



## ORIGINAL ARTICLE

## Cost of care for patients on maintenance haemodialysis in public facilities in Cameroon

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### ABSTRACT

**Background:** The management of end-stage kidney disease constitutes a heavy burden on communities worldwide due to the high cost of renal replacement therapy (RRT). Data on the cost of RRT are scanty in low-income countries. This study aimed to evaluate the global cost of haemodialysis in Cameroon, an emerging economy in Central Africa. This will provide data to help healthcare planners develop more cost-effective strategies for the care of these patients.

**Methods:** A prospective cost analysis of chronic haemodialysis care in three public-sector facilities was conducted in Cameroon. Both incident and prevalent patients were enrolled and followed up for 6 months. Patient data and costs were collected from patient interviews, medical records, bills, hospital price-lists and the procurement departments of the hospitals. Direct medical costs included outpatient consultation fees, dialysis consumables, dialysis session fees, drugs, laboratory and radiological tests. Non-medical direct costs included the cost of transport, feeding, water and electricity. Indirect costs related to the monthly loss of productivity for patients and their caretakers. The annual costs were calculated as the median costs for 6 months multiplied by 2 and were expressed in the local currency, the Central African franc (XAF), and US dollars (\$).

**Results:** A total of 154 patients (62.3% males), mean age of  $46.8 \pm 15.2$  years, were included, with 6 130 dialysis sessions completed during the study period. The annual median cost of haemodialysis per patient was XAF 7 988 800 (\$ 13 581). Out-of-pocket payments amounted to XAF 2 420 300 (\$ 4 114), accounting for 30% of the total cost. The median direct cost was XAF 7 458 200 (\$ 12 679) and indirect cost XAF 530 600 (\$ 902). Direct medical costs accounted for 88%, mainly due to dialysis consumables. In the initiation phase, additional costs of \$ 754 were incurred. The cost of hospitalization, laboratory and radiology tests, feeding, consultation fees and some drugs varied significantly among facilities.

**Conclusions:** Compared to the national gross domestic product per capita in Cameroon, the cost of care of patients on haemodialysis is high. Out-of-pocket payments are out of the reach of most patients and there is a need for implementing other cost-effective strategies to prevent and manage end-stage kidney disease in our setting.

**Keywords:** cost analysis, haemodialysis, peritoneal dialysis, Cameroon.

### INTRODUCTION

The availability of renal replacement therapy (RRT) such as dialysis and transplantation for the treatment of end-stage renal disease (ESRD) has been one of the great successes of medicine in past decades. It has been available in high-income countries for more than 50 years, with rapid growth in the number of people treated [1,2].

The use of dialysis varies among regions, due to differences in population demographics, prevalence of ESRD, and especially access to and provision of RRT [3,4]. The management of renal failure is disproportionately costly in comparison with other medical conditions and constitutes a heavy burden on communities worldwide [5–7].

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RRT consumes many resources, the equipment and consumables are expensive and skilled personnel are required [8]. In contrast to high- and middle-income countries, data on the cost of RRT is sparse in low-income nations, especially in sub-Saharan Africa (SSA) [6,7,9]. In 2010, the annual cost for ESRD-related medical expenses in the USA was estimated at \$\*28 billion [3]. In the UK, the cost of treatment for ESRD was 1–2% of the budget of the National Health Service, for patients who constituted only 0.05% of the population [10].

Globally, the number of patients receiving RRT in 2010 was estimated at 2.618 million, with only 7.2% living in lower-middle income and low-income countries. Further modelling suggests that this number will more than double to 5.439 million by 2030, mostly in developing countries. African patients with ESRD have the lowest access to RRT, with only 9–16% being treated; in central and eastern Africa the treatment rate is estimated to be as low as 1–3% [2].

In SSA, in-centre haemodialysis (HD) is the most common modality of RRT with its provision being very challenging. Treatment for all is beyond the reach of most countries due to the lack of funds or health insurance to cover the high costs for the ever-increasing number affected. Despite this high disease burden, renal registries are almost non-existent and there is a lack of published data on the costs of dialysis in African countries [7,11,12].

Cameroon is a low-income country, with a population of 22.5 million. The human development indices are poor, with a low gross domestic product of \$ 34 billion in 2015 and only 5.1% of the country's budget being spent on health care [13]. The prevalence of chronic kidney disease (CKD) in Cameroon is estimated at 10–13.2% [14,15]. In-centre haemodialysis started in the early 1980s and in the last decade much attention has been focused on the treatment of ESRD with the establishment of public haemodialysis centres nationwide [16]. About 1 200 patients were on treatment in 9 public-sector treatment centres at the end of 2016. Since 2002, dialysis sessions have been subsidized by the government in public-sector centres. Patients pay a fee of XAF 5000 (\$ 8.5) per dialysis session. This does not include related costs for vascular access, laboratory tests, medication, feeding, transportation, hospitalization and vaccination. All these additional costs are borne by patients and their families. This study aimed to evaluate the global cost of ESRD treated by HD in a resource-limited country, to help healthcare planners to develop strategies to minimize the cost of care of these patients.

## METHODS

A prospective cost-analysis of HD care was conducted in 3 facilities in Cameroon (two tertiary, one regional). All centres are equipped with Fresenius 4008S dialysis machines, use consumables produced by the manufacturers and do not practise dialyzer reuse. In these centres, as in other centres in Cameroon, patients undergo two dialysis sessions of 4 hours per week.

We included consenting incident and prevalent patients on HD for ESRD and followed them up for 6 months from November 2012 to April 2013. Outcomes of interest were expenditure by patient or their families as well as by the hospital in relation to HD care. Staff salaries and other utilities, furniture and cost of maintenance of the building were excluded from the analysis. Data and costs were obtained from patient interviews, medical records, bills, hospital price-lists and procurement departments of the hospitals. Direct costs analysed included direct medical costs (dialysis session fees, cost of consumables, drugs, outpatient consultation fees, laboratory and radiological tests) and direct non-medical costs (transport, feeding, water and electricity). One indirect cost considered was the monthly loss of productivity for patients and their caretakers estimated from the time spent for the treatment. Out-of-pocket payments (borne by patients and families) included dialysis session fees, vascular access, all drugs, laboratory and radiology tests, vaccinations, meals and transportation. All other costs were borne by the government/hospital.

The cost of incident patients was used to calculate the cost at the initiation phase. The cost of electricity and water was calculated with the assistance of an engineer at each hospital. Electricity consumption was calculated by taking into account all electrical appliances at each unit, consumption by each appliance, and the duration of its usage per month. Water consumption was calculated by multiplying hours of dialysis by the hourly water usage per dialysis machine, and the number of machines at each dialysis unit.

Data analysis used SAS/STAT® v 9.1 for Windows (SAS Institute Inc., Cary, NC, USA). We reported results using counts and percentages, means and standard deviations (SD) or median (min–max). Comparisons across study centres were made using the chi-squared test and analysis of variance (ANOVA). Costs were expressed as the median of the expenditure recorded over 6 months per patient in the local currency) and converted to US dollars, based on the exchange rate at the end of the study (1 XAF = \$ 0.0017). We estimated the annual cost by multiplying

\*\$ represents US dollars; the currency of Cameroon is the Central African franc (XAF).]

the median cost by 2. A p-value < 0.05 was considered statistically significant.

The study received administrative authorization from the Douala General Hospital and ethical approval was obtained from the ethical board of Douala University.

**RESULTS**

Of the 154 participants included, 106 (68.8%) were prevalent and 48 (31.2%) were incident patients. The mean age was 46.8 ± 15.2 years and 96 (62.3%) were males, with no difference between centres. The majority of our patients were in a low socio-economic class with more than 25% without income. Only 9% had medical insurance. The total number of dialysis sessions included was 6130 (mean 39.8 sessions per patient). See Table 1.

The median cost of haemodialysis per patient for 6 months was XAF 3 994 400 (\$ 6 790), an annual cost of

XAF 7 988 800 (\$ 13 581). Out-of-pocket payments per patient was XAF 2 420 300 (\$ 4 114), accounting for 30.3% of the total cost. Direct costs totalled XAF 7 458 200 (\$ 12 679) and indirect costs XAF 530 600 (\$ 902). Direct medical costs accounted for 87.7% (\$ 11 904) of the total costs, mainly due to the cost of dialysis consumables (59.8%, \$ 8120). Direct non-medical costs accounted for 5.7% (\$ 775) and indirect costs for 6.6% (\$ 902) of the total cost (Table 2).

In the initiation phase, additional costs of \$ 775 were incurred, mainly due to the cost of vascular access, drugs and hospitalization (Table 3).

The itemized costs at each hospital are shown in Table 4. The costs of hospitalization (p <0.013), laboratory and radiology tests (p <0.001), some drugs (p <0.005), consultation fees and feeding (p <0.001) varied significantly among facilities.

**Table 1. Baseline characteristics of the study population at the different dialysis centres.**

	DGH	YGH	BRH	p	Total
<b>N (%)</b>	70 (45.5)	41 (26.6)	43 (27.9)		154 (100.0)
<b>Men (%)</b>	42 (60.0)	29 (70.7)	25 (58.1)	0.42	96 (62.3)
<b>Mean age, years (SD)</b>	46.6 (15.16)	46.04 (14.80)	47.76 (15.76)	0.88	46.77 (15.15)
<b>Level of formal education, n (%)</b>					
None	1 (1.4)	0 (0.0)	2 (4.7)		3 (1.9)
Primary	14 (20.0)	4 (9.8)	11 (25.6)		29 (18.8)
Secondary	33 (47.1)	19 (46.3)	16 (37.2)		68 (44.2)
University	22 (31.4)	18 (43.9)	14 (32.6)	0.24	54 (35.1)
<b>Place of residence, n (%)</b>					
Same town as dialysis centre	67 (95.7)	37 (90.2)	26 (60.5)		130 (84.4)
Out of town	3 (4.3)	4 (9.8)	17 (39.5)	<0.0001	24 (15.6)
<b>Monthly income (XFA), n (%)</b>					
No income	21 (30.0)	9 (22.0)	10 (23.3)		40 (26.0)
<22 500	1 (1.4)	1 (2.4)	3 (7.0)		5 (3.2)
22 500–50 000	13 (18.6)	7 (17.1)	6 (14.0)		26 (16.9)
50 000–100 000	13 (18.6)	4 (9.8)	7 (16.3)		24 (15.6)
100 000–200 000	13 (18.6)	8 (19.5)	11 (25.6)		32 (20.8)
200 000–300 000	1 (1.4)	6 (14.6)	4 (9.3)		11 (7.1)
>300 000	8 (11.4)	6 (14.6)	2 (4.7)	0.21	16 (10.4)
<b>Insurance, n (%)</b>	11 (15.7)	2 (4.9)	1 (2.3)	0.024	14 (9.1)
<b>Number of dialysis machines</b>	16	12	7		35
<b>Number of dialysis sessions</b>	2 855	1 602	1 673		6 130

DGH, Douala General Hospital; YGH, Yaounde General Hospital; BRH, Buea Regional Hospital.



<b>Table 2. Global annual costs of haemodialysis per patient.</b>			
	<b>XAF</b>	<b>\$</b>	<b>%</b>
<b>Direct costs</b>	7 458 199	12 679	93.4
<b>Medical</b>	7 002 478	11 905	87.7
Dialysis session fees*	480 000 (120 000–640 000)	816	6.0
Dialysis consumables*	4 776 623	8 120	59.8
Vascular access*	217500 (60 000–575800)	370	2.7
Blood transfusions*	216 950 (30 000–697 000)	369	2.7
Drugs for hypertension*	164 260 (13 560–698 614)	279	2.1
Heparin*	74 100 (7 450–526 296)	80	0.6
Other drugs*	105 215 (200–621 680)	179	1.3
Erythropoietin*	560 000 (20 000–4 272 000)	952	7.0
Iron*	41 600 (4 900–480 000)	71	0.5
Laboratory and radiology tests*	123 930 (2 000–1 020 800)	211	1.6
Hospitalization*	247 300 (20 000–6 801 098)	420	3.1
Consultation fees*	14 000 (1 200–84 000)	24	0.2
Vaccinations*	8000 (7 000–21 000)	14	0.1
<b>Non-medical</b>	455 721	774	5.7
Transportation*	122 400 (3 000–1 704 000)	208	1.5
Meals*	72 000 (4 800–352 800)	122	0.9
Water*	26 062	44	0.3
Electricity	235 259	400	2.9
<b>Indirect costs</b>	530 562	902	6.6
<b>Total out-of-pocket costs</b>	2 420 255	4 114	30.3
<b>Total state/hospital costs</b>	5 037 944	8 565	63.1
<b>Total costs</b>	<b>7 988 761</b>	<b>13 581</b>	<b>100.0</b>

\* Median (min–max).

## DISCUSSION

The reported cost of dialysis varies considerably among regions and countries [7]. Our annual cost was approximately \$ 13 581, with out-of-pocket payments accounting for 30%. This is close to that reported in Iran (\$ 11 549) [17] but is lower than in most developed countries and some low-income nations. The annual cost of haemodialysis has been estimated at \$ 87 500 in the USA [18], between \$ 22 000–55 000 in Nigeria [19,20], \$ 46 332 in Saudi Arabia [21], \$ 27 440 in Tanzania [22] and \$ 28 570 in Brazil [23]. One of the reasons for our lower cost is that we did not include the staff and building costs as has been done in other studies.

Lower costs have been reported in low/middle-income countries such as Indonesia (\$4900–6500) [24], South

Africa (\$7000) [16], Sri Lanka (\$5869–8804) [25], Sudan (\$6847) [26] and India (\$3000) [27]. These differences may be explained by many factors including the annual per capita income of countries, the methods used in estimating costs, different management protocols, and differences in local import duties, drugs, laboratory tests and the costs of consumables.

The main contributors to cost in our study were those related to the dialysis procedure and, in particular, the haemodialysis consumables. Similar results were reported in Sri Lanka [28] and in Brazil [23] whereas in Europe the haemodialysis procedure accounts for only 29–53% of the cost [29–31]. Like most SSA countries, we import all dialysis supplies from Europe, so the cost of transportation,

Table 3. Cost of haemodialysis in the initiation and maintenance phases of dialysis.					
	Initiation		Maintenance		p
	XAF	\$	XAF	\$	
<b>Direct costs</b>	7 678 553	13 054	7 232 433	12 273	
<b>Medical</b>	7 220 833	12 277	6 762 313	11 495	
Dialysis session fees*	437 500 (120 000–530 000)	744	490 000 (270 000–640 000)	833	<0.001
Dialysis consumables*	4 776 623	8 120	4 776 623	8 120	>0.999
Vascular access*	217 500 (60 000–575800)	370	–	–	
Blood transfusions*	268 000 (73 000–671 250)	456	201 250 (30 000–697 000)	342	0.005
Drugs for hypertension*	185 180 (68 120–698 614)	315	137 600 (13 560–593 400)	234	0.010
Heparin*	89 400 (8 100–526 296)	152	66 300 (7450–263 580)	113	0.028
Other drugs*	133 670 (24 400–597 240)	227	92 040 (200–621 680)	156	0.001
Erythropoietin*	460 000 (40000–4 272 000)	782	580 000(20 000–1 800 000)	986	0.387
Iron*	56 600 (13 800–480 000)	96	41 000 (4900–219 600)	70	0.181
Laboratory and radiology tests*	195 600 (4 000–1 624 144)	333	110 200 (2000–650 600)	187	0.001
Hospitalization*	375 960 (30 400–6 801 098)	639	247 300 (23 000–3 364 566)	420	0.112
Consultation fee*	16 800 (1 800–84 000)	29	12 000 (1 200–42 000)	20	<0.001
Vaccinations*	8 000 (8000–8000)	14	8 000 (7000–21 000)	14	>0.999
<b>Non-medical</b>	457 720	777	470 120	778	
Transportation*	122 000 (3 000–834 000)	207	122 400 (15 200–1 704 000)	208	0.612
Meals*	74 400 (4 800–212 200)	126	86 400 (5 000–352 800)	126	0.122
Water*	26 062	44	26 062	44	>0.999
Electricity	235 258	400	235 258	400	>0.999
<b>Indirect costs</b>	530 118	901	532 668	906	
<b>Total out-of-pocket costs</b>	2 640 610	4 489	2 194 490	3 709	
<b>Total state/hospital costs</b>	5 037 943	8 565	5 037 943	8 565	
<b>Total costs</b>	<b>8 208 671</b>	<b>13 955</b>	<b>7 765 101</b>	<b>13 180</b>	

\* Median (min–max).

currency exchange and import duties all add to the cost of these items.

The cost of consultation fees, feeding, drugs, hospitalisation, laboratory and radiology tests varied among our facilities. These were higher in Douala, the economic capital of Cameroon, compared to Buea, a rural town. This probably reflects the stratification of healthcare costs according to the economic standards of towns within the country. Direct medical costs accounted for almost 90% of our costs and were dominated by the cost of dialysis consumables.

Dialysis is relatively more expensive for poorer than for richer developing countries and may not be cost-effective for low-income countries such as Cameroon [7,11]. Compared to the national income, the costs of haemodialysis

are prohibitive, and beyond the financial capacity of most governments. In Cameroon only 5.1% (\$ 1.3 billion) of the budget is allocated to health care. With other burning health issues such as high maternal and infant mortality, HIV/AIDS and undernutrition, haemodialysis becomes a serious economic burden on the healthcare sector [13]. Despite the government subsidies, the out-of-pocket expenditure borne by patients and their families is almost one-third of the total cost. This is extremely high, especially in the initiation phase when there are the additional costs of vascular access, drugs and hospitalisation. This is out of the reach of most of our patients, who belong to the lower socio-economic class and often have no income. In our setting, health insurance is almost non-existent. Other studies have also shown that in countries in SSA, even

**Table 4. Itemized annual costs of haemodialysis per patient in the 3 centres (XAF).**

	DGH (n = 70)	YGH (n = 41)	BRH (n = 43)	P
Dialysis session fee*	480 000 (160 000–640 000)	495 000 (120 000–560 000)	480 000 (280 000–530 000)	0.270
Dialysis consumables	4 894 285	4 688 780	4 668 837	
Water	26 770	25 675	25 497	
Electricity	285 454	396 293	256 186	
<b>Medications</b>				
EPO*	580 000 (20 000–4 272 000)	556 000 (96 000–856 000)	520 500 (144 000–1 800 000)	0.444
Iron*	38 900 (4 900–480 000)	64 000 (8 000–168 000)	20 600 (13 800–84 600)	0.160
Blood transfusion*	205 500 (36 500–671 250)	277 200 (55 800–697 000)	217 500 (30 000–690 000)	0.229
Hypertension drugs*	167 865 (42 000–698 614)	202 380 (13 560–593 400)	129 945 (13 800–356 000)	0.346
Heparin*	82 600 (32 400–526 296)	37 800 (8 100–196 600)	26 400 (7 450–134 100)	<0.001
Other medications*	120 800 (26 000–597 240)	82 900 (8 100–238 680)	24 000 (100–310 840)	<0.001
Laboratory and radiology*	152 800 (27 000–1 020 800)	162 450 (19 400–800 400)	27 000 (2 000–434 400)	<0.001
Consultation fees*	14 000 (10 200–84 000)	7 500 (6 000–84 000)	1 800 (1 200–14 400)	<0.001
Feeding*	80 800 (4 800–352 800)	104 000 (5000–255 000)	61 600 (12 800–336 000)	<0.001
Transport*	114 000 (3 840–714 000)	119 400 (3 000–1 642 200)	174 500 (23 200–1 704 000)	0.163
Vascular access*	172 000 (60 000–575 800)	142 500 (42 500–385 000)	107 500 (60 000–570 000)	0.850
Hospitalization*	1 399 240 (30 400–6 801 098)	382 950 (40 000–1 698 070)	179 400 (23 000–815 000)	0.013
Vaccination*	42 000 (42 000–42 000)	16 000 (16 000–16000)	7 000 (7 000–7 000)	0.223
Patient's time*	246 528 (0–1 166 754)	289 542 (0–605 382)	266 058 (0–874 682)	0.175
<b>Total out-of-pocket costs</b>	<b>3 650 505</b>	<b>2 650 080</b>	<b>1 730 411</b>	
<b>Total state/hospital costs</b>	<b>5 206 509</b>	<b>5 110 748</b>	<b>4 719 831</b>	
<b>Total costs</b>	<b>9 103 542</b>	<b>8 050 370</b>	<b>6 716 300</b>	

\* Median (min–max).

when the state subsidizes dialysis, the cost covered by patients is high and the majority cannot afford it. Morbidity and mortality are consequently high [32–41].

In SSA, poverty is rampant and over 40% of the population is estimated to live on less than one dollar per day [42]. Given the constant increase in the number of patients requiring dialysis in Cameroon, and considering that haemodialysis is the only modality available, it is imperative to identify cost-effective strategies to meet the demand for renal services. There is a need for policy-makers in low-income countries to look for ways to reduce the cost of dialysis. One major step could be that governments build infrastructure to produce dialysis supplies and generic medications locally, and remove the import duty charged on dialysis consumables. Renal transplantation, which is a more cost-effective treatment for ESRD, remains underutilized in SSA, and Cameroon in particular, due to

lack of qualified health personnel and appropriate infrastructure [43,44]. The most important factor is to reduce the number of patients developing ESRD. Identification and optimal treatment of CKD in high-risk populations, especially in resource-limited settings, remains the only cost-effective and sustainable means of curbing the cost of managing ESRD. However, this approach is still in its infancy in most SSA countries and is not subsidized by the state in Cameroon [45–47].

Some limitations of this study include the fact that we did not incorporate the costs of staff overheads, infrastructure and utilities such as sanitation and laundry. Also, we based our calculations on actual expenditure, which may lead to an underestimation since certain items are self-funded and patients pay for what they can afford, not for what they need. Despite these limitations, this study provides the first estimates of the operational costs of haemodialysis



in Cameroon, where this therapy has been available for more than two decades. The results will help healthcare planners to develop strategies to improve the care of these patients.

## CONCLUSIONS

This multi-centre study demonstrated that the global cost of care of patients on haemodialysis in Cameroon is extremely high compared with the national gross domestic product per capita and that it is mainly due to the cost of dialysis consumables. Most patients are at a low socio-economic level and, despite the state subsidy, out-of-pocket expenditure is extremely high and unaffordable by patients and their relatives in the long term. Haemodialysis is an economic burden on the country, and therefore strategies such as removing import duties on dialysis consumables and establishing kidney transplantation should be implemented. CKD screening and prevention programmes to reduce the number of persons in need of RRT are necessary and this remains the only cost-effective and sustainable approach, especially in developing countries.

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## Conflict of interest

None to declare.

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