



Research Article

Causes and Outcome of Hospitalizations amongst Chronic Haemodialysis Patients at the Buea Regional Hospital

Causes and outcome of hospitalizations amongst chronic haemodialysis patients at The Buea Regional Hospital

Denis Georges Teuwafeu ^{1,2} Brandon Carl Monika Pouekoua ¹, Ronald Gobina Mbua ^{1,2}, Clovis Nkoke ^{1,2}, cyrille Nkounlack, Martin Mokake ^{1,2}, Vincent Verla ^{1,2}, Marie Patrice Halle ^{3,4}

ABSTRACT

- 1- Faculty of health sciences, University of Buea
- 2- Buea Regional Hospital
- 3- Faculty of Medicine and pharmaceutical Sciences
- 4- Douala General Hospital

Corresponding author:

Denis Georges Teuwafeu
Lecturer in Internal Medicine and Nephrology, Faculty of Health Sciences, University of Buea
P.O Box 63 Buea, Cameroon. Tel: (+237) 699961884
E-mail: d.teuwafeu@yahoo.com
ORCID: 0000-0002-7128-273

Keywords: Hospitalization, Frequency, Causes, Outcome, Chronic haemodialysis, Patient, BRH

Mots clés : Hospitalisation, Fréquence, Causes, Issue, Hémodialyse chronique, Patient, HRB

ABBREVIATIONS

BRH: Buea Regional Hospital,
CKD: Chronic kidney disease,
CVD: Cardiovascular disease,
DGH: Douala General Hospital,
ESKF: End stage kidney Failure,
HD: Haemodialysis, HIV:
Human Immunodeficiency Virus,
IHD: Incident haemodialysis,
LMICs: Low and Middle Income Countries, NCDs: Non-communicable Diseases, RRT: Renal replacement therapy, SSA: Sub-Saharan Africa, WHO: World Health Organisation.

Background. The number of patients on dialysis is increasing in Cameroon as a result of the multiplication of dialysis centres and the availability of nephrologists. However significant challenges remain as pertains to delivery of optimal haemodialysis, in part, due to precarious socioeconomic conditions and frequent hospitalizations. Causes of admission have not been identified in our setting. **Objective.** To determine the frequency, causes, predictors and outcome of hospitalizations amongst chronic haemodialysis patients at the Buea Regional Hospital (BRH). **Methods.** We conducted a 5-year retrospective study at the medical ward of the BRH. We included the files of all patients on maintenance haemodialysis (HD) admitted during the time frame and excluded the files of patients with an HD vintage of <3 months. We recorded the socio-demographic data, dialysis parameters, and data of admissions (number of admissions, diagnosis, survival and duration). Data was analysed using statistical package for social sciences version 26. Statistical significance was set at a p-value <0.05. **Results.** A total of 87 patients were admitted for a cumulative total of 201 admissions in five years, giving an average frequency of 2.3 admissions per patient per year. Non adherence to haemodialysis (p=0.01, OR=1.13, 95% CI: 1.03 - 1.70) was a predictor of frequent hospitalizations. Infections (39.13%), anaemia (34.78%), and fluid overload (17.93%) were the most frequent causes of admission. The median hospital stay was 6 (1-20) days and patients with a central venous catheter (p<0.01, OR=1.5, 95% CI: 1.2 - 2.0), and those not adherent to haemodialysis (p<0.01, OR=1.7, 95% CI: 1.3 - 2.3) had an approximately doubled risk of prolonged hospital stay. **Conclusion.** The proportion of chronic HD patients hospitalized at the BRH is high. These patients are admitted for preventable causes, mainly anaemia, sepsis and infections.

RÉSUMÉ

Introduction et objectif. Le fardeau de l'hospitalisation sur la population dialysée est très important par ce que ils sont associé à des résultats cliniques mortels et ont de coûts de santé très élevés. L'objectif du travail était de déterminer la fréquence et les facteurs prédictifs des hospitalisations fréquentes, évaluer l'issue des hospitalisations, chez les patients hémodialysés chroniques à l'Hôpital Régional de Buea (HRB) en 5 ans. **Méthodes.** Nous avons mené une étude rétrospective sur 5 ans (Janvier 2016 à Décembre 2021) à l'unité de médecine interne de l'HRB. Nous avons inclus les dossiers de tous les patients en dialyse d'entretien en hémodialyse (HD) et exclu les dossiers des patients de moins de 3 mois en HD. Les données sociodémographiques, les paramètres de dialyse et les données d'admissions (nombre d'admissions, causes, survie et durée) ont été enregistrées. **Résultats.** Au total, 87 des 112 patients ont eu 201 admissions en cinq ans, avec une fréquence moyenne de 2,3 admissions par patient. La non-adhésion à l'hémodialyse (p=0.01, OR=1.13) était un facteur prédictif d'hospitalisations fréquentes. Les infections (39,13 %), l'anémie (34,78 %) et la surcharge liquidienne (17,93 %) étaient les causes les plus fréquentes d'admission. La septicémie au cathéter (14,13 %) et le paludisme (12,5 %) étaient les causes les plus courantes d'hospitalisations liées à une infection. Parmi les 87 patients, 13 patients (14,9%) sont décédés à l'admission, et les principales causes de décès étaient l'anémie sévère (46,15%) et le sepsis sévère (30,77%). La néphropathie diabétique un déterminant de la mortalité (p=0.039, OR=1.66). La durée médiane d'hospitalisation était de 6(1-20) jours et les patients porteurs d'un cathéter veineux central (p<0.01, OR=1.5) et ceux qui n'adhèrent pas (p<0.01, OR=1.7) à l'hémodialyse présentaient un risque approximativement doublé de séjour prolongé à l'hôpital. **Conclusion.** La fréquence d'hospitalisation des patients HD chroniques à l'HRB est élevée. Ces patients meurent de causes évitables, généralement une anémie sévère et une septicémie.

INTRODUCTION

Dialysis patients have a higher number of hospitalization events compared to patients without renal failure, as they have a high prevalence of comorbid conditions and treatment-related complications [1]. Statistics from developed countries like the United State and Canada reports on an average of two hospitalisations per year [2]. Several factors have been described as being associated with the risk of hospitalization among haemodialysis patients including underlying nephropathy (notably diabetic nephropathy), cardiovascular diseases, infections, complications of renal failure, non-compliance to dialysis and psychological disorders [2-5]. Hospitalization usually necessitates complex and costly interventions which result to prolong hospital stay and increase healthcare costs [6].

The number of patients on chronic haemodialysis is on the rise in many countries owing to the increasing prevalence of end-stage kidney diseases (ESKD) and decreasing mortality [7]. This trend is particularly predominant within many low and middle-income countries (LMICs) [8]. The ESKF profile in Cameroon is similar to other SSA countries, and its burden is becoming alarming as a result of the increasing prevalence of comorbidities [9] and the prevailing socio-economic conditions [10]. Chronic haemodialysis is the main modality of treatment for patients with ESKF in Cameroon [11] and is available in almost all 10 regions in the country. Hospitalization is a major determinant of the prognosis and quality of life of these patients, as it is often associated with multiple adverse clinical outcomes and exorbitant healthcare costs.

The epidemiologic and clinical contrast in our setting suggests other factors than the ones studied in most developed countries and may be associated with the risk of hospitalization among these patients. There is a need to identify causes of hospitalization and determinants of the outcome to curb mortality, reduce healthcare costs and improve the quality of life of these patients in our setting.

PATIENTS AND METHODS

Study design and setting

This was a hospital-based retrospective study carried out over 5 years from January 2016 to December 2021, conducted at the Buea Regional Hospital (BRH). The BRH is a tertiary hospital found in the Southwest Region of Cameroon. It serves as referral hospital for the region and also as teaching hospital for healthcare trainees from varied fields. It hosts the lone haemodialysis centre of the region. The internal medicine unit is one of the biggest units of the hospital, divided into the male and female wards with a capacity of 64 hospital beds, and a present working team of specialists (2 internists, 2 nephrologists, 1 neurologist, 1 cardiologist, 1 pneumologist, and 1 gastroenterologist), 5 general practitioners, and 40 nurses. The unit has an average patient turnover of 84 admissions per month. Patients are admitted in the unit directly after consultation by the general practitioner at the emergency department or from the specialist consultation. Each patient on haemodialysis

admitted is reviewed within 24 hours by the internist or the nephrologists. Admission profile is recorded using paper-based files and a patient can have multiple files (one for each admission). At discharge, the files are stored in shelves found in an administrative office based on the sex of the patient and date of discharges. The hospital also runs a laboratory accredited by Strengthening Laboratory Management Toward Accreditation (SLMTA).

Data collection and analysis

Files of all patients on maintenance haemodialysis at the BRH admitted in the internal medicine unit during the study period were reviewed. We excluded patients with acute kidney injury, patient on dialysis for less than 3 months, patients admitted electively for renal biopsy and arterio-venous fistula creation. Admission history; the number of admissions and data for each admission (year, month, cause of admission, comorbidity on admission, laboratory parameters on admission, interventions on admission, and the outcome of admission) were recorded. For this study we employed the following definitions:

- A chronic haemodialysis patient was defined as patient who has been undergoing haemodialysis for greater than 3 months indicated for End stage Kidney Failure.
- Comorbidity: The presence of additional or co-existing diseases regarding end-stage kidney disease as an initial diagnosis
- File: A folder in which chronic haemodialysis patient admission records are kept.
- Non-adherence was considered when a patient have missed at least one haemodialysis for a week
- Sepsis was defined as the presence of proven or suspected microbial infection in the presence of at least two of this; temperatures $> 38^{\circ}\text{C}$ or $< 36^{\circ}\text{C}$, pulse at $> 90/\text{minute}$, respiratory rate $> 24/\text{cycles/minute}$, white cell count of $> 12,000/\text{cells/mm}^3$ or $< 4000/\text{cells/mm}^3$.
- Catheter related sepsis: Sepsis in a patient having a catheter with the presence of local signs of infections (inflammation, Suppuration) with or without bacterial culture.
- Fluid overload: Include any of the listed signs; limb swelling, ascites, and pulmonary oedema.
- Hypertension: A documented systolic blood pressure (BP) $> 140\text{mmHg}$ and or diastolic BP $> 90\text{mmHg}$ or use of antihypertensive medications
- Diabetes: A documented history of diabetes and or use of anti-diabetic medications.

Data was exported to and analysed using the statistical package for social sciences version 26. Chi-square statistical test, student t-test, and logistic regression were used to analyse for associations between frequency of admission, the outcome of admission, and different predictor variables. A p-value < 0.05 was considered statistically significant.

Ethical considerations.

Ethical approval was obtained from the institutional review board of the Faculty of Health Sciences,

University of Buea (2021/1441/UB/SG/IRB/FHS) and administrative approval was obtained from the director of the BRH. To ensure confidentiality, patient's files were given codes instead of using patient's names for identification.

RESULTS

Frequency of hospitalisation

Of the 112 chronic haemodialysis patients, 4 patient out of 5 (n=87) were admitted at least once during our study period with a total number of admissions of 201. The mean frequency of hospitalization was 2.31 admissions per patient-hospitalized per year (Table 1).

Table 1: Number of admissions per hospitalized patient

Number of admission(s) (n=201)	Frequency (N)	%
Mean(SD)=2.31(0.82)		
1	11	12.64
2	46	52.87
3	23	26.44
4	6	6.89
5	1	1.15

SD: standard deviation

Characteristics of the hospitalized population

The mean age was 46.8(13.24) years. Majority were males (58.62%) and resided outside the town of dialysis (60.92%). Hypertension (58%), HIV (13%) and diabetes (10%) were the most common comorbidities in hospitalized patients. Close half (48.28%) were not adherent to hemodialysis treatment, and the median duration on maintenance hemodialysis was 12 months, (3 to 60 months). Most patients had a central venous catheter (82.78%). (Table 2)

Table 2: Characteristics of chronic hemodialysis patients.

Variable	Category	N(n)	(%)
Age	Mean(SD)=46.40(13.02)		
	15-45	45	51.72
	46-65	36	41.38
	>65	6	6.89
Sex	Male	51	58.62
	Female	36	41.38
Residence	Different town as dialysis	53	60.92
	Same town as dialysis	34	39.08
Comorbidities	Hypertension	51	58.62
	Diabetes	12	10.34
	HIV	9	13.79
	Hepatitis	9	13.79
	Cardiovascular disease	4	4.60
	Others	4	4.60
Adherence	Yes	45	51.72
	No	42	48.28
Duration on dialysis (months)	Median (range) = 12 (3-60)		
	3-12	41	47.13
	13-24	20	22.99
	25-36	14	16.09
	>36	12	13.79
Vascular access	Catheter	72	82.76
	AVF	15	17.24

SD: standard deviation HIV: Human Immunodeficiency Virus.

AVF: Arterio-venous fistula

Others (comorbidities): Gout=1, Lupus=2, Malignancy=1

Cause of hospitalization among the study population

The majority of the hospitalized cases were related to causes whilst not on hemodialysis (n=170, 84.57%). A total of 238 causes were made as patients could have more than one diagnosis.

Non-infectious causes where more frequent and accounted for 67.22 % (160/238) of admissions. Anaemia (40.00%) was the more prevalent, followed by fluid overload (20.06%) and uremic encephalopathy (8.75%) respectively.

For the infectious causes, catheter related sepsis (n=28, 35.89%) was the most common cause, followed by malaria (n=23, 30.76) and CAP (n=9, 11.53%)

Table 3: Causes of non-infection related hospitalizations

Cause of admission	Frequency(n=160)	%
Anemia	64	40.00
Fluid overload	33	20.06
Uremic encephalopathy	14	8.75
Hypotension	9	5.62
Hypertensive encephalopathy	11	6.87
Uremic pericarditis	6	3.75
Decompensated hyperglycemia	3	1.87
Hypoglycemia	5	3.12
Myocardial infarction	3	1.87
Stroke	3	1.87
Acute gout arthritis	2	1.87
Chronic constipation	2	1.87
Seizure	2	1.87
Cellulitis	1	0.62
Dementia	1	0.62
Peripheral arterial disease	1	0.69

Table 4: Causes of infection-related hospitalizations

Cause of admission	Frequency(n=78)	%
Catheter Sepsis	28	35.89
Malaria	25	30.76
CAP	9	11.53
Entero-colitis	6	7.69
Pulmonary tuberculosis	4	5.12
Acute pyelonephritis	3	3.84
Cerebral toxoplasmosis	2	2.56
Osteomyelitis	1	1.28

CAP; community-acquired pneumonia

Outcome of hospitalizations

The mortality rate on hospitalization was 14.94%. Severe anaemia was the cause of death on hospitalization in 46.15% followed by severe sepsis 31% (Figure 1).



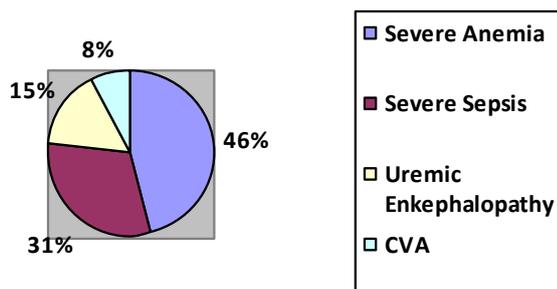


Figure 1: Causes of death

On multivariate analysis, only diabetes was an independent predictor of mortality (OR; 1.66, P=0.039) (Table 6)

Table 5: predictors of mortality among patients (bivariate)

Variable (N=87)	Category	Survivors (n=74)	Non-survivors (n=13)	P-value
Age				
Mean (SD)		45.92 (13.03)	48.68 (13.09)	<0.001
Sex				
	Male	47(54.02)	4(4.60)	0.027
	Female	27(31.03)	9(10.34)	
Comorbidities				
	Hypertension	42(48.28)	9(10.34)	0.399
	Diabetes	7(8.05)	5(5.75)	<0.01
	HIV	6(6.90)	3(3.45)	0.102
Vascular access				
	Catheter	60(81.08)	12(92.31)	0.323
	Fistula	14(18.92)	1(7.69)	
Duration on hemodialysis				
Mean (SD)		15.3(14.4)	12.4(11.2)	1.323
Adherence	No	39(44.83)	3(3.45)	0.041

The median duration of hospitalization was 6 days, ranging from 1 to 20 days.

Table 6: predictors of mortality among hospitalized patients (multivariate)

Variable (N=87)	P-value	AOR	95% Confidence interval	
			Lower	Upper
Age >65	0.806	1.08	0.48	1.85
Diabetic	0.039	1.66	1.64	2.65
Non-adherence	0.310	1.21	1.023	1.79

On multivariate analysis, dialysis catheter as vascular access (OR; 1.45, p<0.01) and non-adherence (OR; 1.67, p<0.01) were independent predictors of prolonged hospital stay.

Table 7: Predictors of prolonged hospital stay (>7 days)

Variable	P-value	AOR	95% CI	
			Lower	Upper
Male	0.111	1.20	1.16	1.61
Female	0.108	1.19	1.15	1.59
Catheter Fistula	<0.01	1.45	1.24	1.99
Non-adherence	<0.01	1.67	1.29	2.31

OR; odd ratio
CI: Confidence interval

DISCUSSION

In this study, we recorded 201 hospitalization rate giving an average frequency of 2.3 episodes per patient hospitalized. The hospitalization rate among patients on maintenance hemodialysis remains high despite a considerable improvement in medical and technical support to these patients [12, 13]. Patients on haemodialysis are prone to high hospitalization rates due to factors related to their comorbid conditions as well as the modality of renal replacement therapy. Haemodialysis as a treatment modality. Our results are similar to that of Quinn et al, in Canada, 2014, who reported a total of 153 (73.9%) patients out of 207 patients on HD requiring at least one hospitalization per year [14], and Hassanien et al, 2014 who observed a comparable but lower rate of 208 (65.4%) of 318 hemodialysis patients were hospitalized at least once in one of the Ministry of Health Hospitals in Makkah, Saudi Arabia [15]. In contrast, Hisham et al, reported a low rate of 49% of 792 ESKD patients on regular hemodialysis were admitted to hospital in Egypt at least once, this low rate could be explained by the fact that the majority of the patients (98%) were using A-V fistula as vascular access [16], in contrast to our study where only 17.24% of patients were using A-V fistula and we had many preventable causes of admissions as central venous catheter is known to be associated to infections leading to hospitalizations.

Infections, anaemia, and fluid overload were the most common causes of admission. Among infections, catheter related sepsis was the most common aetiology documented in our study. Arterio-venous fistula is the goal stand vascular access for chronic hemodialysis, its realization is expensive and not subsidized and many patients have to travel 300 km to have it done in the city capital and also patient are first seen by the nephrologist on the day of initiation to dialysis due to late referral. Almost all patients therefore, start dialysis with a temporal CVC and are exposed to infection due prolong use, catheter malfunction and frequent manipulations. Anaemia is one of the most frequent complications of end-stage kidney disease with the dialysis process itself being a risk factor. The recommended systematic use of erythropoietin to prevent or treat anaemia is near absent due to the associated financial burden. The consequence is increased hospitalization rates for transfusions.. The dialysis policy in Cameroon recommend 02 sessions of dialysis over the recommended 3 sessions imposing a relatively longer inter-dialytic period compared to standard. This results in greater inter-dialytic weight gain and increases incidence of pulmonary oedema requiring hospitalization. Our findings are comparable to Chan et al in 2007 who reported infection, access related and volume overload as the most prevalent diagnosis during hospitalization [17]. Nath et al in 2017 also reported infection as one of the most prevalent causes of hospitalization but in contrast, urinary tract infections were more common (23.5%) [1], this difference in the aetiology of the infections could be explained by the high prevalence of diabetes (35.7%) among patients in their

study and a lower proportion with of central venous catheter (12%). Studies in high income countries showed a different distribution of the causes of admission with non-infectious diseases being the most common causes: In 2005, Vaiciuniene et al, described that cardiovascular diseases (25%), infections (22%), and access related complications (10%) were the most frequent causes of hospitalization among 187 ESKF on regular HD during one year [18]. Hisham et al in 2017 also reported complicated AVF in 33%, and cardiovascular complications (acute coronary syndrome and cardiac arrhythmia) in 11.6% of patients [16]. This mirrors the epidemiologic profile of ESKF in their study, where the majority of patients were old-age, diabetes the main comorbidity and few patients using temporal catheter as dialysis access.

we reported a mortality rate of 14.9% which is lower as compared to that reported by studies on mortality done in Cameroon. Fouda et al in 2005 had a mortality rate of 57.58%, and Halle et al in 2012 reported an estimated rate of 44.9% [19, 20]. The low rate in our study as compared to previous studies can be explained by the fact that we focussed on mortality following hospitalization, whereas the previous studies included all death of patients on hemodialysis. The principal causes of death in our study was severe anaemia and sepsis. This is similar to the results reported in mortality studies done in Africa, such as the case of Ethiopia where sepsis accounted for 34.1% of causes of death and 39% in Sudan [21, 22]. Nonetheless, in literature, cardiovascular diseases are the main causes of death, but that is not usually the case in low-income countries probably due to the high burden of infectious diseases and CVC-related morbi-mortality. The median length of hospital stay in our study was 6 days (1-20 IQR), our result was comparable to Hisham et al in 2017 who reported a median hospital stay of 7 days with (2-7 IQR) in Egypt [12]. Chan et al, in 2007, in the United States in reported the lowest median length of stay of 5 days [17]. We found that several factors were associated with the duration of hospitalization, including; sex, vascular access and adherence to hemodialysis. But after multivariate analysis, only vascular access and adherence to hemodialysis were independently associated with a prolonged stay on admission. This may also mirror the high healthcare cost associated with hospitalization among these patients.

CONCLUSION

The frequency of hospitalization among chronic haemodialysis patients at the Buea Regional Hospital is high, and non-adherence to haemodialysis is a predictor of frequent admissions. Infections (catheter sepsis and malaria), anaemia and fluid overload were the most common causes of hospitalization. This study shows that most hospitalized patients died of preventable causes, the main ones were severe anaemia and sepsis.

CONSENT FOR PUBLICATION

Not applicable

AVAILABILITY OF DATA AND MATERIALS

The materials described in the manuscript, including all relevant raw data, will be freely available to any scientist wishing to use them for non-commercial purposes. The data that support the findings of this study are then available from the corresponding author (d.teuwafeu@yahoo.com) upon reasonable request.

COMPETING INTERESTS

The authors declare that they have no competing interests

FUNDING

The authors did not receive any funding for the study or the publication

AUTHORS' CONTRIBUTIONS

TDG, HMP, BMP, RGM were responsible entirely for the conception and design of the study. TDG, HMP, BMP, RGM, CN, CN designed data collection tools, collected and monitored data collection for the whole trial, cleaned, analysed and interpreted the data, and drafted the manuscript. TDG, HMP, MM, VV revised the paper and had the final manuscript. All authors read and approved the final manuscript

REFERENCES

- Nath J, Kashem A. Etiology and frequency of hospital admissions in maintenance hemodialysis patients in chronic kidney disease. *Saudi J Kidney Dis Transpl.* 2019;30 (2):508.
- Molnar AO, Moist L, Klarenbach S, LaFrance JP, Kim SJ, Tennankore K, et al. Hospitalizations in Dialysis Patients in Canada: A National Cohort Study. *Can J Kidney Health Dis.* 2018;5:2054358118780372. doi: 10.1177/2054358118780372.
- Jones KR. Factors associated with hospitalization in a sample of chronic hemodialysis patients. *Health Serv Res.* 1991;26(5):671–99.
- Funiaková M, Funiaková S, Jezíková A, Holman B, Mokán M, Funiak S. Causes of hospitalization in patients on chronic hemodialysis. *Vnitr Lek.* 2004;50 (3):213-7.
- Halle MP, Nelson M, Kaze FF, Denis T, Fouda H, Ashuntantang EG, et al. Non-adherence to hemodialysis regimens among patients on maintenance hemodialysis in sub-Saharan Africa: an example from Cameroon. *Renal Failure.* 2020;42(1):1022–8.
- Zhang H, Zhang C, Zhu S, Zhu F, Wen Y. Costs of hospitalization for chronic kidney disease in Guangzhou, China. *Public Administration and Policy.* 2019;22(2):138–5.
- Abbasi M, Chertow G, Hall Y. End-stage Renal Disease. *AFP.* 2010;82(12):1512.
- Collins AJ, Foley RN, Gilbertson DT, Chen S-C. United States Renal Data System public health surveillance of chronic kidney disease and end-stage renal disease. *Kidney Int Suppl* (2011). 2015;5(1):2–7.
- Aseneh JB, Kemah B-LA, Mabouna S, Njang ME, Ekane DSM, Agbor VN. Chronic kidney disease in Cameroon: a scoping review. *BMC Nephrol.* 2020;21(1):1–11.
- Ashuntantang G, Metim KL, Kaze FF, Nsangou MM, Mahamat-Alamine M, Nono A, et al. SUN-088 Socio-economic changes after initiation of maintenance hemodialysis in Cameroon. *Kidney International Reports.* 2019;4(7):S192.

11. Kaze FF, Kengne AP, Choukem SP, Dzudie A, Halle MP, Ashuntantang G, et al. Dialysis in Cameroon. *Am J Kidney Dis.* 2008 Jun;51(6):1072-4. doi: 10.1053/j.ajkd.2008.02.366.
12. Chan KE, Lazarus JM, Wingard RL, Hakim RM. Association between repeat hospitalization and early intervention in dialysis patients following hospital discharge. *Kidney Int.* 2009;76(3):331–41.
13. Carlson DM, Duncan DA, Naessens JM, Johnson WJ. Hospitalization in Dialysis Patients. *Mayo Clinic Proceedings.* 1984;59(11):769–75.
14. Quinn RR, Ravani P, Zhang X, Garg AX, Blake PG, Austin PC, et al. Impact of Modality Choice on Rates of Hospitalization in Patients Eligible for Both Peritoneal Dialysis and Hemodialysis. *Perit Dial Int.* 2014;34(1):41–8.
15. Hassanien AA, Majeed A, Watt H. Retrospective observational study examining indications for hospitalisation among haemodialysis patients at one of the Ministry of Health Hospitals in Makkah, Saudi Arabia. *JRSM Open.* 2014;5(10):20.
16. Hospitalization among prevalent hemo dialysis patients: one year retrospective study. *The Egyptian Journal of Community Medicine,* 2016; 34(2): 19-32. doi: 10.21608/ejcm.2016.650.
17. Chan KE, Lazarus JM, Wingard RL, Hakim RM. Association between repeat hospitalization and early intervention in dialysis patients following hospital discharge. *Kidney Int.* 2009;76(3):331–41.
18. Vaiciuniene R, Kuzminskis V, Bumblyte IA. Hospitalization in hemodialysis patients in one region of Lithuania. *Int J Artif Organs.* 2005;28(12):1228–31.
19. Halle MP, Ashuntantang G, Kaze FF, Takongue C, Kengne AP. Fatal outcomes among patients on maintenance haemodialysis in sub-Saharan Africa: a 10-year audit from the Douala General Hospital in Cameroon. *BMC Nephrol.* 2016;17(1):165. doi: 10.1186/s12882-016-0377-5.
20. Fouda H, Ashuntantang G, Kaze F, Halle MP. Survival among chronic hemodialysed patient in Cameroon. *Pan Afr Med J.* 2017;26:97–97.
21. Elsharif ME. Mortality rate of patients with end stage renal disease on regular hemodialysis: a single center study. *Saudi J Kidney Dis Transpl.* 2011;22(3):594–6.
22. Shibiru T, Gudina EK, Habte B, Derbew A, Agonafer T. Survival patterns of patients on maintenance hemodialysis for end stage renal disease in Ethiopia: summary of 91 cases. *BMC Nephrol.* 2013;14:127. doi: 10.1186/1471-2369-14-127.