

# Institutional and familial cost of patients in continuous ambulatory peritoneal dialysis

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## SUMMARY

**Objective:** to determine the cost of institutional and familial care for patients with chronic kidney disease replacement therapy with continuous ambulatory peritoneal dialysis.

**Methods:** a study of the cost of care for patients with chronic kidney disease treated with continuous ambulatory peritoneal dialysis was undertaken. The sample size (151) was calculated with the formula of the averages for an infinite population. The institutional cost included the cost of outpatient consultation, emergencies, hospitalization, ambulance, pharmacy, medication, laboratory, x-rays and application of erythropoietin. The family cost included transportation cost for services, cost of food during care, as well as the cost of medication and treatment materials acquired by the family for home care. The analysis included averages, percentages and confidence intervals.

**Results:** the average annual institutional cost is US\$ 11,004.3. The average annual family cost is US\$ 2,831.04. The average annual cost of patient care in continuous ambulatory peritoneal dialysis including institutional and family cost is US\$ 13,835.35.

**Conclusion:** the cost of chronic kidney disease requires a large amount of economic resources, and is becoming a serious problem for health services and families. It's also true that the form of patient management in continuous ambulatory peritoneal dialysis is the most efficient in the use of institutional resources and family.

**Uniterms:** institutional cost, relative cost, chronic kidney disease, peritoneal dialysis continuous ambulatory.

Study conducted by the Mexican Social Security Institute, Querétaro, Mexico

Article received: 2/27/2013

Accepted for publication: 30/01/2014

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<http://dx.doi.org/10.1590/1806-9282.60.04.012>

## INTRODUCTION

Chronic kidney disease is defined as a decreased glomerular filtration rate less than 15% of renal function.<sup>1</sup> The diagnosis is established by the criteria of the clinical guidelines from the National Kidney Foundation as referenced in the KDOQI (Kidney Disease Outcomes Quality Initiative).<sup>2</sup> In the literature, references to its prevalence vary widely, with one group of authors placing it at 3,8%,<sup>3</sup> 8,5%,<sup>4</sup> 9%,<sup>5</sup> 11%<sup>6</sup> and 15,6%;<sup>7</sup> however, another group of authors record it as 23,4%<sup>8</sup> and 35,4%.<sup>9</sup>

It has been noted that the prevalence of this disease varies between 3 and 10% of the population in Mexico.<sup>10,11,12</sup>

Replacement therapy treatment for terminal kidney disease includes five modes, including intermittent peritoneal dialysis (IPD), cyclic or ambulatory peritoneal dialysis (APD), continuous ambulatory peritoneal dialysis (CAPD), hemodialysis (HD) and kidney transplantation.<sup>13</sup> Of these modalities, CAPD has the highest prevalence of use and involves the execution at home by the patient assisted by the family.<sup>14,15,16,17</sup>

In this regard, the literature has identified the total annual cost of institutional care using replacement therapy in chronic kidney disease as \$ 3,547 million (Mexican pesos), plus \$ 1,400 million (Mexican pesos) in inva-

lidity expenses.<sup>18</sup> Other authors note that the average annual cost ranges from \$ 67,315 (Mexican pesos), \$ 5,643 (US dollars) and € 28,207 (Euros). Notwithstanding the above, none of these studies reported the expenditure incurred by the family to implement the continuous ambulatory peritoneal dialysis method at home.<sup>19,20,21</sup>

In this context the aim of this article is to identify the institutional and family care costs of patients with chronic kidney disease using continuous ambulatory peritoneal dialysis.

## METHODS

An economic assessment was conducted on the cost modality of care for patients with chronic kidney disease undergoing treatment using continuous ambulatory peritoneal dialysis at the Hospital General Regional N° 1 del Instituto Mexicano belonging to the Mexican Social Security Institute in the city of Queretaro, Mexico. The data was collected from September to October 2011 and the information collected corresponded to the year 2010.

The study included patients with chronic kidney disease undergoing replacement therapy with continuous ambulatory peritoneal dialysis for at least one year, who attended the outpatient nephrology clinic and agreed to participate in the study. The study excluded patients under 18 years and those diagnosed with cancer.

The sample size of 151 was calculated with the formula of averages for infinite populations, at a 95% confidence level with a region for rejection of the null hypothesis ( $Z=1.64$ ), and the hypothesis that the average annual cost is \$ 30,000. The sampling frame for the selection of patients was the list of patients attending the nephrology clinic during the months of the study, incorporating them into project in accordance with their order of attendance and agreement to participate until the required sample size was reached.

The sociodemographic variables studied included age, sex, level of education, occupation and marital status. The average length of entering the continuous ambulatory peritoneal dialysis program was also identified.

The cost of care was estimated in Euros for one year and covered the cost of the institution and the cost of the family. The institutional cost included the cost of outpatient consultation, emergencies, hospitalization, peritonitis, pleural effusion, catheter changes, ambulance, pharmacy, medication, laboratory, imaging and application of erythropoietin. The family cost included transport to receive services, the cost of food during care and

the cost of medication and treatment materials purchased by the family for home care.

Institutional cost		Institutional cost		Familial cost
		Outpatient consultation		
		Emergencies		
		Hospitalization		
		Peritonitis		Transport
		Pleural effusion		Food
Cost of care	=	Catheter changes	+	Medication
		Ambulance		Material
		Pharmacy		
		Medication		
		Laboratory		
		Imaging		
		Erythropoietin		

$$\text{Cost of care} = \sum_{i=1}^K (\text{Institutional cost } i + \text{familial cost } i)$$

### Cost of care

#### 1. Institutional cost

##### 1.1 Cost per service

###### A) Unit cost

###### a) Cost per minute

The cost per minute of outpatient consultation, emergencies, hospitalization, ambulance, pharmacy, laboratory, imaging and application of erythropoietin was estimated using the time and motion technique. To calculate the personnel costs, the personnel in each of the services were identified, their monthly salary and days worked per month. This information enabled identification of the cost per day per personnel type, subsequently investigating the total minutes worked per day per personnel type, and obtaining the cost per minute per personnel type.

###### b) Duration of care

The duration of outpatient consultation, emergencies and hospital visits was measured in minutes, with the latter measured by the number of visits per day, to identify the total minutes allocated per day to a hospitalized patient. Time spent by the ambulance to provide dialysis bags at patient's home, the duration of pharmacy care provide the prescription, the duration of laboratory and imaging studies as well as the duration of the application of erythropoietin was also identified.

###### c) Unit cost

The unit cost was estimated by multiplying the cost per minute for outpatient consultation, emergencies, hospi-

tal, ambulance, pharmacy, laboratory, imaging and application of erythropoietin by the total minutes spent in these services.

$$\text{Unit cost} = \sum_{i=1}^K (\text{Cost per minute } i \times \text{Duration of care } i)$$

d) *Average annual use*

To find out the average annual use of the health services, the clinical records were used to investigate the number of visits per year for outpatient consultation and emergencies, as well as the number of days of hospitalization for peritonitis or pleural effusion. The number of occasions when the institution used ambulance services to provide dialysis bags to patients at home was also identified, as well as the number of applications of erythropoietin, and the number of pharmacy, laboratory and imaging visits.

e) *Annual cost per service*

The annual cost per service was obtained by multiplying the unit cost by the average annual use.

$$\text{Annual cost per service} = \sum_{i=1}^K (\text{Unit cost } i \times \text{Average annual use } i)$$

1.2. *Mediation cost*

The cost of medication was estimate using the micro-costing technique, using an interview to identify the type of medication used by each patient, as well as the average annual use. The unit cost of the medication was subsequently investigated. Multiplying the unit cost by the average annual use gives the annual cost per medication.

$$\text{Cost of medication} = \sum_{i=1}^K (\text{Amount of medication } i \times \text{Unit cost of the medication } i)$$

1.3. *Institutional cost*

The institutional cost was identified by adding the annual cost of all of the services involved plus the cost of medication, including the cost of dialysis bags and the cost of the erythropoietin.

$$\text{Institutional cost} = \sum_{i=1}^K (\text{Cost of service } i) + (\text{Cost of medication } i)$$

2. *Familial cost*

2.1. *Transport cost*

The transport cost was identified using the micro-costing technique.

A) *Unit cost*

The cost of transport to and from home and the medical unit was investigated. This value was adopted as the unit cost.

B) *Annual use*

The annual use was obtained from direct interviews with the patient and the information contained in the clinical record, identifying the number of occasions when they attended outpatient consultation, emergencies, hospital, pharmacy, laboratory, imaging services and application of erythropoietin. This information was supplemented by the number of escorts per patient for each of the services.

C) *Annual transport cost*

This was obtained by multiplying the unit cost of transport by the annual use of such.

$$\text{Annual transport cost} = (\text{Unit cost of transport} \times \text{Number of trips})$$

2.2. *Food cost*

The cost of food was obtained using the micro-costing technique.

A) *Unit cost*

The cost of consuming food when attending the medical unit was investigated with the patient. Thus amount was adopted as the unit cost.

B) *Annual use*

The annual use was obtained via direct interview with the patient, identifying the number of occasions they used outpatient consultations, emergencies, hospital, pharmacy, laboratory, imaging and application of erythro-

poietin. This information was supplemented by the number of escorts per patient for each of the services.

#### C) Annual food cost

This was obtained by multiplying the unit cost of food by the annual use of such.

$$\text{Annual food cost} = (\text{Unit cost of food} \times \text{Number of food items})$$

#### 2.3. Medication and treatment material cost

This was identified by questioning the patient directly on the amount spent on medication and treatment material, investigating the expenditure in the last month. This amount was used as a reference to extrapolate the expenditure in the last year by the family.

#### 2.4. Familial cost

This was obtained by adding the transport and food costs of the services used, plus the cost of medication and treatment material.

$$\text{Cost for the family} = \text{Cost Transport} + \text{Cost Food items} + \text{Cost Medication} + \text{Cost Treatment materials}$$

#### 3. Total annual cost

This was obtained from adding the institutional and familial costs, with this information used to make projections for different amounts of population. The analyses included averages, percentages and confidence intervals.

$$\text{Total annual cost} = (\text{Institutional cost} + \text{Familial cost})$$

## RESULTS

The average age in the population studied is 54.05 years (95% CI; 51.86 to 54.23), predominantly female with 55% of the female sex (95% CI; 47.1 to 62.9), 75.2% with primary education completed, or less (95% CI; 68.2 to 82.2), the main occupation of housewife with 48.3% (95% CI; 40.3 to 56.3), and 78.8% (95% CI; 72.3 to 85.3) living as a couple.

The average time of joining the continuous ambulatory peritoneal dialysis program is 2.66 years (95% CI; 2.37 to 2.95). The average annual outpatient consultations was 2.77 (95% CI 2.63 to 2.92) and 1.51 for emergencies (95% CI; 1.25 to 1.77). In hospital, the annual average number of days was 5.52 days (95% CI; 4.13 to 6.92), with 0.59 (95% CI; 0.45-0.73) peritonitis events, 0.21 (95% CI; 0.10 to 0.32) pleural effusion events and 1.90 (95% CI; 1.85 to 1.94) catheter changes. Table 1 presents the average annual laboratory studies, imaging and applications of erythropoietin, use of pharmacy and ambulances, as well as unit cost for each of these services.

The average annual cost of the aforementioned services is US\$ 2,707.45, with the highest cost being that of erythropoietin application, corresponding to US\$ 1,054.18. The annual cost per service is presented in Table 1.

The average annual medication cost is US\$ 8,296.85 with the highest cost corresponding to dialysis bags and erythropoietin at US\$ 7,298.1 and US\$ 783.51 respectively. Table 1 presents the cost per medication type. The average annual institutional cost is \$ 11,004.3.

The average escorts per patient when using institutional services is 1.05 (95% CI; 0.87 to 1.12). Consequently, the average annual number of people attending outpatient consultations is 5.68, with 3.10 for emergencies and 11.32 at hospital, and 319.80 for application erythropoietin.

The highest cost familial cost is transportation and food for application of erythropoietin at US\$ 1,643.21 and US\$ 606.73 respectively. The average annual family cost is US\$ 2,831.04. The information is presented in Table 2.

The average annual cost of patient care in continuous ambulatory peritoneal dialysis, including institutional and familial costs, is US\$ 13,835.35. US\$ 8,296.85 of this amount corresponds to medication paid by the institution. The information is presented in Table 3.

When projecting spending for 1,000 patients, the institutional cost is US\$ 11,004,300, while the familial cost is US\$ 2,831.04, at a total cost of US\$ 13,835,350. Costs for different population scenarios are presented in Table 4.

## DISCUSSION

The importance of identifying the institutional and familial cost of patients undergoing CAPD lies in the increasing trend of this disease and the large amount of resources required for care from the institution, supplemented by the familiar costs, a subject which has been neglected in the literature. Nevertheless, it is fact experienced by the families of patients with chronic kidney disease undergoing CAPD, hence the importance of the item presented.

**TABLE 1** Inputs, use and cost of medical care for the institution in patients undergoing continuous ambulatory peritoneal dialysis

Input	Annual average use	Unit cost	Annual cost
<b>Services</b>			
Outpatient consultation	2.77	17.63	48.83
Emergency consultations	1.51	32.81	49.55
Day at hospital	5.52	70.57	389.54
Peritonitis	0.59	339.03	200.03
Pleural effusion	0.21	200.14	42.03
Catheter changes	1.9	245.38	466.22
Ambulance	12	18.31	219.77
Pharmacy	2.81	2.18	6.13
Laboratory	19.39	10.42	202.1
Imaging	1.21	24.02	29.07
Erythropoietin	159	6.63	1,054.18
<b>Average annual cost of services</b>			<b>2,707.45</b>
<b>Medication</b>			
B complex	13.2	0.17	2.31
Enalapril	27.24	0.17	4.72
Prazosin	8.64	0.61	5.24
Captopril	42	0.17	7.27
Ferrous fumarate	11.4	0.65	7.36
Losartan	9	1.17	10.49
Calcitriol	19.44	0.59	11.48
Folic acid	14.76	1.34	19.75
Felodipine	13.56	2.5	33.95
Calcium	39.36	1.24	48.96
Nifedipine	42	1.73	72.71
Erythropoietin	156	5.02	783.51
Dialysis bags	1,543.2	4.72	7,289.1
<b>Average annual cost of medication</b>			<b>8,296.85</b>
<b>Average annual institutional cost</b>			<b>11,004.3</b>

The results are expressed in US dollars.

\* The cost of peritonitis includes antibiotics.

\*\* Catheter changes and pleural effusion includes the material employed.

**TABLE 2** Inputs, use and cost of medical care for the family of patients undergoing continuous ambulatory peritoneal dialysis

Input	Annual average use	Unit cost	Annual cost
Transport for outpatient consultation	5.68	5.14	29.18
Transport for emergencies	3.1	5.14	15.91
Transport to hospital	11.32	5.14	58.17
Transport for erythropoietin	319.8	5.14	1,643.21
Food in consultation	5.68	1.9	10.78
Food in emergencies	3.10	1.90	5.88
Food in hospital	11.32	1.9	21.48
Food in erythropoietin applications	319.8	1.9	606.73
Medication		341.03	341.03
Treatment material		98.66	98.66
<b>Total annual cost</b>			<b>2,831.04</b>

The results are expressed in US dollars.

**TABLE 3** Annual institutional, familial and total cost in patients undergoing continuous ambulatory peritoneal dialysis

Input	Cost
<b>Institution</b>	
Services	2,707.45
Medication	8,296.85
<b>Institutional cost</b>	<b>11,004.3</b>
<b>Family</b>	
Transport	1,746.49
Food items	644.86
Medication	341.03
Treatment material	98.66
<b>Familial cost</b>	<b>2,831.05</b>
<b>Cost of care</b>	<b>13,835.35</b>

The results are expressed in US dollars.



**TABLE 4** Projections of the cost of care of continuous ambulatory peritoneal dialysis

Population	Institution	Family	Institution and family
1	11,004	2,831	13,835
500	5,502,150	1,415,520	6,917,675
1,000	11,004,300	2,831,040	13,835,350
5,000	55,021,500	14,155,200	69,176,750
10,000	110,043,000	28,310,400	138,353,500
50,000	550,215,000	141,552,000	691,767,500
100,000	1,100,430,000	283,104,000	1,383,535,000

The results are expressed in US dollars.

In the estimation of the institutional fixed cost and variable cost, the time and motion and micro-costing techniques were used, which allows it to attain the unit cost. This method seems to be an appropriate way to approach this situation. Furthermore, that used in the estimation of familial cost is closely related to the resources that must be used to provide patient care.

It is a fact that the cost of continuous ambulatory peritoneal dialysis modifies the structure of institutional costs, as revealed by the results of the study presented herein. Approximately 80% of the cost corresponds to medication. Within the medication item, dialysis bags make up the highest cost (70%), a logical situation given it is the basis of replacement therapy for these patients.

Given the scenario described, reducing institutional cost by avoiding the use of inpatient services and consultation, it could be assumed that costs are transferred to the family, yet the results show family savings. When analyzing the familial cost, approximately 85% of the cost relates to transportation and food for attending the medical unit, which means that if the patient continued receiving hospital care for peritoneal dialysis, family transportation and food costs would increase proportionately.

It is a fact that institutional costs decrease with the strategy of outpatient care for patients with chronic kidney disease, and these are transferred to the family (about 20% of the cost), which can be considered a major burden on a population that has social security but economic conditions that are not ideal, affecting the family budget and all the social consequences this implies. However, in absolute terms the cost to the family is lower with this modality, as noted in the previous paragraph.

Consequently, this modality seems to be the best option for the management of patients requiring this type of care, and, coupled with this, the evidence demonstrates that for the institution this is a treatment that allows it to have greater efficiency in the use of economic resources.

## CONCLUSION

In conclusion, the management of chronic kidney disease requires a large amount of resources, becoming a serious problem for health services and the patient's family. It is also true that the modality of patient management using continuous ambulatory peritoneal dialysis is the most efficient use of institutional and familial resources.

## CONFLICT OF INTERESTS

There are no conflicts of interest in this study, conducted with the resources of the Epidemiological Investigation and Health Services Unit and the Mexican Social Security Institute.

## ACKNOWLEDGEMENTS

The authors would like to thank the Mexican Social Security Institute for supporting the research activities, especially the facilities offered to conduct this study.

## RESUMO

Custo institucional e da família do paciente em diálise peritoneal ambulatorial contínua.

**Objetivo:** determinar o custo da atenção institucional e familiar do paciente com doença renal crônica terminal em tratamento substitutivo com diálise peritoneal ambulatorial contínua.

**Métodos:** foi desenvolvido um estudo de custo da atenção com pacientes com doença crônica renal em tratamento com diálise peritoneal ambulatorial contínua. A amostra foi de 151 pessoas, calculada com a fórmula das médias para população infinita. No custo institucional foi incluído o custo da consulta externa, urgências, internamento, ambulância, farmácia, medicamentos, laboratório, raios X e administração de eritropoetina. No custo da família foi considerado o custo do traslado para receber os serviços,

o custo das refeições durante a atenção, além do custo dos medicamentos e do material para curativos comprados pela família no atendimento domiciliar. A análise foi com médias, porcentagens e intervalo de confiança.

**Resultados:** o custo anual institucional é US\$11.004,3. O custo anual da família foi em média de US\$2.381,04. O custo anual, em média, da atenção do paciente com diálise peritoneal ambulatorial contínua, incluindo o custo institucional e familiar, é de US\$13.835,35.

**Conclusão:** o custo da doença renal crônica requer uma grande quantidade de recursos econômicos, convertendo-se em um sério problema para os serviços de saúde e a família.

**Unitermos:** custo institucional, custo familiar, doença renal crônica, diálise peritoneal ambulatorial contínua.

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