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The role of Key Performance Indicators (KPIs) in Clinical Self-Assessment of Quality of Service Offered to the Patients under Chronic Hemodialysis in Rwanda

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ABSTRACT

Introduction: Key Performance Indicators (KPIs) are quantifi ble metrics used in managing patients under hemodialysis and measuring performance in care quality. This study examined the performance of hemodialysis centers at Africa Healthcare Network, Rwanda using KPIs.
Methods: We analyzed the data recorded in Clinicea (electronic file) between February and November 2022, using KPIs.
Results: In all three centers during the above-mentioned period, all sessions were recorded; in more than 94% of patients, their Kt/V urea was recorded, and the target varied between 69% to 85%; almost half of the patients did their blood tests, and less than three quarters met the target. Few patients had AVF (30% in November). The beds were under-used; no center has met two shifts per day at 100%, the same for the nurses with less than 2.5 sessions per nurse per day.
Conclusion: This study showed that the hemodialysis centers were performing fairly and highlights the need for improving the quality of care, especially in Low-Income Countries like Rwanda, where there is a shortage of Physicians and Nephrologists.

INTRODUCTION

Hemodialysis is needed when kidneys are not able to clean the blood by removing fluid and enough waste. This procedure uses the dialysis machine and a special filte , an artificial kidney called a dialyzer, and through vascular access, it is connected to the patient [1]. It helps control blood pressure and balance important minerals, such as serum sodium, potassium, and calcium. It gives supportive care to improve quality of life and live longer but does not cure kidney failure [2].
Chronic kidney disease (CKD) is defined as a clinical syndrome associated with a definitive change in the structure of the kidney or kidney function; it is mainly irreversible or associated with slow and progressive evolution [3].

CKD is associated with high-risk complications and mortality3. In adult patients, CKD is defined with a glomerular filtration rate (GFR) less than 60 ml/min/1.73m2 or greater than 60 ml/min/1.73m2 when there is evidence of renal structure injury [4]. Worldwide, the incidence of CKD is increasing; the average is estimated to be 150-200 per million population, and its prevalence is estimated to be

800 per million population [4]. Globally, there is an annual increase of 7% in needing chronic dialysis [4,5]. In sub-Saharan Africa, aging, lifestyle modification, and rapid urbanization are the basis of CKD increment in addition to the overspreading of HIV, diabetes mellitus, hypertension, and obesity [5].

Physicians and patients have to decide together subjective and objective parameters before starting dialysis [3]. The physician has to evaluate the quality of life, fall in renal function, and the patient's psychology since the dialysis is started when the patient becomes symptomatic or if there are remarkable changes in laboratory results suggesting a high risk of developing symptoms [3].

Hemodialysis outcomes are influenced by several factors, such as quality of life, socio-demographics, and comorbidities, making it difficult to do follow-up and may worsen outcomes [6]. Therefore, Key Performance Indicators (KPIs) are essential in managing patients under hemodialysis. KPIs are quantifiable metrics that express an institution's performance in fulfilling its goals and objectives [7].

KPIs are used to assess and improve the quality of renal services at CKD clinics, dialysis clinics, and transplant clinics without extra funding [7]. KPIs are used to set measurable goals in a certain time range, followed by performance assessment, recommendations, and next steps [7]. This study examined the performace of hemodialysis centers at Africa Healthcare Network (AHN) using KPIs, and its findings can help improve clinical service provided to CKD patients in Rwanda. AHN is the first and largest dialysis chain across Sub-Saharan Africa, with dialysis centers in Rwanda. The findings would inform strategies under development to expand the dialysis centers countrywide since Rwanda has only 7 centers, mostly concentrated in Kigali city.

METHODS

Study design: This was a retrospective study conducted at three hemodialysis centers of AHN, Rwanda (Gihundwe dialysis center and Gisenyi dialysis center in remote area and Kimihurura standalone center in the City of Kigali). We analyzed the recorded data in Clinicea (electronic file in use at Africa Healthcare Network, Rwanda, in consultation) from February to November 2022. The hemodialysis sessions, blood tests results, Kt/V urea, vascular access types, catheter infections breakdown, admissions, bed occupancy, deaths, and daily presented nursing staff were recorded.

Statistical analysis: Recorded data in Clinicea were exported to Microsoft Excel 2021 for analysis. Descriptive statistics was performed and data was presented in frequencies (n) and percentages (%).

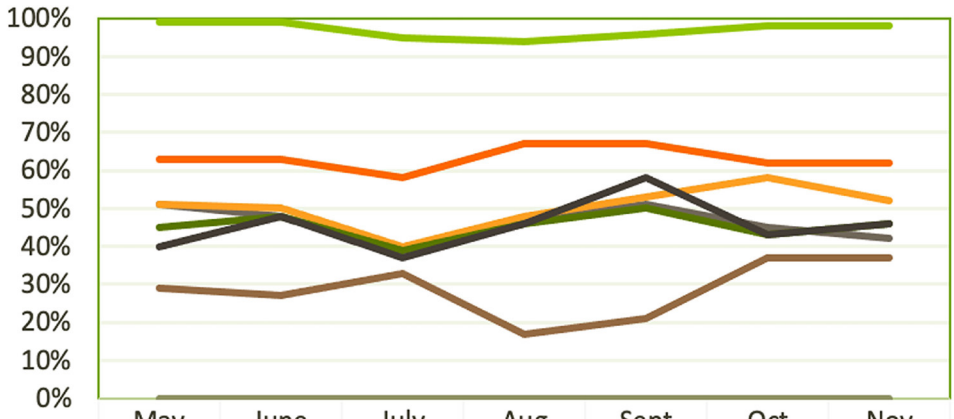
Ethical considerations: Both ethical approval and informed consent were waived by Gihundwe Hospital and Gisenyi Hospital, Education and Research Committees considering the study's retrospective nature, as it used the anonymized records that existed in dialysis centers and did not involve interaction with the patients.

RESULTS

We found 67 patients at all centers, with all sessions (100%) recorded in Clinicea (Table 1). From May to November 2022, more than 94% of their Kt/V urea was tested and recorded, the patients who did serum albumin test dropped from 51% to 42%. There was an improvement in

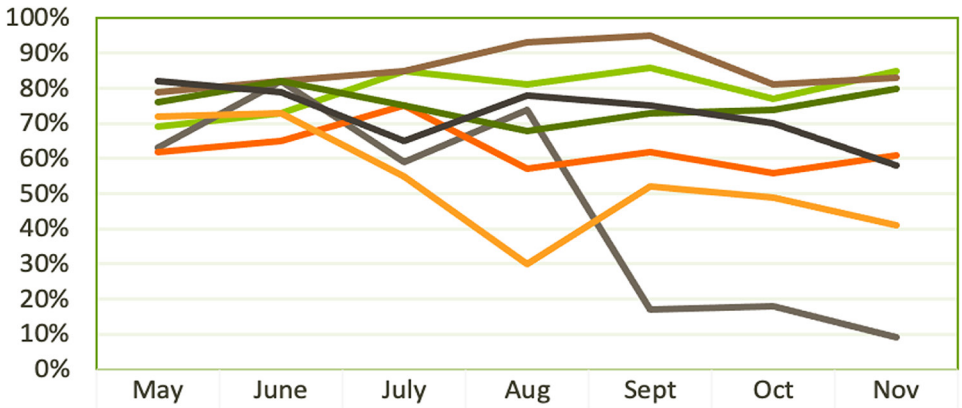
Table 1: *Clinicea Data Entry*

	Total Sessions	Sessions entered in Clinicea	% of sessions entered in Clinicea
Total	1,053	1,052	100%
Kimihurura	671	670	100%
Gisenyi	192	192	100%
Gihundwe	190	190	100%



	May	June	July	Aug	Sept	Oct	Nov
Kt/v	99%	99%	95%	94%	96%	98%	98%
Albumin	51%	48%	39%	47%	51%	45%	42%
Hemoglobin	63%	63%	58%	67%	67%	62%	62%
TSAT	0%	0%	0%	0%	0%	0%	0%
Ferritin	29%	27%	33%	17%	21%	37%	37%
Calcium	51%	50%	40%	48%	53%	58%	52%
Phosphorous	45%	48%	39%	46%	50%	43%	46%
Ca*Po4	40%	48%	37%	46%	58%	43%	46%

Figure 1: *Patient level KPIs: Blood tests (percentage of the patients tested from May to November)*



	May	June	July	Aug	Sept	Oct	Nov
Kt/v	69%	73%	85%	81%	86%	77%	85%
Albumin	63%	82%	59%	74%	17%	18%	9%
Hemoglobin	62%	65%	75%	57%	62%	56%	61%
TSAT	-	-	-	-	-	-	-
Ferritin	79%	82%	85%	93%	95%	81%	83%
Calcium	72%	73%	55%	30%	52%	49%	41%
Phosphorous	76%	82%	75%	68%	73%	74%	80%
Ca*Po4	82%	79%	65%	78%	75%	70%	58%

Figure 2: *Patient level KPIs review: Blood tests (Percentage of the patients meeting target values)*

testing Ferritin from 29% to 37%. Other elements like Calcium, Phosphate, and Hemoglobin did not change (Figure 1).

From May to November 2022, there was an improvement in patients meeting KT/v target levels from 69% to 85% with much difference between October and November 2022 (From 77% to 85%), there was a fall in patients with target levels of serum albumin and calcium-phosphorus tests from 63% to 9% and 82% to 58% respectively, and for other elements, there was no much change (Figure 2). For hemoglobin, 40% of the patients met the target levels (Hb 11-12g/dl). Gihundwe dialysis center had a high percentage of patients with anemia (Hb <8g/dl), and Kimihurura Standalone had a high number of patients with anemia (Hb<8g/dl) (Table 2).

Target hemoglobin levels over a period of time at Gisenyi dialysis centers had dropped to 30% by June 2022, while the patients of Gihundwe dialysis center had reached their apogee of 90% (Figure 3).

For vascular access type, there was an increase in the number of patients who had Arteriovenous fistula (AVF) (21% to 30%); on the other side, there was a fall in the number of patients who had Permanent cannula (PC) from 66% to 57% (Figure 4). June had the highest prevalence of infections

Table 2: *Patient Hemoglobin Breakdown*

HEMOGLOBIN (g/dl)	<8	8-9	9-10	10-11	11-12
RWANDA (%)	16%	7%	15%	21%	40%
KIMIHURURA (%)	16%	5%	19%	22%	38%
GISENYI (%)	7%	13%	20%	7%	54%
GIHUNDWE (%)	27%	7%	0%	33%	33%

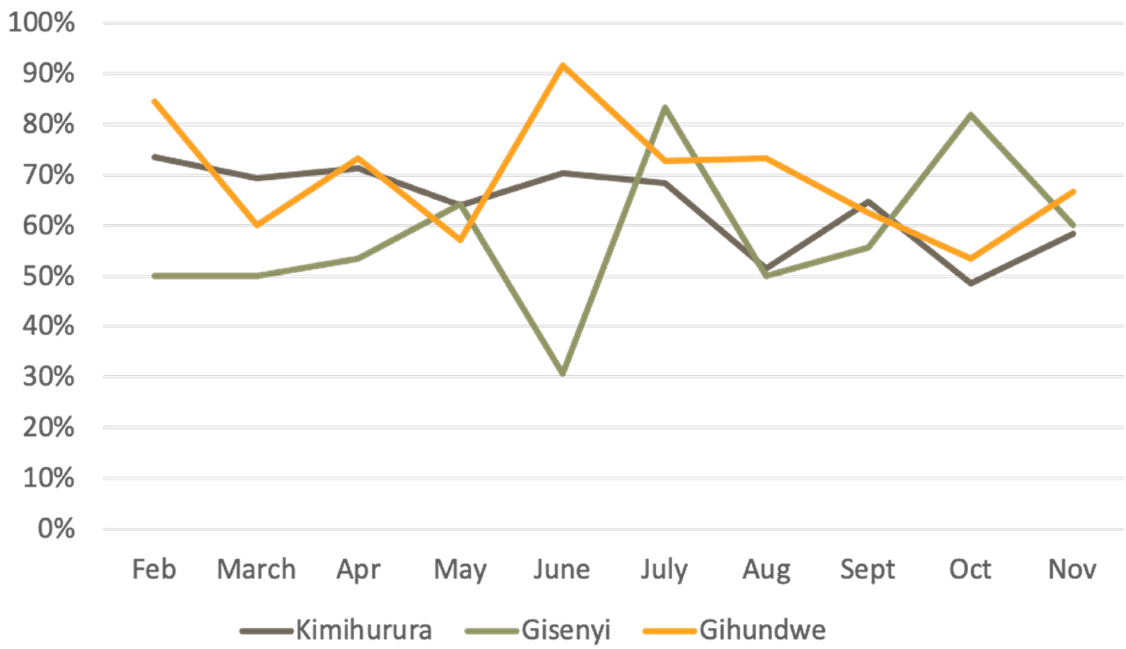
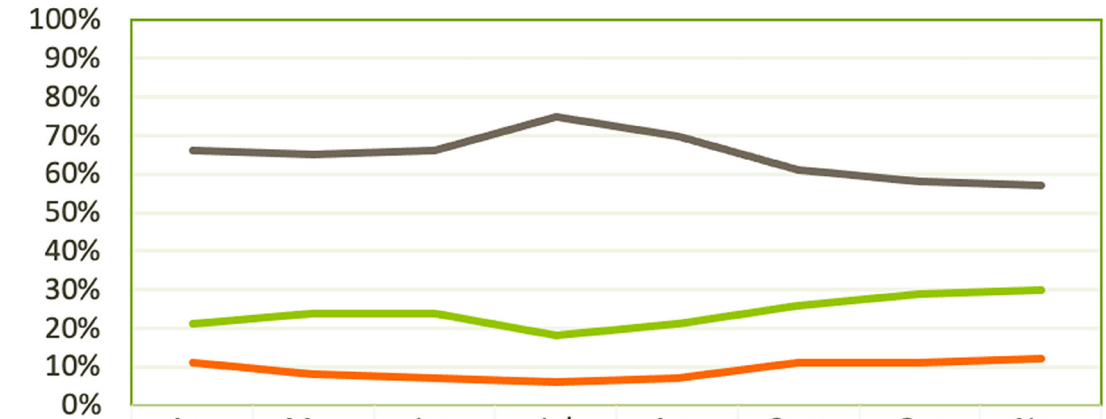
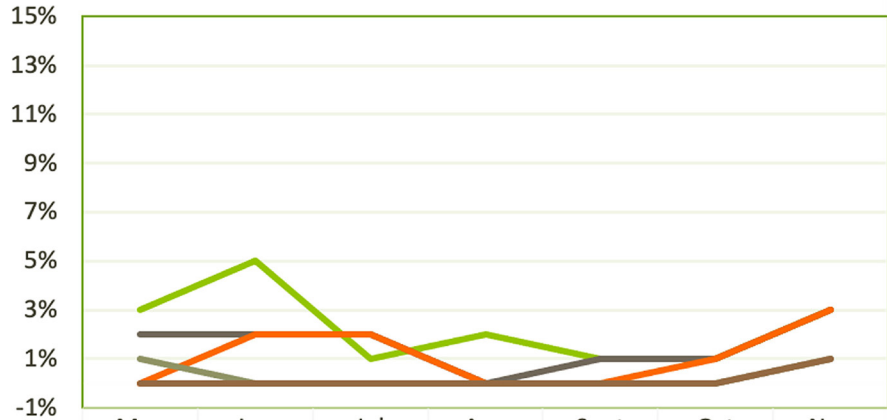


Figure 3: *Patient level KPIs: Blood tests (Patients meeting hemoglobin target overtime in centers*



	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov
AVF	21%	24%	24%	18%	21%	26%	29%	30%
PC	66%	65%	66%	75%	70%	61%	58%	57%
IJC	11%	8%	7%	6%	7%	11%	11%	12%

Figure 4: *Other clinical outcomes-Vascular access types (AVF: Arteriovenous fistula; PC: Permanent cannula, and IJC: Internal jugular catheter)*



	May	Jun	Jul	Aug	Sept	Oct	Nov
Catheter infection	3%	5%	1%	2%	1%	1%	3%
Admissions	2%	2%	2%	0%	1%	1%	3%
Admissions (CKD only)	0%	2%	2%	0%	0%	1%	3%
Mortality	1%	0%	0%	0%	0%	0%	1%
Mortality (CKD only)	0%	0%	0%	0%	0%	0%	1%

Figure 5: *Other clinical outcomes (Percentage of infections, admissions and mortality)*

(5%), and November recorded the highest prevalence of admissions (3%) and mortality (1%) (Figure 5).

The overall average sessions per day to nursing staff ratio was around 2.3 per nurse per day, with the highest record in Kimihurura standalone, where the ratio was 2.5 per nurse per day in September 2022 (Figure 6).

For the bed occupancy at all centers, many shifts were done in November 2022, with two full shifts at 60% on average, with the highest in Kimihurura standalone (85%) (Figure 7).

Comparing October and November 2022, in data recording in Clinicea, there was no much difference

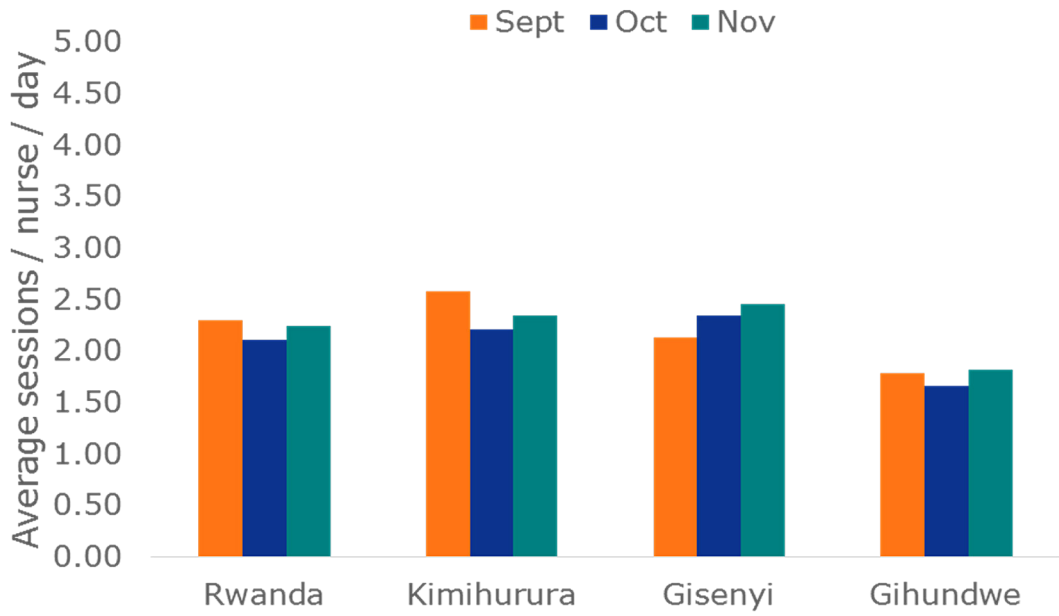


Figure 6: *Operational KPIs: Average sessions per day to nursing staff ratio*

Table 3: *Clinical KPI: October Blood tests (Percentage of patients tested in October and November)*

	Kt/V	Albumin	Hemoglobin	TSAT	Ferritin	Serum Ca	Serum Po4	Ca*PO4
OCTOBER BOOD TESTS								
Total	98%	45%	62%	0%	37%	58%	43%	43%
KIMIHURURA	97%	46%	52%	0%	37%	49%	43%	43%
GISENYI	100%	50%	69%	0%	38%	69%	50%	50%
GIHUNDWE	100%	38%	94%	0%	38%	81%	38%	38%
NOVEMBER BLOOD TESTS								
Total	98%	42%	62%	0%	37%	52%	46%	46%
KIMIHURURA	99%	42%	50%	0%	38%	42%	39%	39%
GISENYI	94%	69%)	94%	0%	44%	75%	56%	56%
GIHUNDWE	100%	17%	83%	0%	28%	72%	67%	67%

between the two months but by stratification, the Gihundwe dialysis center had recorded 100% Kt/V urea in both months (Table 3), and in meeting the target levels. No TSAT recorded.

At all centers, the percentage of patients achieving target Kt/V urea increased from 77% to 85%, the

Table 4: *Clinical KPIs: October Blood tests (Percentage of the patients meeting the target and average value between October and November)*

	Kt/v	Albumin	Hemoglobin	Ferritin	Serum Ca	Serum Po4	Ca*PO4
OCTOBER BLOOD TESTS							
Total	77%	18%	56%	81%	49%	74%	70%
KIMIHURURA	82%	13%	49%	80%	58%	76%	69%
GISENYI	44%	13%	82%	67%	18%	75%	75%
GIHUNDWE	94%	50%	53%	100%	54%	67%	67%
NOVEMBER BLOOD TESTS							
Total	85%	9%	61%	83%	41%	80%	58%
KIMIHURURA	84%	6%	59%	82%	55%	72%	69%
GISENYI	73%	9%	60%	71%	33%)	100%	44%
GIHUNDWE	100%	33%	67%	100%	15%	83%	42%

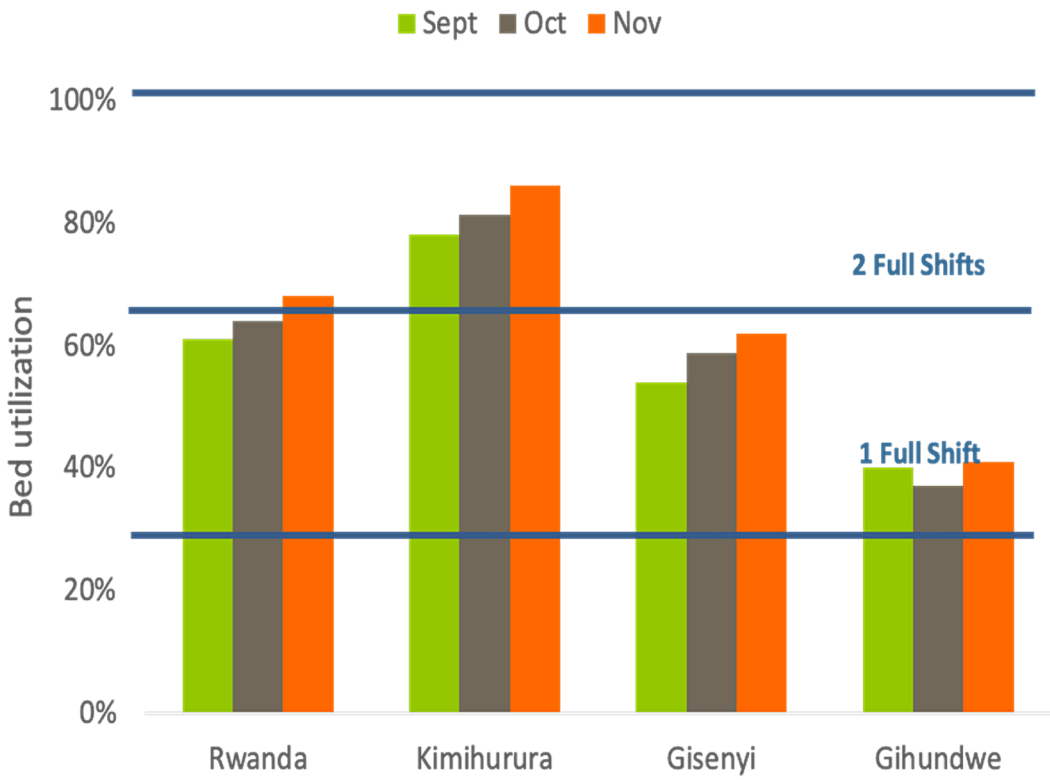


Figure 7: *Operational KPIs: Bed occupancy*

Table 5: *Clinical KPI: Other clinical outcomes (Vascular access between October and November)*

	Fistula	Permanent catheter	Acute catheter
VASCULAR ACCESS IN OCTOBER			
Total	29%	58%	11%
KIMIHURURA	39%	45%	13%
GISENYI	6%	81%	13%
GIHUNDWE	13%	88%	0%
VASCULAR ACCESS IN OCTOBER			
Total	30%	57%	12%
KIMIHURURA	38%	45%	16%
GISENYI	13%	88%	0%
GIHUNDWE	11%	83%	6%

Table 6: *Clinical KPIs: Catheter-related infection, hospital admissions and mortality between October and November*

	Catheter infection	**Hospital admission (all patients)**	**Hospital admission (CKD only)**	**Mortality (all patients)**	**Mortality (CKD only)**
OCTOBER CLINICAL OUTCOMES					
Total	1%	1%	1%	0%	0%
KIMIHURURA	1%	0%	0%	0%	0%
GISENYI	0%	5%	5%	0%	0%
GIHUNDWE	0%	0%	0%	0%)	0%
NOVEMBER CLINICAL OUTCOMES					
Total	3%	3%	3%	1%	1%
KIMIHURURA	4%	3%	3%	1%	1%
GISENYI	5%	0%	0%	0%	0%
GIHUNDWE	0%	10%	10%	0%	0%

Gisenyi hemodialysis center saw the most increase, from 44% to 73%. Patients with the hemoglobin target dropped from 82% to 60% at Gisenyi dialysis center, and patients with calcium target dropped from 54% to 15% at Gihundwe center but the percentage of patients with phosphorus target has increased from 67% to 83% at Gihundwe dialysis center and patients with albumin target dropped from 13% to 6% at Kimihurura standalone (Table 4).

In all centers, the patients using AVF increased from 29% to 30% between October and Novemeber with the highest increase at Gisenyi dialysis center (from 6% to 13%), and there was no patient using IJC at Gisenyi dialysis center in November 2022 (Table 5).

Regarding catheter-related bloodstream infections (CRBSI), hospital admissions (all patients or CKD patients only), and mortality of all dialysis patients or patients with CKD only at all centers, the highest percentage of admissions for CKD patients (5%) and all patients (5%), in general, was in Gisenyi dialysis center in October, which droped to 0% in Novemeber. In contrast Gihundwe dialysis center which had recorded no admissions in October, reported the highest percentage (10%) for both types of admissions in November. Gisenti dialysis center had the highest number of patients with CRBSI (5%) in November, while it had none (0%) in October (Table 6).

DISCUSSION

KPIs in monitoring and reporting are key to delivering standard hemodialysis service, and their implementation may help measure adherence to the dialysis standards [7]. Due to the increasing patients` number under chronic dialysis, implementing KPIs was found to help improve the CKD medical treatment system for early detection, optimal management, and criteria for referral to a nephrologist with the goal of achieving a reduction of new dialysis patients [8]. This study assessed how AHN dialysis centers performed in Rwanda, using KPIs.

The findings showed that an overall improvement in meeting target levels of Kt/v, and hemoglobin from May to November 2022. Kt/V urea of is associated with good general health status [9], but very difficult to achieve Kt/V urea of 1.45, especially in men with body weight between 70 kg to 80 kg for treatments of 4.5 hours during dialysis [10]. The patients with high or low serum concentrations of serum albumin-corrected calcium, phosphorus, and parathyroid hormone (PTH) have an increased risk of all-cause mortality [11]. We found a fall in patients with target serum albumin and calcium-phosphorus levels between May and November, indicating an increased risk for patients. Low hemoglobin levels may also be attributed to the inaccessibility of the erythropoiesis-stimulating agent. Though patients on dialysis tend to have anemia, 40% of the patients met the target hemoglobin levels. Hemoglobin increase depends on erythropoietin response, nutrition status, inflammation, and oxidative stress markers. In addition, serum albumin concentration strongly predicts baseline hemoglobin and erythropoietin sensitivity, and its improvement improves anemia in hemodialysis patients [12]. Moreover, serum albumin concentration level in patients under chronic dialysis was found to be a predictor to determine the nutrition status of the patients [13]. Therefore, the fall in target albumin levels might have affected the achievement of hemoglobin levels in 60% of patients through multiple factors. Many patients missed investigations, which is associated with high-frequency reagents stock-out in laboratories of public hospitals, and support the study which documented sub-optimal diagnosis capacity of kidney diseases in different hospitals in Rwanda [14].

We found an increase in the number of patients who had AVF. However, the patients with AVF remained few, which may be attributed to a lack of vascular surgeons in Rwanda. AVF is considered the gold standard hemodialysis vascular access [15], and efforts should be made to increase its use in patients under hemodialysis. At Kimihurura standalone, two full shifts reached 80% in November, which is attributed to the dialysis accessibility, and the patients rarely miss the scheduled dialysis sessions compared to the rest of the centers of remote areas. In Rwanda, 90% use Community Base Health Insurance (CBHI) [16], a public universal health insurance. The CBHI benefici ries do not have access to chronic dialysis unless they are able to pay for 100% hemodialysis services. This may justify the low rate of bed occupancy, low nurse-to-hemodialysis session ratios, and the inability to reach at least two full shifts per day. Besides this, the nephrologist to hemodialysis patients ratio in the studied centers was 1:67, highlighting the need for nephrologists in Rwanda as one nephrologist covered all three centers during the study period.

The staff shortage might affect service delivery, leading to complications, such as infection [17,18]. In Sub-Saharan countries, the shortage of trained nursing staff and nephrologists was reported to affect the dialysis service delivery [17]. This aligns with our findings and might have contributed to CRBSI in dialysis centers, as it might lead to less change of catheters, increasing the risk of infections. CRBSI at some centers also aligns with low levels of hemoglobin and albumin recorded in those centers, indicating their contributions to the infection. Studies have shown that catheter type and duration, comorbidity, immunosuppression, low hemoglobin level, and low albumin level were significantly linked with CRBSI [19], all of which are more prevalent among dialysis patients.

There are some limitations to this study that should be considered. We could not include TSAT in KPIs. TSAT testing was not done at all centers, which might be attributed to the lack of materials/ reagents. However, testing TSAT is important as it helps monitor the response to erythropoiesis-stimulating agents and/or iron therapy in CKD. Moreover, the KPIs used in our study did not include injectable erythropoiesis-stimulating agent and iron sucrose, serum glucose, glycated hemoglobin, missed scheduled hemodialysis sessions, BMI, and vital signs monitoring because their details were missing or incomplete in patients' files

CONCLUSION

Our findings show that services provided at AHN dialysis centers in Rwanda generally improved. This indicates that KPIs may help self-assessment of the dialysis services offered to chronic hemodialysis patients. The findings of this study highlight weaknesses to improve, such as increasing patients meeting Kt/v urea, hemoglobin, albumin, and calcium and phosphorus targets. The number of nutritionists and local vascular surgeons should also be increased. Health officials and partners should increase laboratory reagents to improve Kt/V urea testing has to be recorded 100% and meet the target as it is used to measure vascular access patency. The physicians have to check the adherence and compliance of the drug with the patients, and also to put enough effort in TSAT testing. The Ministry of Health needs to collaborate with different stakeholders in order to improve renal service in terms of dialysis accessibility and increase the number of nephrologists and laboratory equipment.

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