical, surgical, oncology, etc.), the category of hospital to which they are admitted, and the nutritional assessment markers used for patient evaluation. There is consensus that the prevalence of disease-related malnutrition ranges from 20 to 50%[1-6]. When nutritional status is deficient, recovery is delayed, hospital stays are prolonged and readmission rates increase, negatively affecting health care costs.[7,8]

In developed countries the problem of malnutrition particularly affects hospitalized persons. As early as 1994 the high prevalence of malnutrition (40%) and the poor documentation of nutritional information in medical records was made evident, with coding at less than 50% in malnourished patients.[9]

Pérez de la Cruz et al.[10] found a malnutrition prevalence of 0.3% using only anthropometric measurements, and 13.4% considering body mass index. When analyzing biochemical markers, the rate rose to 65.7%.

There was an increase in corresponding costs in relation to duration of hospital stay (68.04% higher in malnourished patients than in normally nourished patients). The same authors studied the relationship of malnutrition on admission to mean stay (MS) and premature readmission rates (RR), finding an increase of 2.7 days in MS.[11]

The PREDyCES[12] multicenter study recently concluded that 23.7% of 1597 patients evaluated presented malnutrition on hospital admission (rising to 37% in those >70 years and 47% in those >85 years). Patients with malnutrition (on admission or discharge) had a significantly higher MS (11.5 days versus 8.5 days, p <0.001, and 12.5 days *versus* 8.3 days, p <0.001 respectively).

Given the importance of the problem of malnutrition, both because of its prevalence, and the clinical and economic consequences involved, various international agencies[13,14] and scientific societies[15-18] have highlighted the need for a screening method that is valid, reliable, reproducible, convenient and coordinated with specific action protocols. There are clinical, automated and mixed screening methods. Most clinical screening methods include subjective and objective data (weight, height, weight changes, changes in food intake, comorbidities, etc.). Automated methods are fundamentally based on analytical data, but also collect other useful objective screening data (diagnosis, age, duration and evolution of illness, resources used, etc.) available in the database of the hospital computer system.[16] In 2005, the II SENPE Discussion Forum[15] noted that given the positive predictive value of filters such as CONUT®[19] and FILNUT®,[20] where weighing and measuring all patients on admission is not possible, these types of information systems must be used to identify those patients who can most benefit from a complete nutritional assessment.

By applying the CONUT® analytical nutritional filter, Ulíbarri et al. detected malnutrition on admission in more than a quarter of patients. Among the various causal elements of malnutrition they describe, they highlighted the existence of widespread ignorance about this problem. Thus disease-related malnutrition is common, fails to be detected and worsens during hospital stays, except for a small group of patients (<10%), from among those who would have been detected by the filter method had it been used.[19,21,22]

The INFORNUT® process is based on an automated screening program of systematic detection and early identification of malnourished patients on hospital admission, as well as for documentation and reporting.[16] It has three phases.

In the first phase, the analytical nutritional filter, the conditions applied are: albumin <3.5 g/dL and/or total protein <5 g/dL and/or prealbumin <18 mg/dL with or without total lymphocytes <1600 cells/ml and/or total cholesterol <180 mg/dL. The FILNUT-Scale[23] assessment scale is then applied to the positive results. These conditions have been validated as an analytical filter for risk of malnutrition, with a positive predictive value of 94.1%, sensitivity of 92.3% and specificity of 91.2%.[20] The good cost/benefit ratio of implementing analytical screening at hospital admission, with a cost of less than 0.60 €, seems clear, especially when it increases efficiency and early detection of at-risk patients[24]. The second and third phases of the INFORNUT® process are explained in the materials and methods section of this paper.

The resolution on Food and Nutritional Care in Hospitals, issued by the Committee of Ministers of the Council of Europe in 2003,[13] considers that the lack of cooperation between the different groups and levels of professionals involved is one of the factors causing hospital malnutrition and urges the different professionals to work together to provide nutritional care.[25]

We know that coding is a key exercise in health management that is governed by well-established procedures. Proper coding of hospital malnutrition, as a primary or secondary diagnosis, and of therapeutic procedures employed, contributes an understanding of the reality of healthcare activity and resource consumption at each center.[26] Aware of the importance of these measures, the Spanish Society of Parenteral and Enteral Nutrition (SENPE), together with the Spanish Society of Medical Documentation (SEDOM), has contributed to the EU strategy by developing the Consensus Document on Coding Malnutrition SENPE-SEDOM[27]. This document has enabled standardization of the coding process for this condition by assigning specific codes to specific defining terms and optimizing the information on malnutrition, its types and degrees and the methods used for prevention and treatment in hospitals in our National Health System. In 2011, the Multidisciplinary Consensus on Addressing Hospital Malnutrition in Spain[1] ratified the malnutrition criteria established in the SENPE-SEDOM consensus when performing malnutrition screening.

Villalobos Gámez et al.[28] in 2004 measured the impact of coding malnutrition and nutritional support procedures showing a Complexity Index (CI) or Case Mix Index increase from 1.84 to 1.89. This also affected a drop in the Hospital Stay Usage Index from 1.05 to 1.03. Of 21,121 total discharges, they found that this coding caused a change in Diagnosis-Related Group (DRG) in 721 patients (3.41% of the discharges and 24.47% of those coded). The authors concluded that the integrated action of the nutritional support teams with pharmacy, clinical documentation and information systems development services, greatly improved management results. Álvarez Hernández et al.[29] evaluated 10,451 discharges, recoding a sample of 134 patients using information from the nutrition unit. The impact found was an increase of 0.035 in CI.

Another 2004 study in Singapore[30] applied the Subjective Global Assessment (SGA) screening[31] to 658 patients. The authors estimated an overall prevalence of malnutrition of 15%. Malnutrition coding showed increased complexity in 23% of episodes, measured in terms of costs and expected duration of stay. For pa-

tients whose complexity increased through malnutrition coding, an increased case-mix funding of 59.7% was estimated. If none of the cases of malnutrition had been coded, it was estimated that the hospital would have experienced the equivalent of $16,617 in lost reimbursement.

Following the precedent set by similar studies such as those conducted in the US,[32] the Ockenga group,[33] in 2005, evaluated the effect of the identification and coding of malnutrition in the DRG system adapted to Germany. To do this, they performed SGA[31] screening in 541 patients in the gastroenterology area of a German hospital. The malnutrition rate detected increased from 4% to 19%. Malnourished patients showed a significantly longer hospital stay. The additional malnutrition coding raised the case mix index from 1.53 to 1.65, given that it was only relevant in 27% of patients, because in patients with comorbidities, which in themselves are already complex, the effect of malnutrition may not add differences in severity. However, the malnutrition coding resulted in an overall reimbursement increase of 360€ per malnourished patient. The authors note that this additional reimbursement covered about 75% of the nutritional interventions necessary.

In a study conducted in Portugal,[34] 469 patients from two hospitals were assessed with Nutritional Risk Screening (NRS) 2002.[35] Of these, 42% were classified as nutritionally at-risk patients. Using a multivariate model, it was estimated that the cost of treating a nutritionally at-risk patient was 19% higher than the average for the respective german DRG. Moreover, the hospitalization costs for nutritionally at-risk patients were double those who were not at nutritional risk. From the sample analyzed, and considering the observed case-mix, this may represent a cost increase of between 200 and 1500 €. From an economic point of view, given the low cost of most nutritional interventions, these results support the need for appropriate nutritional screening and nutritional treatment.

In 2011 Rowell[36] published the results of a study involving 256,865 Australian patients admitted between 2003 and 2004. Hospitalization costs were estimated by a least squares regression model that included malnutrition coding, coded malnutrition treatment and severity of disease as factors. Approximately 1.87% of patients were coded as malnourished, but up to 17.3% had a documented diagnosis and/or treatment for malnutrition. Adjusting the model, they estimated the cost to their health system of malnutrition at 10.7 million Australian dollars.

More recently, the prevalence of malnutrition and its impact on outcomes and hospital costs was evaluated in 818 patients at a hospital in Singapore.[37] Through SGA, 235 malnourished patients (29%) were detected, of whom only 3 had been coded as such. Forty-five percent had a longer than recommended hospital stay, according to their DRG, compared to 21% of the normally nourished. Adjusting for age, gender, race and DRG, a greater MS (6.9 *vs* 4.6 days) and a longer stay by DRG, RR 15 days from discharge, Mortality Rate (MR) in the first year, and annual hospitalization costs per patient were detected and found to be statistically significant. The authors believe that the adjustment for DRG minimizes the confounding effect of the disease and its complexity. Thus they argue that malnutrition is an independent predictor of hospital stay, readmission, mortality and hospital costs.

Regarding consumption costs for nutritional support, Villalobos et al.[38] studied the difference between 1996 and 1998 produced by the implementation of an instruction protocol. Use of enteral nutrition increased and an approximate cost savings of 99,000€ in parenteral nutrition was seen. The cost per admission fell from 14.86€ to 12.63€ and the cost per stay from 1.54€ to 1.42€ (Original expressed in pesetas, only the purchase prices of components are considered).

Objectives

To describe the INFORNUT® program/process and the tables and algorithms used: Analytical risk rating scale, scale for scoring nutritional risk, assessment scale —for diagnosis— of analytical and anthropometric parameters and the diagnostic orientation algorithm. To present the INFOrme de Riesgo por desNUTrición (INFORNUT) model for individualized malnutrition risk reporting which, in Spanish, gives the name to the process. To cite other tools used as a coding source.

To quantify performance at different phases of the process, applied to admissions with stays of more than three days, from 2008 through 2010 at the Virgen de la Victoria University Hospital.

To describe the diagnostic coding rates of malnutrition and related therapeutic procedures, according to ICD-9, at our hospital in 2009 and 2010. To compare these coding rates with those described for Andalusia during this period. To quantify the impact of malnutrition on CI, MS, MR and RR at this hospital.

To estimate the justification of hospitalization costs linked to the incidence of coding on the center's CI in 2009 and 2010. Compare this amount with the cost per use of enteral and parenteral nutrition. Calculate the cost of nutritional support given per discharge and per stay.

To show, through its results, that INFORNUT® is a tool for integrated teamwork, improving patient access to early diagnosis of malnutrition, nutritional support treatment and coding at discharge, with implications for management indicators.

Material and Methods

Hospital Information Systems Tools

The project involved several departments, including Information Systems, which provided an analyst-developer tasked with carrying out the applications needed

to meet the functionality requested by the Nutritional Support Team for INFORNUT. In the first stage of analysis we agreed to address the following challenges:

– Integration of data from three environments that were not interconnected at that time:

- Laboratory
- Admissions / Hospitalization
- Nutritional Support Team / Pharmacy.

– Creation of tools for input, storage and management of information to allow interdisciplinary work.

The system performs a daily analytical screening, at dawn, from the analytical results of hospitalized patients, to assess the degree of malnutrition risk for each patient. This information is incorporated into the rest of the information on which the nutritional filter algorithm is based. To carry out this integration of information the free software application Talend Open Studio (TOS) was used. This is an ETL (Extract, Transform, Load) system that allows the extraction of information from one system and its processing and loading into another system. There are no license fees for use, which influenced this choice.

Although, traditionally, the Health Language 7 (HL7) messaging protocol has been used for communication between systems handling health information, when the project was launched TOS lacked these HL7 connectors. For this reason a shared space is used where the Laboratory Information System provides the patients' analytical results, from which TOS extracts the

necessary information. After determining the degree of malnutrition based on the calculation algorithm, TOS transfers the results to the Hospital Information System.

For a better understanding of the results, we briefly describe the INFORNUT® process and program. In the first phase, or nutritional filter stage, a score from a check of the analyses is given according to the FIL-NUT-Scale (table I)[39] activating a visual risk alarm on the control panel of the ward nurses, as well as on that of the medical department responsible for the patient.

This is followed by a second phase of incorporation of clinical data into the software application (fig. 1) by the nurse, doctor, nutritionist or pharmacist responsible

Table I
FILNUT-Scale

Malnutrition risk	No risk	Low	Medium	High
ALBUMIN	≥ 3.5	3.49-3	2.99-2.5	< 2.5
Score	0	2	4	6
Serum Prealbumin (mg/dl)*	≥ 18	17.99-15.01	15.-10	< 10
Score	0	2	4	6
Total Protein (g/dl)**			≥ 5	< 5
Score			0	5
Lymphocytes*** totals/ml	≥ 1600	1599-1200	1199-800	< 800
Score	0	1	2	3
Cholesterol*** total (mg/dl)	≥ 180	140-179	100-139	< 100
Score	0	1	2	3
Total Score	0-1	2-4	5-8	9-12

* Taken when prealbumin score is higher than that of albumin.

** Scored when neither albumin nor prealbumin are available.

*** Lymphocytes and total cholesterol are scored only when albumin, prealbumin and total protein score have been scored.
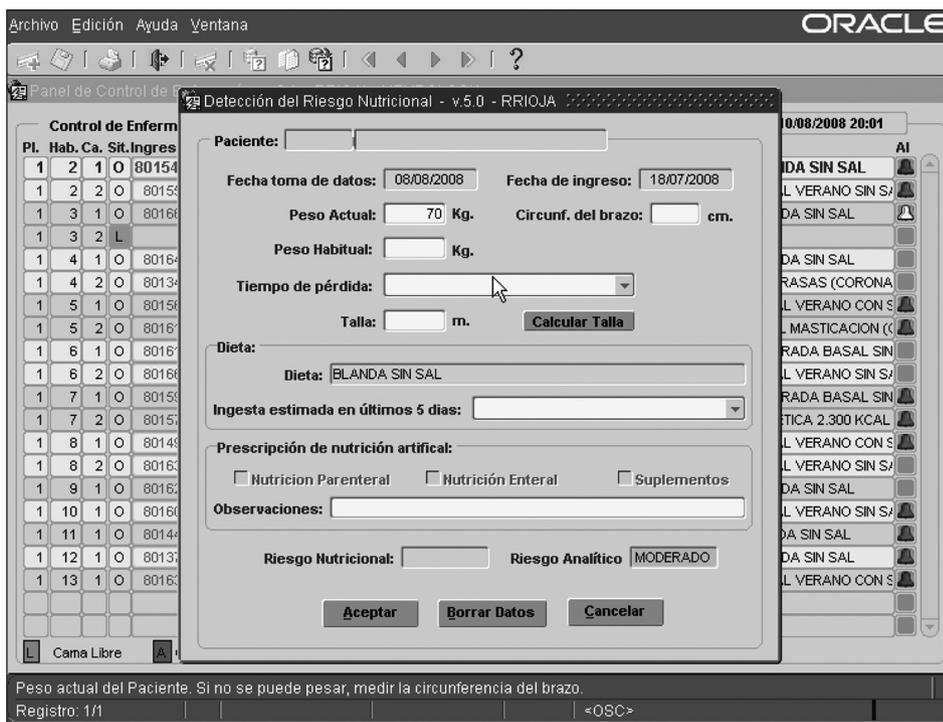

Fig. 1.—Malnutrition risk alarm on Mainake screen.

for each patient, through completion of a MUST[40-42] test the rating scale which was modified for use in the process (Modified-MUST) (table II).[39]

On the same screen the survey on intake by quartiles over the preceding five days is completed, as defined in NRS 2002,[35] leaving a field for notes. Furthermore, functionality within the hospital information system was developed to allow health care personnel to view nutritional risk alarms and introduce anthropometric data to calculate the Modified-MUST. The transverse solutions require more initial analysis and coordination effort, but they provide a greater benefit.

The possibility of carrying out the MUST assessment on any patient admitted, particularly those displaying obvious thinness, regardless of whether an analytical alert was produced, provides the opportunity to detect cases of calorie malnutrition exclusively, as would be the case with anorexia nervosa, that do not affect analytical parameters. There are clinical nutrition care processes recommended by the Health Systems for the different geographical areas of responsibility that prescribe structured tests as a screening measure in hospitalization. In this sense INFORNUT® does not contradict these recommendations as the possibility exists of performing this screening test on any patient admitted, regardless of the analytical data. This feature enables the incorporation of this system into other nutritional assessment strategies on admission.

Based on the laboratory data and information collected by the nursing staff, the system performs a recalculation using the scoring algorithm and establishes a modified-MUST nutritional risk for the patient. This nutritional risk is visible through alerts in key points of the patient's dietary treatment, such as in the care processes, pharmacy and kitchen. The alerts are dis-

Table II
Calculation of modified must nutritional risk

A. The patient can be weighed and measured.

1. SCORE by BMI

BMI ≤ 18.5	2 points
18.5 < BMI < 20	1 point
BMI > 20	0 points

2. Score by % Weight Loss (WL). Patient has been weighed and weight recorded.

WL ≥ 10	2 points
5 < WL < 10	1 point
WL ≤ 5	0 points

3. Score by insufficient intake due to acute disease. Estimated intake over last five days

¾ parts or more	0 points
from ½ to ¾ parts	1 point
from ¼ part to ½	2 points
< ¼ part	2 points (eat nothing or almost nothing)
Complete fasting	2 points

B. The patient cannot be weighed or measured.

Ulna length is measured to calculate the extrapolated size (see MUST table)
Arm Circumference (AC) is measured

AC < 23.5 cm	1 point
AC ≥ 23.5 cm	0 points

Overall risk scale (modified MUST): Low = 0, medium = 1 and high ≥ 2 points.

played in different colors depending on the seriousness of the malnutrition (fig. 1).

Each individual parameter is analyzed according to a "modified" scale (table III)[39] based on the scale con-

Table III
Evaluation of analytical and anthropometric parameters

	Parameters	No malnutrition	Malnutrition		
			Low	*Moderate*	*Severe*
Caloric parameters	BMI	≥ 18.5 - 25	17-18.4	16-16.9	< 16
	AC (cm)			< 23.5	
	% Weight loss				
	2 weeks	< 1	1- < 1.5	1.5-< 2.5	≥ 2.5
	1 month	< 1.5	1.5-< 2.5	2.5-< 5	≥ 5
	3 months	< 2.5	2.5-< 5	5-< 7.5	≥ 7.5
	6 months	< 5	5-< 7,5	7,5-< 10	≥ 10
	7-12 months	< 7.5	7.5-< 10	10-< 15	≥ 15
	Cholesterol (mg/dl)	≥ 180	140-179	100-139	< 100
Calorie-protein parameters	Lymphocytes	≥ 1600	1200-1599	800-1199	< 800
Protein parameters	Albumin (g/dl)	≥ 3.5	2.8-3.49	2.1-2.79	< 2.1
	Protein (g/dl)			< 5	
	Prealbumin (mg/dl)	≥ 18	> 15-17.99	10-15	< 10

Malnutrition risk report (INFORNUT®) includes a diagnostic orientation based on these values and a therapeutic orientation for nutritional support. Adapted from: SENPE-SEDOM[22] Document.

tained in the SENPE-SEDOM agreement.[27] This scale then assigns a diagnostic (fig. 2) and therapeutic orientation based on local algorithms incorporated into the program, depending on the type of malnutrition and intake capacity.[39] Although there are no universally accepted criteria for nutritional diagnosis, the INFORNUT® process is open to recalculating diagnostic criteria according to changes in worldwide recommendations. There are analytical data such as the prealbumin/C-reactive protein ratio performed systematically in our laboratory that are helping to bring us closer to the acute disease-related malnutrition concepts of the American Society for Parenteral and Enteral Nutrition (ASPEN) recommendations.[43]

Regardless of the name of the relevant information format from the nutritional point of view, MUST, NRS, etc., anthropometric and laboratory data on malnutrition are similar for risk screening, nutritional assessment and diagnostic guidance; hence albumin levels and weight loss are two standards used throughout the entire process. Linking screening with assessment, diagnosis and treatment is, because of its importance, the aim of INFORNUT®.

Finally, in the third phase, which gives its name to the program, the Malnutrition Risk Report (MRR) becomes part of the Clinical Course in the patient history (Appendix 1). In this annex the MRR is compressed to fill a single page. It usually takes two pages with automatic digital validation of the person responsible for the process and the signature of the physician responsible for the patient. The MRR has another page for the nurse's progress notes containing guidance on nursing care.

Coding of Clinical Episode: Lastly the system automatically associates an episode with the ICD-9 CM[44]

codes corresponding to the degree and type of malnutrition of the patient through the diagnostic algorithm developed. Nutritional information is also automatically included in the care reports at discharge so the primary care professionals can continue to respond to the specific needs of these patients.

Calculation of process performance in its different phases

Of total admissions with stays longer than three days incurred in the years 2008 and 2010, the absolute number and percentages were calculated for: patients who underwent analytical screening with an alert for a medium or high risk of malnutrition, as well as the subgroup of the latter for which, having undergone assessment questionnaires as described for the second phase of the process, the corresponding MRR was obtained.

To quantify and improve the coding rates for malnutrition and nutritional support procedures, a joint action plan was implemented between the Clinical Management Unit (CMU) Endocrinology and Nutrition / Nutritional Support Team, CMU Pharmacy / Nutrition Section, Clinical Documentation Department, Committee on Nutrition and Information Systems Department. The following coding tools were used:

– Discharge reports and documentation in response to inter-office consultations.
– MRR for the INFORNUT® program already described; (there is an improvement project for auto-coding after digital validation).

Fig. 2.—INFORNUT® diagnostic orientation algorithm (SENPE-SEDOM CODING).

Informe de Riesgo por Desnutrición (IRD)

Hospital Universitario Virgen de la Victoria
Servicio Andaluz de Salud
Consejería de Salud

EQUIPO DE SOPORTE NUTRICIONAL (ESN)
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HOJA PARA EVOLUCIÓN CLÍNICA

Datos del Enfermo

Nº Historia	NUHSA	Apellidos y Nombre	Sexo	Edad

Datos del Ingreso

N.Ingreso	Planta	Habitación	Cama	Fecha del Ingreso	Diagnóstico al Ingreso
12003191A	6	66	1	06/02/2012	PANCREATITIS AGUDA

Fecha del Alta	Servicio Responsable
	DIGESTIVO

Cribaje Nutricional Analítico

ALBÚMINA	2.09 g/dl	09/02/2012
COLESTEROL	92.00 mg/dl	09/02/2012
LINFOCITOS	0.72 cel/ml	09/02/2012
PROTEINAS TOTALES	3.96 g/dl	09/02/2012

Riesgo Analítico
ALTO

Fecha de la Muestra
06/02/2012 08:53

Riesgo Nutricional MUST-Modificado

IMC (Kg/m2)	Talla	Circunf. Brazo	Peso Actual	Peso Habitual	Ingesta estimada en los últimos 5 días
22,43	158 cm		56 Kg	62 Kg	De 1/4 parte a la mitad

Dieta	Pérdida de Peso	Riesgo Nutricional
BLANDA DIABETICA SIN SAL	10 % en 1 mes	ALTO

Soporte Nutricional Prescrito

Nutrición

Observaciones

Orientación Diagnóstica (CIE-9-MC)

Descripción
DESNUTRICIÓN CALÓRICO-PROTÉICA SEVERA   15/02/2012

Valoración

Orientación Terapéutica

Come entre ¼ y ½ de la dieta oral prescrita y no cubre la mitad de sus requerimientos.
En primer lugar se tratará de mejorar la ingesta proteica de la dieta. Después:
Si buena capacidad de beber líquidos adicionales pautar 1.000 - 2.000 ml de NE Estandar o Hiperproteica ± fibra.
Si capacidad de ingesta líquida limitada Intentar ingesta oral de 4-6 uds/día de dieta de NE concentrada ± fibra.

Consultar Póster de Nutrición Artificial. Si patología específica seleccionar la dieta indicada. Asesoramiento adicional de Soporte Nutricional en la Sección de Nutrición de la UGC de Farmacia.
Si especial complejidad clínica o complicaciones: considerar dar curso a una Hoja de Consulta al ESN. También se podrá solicitar apoyo de Enfermería o Dietética.

NOTA: Confirmar con la restante información clínica y registrar en el Informe de Alta.

Annex 1.—Malnutrition risk report.

– Nutritional Case Reports after completing parenteral nutrition (PN) obtained by the NUTRIDATA® program, including assessment of nutritional status and PN or enteral nutrition (EN) procedures used.
– Treatment Forms of patients in Critical Care Units, coded from the Pharmacy through password access into the documentation program, as well as previous reports of PN.
– Finally, a local software application was also used as a coding tool, analyzing prescription data dumps in the X-FARMA® and Dominion® application, and coding all parenteral nutrition, binary PN ≥ 2000 ml, and EN ≥ 1000 kcal.

Calculation of rates and impact on Complexity Index

The codes used for malnutrition and nutritional support procedures were those specified in the SENPE-SEDOM agreement[27] detailed below:

For the calculation of coding rates, the Minimum Basic Data Set (MBDS) from both our center and from the overall figures for Andalusia registered in the Health Product Department of the Andalusian Health Service were used. These were measured in ‰ of discharges in 2009 and 2010, differentiating those related to diagnoses of malnutrition, methods of nutritional support, diagnoses associated with procedures (in the

same patient), and also the rate of those who had an ICD-9-CM code[44] as defined in the SENPE-SEDOM consensus.[27] Finally, we obtained the percentage of malnutrition diagnoses coded as "unspecified degree" out of all the codes. All data were processed by the clinical documentation department with the Alcor-DRG® program and grouped using version 27.0 of the DRG grouper program.

Calorie malnutrition:
Mild: 263.1.
Moderate: 263.0.
Serious or severe: 261
Unspecified degree: 263.9

Protein malnutrition:
Any degree: 260
Hypoalbuminemia: 273.8

Mixed or protein-calorie malnutrition:
Mild: 263.8.
Moderate: 263.8.
Serious or severe: 262
Unspecified degree: 263.9

Unspecified malnutrition:
Mild: 263.1.
Moderate: 263.0.
Serious or severe: 261
Unspecified degree: 263.9

Parenteral nutrition: 99.15.

Enteral nutrition: 96.6

For the calculation of the RR, readmission was considered as readmission of a patient within 365 days from the discharge date for the index event, whether urgent or scheduled. Urgent readmission was defined as occurring within 30 days from the date of the index event. The annual overall RR from any cause and mode of entry and urgent RR caused by processes belonging to the same Major Diagnostic Category (MDC) were calculated. The MDC consists of 25 groups, plus a pre-major diagnostic category, of DRGs based on organs, systems or broad disease areas (nervous system, digestive system diseases, pregnancy, delivery and postpartum, infectious and parasitic diseases, multiple significant trauma).

A hospital's Complexity Index or CI is the average DRG weight, or Case Mix, of all episodes, excluding those patients grouped by DRG weight = 0 (nonspecific DRG). The assignment of ICD-9-CM[44] codes for malnutrition and/or support procedures could affect the case mix converting an uncomplicated process into one with a complication or comorbidity (CC) or a process with major complications or comorbidities (MCC), the latter only with codes 260, 261, 262, 263.8. This would imply that processes with complications are related to increased demand for resources and associated costs.[12,34,37] However in some circumstances a process is not altered by malnutrition because the process *per se* would already have a high complexity. This occurs, for example, in certain malignancies. From a DRG perspective, the hospital case mix is related to the demand for resources and the costs associated with these patients. A more complex case mix means that the hospital treats patients who require more hospital resources. For its calculation, a weight is assigned to each DRG that considers that complexity. The impact on the CI is derived by removing these codes from the database to obtain a CI free of their influence; the difference is expressed in hundredths or as a percentage of the CI.

The MBDSs from 2009 and 2010 were updated in 2012 and their complexity is the result of grouping the MBDSs from 2009 and 2010 with the AP-DRG version 27.0. They therefore have a complexity index with differences, either upwards or downwards, with respect to the official Andalusian Health Service data for those years that were processed with AP version 23.0 for 2009 (Minimal Basic Data Set at Hospital Discharge. Diagnosis-Related Groups, Andalusia 2009). http://www.sas.junta-andalucia.es/publicaciones/Listadodeterminado.asp?idp=377) and AP 25.0 in 2010 (Minimal Basic Data Set at Hospital Discharge. Diagnosis-Related Groups, Andalusia 2010. http://www.sas.junta-andalucia.es/publicaciones/Listadodeterminado.asp?idp=439).

Justification of Hospitalization Costs

A portion of the total hospital costs are charged to hospitalization costs. Excluded are: outpatient consultations, major ambulatory surgery, oncology day hospital, radiotherapy sessions, outpatient emergency room care, etc. At the same time this could be considered a net cost of hospitalization excluding proportional costs that correspond to basic services (maintenance, catering and cleaning or general administration) and Intermediate Services (pharmacy, x-rays, laboratory, etc.) which therefore would include only: chapter 1, consumables, medicines, prosthetics, reagents and cleaning supplies related to hospitalization. For the calculation of cost justification, the total cost of hospitalization was used, not the net cost.

From Financial Control Department data, recorded according to the Andalusian Analytical Accounting System 45 (Coan-hyd©), the known net hospitalization costs and total DRG hospitalization points were used to calculate the cost per DRG point. Once the impact in hundredths of malnutrition and procedures coding in the CI is known and its percentage calculated, this impact percentage is multiplied by the total DRG hospitalization points giving us the score resulting from this coding. Multiplying the number of points by the per point cost, we obtain the cost figures that would be explained by this activity; otherwise this value would be attributed to inefficiency.

From the consumption data reported to the Financial Control Department by Pharmacy, costs for nutritional

support consumption were obtained. These costs were then compared to the costs justified by coding. Due to changes in programs and databases in both departments, we could not obtain data for the years 2009 and 2010. Therefore, costs by discharge and by stay were calculated for more recent annual periods. Although it is not the same period, these costs serve as a reference.

The care model itself as material and method

The authors believe that the main tool for this work was, and continues to be, our own purely participatory care model. A support team, dedicated to the rational use of nutritional support and management of malnutrition, with the interdisciplinary features inherent in Clinical Nutrition, promotes early detection of hospital malnutrition as well as good clinical practice and greater autonomy for health center professionals. This team advises and monitors practices without assuming the exclusive control of this therapeutic tool, although intervening automatically or in response to interconsultations, in this way exercising clinical leadership in nutrition.[39] This philosophy, in place for over two decades, has been presented by members of our team, not only in the works already cited, but at many communications, conference presentations, courses, congresses and working group recommendations in which we have participated. Since implementing this care model at our center we have imparted ten courses in "Basics in artificial clinical nutrition" for medical staff, in addition to having published several posters and pocket guides to the basic protocols; all with the collaboration of the members of our hospital Nutrition Committee. Our own performance, always of an edu-cational nature, contributes to the training and subsequent autonomy of health professionals. Other centers have already joined this shift in focus.[46]

Results

Performance in the different phases of the INFORNUT® process in 2008 and 2010 is shown in table IV.

The coding rates for diagnoses of malnutrition and nutritional support procedures for the years 2009 and 2010, for all hospitals in Andalusia as well as for Virgen de la Victoria University Hospital, expressed in ‰ of discharges, are listed in table V.

Table VI shows the impact of diagnosis coding for malnutrition and nutritional support procedures on the hospital CI in 2009 and 2010, mediated by changes in the average weight of the DRGs. Also, for the same years, Table VI shows the overall MS, MR and RR of the hospital and for those patients who, at discharge, had malnutrition coding in the MBDS by the clinical documentation department; all from the coding tools and documentation described above.

Table VII shows the results of the hospitalization costs justification study in 2009 and 2010, specifying the amount justified by the effect of our activity.

Finally, table VIII shows the costs for nutritional support consumption from in the last two years (November to October accounting period), including overall, by discharge and by stay.

Discussion

The INFORNUT® process had two critical points that decreased performance in the successive phases of

Table IV
INFORNUT® phase performance

Year	n.º Admissions (stay > 3 days)	FILNUT-Scale Screening (%/n.º)	Risk Alarm medium/high (%/n.º)	Modified-MUST assessed MRR (%/n.º)
2008	12,000	31.0 / 3,720	48.4/1,800	58.3/1,050
2010	13,270	27.3 / 3,620	50.6/1,830	52.1/954

Table V
Coding rates in Andalusia vs HUVV

(% discharges)	Andalusia		H. U. Virgen de la Victoria	
Year	2009	2010	2009	2010
Discharges	558,819	543,994	20,805	20.555
DIAGNOSES (D)	9.5	11.6	31.5	35.5
PROCEDURES (P)	21.2	21.4	46.8	51.5
D + P	3.5	4.6	24.7	26.8
Either (D or P)	26.8	28.4	53.6	60.2
% Diagnoses of unspecified degree	44.1	40.8	22.7	29

Table VI
Impact of malnutrition on the complexity index, stay and rates

Hospital Universitario Virgen de la Victoria		2009	2010
Complexity Index (CI)	Overall	2.12	2.19
or Average Complexity.	Excluded D	2.09	2.15
D = Malnutrition Diagnoses	Excluded D + P	2.08	2.15
P = Support Procedures	Only Patients with D	6.84	6.79
Average Stay (AS, days)	Overall	9.72	9.19
	Patients with D	31.63	31.81
Mortality Rate % (MR)	Overall	5.66	5.17
	Patients with D	21.79	21.78
Readmission Rate % (RR) urgent or scheduled, within 365 days from discharge	Overall	15.27	15.13
	Patients with D	24.24	26.71
"Urgent" RR in the 30 days after discharge and for the same MDC of DRG	Overall	2.93	2.84
	Patients with D	5.49	5.48

MDC: Major Diagnostic Category DRG: Diagnosis-Related Group.

Table VII
Justification of costs

Study of cost justification for coding Malnutrition and Nutritional Support According to the cost accounting system of Andalusia —Coan.HyD—. H. Virgen de la Victoria

Hospitalization year (H)	**2009**	**2010**
Total overall cost for H.V.V (€)	257,398,133	257,757,798
Total Hospitalization cost * (H) (€)	109,439,344	118,725,103
Total DRG points	72,451	77,322
Total DRG for H	44,106	45,242
Cost / DRG point for H (€)	2,481.6	2,624.3
Impact of coding on CI	0.04 (1.88 %)	0.04 (1.82%)
D**RG points for H by codes D + P**	832.2	822.2
Justified cost (€)	2,065,187.5	2,157,699.4

* Includes impact on hospitalization costs for Basic and Intermediate Services.

screening and assessment. For continuous improvement we planned to implement the following measures, among others:

a) On generating the hospital admission in the admission program, through the DIRAYA program (clinical management program used in the Andalusian Health Service), a printed or digital request for nutrition screening analysis will be produced automatically.

b) Link nursing productivity incentives to performance of the modified-MUST in response to the risk alarm to obtain the MRR according to the INFORNUT® program.

c) As an alternative to the above measure, implement a motivational campaign geared towards physicians responsible for patients with a risk alarm so that they fill in the patient data needed to generate the MRR.

Requests for analytical screening on admission should be made universal since, in our view, there is a very positive cost-benefit relationship. In our center, the 2013 cost of tests that score on the FILNUT-Scale 22 was as follows: albumin 0.11€; total cholesterol 0.097€; blood count 0.51€; total protein (TP) 0.10€ and prealbumin (PR) 0.74€. Given that at a minimum, a blood count is ordered for all admitted patients, the additional request for albumin and cholesterol has a cost of 0.207€. There is an unquestionable benefit of a nutritional screening that, for a few extra cents on admission, prevents a much higher cost; namely, the time needed to perform other types of screening based on questionnaires that also require weighing and measuring all patients admitted[23]. According to the scoring system of our filter, TP and PR are not essential but useful because at any time during the hospital stay they may result in scoring.[22] With

Table VIII
Costs* by consumption of artificial nutrition (€)

Period	Enteral nutrition	Parenteral Nutrition	Total N. Artificial	Discharges	Cost/discharge €	Stays	Cost/stay €
Nov 2011 to Oct 2012	149,034.53	286,178.87	435,213.40	20,675	21.05	167,852	2.59
Nov 2012 to Oct 2013	86,378.00	280,443.55	366,821.55	20,156	18.20	165,094	2.22

* Includes only prices of components acquired by pharmacy.

analytical screening we would focus the process on those patients with a medium or high risk. The program and process is designed to enable response by the patient's nurse, the physician responsible, and nursing or medical staff belonging to the nutritional support team or unit.

Even though it has some limitations, the process facilitated access to the diagnosis of malnutrition and to the knowledge of the risk of developing it, as well as to the prescription of procedures and/or supplements to correct it, reaching more than 3,600 patients annually. We understand that efficiency is high, since staff effort and time is reduced by targeting only patients at medium and high risk and we achieve the maximum benefit from the subsequent intervention, given that by merging analytical data with the modified-MUST, we obtain sufficient information to achieve a diagnostic and therapeutic target unlike with simple screening. The perennial difficulty of implementing screening based on patient height and weight on admission is well known. In 2008[42] we reported the results we obtained on performing the MUST screening test on FILNUT positives: of 568 patients at a medium or high risk on the FILNUT Scale, 100% proved to be medium (25.9) or high (74.1) MUST. This, plus the issue of staff cost, affirmed our idea of starting with the analytical filter to detect patients requiring some form of nutritional intervention.

The interdisciplinary coordination of the team, the decentralized nature of our process, the agreements reached and the tools used improve coding rates to give results far above the Andalusian average; three times higher in diagnosis, two in procedures and five in diagnosis-related procedures; that is, care activity related to malnutrition. Even so, our malnutrition coding rates remain well below the actual prevalence. Rates in 2010 were 11.6‰ in Andalusia and 35.5‰ in our center, both well below those described in the literature. Much remains to be done to overcome this important undercoding.[27,28,32,36]

Our results help to adjust the CI, or Mean Complexity, of the hospital upwards, with the resulting economic implications and justification for stays[27] which would otherwise be considered inefficient. On removing the malnutrition and procedure codes from the MBDS for the years studied we see that the CI decreases by four hundredths or, equivalently, the contribution of their coding to the index is these four hundredths, which to us is an important contribution and consistent with previous findings.[27,28] The fact that in 2010 PN and EN coding did not add complexity to that already produced by malnutrition may be due to the usual approximation of the number to only two decimal places. Our higher rate of diagnosis-related treatments that would not add complexity also had an influence; as well as the fact that in certain clinical situations their coding, and even malnutrition itself, no longer adds weight per DRG, as has already been described by other authors with a DRG change in 24% or 27% of cases.[27,29,32] Neverthe-less, it is very notable to see (table VI) how the complexity of a supposed virtual hospital with only those patients whose MBDS had a malnutrition code at discharge is three times greater than the average complexity. We must consider that our center, with a CI of 2.19 in 2010, is the most complex in Andalusia, where the average complexity of all hospitals in the Andalusian Health Service is 1.76, according to the Cost Accounting data of centers in the Andalusian Health Service. InforCoan System (18 December 2012).

The results of MS and MR indicate that diseases that present with malnutrition (and which are recorded in the MBDS) have much higher morbidity and mortality, reaching a 3-fold increase in MS and a 4-fold increase in MR. These results are consistent with those of the PREDyCES[11] study and those of Ockenga[32] and Lim.[36] It should also be noted that when the calculation is adjusted for age, mortality rates change. With regard to RR we prefer to focus, as do other authors,[10] on the urgent RR; i.e., within 30 days after discharge of the episode under study, but with one specification: that it be produced by the same MDC corresponding to the DRG, so as to not record a subsequent admission caused by a clinical picture unrelated to the MDC as caused by malnutrition. An example is a patient with a gastric tumor who is readmitted for cataract surgery. This "urgent" RR is 1.9 times higher in patients with a record of malnutrition. Logically readmissions to other hospitals escape this rate. Other authors,[36] however, used the RR at 15 days of discharge, with similar results.

Comparing these results with previous studies is not easy, due to differences in the method of screening or assessment used, baseline characteristics of the study population and primary diagnosis, definition of malnutrition followed, economic terms used and DRG systems applied in different countries. The fact that our results refer to all discharges, with no exclusion criteria, obtained through the standardized work system, with no *ad hoc* coding, means we believe they have an added value as they can be considered structural results. Awareness of the prevalence and economic impact of malnutrition,[9,25,33] requires tools to improve its diagnosis and subsequent coding, which would generate an opportunity for economic reimbursement[32] in a hospital financing system based on complexity.

The four hundredths that the coding of our diagnostic activity and nutritional therapy contributes to the CI, translated into justified hospitalization cost, involve a number (two million euros) five to six times higher than the cost generated by support treatments that are, or would have been, necessary. This supports the efficiency of this activity, in addition to its clinical efficacy.

The INFORNUT® process uses its own applications and free software; similar development would, in theory, be achievable in other centers. DIRAYA is the information system that supports the Single Digital History of Andalusia. As a challenge for the future we can say that we are currently taking the first steps to trans-

ferring all the knowledge gained through implementation of the system in our hospital to DIRAYA and thereby extend its benefits to other public hospitals in Andalusia. To that end we are participating in a functional development team within the program. DIRAYA has an Analytical Requests Module (ARM) that enables management of all requests going to the clinical analysis laboratories, as well as distribution to the various laboratories and receipt of the results provided by them. Analytical tests are uniquely coded throughout Andalusia, thus the filtering of measurement results required for the malnutrition detection algorithm is immediate. Management of messaging between the various systems and modules that make up DIRAYA uses HL7, which facilitates the information arriving at its destination successfully. However, as mentioned above, the fact that TOS does not work with HL7 would need to be resolved. Once the algorithm is applied, the system will generate necessary patient alerts and recommendations, with the advantage that this information will be accessible from anywhere in the Andalusian Public Health System. We think this could also be extended to information systems in other Spanish autonomous regions.

Conclusions

Aware that quality healthcare implies equality, we believe the INFORNUT® process promotes equal access to the diagnosis of malnutrition and its nutritional support treatment and reaches more patients, making efficient use of human and economic resources, taking into account the current economic situation.

The interdisciplinary coordination of the team, the multidisciplinary and participatory nature of the process and the tools used, improve coding rates to give results far above the Andalusian average. These results help to adjust the hospital Complexity Index —or Case Mix— upwards, having a significant impact on the justification of hospital costs and demonstrating the efficiency of the clinical activity of these teams.

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