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Economic evaluation of haemodialysis. Analysis of cost components based on patient-specific data

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ABSTRACT

Background: Hemodialysis (HD) cost analysis provides information about the economic impact of the disease on the community. Its knowledge is crucial to adequate and optimize health resources. Our aim was to study sanitary and non-sanitary direct costs of HD, based on patients individual data. Furthermore, the effect of sociocultural factors and comorbidity on costs will be evaluated. **Material and methods:** Retrospective and observational study of prevalence costs produced during one year of HD therapy. All patients from North Health District of Tenerife province (Canary Islands, Spain) included for at least 3 months on HD were considered for the study. Sociodemographic parameters and comorbidity data were collected from a generic individual survey and reviewing database records. Direct sanitary and non-sanitary costs were organized in 6 categories: HD sesions, medicaction costs, hospitalization costs (evaluated by Diagnosis-Related Groups classification system), outpatient care (including consultation and complementary studies); sanitary material and patient transportation. **Results:** Finally, 161 patients were included (63 ± 16 years, 63% males, 38% diabetics). Of note, the proportions of sociocultural deprivation was high among this population (75-85% did not complete first school and had non-qualified jobs. Mean cost ot global therapy was 43,070 ± 13,932 €. Proportional allocation of costs was as follow: HD sesion 51%, pharmacy 27%, hospitalization 17%, transportation 3% and ambulatory cares 2%. It was not association between sociocultural profile, comorbidity and therapy cost. **Conclusions:** This is the first study of HD costs, itemized by components of expenses, based in individual data and introducing GRD model for hospitalization cost. The highest expenses corresponded to HD sesions and medication (79%), both very homogeneous to this patient population. The saving in economic term should be, fundamentally, the prevention of CKD.

Key words: Hemodialysis, Costs-of-illness, End-stage renal disease, Diagnosis-related groups.

Evaluación económica de la hemodiálisis. Análisis de los componentes del coste basado en datos individuales

RESUMEN

Antecedentes: El conocimiento del coste de la hemodiálisis (HD) proporciona información del impacto económico de la enfermedad sobre la comunidad. Dicho conocimiento es crucial para adecuar y optimizar la asignación de recursos. Nuestro objetivo ha sido estudiar los costes sanitarios directos pormenorizados de la HD. Además, analizamos el eventual impacto de los factores socioculturales y de comorbilidad sobre los costes. Material y métodos: Estudio retrospectivo y observacional durante un año de tratamiento con HD basado en datos individuales de pacientes. Se incluyeron todos los pa-

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cientes del Área Norte de Salud de la Provincia de Tenerife que durante el primer semestre de 2006 llevaran al menos 3 meses en HD. Se recogieron variables sociodemográficas y de comorbilidad mediante una encuesta individual y revisión de bases de datos. Los costes sanitarios fueron organizados en cinco categorías: sesiones de HD; consumo farmacéutico; hospitalizaciones (evaluado por GRD, grupos relacionados por el diagnóstico); atención ambulatoria (incluyendo exploraciones complementarias y uso de material sanitario), y empleo de transporte. *Resultados:* La muestra final fue de 161 enfermos (63 ± 16 años, 63% hombres, 38% diabéticos). Destacó la elevada deprivación sociocultural de la población: 75-85% sin graduado escolar y/o trabajos no cualificados. El coste medio del tratamiento global fue de 43.234 ± 13.932 €. La proporción de costes fue: sesiones HD 51%, gastos farmacéuticos 27%, hospitalizaciones 17%, transporte 3% y atención ambulatoria 2%. No se demostró una asociación relevante entre el perfil sociocultural o la comorbilidad y el coste del tratamiento. *Conclusiones:* Es el primer estudio de coste de HD por componentes de gasto, basado en datos individuales, e introduciendo el modelo de GDR para los costes de hospitalización. La mayor partida de gastos correspondió a las sesiones de HD y medicación (78%), ambos factores son muy homogéneos en esta población, minimizando el impacto del perfil demográfico y de comorbilidad. El ahorro económico debe buscarse fundamentalmente en la prevención.

Palabras clave: Hemodiálisis, Coste de la enfermedad, Enfermedad renal crónica terminal, Grupos relacionados con el diagnóstico.

INTRODUCTION

The need for renal replacement therapy has increased dramatically in recent years in both the U.S. and Europe.[1,2] This is due mainly to the increase in the elderly and diabetic population.[3,4] Indeed, this disease has become the leading cause of the inclusion of dialysis in most countries, although there are differences between them, and even between regions.[1-5] The data taken from the Spanish Registry of Renal Patients confirm this trend,[4] with some regional differences to be considered.

This is the case in the Canary Islands, where the incidence of diabetic patients on dialysis is surprisingly high: triple the national average and it has remained constant in recent years.[7-9] In fact, almost half of the individuals with advanced chronic kidney disease in our practice are diabetics[10] and this rate is growing annually.

In health economics, cost plays an important role. This aspect is particularly important in chronic diseases such as end-stage renal disease and diabetes, given the aging population and the increased number of patients exposed. As a result, the high social and economic costs of dialysis should be of priority concern. However, available information regarding treatment costs, both at a national and regional level, is scarce, and comes from studies developed around a decade ago.[11,12] Furthermore, comparisons between studies are difficult, since the cost estimation varies substantially according to whether different components that affect direct and indirect costs are included. Furthermore, there is often variability in terms of care through public centres or subcontracted care, among other situations, that imply a differential use of resources. The information relevant to this area is non-existent in our healthcare context. More difficult still is comparing costs across different countries, basing decisions on funding and type of healthcare provided.[13-15]

Even considering these difficulties, an understanding and an analysis of costs is necessary. With this information we can achieve an idea of the effect of disease on the utilisation of social resources and the socioeconomic impact or weight of disease on our communities. On the other hand, better understanding of the distribution of costs among its various components allows us to identify areas of inefficiency and to make decisions that allow a better allocation of resources.[16]

Based on the above, the problem from both the human and economic perspectives is serious, and more so in the Canary Islands, given the high incidence of diabetic patients on dialysis. Considering that over 90% of the incident patients end up in haemodialysis (HD), our objective was to study the detailed direct health costs of treatment with HD, based on individual patient data. A secondary objective was to determine the demographic, socio-cultural and health profile of this population and to study a possible association between these factors and the cost of treatment.

MATERIAL AND METHODS

Design

A retrospective and observational study of direct health costs during one year of treatment with HD. We define "cost" as the consumption of goods and services that cost money, in order to achieve a specific objective or product. As an additional objective the possible impact of comorbidity and socio-cultural cost factors will be analysed.

Study subjects

We evaluated all current HD patients in the Northern Health Area of the Province of Santa Cruz de Tenerife at the time study began. This region has a population of approximately 400,000 inhabitants and treatment for HD is offered at three centres: The Hospital Unit of the Canaries University Hospital (HUC), the outpatient HD unit of the HUC and

Tamaragua Hospital, which has an HD unit coordinated by the Canary Islands Health Service.

In order to focus the cost study during a period of clinical stability, all patients who had spent at least three months in HD during the first half of 2006 were included. Those patients who completed 6 months of follow-up were included in the final analysis and the cost allocation was extrapolated to one year. Patients who did not complete 6 months of follow-up were considered to have been in the study period for an insufficient amount of time and were excluded.

Exclusion criteria

1. Patients whose circumstances or illnesses could interfere with the development of the study (e.g., drug users, people with mental problems, etc.)
2. Denial or impossibility of obtaining informed consent.
3. Rejection of the attending physician's recommendations or lack of collaboration on the part of the patient or his responsible family member during the evaluation visits.

Sociodemographic variables

A generic survey was administered to the patient and/or a family member according to individual circumstances. The following data were collected: age, sex, underlying disease, educational level, work situation and activity, capacity for self-care, family support, living environment (urban, rural).

Clinical comorbidity data were obtained from the computer databases of the haemodialysis units. We evaluated the Khan comorbidity index,[17] the level of physical activity scale by Karnofsky[18] and the Charlson comorbidity index, modified for use in HD patients.[19] In our case we did not assign scores for end-stage renal disease, since obviously all had this condition.

To estimate the cost of the patient on HD, the prevalence cost method was used, that is, the direct health costs attributable to the disease during the year of the study.[20]

Health care costs

These costs were organized into five main categories: 1) HD sessions, 2), pharmaceutical consumption, 3) hospitalisations, 4) outpatient visits, emergency department, tests and complementary examinations, use of medical and self-care equipment (wheelchairs, canes, diapers), and 5) use of transport.

Haemodialysis sessions

For the specific cost of the HD session there are different models across countries. We are in the European context, and an amount of money is assigned based on the protocol arranged, that is, sufficient for dialysis, adjusted based on the performance protocol. In the Official Canaries Bulletin[21] some fees were published as a function of the characteristics of the centres, and there were several types. In our region there are three types: a publicly-owned hospital (Canaries University Hospital), dependent outpatient haemodialysis units coordinated by that hospital and the Haemodialysis Centre of Tamaragua Hospital which is coordinated by the Canary Islands Health Service. To assign costs per HD session we calculated an average of these allocations, which simplified comes to 140 euros per session. As often occurs in the Spanish territory, the HD unit only defines one single activity that is billed as an HD session. The only choice among modalities was bicarbonate dialysis, which these days is universal. No differential reimbursement was defined as a function of the number of hours per session or the modality of treatment. Periodic examinations that were performed on these patients were included in the reimbursement for dialysis, so they were not included in a separate section.

Pharmaceutical costs

The information on consumption of drugs and diagnostic material for self-care was taken from clinical databases and from surveys conducted with patients and/or their family members. The cost was obtained by calculating the daily cost for each of these (depending on the cost of the package and the doses used) multiplied by its duration. For each of the drugs we calculated the price in euros per unit (tablet, capsule, etc.). Costs were obtained from various sources such as the Medication Database of the General Council of Official Pharmacy Schools and the official sales prices of the pharmaceutical laboratories. We have expressed the pharmaceutical cost in euros/patient/day or year according to what is presented in the results.

Hospitalisations

The volume of hospital admissions per patient was obtained from the hospitals where the patients were admitted. The total number of admissions during the study period (12 months) was recorded, starting with the Minimum Hospital Data Set (NMDS). We applied mortality-attributable fractions of disease for each diagnosis code of the International Classification of Diseases (ICD-9-CM) and its subsequent processing to diagnosis related groups (DRGs). DRGs, as a system of risk adjustment of patients, include a cost estimate for each patient, based on a measure of the average

complexity of the patients treated at hospitals, and "relative weights" or level of consumption of resources attributable to each type or group of patients.[22] The average cost for each DRG was obtained from the Health Information System of the National Health System of the Ministry of Health.

Outpatient care

Outpatient care comprises outpatient hospital or community health centre visits, vascular access for patients on an outpatient basis, complementary tests and imaging. The information on the use of these health resources was obtained from three sources: review of clinical histories, review of electronic hospital records (SAP) and review of the survey conducted with patients and/or their family members. The average cost of outpatient visits was obtained from the SOIKOS23 database, and this was multiplied by the number of visits made by the patient. For the allocation of cost to the complementary studies, billing tables from the Canaries University Hospital were used. In this section transport expenses are also included for ambulatory care and health material whose cost was obtained from the reimbursement tables established by the Canary Islands Health Service.

Transportation for dialysis

The cost of transport to HD sessions must be added to the HD sessions themselves. This expenditure was obtained from the reimbursement tables established by the Canary Islands Health Service for the use of private car, taxi, bus health, non-medicalised and medicalised ambulance.

Data analysis

The results of this study are mainly descriptive, so we only used univariate statistical tests. Given that the cost figures were extreme in some patients, an asymmetrical distribution was produced that is skewed toward higher values. This becomes evident because the average is higher than the median, especially in the areas of hospital expenses and visits. For this type of data, with multiple outliers, the median should be considered a more robust basis for comparison, but the arithmetic average is considered more informative of the total cost for making decisions regarding health policy.[24] At the end, we present the results in both formats, average ± standard deviation (SD) and median (interquartile range). We used a linear regression model to explore cost predictors. Statistical analysis was performed using SPSS 13.0 for Windows (SPSS Inc., Chicago, IL, (USA).

RESULTS

Of a total of 201 patients on HD initially included, 40 were rejected for not meeting the inclusion criteria (n = 10), because they declined to participate in the survey (n = 4) or because they did not complete the required minimum follow-up period (n = 26). In the end, we included 161 patients. 86 carried out their HD at the Canaries University Hospital or its outpatient HD centre, and 75 went to Tamaragua Hospital. In table 1 the sociodemographic data and comorbidity indices by centre and totals are listed. The table shows that the degree of socio-cultural deprivation of the population in HD is considerable; 85% patients had not finished grade school, 75% were or had been unskilled workers, and 79% were retired due to age or illness. Within this context, family support was relatively high (82%), especially considering that 36% required partial or total support in their personal care. This sociocultural profile was more evident in rural areas or villages, which had their dialysis mainly at Tamaragua Hospital. Furthermore, these patients had an average age slightly higher, with a greater proportion of diabetic patients and those with high comorbidity.

Cost of the haemodialysis sessions

With the adapted model, the cost of the HD sessions (table 2) was virtually identical for all patients and centres, independently of comorbidity, sociocultural status or place of residence of the patients.

The price of HD included the cost of consumables, depreciation of non-disposable material, staff, and medication administered during the HD session, with the exception of erythropoietin. This cost, as mentioned before, was part of the reimbursement stipulated by the Canary Islands Health Service. The average cost per patient/year was €22,052. This high cost and the uniformity in reimbursement per patient make the differences in the total treatment cost between patients, and even between centres, irrelevant. The typical pattern in HD in all centres was 4 hours, three times a week. Only differeces were seen in those patients that received more than three weekly sessions, in general, because of high weight gain in the long period of dialysis.

Pharmaceutical costs

Pharmaceutical costs represent the second chapter in terms of costs, after the HD sessions (Table 2). The median total annual cost per patient was €11,702, that is, €34.6/patient/day. The greatest economic burden was represented by erythropoietin (€22.6/patient/day) that comprised approximately 68% of the total pharmaceutical

Table 1. Total demographic parameters and by dialysis centres: University Hospital of Canarias and Tamaragua Hospital
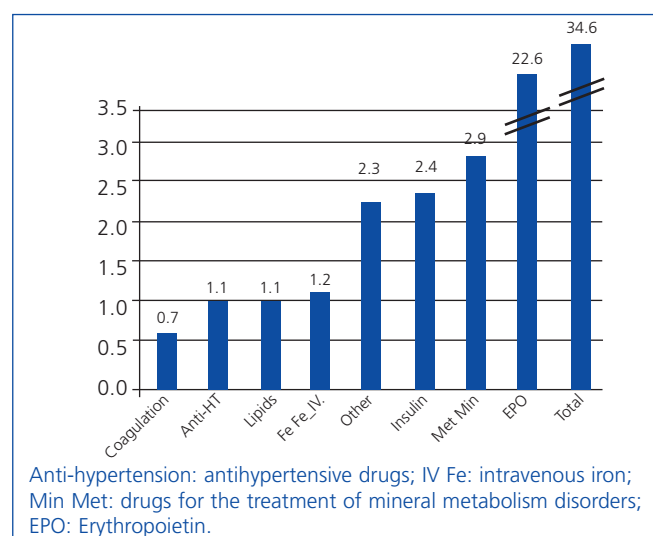
		Total	HUC	H. Tamaragua
Patient number		**161**	**86**	**75**
Age (years)		63 ± 16	62 ± 18	65 ± 15
Gender (V,%)		63	67	57
Diabetes (%)		38	28	49
Comorbidity	**Category**	**%**	**%**	**%**
Khan's index	Low Risk	24	30	16
	Middle	35	29	43
	High risk	41	41	41
Karnofsky's scale	Normal	62	64	59
	Help	30	26	33
	Disability	9	10	8
Charlson's index	$\overline{X} \pm SD$	4.7 ± 2.6	4.3 ± 2.6	5.1 ± 2.4
Demographical data		**%**	**%**	**%**
Education	≤School Graduate	85	81	90
	Bachellor Degree	7	9	6
	≥Graduate	8	10	4
Professional situation	Retired due to age	35	28	43
	Retired due to disease	44	40	47
	Active	21	30	10
Job	Non-qualified	75	72	77
	Qualified	20	22	18
	Graduate	5	6	5
Selftcare	Independent	64	73	53
	Partial help	23	20	27
	Total help	13	7	20
Family support	High	82	75	79
	Medium	9	14	11
	Low	9	11	10
Environment	Rural	11	6	16
	Town	40	23	59
	Urban	49	71	25

cost. The remaining pharmaceutical expenditure, which includes oral medication and medication administered in dialysis (iron, vitamin C, intravenous analogs to vitamin D), comprises an average of €11.06/patient/day. Figure 1 shows the daily costs of the drugs grouped by the most common medications. At the time of this analysis a few patients (<10%) initiated the consumption of high cost mineral metabolism products, whose growing economic impact has not been assessed in this analysis.

Hospitalisation costs

Of the 161 patients, 107 (66%) were admitted at least once. The average total expense for hospitalisations, including those who were never admitted, was 7,260 ± ?8,838 per patient per year, while the median was reduced to 4,335 euros/patient year. The range was very wide, from zero for those never admitted, to €51,779. If we consider patients who were hospitalised at least once, the expenditure was €11,085 ± 9,378 (1,089-51,779). The median number of admissions was two, with a maximum of nine admissions in

one year. The reasons for admission in order of frequency were: vascular access (catheter or fistula), various causes

Anti-hypertension: antihypertensive drugs; IV Fe: intravenous iron; Min Met: drugs for the treatment of mineral metabolism disorders; EPO: Erythropoietin.

Figure 1. Drug average price (€ per day).

21%, infection 18%, cerebral or peripheral vascular 12%, cardiac 10%, and digestive 10%.

The number of hospitalisations was significantly greater at Tamaragua Hospital 2.79 ± 2.1 than in the Canaries University Hospital 2.04 ± 1.2 (p<0.029) although in terms of the cost of hospitalisations there were no differences. There were also no differences in the days of hospitalisation between centres. There were no differences in the number of hospitalisations, nor in the costs of hospitalisation between genders, tertiles of age, Khan index, Karnofsky index, Charlson index, nor between diabetics and non-diabetics.

Outpatient care

The total outpatient costs varied significantly from patient to patient, with an average cost of €1,116 ± 1,363/patient/year (median = €599/patient/year), representing only 3% of the total cost of treatment.

Transportation for dialysis

Another expense that must be considered is transportation to the HD sessions. This component cost €1,398/patient/year (median €1,073/patient/year), that is, 3% of the total cost of treatment and 6% of the cost of the HD session, and very similar to the cost of outpatient care, as we shall soon see.

Sum of costs

The sum of expenditures and the relative percentage of each item are shown in Table 2. More than half of the costs are attributable to HD sessions. Next is the pharmaceutical cost, which reaches 27% and next the hospitalisation cost (17%). The component of costs for visits and complementary outpatient tests only represent 2% of the total, even less than the cost of transport to HD.

Association between cost, sociocultural factors and comorbidity

We must emphasise that the statistical analysis showed no significant association between the socio-cultural profile and the cost of treatment. Nor could we establish a correlation between the comorbidity indices and the cost. In general, the greatest economic burden fell on the younger patients, which was attributable to hospitalisation and pharmaceutical costs. Age was the only predictive parameter of cost (p<0.001). Younger patients incur greater expenses. Applying the multivariate linear regression model with interest as potential predictors of work activity, educational level, environment in which they live, sex and comorbidity index; age was the only parameter that remained an independent predictor of cost.

DISCUSSION

The aim of this study is to provide a framework for analysing the economic impact of the various components of HD. For the first time we can see the cost of dialysis for a specific region, based on individual patient data and on incorporating the DRG model to evaluate the economic impact of hospitalisations, which is designed to provide a common format for analysis of the cost of disease.

Table 2. Treatment costs in euros/patient/year

		Total	HUC	H. Tamaragua	p	Cost %
HD session	Average (SD)	22,052 (2,865)	22,395 (3,760)	21,658 (1,101)	0.103	51
	Median (RI)	21,216 (21,148-21,448)	21,216 (20,536-21,930)	21,216 (21,216-21,216)		
Pharmaceutical	Average (SD)	12,026 (6,666)	12,843 (6,439)	11,091 (6,842)	0.098	27
	Median (RI)	11,702 (7,939-16,112)	12,139 (7,944-17,993)	11,094 (7,936-14,499)		
Hospitalisations	Average (SD)	7,26 (8,838)	6,759 (9,135)	7,834 (8,508)	0.552	17
	Median (RI)	4,335 (0-11,354)	3,081(0-10,127)	5,424 (1,458-11,945)		
Transport	Average (SD)	1,398 (1,319)	1,636 (1,553)	1,125 (923)	0.010	3
	Median (RI)	11,073 (740-1,091)	1,066 (802-1,397)	1,073 (664-1,073)		
Ambulatory Care	Average (SD)	1,116 (1,363)	1,545 (1,458)	624 (1,056)	0.001	2
	Median (RI)	599 (195-1,455)	941 (191-2,341)	278 (40-840)		
Total	Average (SD)	43,234 (13,932)	44,654 (14,950)	41,605 (12,567)	0.155	100
	Median (RI)	40,070 (33,176-49,531)	41,837 (33,693-51,519)	39,005 (32,149-49,268)		

Data are represented as mean (SD: standard deviation) and as median (IR: interquartile range). HD: haemodialysis.

Global cost of treatment

As far as we are concerned, in Spain we do not have updated data regarding the overall cost of HD separated into its components. Studies to date are not homogeneous, and mainly aimed at comparing treatment modalities without including other aspects of cost such as, for example, hospitalisations. Hernandez Jaras, et al.[11] published in 2000 an economic study of HD using a weighting factor called Relative Value Units based on the complexity of the sessions. This study only looked at the cost of HD sessions without including other aspects of treatment. The "cheapest" cost per session was €149, slightly higher than the reimbursement established by the Canary Islands Health Service for HD sessions for 2007-2008 in the Canaries. In 2001, Lamas et al.[12] published a study of dialysis costs in a public hospital. It is notable that the relative cost of HD sessions (€20,268/patient/year) and hospitalisations (€3,174/patient/year, based on average estimates and not the individual analysis by DRG) is consistent with our data, although it was done more than a decade ago. Outside of our environment, Lee et al.[14] published a detailed study of the economic impact in Canada of the different modalities of dialysis and vascular access in 2002. The global annual cost of HD in hospital was €43,528 (95% CI, 40,528-46,600) (based on the initial conversion of €0.85 01/01/1999 = 1 U.S. dollar). The cost analysis was done in categories similar to ours, although the price of the physician was included in a separate section. Specifically, the cost of HD was €22,688. Despite the many differences between models and healthcare structures, the specific cost of HD and the proportion that it represents of the total cost of treatment was similar to ours. On the other hand, other methodologically different European studies, describe a cost of dialysis treatment in a wide range of €20,000-80,000/patient/year.[25-28] Our costs are well within that range, but unfortunately, a more rigorous comparison is impossible with the available information. Very recently, Icks et al.[29] published a study of the overall cost of dialysis in a region of Germany in 2006, analysing cost components similar to ours. The average global cost was €54,777/patient/year, that is, 25% higher than ours, mainly due to the cost of the dialysis procedure (€30,029/patient/year). Most notable is the coincidence in the economic burden relative to the cost components: dialysis procedure (55%) medication (22%) and hospitalisation (14%); ours were 51, 27 and 17%, respectively.

Specific cost of the haemodialysis sessions

The allocation of costs attributable to the HD is a complicated issue. Most countries with structured public health services assume the costs of HD by assigning a standard price per session and imposing minimum standards of quality. In general, Spanish health services have adopted this model, including the Canary Islands Health Service.

However, even within this model, there is also variability of options, depending on the centre and the type of arrangement reached. Following are some of the variants that are included in the arrangements: HD modality and types of dialyzers, variety in clinical practice (e.g., Privacy Policy for infectious patients), variety in the type of services agreed (e.g., vascular access) among others. Furthermore, in many instances the reimbursement per dialysis session includes the amortisation of dialysis monitors and maintenance, which further complicates the comparative analysis.

While the weighting of specific features of the HD sessions brings costs closer to reality, in order to standardise the analysis, we decided to assign each HD session the average reimbursement allocated by the Canary Islands Health Service, based on the arrangements made with the centre or hospital concerned. But it should be clarified that the economic allocation per HD session could have an important impact on the total cost. For example, in a detailed study of the average cost of HD in our hospital for about a decade (internal report, unpublished data), the cost per session was €262. This analysis did not include hospitalisations, but it did include all examinations and catheter interventions, in addition to the cost of personnel on duty. Although these data are not comparable with ours, we can infer that the cost of HD in public hospitals may be 25-50% higher than the fee for the Canary Islands Health Service and that we used in our analysis.

Pharmaceutical costs

The area of pharmaceutical costs was, in terms of percentage, second in terms of magnitude, representing 26% of the global cost, which is much higher than the costs of hospitalisation. It makes sense if we remember that drug use is commonplace and universal, while hospitalisation is temporary and affects only a proportion of patients (33% were not admitted during the study period).

Erythropoietin consumes two-thirds of the pharmaceutical expenditure. Since its use is almost universal and doses are within a narrow range for most patients, the pharmaceutical expenditure is fairly uniform in the HD population. In this study we have not considered the discounts offered by many pharmaceutical companies in a different format. However, they must be taken into account given their magnitude, but such is the heterogeneity of these offers it is impossible to make a general estimate.

Much different is drug spending for patients with chronic kidney disease who are not yet on dialysis. Pons, et al.[30] published in 2002 that the pharmaceutical cost of patients with chronic kidney disease (CKD) Stage 5, was approximately one third lower (€11-12/ day) than that of our HD patients. This is due mainly to the increased use of

erythropoietin in HD. The prescription of intravenous iron and the increased use of drugs to control mineral metabolism changes undoubtedly are also determinants of pharmaceutical spending increases, which are three times higher (2.5 times if we exclude the erythropoietin) in patients on HD in front of the pre-dialysis stage.

Pharmaceutical costs are probably the area with the largest annual increase because of the more expensive drugs entering the market, all of which are related to mineral metabolism: new phosphate binders (sevelamer, lanthanum carbonate), vitamin D receptor activators, calcimimetics, etc. A patient who receives three of these products in half doses may represent a cost of €25-30/day, that is, an increase of approximately 70-80% in the global daily drug cost. The benefits on morbidity and mortality of these new and expensive products are not yet definitively established.[16,31]

Hospitalisation costs

For the first time we use the concept of DRG to describe the costs for hospitalisation in patients with HD. This tool should serve as a frame of reference, and also for comparisons, to assess the quality of patient care and the use of services provided by hospitals. This system was first used to establish a system of payment by the Administration to hospitals in the U.S. It is based on a fixed amount depending on the specific DRG for each patient treated. The classification is made using ICD-10 codes and the presence of complications and comorbidity. The purpose of this classification is to group the diseases to assign a monetary value to each in order to improve management of hospital costs.

In our study, 107 (66%) of the 161 patients were admitted at least once. The average total expense for hospitalisations, including those who were never admitted, was €7,367 ± 9,265/patient/year. The range was very wide, from zero for those never admitted, to €51,779. If we consider those who were hospitalised at least once, the expenditure was €11,085 ± 9,378 (1,089-51,779).

Although this method provides interesting information, unfortunately comparative national data is not available. It is curious that the study published by Ploth et al.[15] shows rates of hospitalisation that are almost the same as ours: 32% of the patients did not require hospitalisation during the year of the study, with an average of two hospitalisations/patient/year. However, the days of hospitalisation are quite variable among series; Plot et al.[15] reported the briefest average, 5.7 days; the series by Sehgal, et al.[32] rose to 2 weeks per patient and year, while in our study it was 18.7 days. However, nothing indicates that these are parameters of reference, given the variability of circumstances that affect care in each

region or centre. Indeed, we have not found a relationship between costs, time and days of hospitalisation with initial patient comorbidity, and this is probably due to social and family circumstances or healthcare-related deficiencies of various kinds involving income or long hospital stays not strictly justified by medical reasons.

Other expenses

The under-representation of ambulatory care costs reflects the role of the nephrologist in global patient care, basically converted into a general practitioner. Given the precarious social and health situation of patients in our area, along with the alarming delays in appointments for tests and consultations, difficulties with travel, often increasing the number of short stays for studies that in many cases should be done on an outpatient basis. "The real world".

Absence of relationship between cost of treatment with haemodialysis and socio-cultural factors or comorbidity

The association between socio-cultural factors and cost is very difficult to establish,[33] especially in a population affected with a chronic disease, of advanced age and with significant accompanying comorbidity. Indeed, the cost of treatment is not associated with any of the expected factors: Khan index, Karnofsky index, diabetes, nor with the constellation of variables associated with sociocultural deprivation. Beddhu et al.[19] described similar results in which case only the Charlson index modified by the authors was associated directly with the cost of treatment. We reanalysed our data applying the same criteria as these authors, but not considering the score for terminal renal disease, given that all our patients were on HD; nor did we find a relationship between the modified Charlson index and costs. However, all comorbidity indices (Khan, Karnofsky and Charlson) were associated directly and significantly with parameters of sociocultural deprivation, such as level of studies and work activity (data not shown). This is not surprising, given the greater precariousness of health found in patients of advanced age, almost all on early retirement, without access to schooling and with less skilled jobs. We must insist that, contrary to what was expected (at least by the authors), none of these factors was associated with the cost of treatment. However, for this comment there is a critique: the studied population was very homogeneous in terms of sociocultural deprivation and even comorbidity. Table 1 eloquently shows that more than two thirds of the patients did not complete grade school and their work activity was unskilled, and all was associated with considerable initial comborbidity. This may explain the lack of association between these parameters and the cost. It is possible that very large series

are needed that reach a more diverse population to be able to elucidate the effect of sociocultural deprivation on costs; although in studies carried out in the USA, in general the association between sociocultural factors and costs were weak in patients on dialysis.[14]

Limitations of the study

Our study has limitations. First, the data obtained from the patient intervew are not necessarily precise or verifiable. Assuming this limitation, the surveys used have been validated and used before,[35] although with slight modifications to adapt them to the situation of patients on HD. The information obtained regarding the cost of treatment will be difficult to extrapolate to other regions and populations in absolute terms. The costs allocated to the different areas of expenses will surely vary between health services. The study population is not necessarily representative of the national average, although age and gender distribution is similar, the rate of diabetic patients is significantly higher, and the sociocultural environment is likely to have considerable interregional differences. However, the detailed information by cost components can serve as a benchmark for future studies or for estimating costs.

CONCLUSIONS

This is the first study of HD by component expenditure data based on «individual» patients, and introducing the DRG classification system as the source of the cost of hospitalisations. While these results are not directly extrapolated to other regions, the information derived is relevant. We know that HD is an expensive procedure, having found that the biggest expense is for the HD sessions and medication (similar in most patients), leaving the expenditure per hospitalisation in third place and at a good distance. From this observation and confronted with a rather homogeneous population with a socio-cultural profile of comorbidity, the economic impact of these factors has less weight than you might expect a priori. In other words, economic savings should be sought mainly in the prevention of terminal renal disease.

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