Original Article

Demographics, Cost, and Sustainability of Haemodialysis among End-Stage Kidney Disease Patients in Southern Nigeria: A Single-Center Study

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Abstract

Context: Access to chronic hemodialysis for patients with end-stage kidney disease has improved over the years. However, it is unclear if this has resulted in lower cost and improved dialysis vintage. **Aim:** We aimed to assess the demographics, cost implication, and sustainability of maintenance hemodialysis in our cohort of end-stage kidney disease (ESKD) patients. **Methods:** Retrospective descriptive study of ESKD patients on maintenance HD from 2014 to 2018 using hemodialysis records. Time-to-HD discontinuation and reasons for discontinuation were recorded. Using Kaplan–Meier graphs, the time-to-dialysis discontinuation experience of the cohort was shown. Log-rank test was used to compare the experience between both genders. Univariable and multivariable Cox proportional hazard models were built to identify independent associations with time-to-dialysis discontinuation. **Results:** Over the 5-year period, 702 individuals initiated HD, males were older than females, the complete cohort contributed 65,714 person-days to the study and the median time-to-HD discontinuation was 10 days (interquartile range, 2–42). Females had a shorter time to HD discontinuation (8 days [1–32 days]) compared to males (11 days [2–48 days]). Only 28.5%, 15.3% and 8.3% of the patients had HD beyond 30, 90, and 180 days, respectively. About 128 (18.2%) had thrice-weekly HD. Most sustained the treatment for the 1st week. Majority (98.4%) of the patients were presumed dead, while 4 (0.65%) were still alive and 6 (0.98%) had renal transplantation. All patients who discontinued dialysis did so for financial reasons. Multivariable Cox proportional hazards model showed that individuals who could afford dialysis more than once a week had reduced hazard of dialysis discontinuation. **Conclusion:** Most patients cannot sustain HD beyond a few weeks for financial reasons. Several cost containment strategies need to be deployed to bring down the cost of care.

Keywords: Cost, end-stage kidney disease, hemodialysis, sustainability

Introduction

Chronic kidney disease prevalence is increasing globally, mainly because of the rising prevalence of noncommunicable diseases (NCDs) such as hypertension and diabetes. The prevalence of end-stage kidney disease (ESKD) and the requirement for dialysis is expected to double by 2030.[1] Middle and low-income countries appear to be worst hit because of the increasing prevalence of NCD, such as hypertension, diabetes, and obesity[2,3] in addition to the prevalence of sickle cell disease and the HIV pandemic. In Nigeria, the prevalence of chronic kidney disease (CKD) ranges between 2.5% and 26% using the modification of diet in renal disease, CKD epidemiology collaboration, Cockcroft–Gault formulae.[4] As of 2015, estimates from the Global Burden of Disease data show that 1.2 million people died of kidney failure representing an increase of 32% since 2005.[5] In addition, in 2010, an estimated 2.3–7.1 million people with ESKD died without access to chronic dialysis.[6] Furthermore, the estimated number of the disability-adjusted life year attributable to kidney disease worldwide increased from 19 million in 1990 to 33 million in 2013.[7] The true burden of kidney disease may

Access this article online

Quick Response Code:

Website: www.nigeriamedj.com

DOI: 10.4103/nmj.NMJ_106_20

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Submitted: 19-Apr-2020 **Revised:** 16-Sep-2020
Accepted: 19-Oct-2020 **Published:** 19-Dec-2020

How to cite this article: Akpan EE, Ekrikpo UE, Effa EE, Udo AI, Umoh VA. Demographics, cost, and sustainability of hemodialysis among end-stage kidney disease patients in Southern Nigeria: A single-center study. Niger Med J 2020;61:307-11.

be underestimated, especially in resource-poor countries like ours where there are neither renal nor death registries.

The management of CKD often involves chronic dialysis of three times weekly or renal transplantation. This comes with a huge economic burden to both the patient and patients' relatives and government. Globally, about 1.4 million people are said to be receiving renal replacement therapy[8] with a growing annual incidence estimated at about 8%.[9] In the United States, about $32.8 billion representing 7.2% of total Medicare is spent on providing dialysis.[10] In Canada, over $1.8 billion is spent on dialysis each year,[11] while about 2% of national health budgets across Europe go into dialysis. [11] Elsewhere, the annual cost of dialysis per patient in Brazil, China, India, and Indonesia is estimated at US$ 7332, US$ 7500 US$ 5000, and US$ 6240, respectively.[12-15] In Nigeria, there are no national data on the cost of hemodialysis and centers have their different charges depending on location and ownership (whether private or public).[16] However, the estimated annual cost of HD in Nigeria is put at ₦1,889,450 (US$ 5,249) for twice-weekly dialysis and ₦2,760,450 (US$ 7,668) for thrice-weekly dialysis.[17] Patients often pay out of pocket for the treatment and it represents a huge financial burden considering the present monthly minimum wage of ₦30,000 (US$ 80) for federal public sector workers at an exchange rate of ₦375-1US$. When considered against the backdrop of limited health insurance coverage where just about 10% of the population is covered,[18] sustainability becomes extremely difficult.

Across different parts of the country, studies have shown that between 3.3% and 20% of patients were able to sustain thrice-weekly HD for 6 months.[19,20] In one center, about 70% could pay for once-weekly HD for 6 months, while in another, over 70% could not afford thrice-weekly dialysis over a 7 months period.[21] Given the likelihood that twice-weekly HD may have beneficial outcomes, only 13% of patients were able to achieve 70% of scheduled twice weekly HD.[22] None of these studies have clearly indicated any association of sustainability with the demographics of patients. Although access to hemodialysis has improved over the years across the country owing to the establishment of more centers, it is uncertain if the demographics, cost, and sustainability of the intervention have changed remarkably. Furthermore, prevalent NCDs and HIV infections suggest an additional cost of care for patients. From the foregoing, it has become necessary to evaluate our cohort of HD patients on maintenance hemodialysis with respect to the demographics, cost implication, and sustainability.

Methods

This was a retrospective descriptive study of patients who had ESKD and were on dialysis from January 2014 to December 2018. Patients' sociodemographic information such as age, sex, occupation, and marital status were all retrieved from the dialysis records. Clinical data retrieved included the individual diagnoses, blood pressures, hematocrit, and serum chemistries including electrolytes, urea, and creatinine at the initiation of dialysis. Duration on dialysis was also documented. Duration of the patient on dialysis was calculated from the time of dialysis initiation to the time of discontinuation. The reason for discontinuation was categorized as either inability to continue payment for HD, death, or having a kidney transplant. The frequency of dialysis was also recorded.

Ethical approval for the study was obtained from the University of Uyo Teaching Hospital Health Research Ethics Committee.

Statistical analysis

All analyses were performed using Stata 15.1 (StataCorp, TX, USA). Normally distributed continuous variables were reported as means (± standard deviation), while categorical variables were reported as frequencies (percentages). Comparison of means was done using the Student's *t*-test. Kaplan–Meier graphs were drawn to show the time-to-dialysis discontinuation experience of the cohort, while the log-rank test was used to compare the time-to-dialysis discontinuation experience between both genders. Univariable and multivariable Cox proportional hazard models were built to identify independent associations with time-to-dialysis discontinuation.

Results

Over the 5-year period, 702 individuals were initiated on HD in our center [Figure 1]. Of these, 89 (12.7%) had acute kidney injury and were excluded from the analysis. The analysis was performed on a total of 613 ESKD patients (109 in 2014; 151 in 2015; 120 in 2016; 111 in 2017; and 122 in 2018). The cost of hemodialysis has ranged from $41 to $100 per session over the period.

Demographic and clinical characteristics

The demographic and clinical characteristics of the ESKD patients who initiated hemodialysis are summarized in Table 1. Males were older and had higher systolic blood pressures than females. Over the 5-year period, the most common single CKD risk factor occurring in incident hemodialysis patients was HIV (150, 24.5%). This was followed by diabetic nephropathy (114, 18.6%), hypertension (103, 16.8%), chronic glomerulonephritis (76, 12.4%), obstructive uropathy

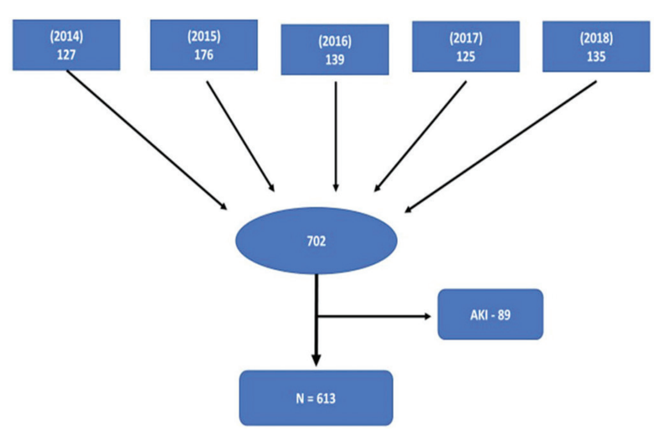

Figure 1: Flow chart showing patient recruitment over a 5-year period

(41, 6.7%), and others such as sickle cell nephropathy, lupus nephritis, chronic pyelonephritis, multiple myeloma, and autosomal dominant polycystic kidney disease (13, 2.1%). A relatively large proportion (116, 18.9%) had CKD of uncertain aetiology.

Time-to-dialysis discontinuation

The complete cohort of patients contributed a total of 65,714 person-days to the study. The females contributed a total of 9572 patient-days to the study and had an incidence rate of dialysis discontinuation of 2.3/100 person-days, while the males had a total of 56,142 person-days with a dialysis discontinuation rate of 0.7 per 100 person-days (log-rank test $P = 0.01$).

The median time-to-dialysis discontinuation was 10 days (interquartile range, 2–42). The females had a shorter time to dialysis discontinuation (8 days [1–32 days] vs. 11 days [2–48 days]). Figure 2 shows a dramatic drop in the proportion of patients sustained in the maintenance hemodialysis program. Only 28.5% of the patients were still having dialysis 30 days after initiation of maintenance hemodialysis, 15.3% by the 90th day, and 8.3% by the 6th month postdialysis initiation. Only 128 (18.2%) had a dialysis frequency of thrice a week. Most of these could only sustain dialysis for the 1st week. Two hundred and eighty-eight (41.0%) could only afford once weekly dialysis, while 286 (40.7%) could afford twice-weekly hemodialysis.Most (98.4%) of the patients were presumed dead on dialysis discontinuation, while 4 (0.65%) were still alive and 6 (0.98%) had renal transplantation done. The presumption of death was 6 months after their last dialysis. In some cases, we called their relatives who confirmed their demise. All the patients that discontinued dialysis did so because of financial constraints.

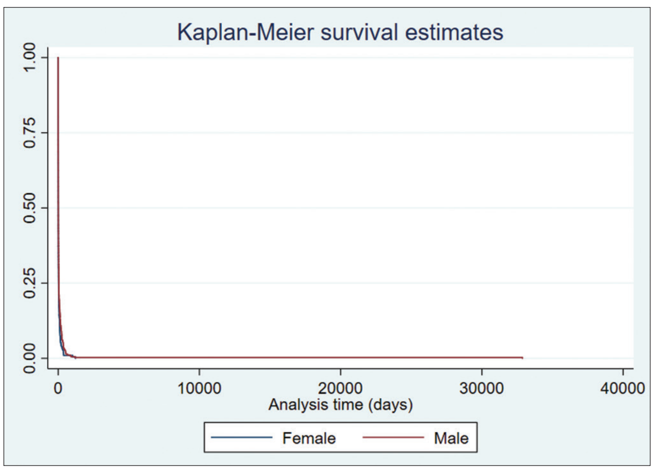

Figure 2: Kaplan–Meier curves for survival of end-stage kidney disease patients on hemodialysis

Kaplan–Meier analysis [Figure 2] showed an abrupt reduction in individuals retained in the maintenance hemodialysis program within the first few weeks of initiation into the program.

Independent associations with dialysis discontinuation

Multivariable Cox proportional hazards model showed that individuals who were able to afford dialysis more than once a week had reduced hazard of dialysis discontinuation [Table 2]. At the univariable level, females had increased hazards for dialysis discontinuation compared to males, but this difference was not sustained after controlling for other potential confounders.

Discussion

In this single-center study of demographics, cost of treatment, and variables associated with dialysis discontinuation in ESKD patients, we have shown that most of the patients enrolled into the chronic hemodialysis program were middle-aged adults with most having HIV-related CKD. Furthermore, male patients were on dialysis for disproportionately and significantly longer duration than females and individuals who were able to afford dialysis more than once a week had reduced hazard of dialysis discontinuation. Overall, <10% were still on dialysis just 6 months after initiating treatment, with an alarming majority presumed dead at that time.

Understandably, males are kept longer on HD, perhaps based on their perceived roles as the breadwinners of their

Table 1: Demographic and clinical characteristics

	Total (n=613)	Male (n=387)	Female (n=226)	P
Age (years)	46.2±15.9	48.9±16.1	41.6±14.2	<0.001
SBP (mmHg)	154.2±27.6	154.2±27.6	148.5±27.6	0.01
DBP (mmHg)	84.5±17.8	84.7±18.0	84.2±17.7	0.74
mABP (mmHg)	107.1±19.3	107.9±19.3	105.7±19.3	0.16
Na^+ (mmol/L)	134.2±17.5	133.7±18.3	134.9±16.5	0.59
K^+ (mmol/L)	5.6±1.3	5.6±1.2	5.7±1.3	0.78
Cl^- (mmol/L)	103.0±11.2	103.1±11.1	102.7±11.5	0.81
HCO_3^{2-} (mmol/L)	15.0±4.2	15.4±4.3	14.5±3.9	0.11
Hematocrit	24.6±6.1	24.9±6.2	24.2±5.8	0.17
Cr (µmol/L)	1271.0±673.5	1278.0±624.2	1260.4±745.7	0.83
Urea (mmol/L)	34.6±15.4	34.6±14.2	34.6±17.2	0.99

SBP - Systolic blood pressure, DBP - Diastolic blood pressure, mABP - Mean arterial blood pressure, Na^+ - Serum sodium, K^+ - Serum potassium, Cl^- - Serum chloride, HCO_3^{2-} - Serum bicarbonate, Cr - Serum creatinine

Table 2: Univariable and multivariable associations with dialysis discontinuation

	Hazard ratio (95% CI) *p*-value	
	Univariable models	**Multivariable models**
Age (years)	0.99 (0.98- 1.00) 0.07	0.99 (0.99- 1.01) 0.74
Male gender	0.82 (0.69- 0.96) 0.02	0.86 (0.72- 1.02) 0.09
Initial hematocrit	1.00 (0.99- 1.02) 0.53	1.01 (0.99- 1.02) 0.22
mABP (mmHg)	0.99 (0.99- 1.00) 0.13	1.00 (0.99- 1.00) 0.30
Weekly frequency of dialysis		
1	1	1
2	0.70 (0.59- 0.84) <0.001	0.71 (0.59- 0.85) <0.001
3	0.60 (0.48- 0.75) <0.001	0.60 (0.47- 0.75) <0.001
Etiology		
CGN	1	1
DM	0.78 (0.59- 1.04) 0.09	0.84 (0.60- 1.19) 0.33
HIV	1.21 (0.92- 1.58) 0.17	1.23 (0.92- 1.64) 0.16
HTN	0.88 (0.66- 1.19) 0.42	0.97 (0.70- 1.34) 0.87
Obstructive uropathy	1.15 (0.78- 1.70) 0.47	1.23 (0.78- 1.95) 0.38
Unknown	1.31 (0.98- 1.73) 0.07	1.34 (1.02- 1.89) 0.04

CI - Confidence interval, mAPB - Mean arterial blood pressure, CGN - Chronic glomerulonephritis, DM - Diabetes mellitus, HIV - Human immunodeficiency virus, HTN - Hypertension

families. This perception is still largely the case in many low- and middle-income countries (LMICs).[23] Although this raises equity and equality concerns, the quality of life and the subsequent economic contribution of the males on HD to the family is not known.

Chronic HD programs have been run based on different models in different parts of the world. These have included full insurance cover and reimbursement for both the insured and uninsured in most upper-income countries, a rationing model in countries like South Africa and predominantly out-of-pocket financing in the majority of LMICs including Nigeria.[24-26] These latter models of financing have outcome implications for CKD. Indeed, a recent systematic review that focused on dialysis requiring ESKD in sub-Saharan Africa reported very appalling outcome data with mortality in excess of 90% for those without access to HD and 88% for those initiated on HD.[27] These outcomes are certainly a composite of poor health infrastructure, limited access to specialist care and diagnostics as well as very high out-of-pocket payments. Nonetheless, they suggest the inability of the current health system in sub-Saharan Africa to support chronic kidney care and specifically chronic HD. In Nigeria, chronic HD is largely paid for by individuals, with a few patients being sponsored by their companies or wealthy relatives.

The median time to HD discontinuation of 10 days compared fairly well with an average of 7 days reported in several parts of Nigeria as well as other parts of sub-Saharan Africa.[2,28,29] Overall, across all these studies, HD discontinuation at 3 months was over 90%. Presumably, these outright discontinuations were preceded by periods of nonadherence to prescribed dialysis schedules. Impliedly, this has contributed to the very high poor outcomes. Elsewhere, in the dialysis outcomes and practice patterns study, nonadherence has been associated with increased mortality and hospitalization risks.[30] However, we have previously shown that meeting even 70% of scheduled dialysis sessions in a low-resource setting like ours reduces mortality by about 93%.[22]

HD discontinuation associated with the inability to pay for HD for more than once a week suggests the possibility of offering a less intensive schedule of treatment to our patients. Indeed, studies have shown that twice-weekly HD may be safer, more cost-effective with associated reduced mortality risks, especially in those with substantial residual renal function.[31,32]

The inability of the overwhelming majority of ESKD to fund their HD treatment – a lifesaving intervention – in a sustainable manner is concerning. Exploring ways and means of reducing not only the cost of HD treatment but also the cost of adjuvant treatment targeting blood pressure, anemia, cholesterol, etc., is an urgent imperative. First, it may help to leverage the support of nongovernmental organizations to subsidize the cost of HD treatment. Presently, a mobile telecommunications company in Nigeria through its foundation (MTN Foundation) is providing such subsidies at twelve HD units across the six geopolitical zones of Nigeria. The impact of such interventions on clinical outcomes such as mortality and sustainability however remains to be seen. Second, cost containment strategies such as in-country manufacture of core HD consumables, duty-free import regime for HD hardware as well as the production and use of generic medications for ESKD-related complications and comorbidities need to be implemented. Third, the effective implementation of health insurance even if a co-pay model should cut down the cost of care dramatically. Fourth, peritoneal dialysis may yet prove to be a more cost-effective dialysis option for patients in LMICs, especially if the consumables especially the fluids are produced locally. Finally, the adoption of a legal framework for cadaveric organ donation should scale up the transition from HD to transplantation leading to significant cost savings in the long term.

As promising as these policy initiatives may appear, setting up community level primary prevention programs may have the most cost gains for a lower middle-income country such as Nigeria. These programs are in themselves cost-effective to set up and should lead to early diagnosis and institution of interventions to mitigate the progression of established CKD.

This study is limited by its single-center design as well as the small number of patients studied. However, a trend to higher costs over the years has been shown by its multi-year data collection. We have reported only the cost of HD treatment, although patients generally pay for other adjuvant interventions. The cost of HD treatment remains the single largest component of the composite cost of care and is usually the most significant reason for discontinuing HD.

Conclusion

End-stage kidney disease still affects young and productive adults in our environment. Despite modest improvements in health-care infrastructure and access to specialist care, the cost of HD is still unaffordable by the most patients. Many patients cannot sustain HD beyond a few weeks owing to catastrophic out-of-pocket payments for the treatment with resultant very high mortality. Several strategies for cost containment will need to be deployed to bring down the cost of care.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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