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Original Research Article

Direct Costs of Inpatient Care among Patients with Heart Failure at the Abidjan Heart Institute: A Prospective Study

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Abstract: ***Background*:** Heart failure (HF) is a major public health problem, responsible for numerous hospitalizations and a substantial economic burden. This study aimed to assess the direct cost of inpatient management of HF at the Abidjan Heart Institute. ***Methods*:** Prospective cross-sectional descriptive and analytical study conducted from January 1 to May 31, 2025. Adults ≥18 years hospitalized for HF in medical wards and intensive care units were included. Two hundred patients were interviewed; healthcare and associated costs were collected; indirect costs were excluded. The mean total cost incurred during hospitalization was estimated in West African CFA francs (XOF). ***Results*:** The mean total cost of inpatient care was 439,560.75 XOF (US$724.15), with values ranging from 303,171 XOF (US$499.45) to 1,340,306 XOF (US$2,200.10). The mean length of hospital stay was 7.1 ± 2 days. Medication costs averaged 169,038.15 XOF (38% of total cost). Diagnostic investigations accounted for 183,832.60 XOF (42% of total cost), and accommodation/hospitalization costs averaged 86,690 XOF (20% of total cost). In multivariable analysis, overall cost was significantly associated with underlying cardiac disease: ischemic heart disease (OR 3.20; 95% CI 1.6–6.5; p = 0.001) and valvular heart disease (OR 4.08; 95% CI 1.1–14.4; p=0.029). ***Conclusion*:** The direct cost of inpatient management of HF is substantial in our setting. Strengthening prevention and management of cardiovascular risk factors and improving access to health insurance may help reduce the financial burden associated with HF.

Keywords: Heart Failure, Direct Costs, Hospitalization, Healthcare Expenditure, Côte d'Ivoire.

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INTRODUCTION

Heart failure (HF) is a major global public health problem affecting more than 64 million people worldwide [1]. It is responsible for more than 26 million hospitalizations worldwide [2]. HF is a chronic, complex, and severe condition whose symptoms can substantially impair patients' quality of life and are associated with considerable mortality [3]. The number of diagnosed cases has increased by approximately 12% over the past decade, largely as a consequence of population ageing, highlighting the continuing rise in the global prevalence of HF. Previous studies have estimated that HF accounts for approximately 2% of healthcare expenditure in the European Union, corresponding to €29 billion annually [4]. Hospitalizations represent the largest component of HF-related healthcare expenditure, and these costs are projected to increase by 50% over the next 25 years [5]. The natural history of HF is characterized by recurrent hospitalizations, predominantly resulting from episodes of acute decompensation. Consequently, the management of HF and its associated comorbidities imposes a substantial financial burden on households in low- and middle-income countries, with important repercussions for both household and national economies. In Africa, hospital admission rates for HF range from 3% to 7% in hospital-based series, with mortality estimated at approximately 20% [6].

In Côte d'Ivoire, HF accounts for approximately 60% of the reasons for hospitalization at the Abidjan Heart Institute [7]. Improving knowledge of the costs associated with HF and their determinants is essential for optimizing disease management and reducing the associated financial burden. However, data on the economic burden of HF in sub-Saharan Africa, and particularly in Côte d'Ivoire, remain scarce. We therefore conducted this study to assess the direct cost of

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inpatient management of HF at the Abidjan Heart Institute.

PATIENTS AND METHODS

Study Design and Population

This was a prospective, cross-sectional medico-economic evaluation with descriptive and analytical objectives, conducted over a five-month period from January 1 to May 31, 2025.

The study population consisted of patients hospitalized for HF in the medical wards and intensive care units of the Abidjan Heart Institute during the study period. Patients were eligible if they were aged ≥18 years, had been admitted to a medical ward or medical intensive care unit for HF, and had a complete medical record. Patients who did not provide informed consent and/or whose medical records were incomplete were excluded.

Data Collection

Data were collected throughout the study period using medical records and patient interviews. A standardized data collection form was used.

The collected variables included:

- Sociodemographic characteristics: age, sex, occupational status, place of residence, nationality, educational level, health insurance status, and monthly income;
- Clinical characteristics: medical history, cardiovascular risk factors, hemodynamic parameters, New York Heart Association (NYHA) functional class, type of HF, precipitating factors for decompensation, and associated comorbidities;
- Healthcare expenditure: hospitalization-related amenities, therapeutic strategy, complementary investigations, and length of hospital stay.

All costs were expressed in West African CFA francs (XOF). For international comparability, costs were additionally converted into US dollars (USD) using the average USD/XOF exchange rate over the study period (January 1 to May 31, 2025), corresponding to approximately 607 XOF per USD.

The costs assessed included the costs of diagnostic investigations (laboratory tests, electrocardiography, and echocardiography); medication costs; and hospitalization/accommodation costs. Medication costs were calculated directly from each patient's prescription invoices. Similarly, the cost of complementary investigations was determined by matching the investigations performed during hospitalization with the prices applicable at the Abidjan Heart Institute. Hospitalization-related accommodation costs primarily consisted of the daily room rate, which was multiplied by the total number of days of hospitalization. Indirect costs were not included in this study.

Statistical Analysis

Data were entered and analyzed using Microsoft Excel. Results were expressed as means, frequencies, standard deviations, counts, or proportions, as appropriate. A p-value <0.05 was considered statistically significant. The chi-square and Fisher's exact tests were used to compare categorical variables, whereas analysis of variance (ANOVA) and the Kruskal–Wallis test were used for quantitative variables. Logistic regression analysis was performed to identify factors associated with the cost of care.

Ethical Considerations

The study was conducted in accordance with ethical principles governing research involving human participants, following approval from the Ethics Committee of the Medical and Scientific Directorate of the Abidjan Heart Institute. Patient anonymity and confidentiality of the collected data were ensured.

RESULTS

A total of 200 patients hospitalized for HF were included in the study. There was a male predominance (63%), with a sex ratio of 1.7. The mean age was 55 ± 15.2 years, ranging from 18 to 87 years. Regarding occupational status, salaried employees were the most represented group (59%), followed by workers in the informal sector (26%) and retirees (15%). In terms of educational attainment, most patients had completed secondary education (46.5%), followed by university-level education (32%). The majority of patients (88.5%) resided in Abidjan. Nearly half of the patients (49%) reported a monthly income between 100,000 and 300,000 XOF, while most (72.5%) did not have health insurance. Sociodemographic characteristics are summarized in Table 1.

Table 1: General characteristics of the study population

Variable	n	Percentage (%)
Sex		
Female	74	37
Male	126	63
Age group (years)		
[18-25]	6	3
[26-35]	12	6
[36-45]	24	12

[46-74]	144	72
≥75	14	7
Occupational status		
Salaried employee	118	59
Informel sector	52	26
Retired	30	15
Health insurance		
No	145	72.5
Yes	55	27.50
Educational level		
No formal education	11	5.5
Primary	32	16
Secondary	93	46.5
University	64	32
Monthly income (XOF)		
<100,000	53	26.5
100,000–300,000	98	49
>300 000	28	14
No income	21	10.5

Hypertension was the most prevalent cardiovascular risk factor (79.6%), followed by diabetes (15.9%) and physical inactivity (14.4%). Most patients with HF were admitted with NYHA functional class III symptoms (63.9%). Global HF was the most frequent clinical presentation (67.6%), followed by left-sided HF (10.7%). The most common precipitating factor for decompensation was poor treatment adherence (61.8%), followed by bronchopulmonary disease (50.2%). The most frequently observed comorbidities were electrolyte disturbances (81%), renal impairment (52.2%), hematological abnormalities (30.3%), and hepatic involvement (18.4%). Clinical characteristics are summarized in Table 2.

Table 2: Clinical characteristics of the study population

Variable	n	Percentage (%)
Cardiovascular risk factors		
Hypertension	160	79.60
Diabetes	32	15.92
Physical inactivity	29	14.43
Dyslipidemia	28	13.93
Smoking	20	9.95
Obesity	10	4.98
Overweight	5	2.49
None	34	16.62
NYHA functional class		
II	12	6
III	128	63.96
IV	60	30.04
Type/pattern of HF		
Left-sided	22	10.77
Right-sided	17	8.21
Global	133	67.69
Acute pulmonary edema	17	8.21
Cardiogenic shock	11	5.13
Precipitating factors		
Poor treatment adherence	125	61.80
Bronchopulmonary disease	104	51.25
Arrhythmias	19	8.96
Pulmonary embolism	18	8.46
Ischemic exacerbation	15	6.97
Dietary non-adherence	11	4.98
Anemia	9	4.48
Pregnancy	5	1.99

Variable	n	Percentage (%)
Therapeutic failure	4	1.5
Comorbidities		
Electrolyte disturbances	163	81.09
Renal impairment	105	52.24
Hematological abnormalities	61	30.35
Hepatic involvement	18	18.41
Other	86	43

Most patients (94.8%) had a favorable clinical outcome. The mean duration of hospitalization was 7.1 ± 2 days. The mean total cost of hospitalization was 439,560.75 XOF (US$724.15), ranging from 303,171 XOF ($US499.45) to 1,340,306 XOF ($US2,200.10) (Table 3).

Table 3: Distribution of patients according to mean hospitalization costs

Cost component	Mean cost (XOF)	Minimum
Diagnostic investigations Laboratory investigations	123,709.80	108,000
Imaging	60,122.800	8,000
Hospitalization/accommodation	86,690.00	68,733.8
Medications	169,038.15	118,437
Total	**439,560.75**	**303,171**

Costs are expressed in West African CFA francs (XOF).

Medication-related costs averaged 169,038.15 XOF, accounting for 38% of the total cost. Diuretic therapy represented the largest component (58,532 XOF), followed by antiarrhythmic therapy (33,558.9 XOF) and anticoagulant therapy (28,475.6 XOF). Diagnostic investigations accounted for an average cost of 183,832.60 XOF, representing 42% of the total cost. Laboratory investigations constituted the largest component (123,709.80 XOF), followed by radiological and ultrasonographic investigations (60,122.80 XOF). Hospitalization and accommodation costs averaged 86,690 XOF, representing 20% of the overall cost. These costs included intensive care unit hospitalization (85,564.5 XOF) and hospitalization in the medical ward (96,230.85 XOF). In multivariable analysis, the mean total cost varied according to the underlying cardiac disease. Ischemic heart disease was significantly associated with higher costs (OR 3.2; 95% CI 1.6–6.5; p=0.001), as were valvular heart diseases (OR 4.08; 95% CI 1.1–14.4; p=0.029) (Table 4).

Table 4: Association between hospitalization cost and underling heart disease

Underling heart disease	n	Mean cost (XOF) ± SD	OR [95% CI]	p-value
Dilated cardiomyopathy	88	445,737.8 ± 225,122.2	0.59 [0.3–1.1]	0.101
Ischemic heart disease	43	670,404.7 ± 538,119.1	3.2 [1.6–6.5]	0.001
Hypertensive heart disease	33	389,691.8 ± 203,016.5	0.40 [0.1–1.0]	0.052
Valvular heart disease	15	502,205.6 ± 144,431.7	4.08 [1.1–14.4]	0.029
Peripartum cardiomyopathy	11	452,367.8 ± 303,969.5	0.2 [0–2]	0.203
Restrictive cardiomyopathy	5	593,212.6 ± 360,362.5	3.31 [0.5–20.3]	0.195
Hypertrophic cardiomyopathy	3	502,240.7 ± 585,577.8	1.07 [0–12]	0.954
Arrythmic heart disease	2	502,205.6 ± 144,431.7	4.2 [0.3–52.9]	0.250

No statistically significant association was observed between the cost of care and either NYHA functional class or the mode of cardiac decompensation (Tables 5 and 6).

Tableau 5: Distribution of hospitalization costs according to NYHA functional class

Cost component	Class II n = 12	Class III n = 128	Class IV n = 60	p-value
Diagnostic investigations	6,160.7 ± 3,178.8	77,553,6 ± 42 935,7	35,702.6 ± 19,735.4	0.706
Hospitalization/ accommodation	783,804.1 ± 193,094.5	448,408.9 ± 263,330.4	516,744.3 ± 263,539.9	0.54
Medications	70,597.6 ± 28,718.2	688,707.6 ± 271,969.6	409,125.8 ± 251,420.4	0.67

NYHA: New York Heart Association

Table 6: Distribution of hospitalization costs according to the mode of decompensation

Decompensation mode	n	(%)	Mean cost (XOF)± SD	OR [95% CI]	P-value
Left-sided	21	10.5	639,284.5± 699,700.6	0.84 [0.3-2.2]	0.737
Right-sided	16	8	416,744.7 ± 191,432.6	0.97 [0.3-2.9]	0.953
Global	137	68.5	473,355.8 ± 250,057.5	1.10 [0,5-2.0]	0.751
Acute pulmonary edema	16	8	523,742.93 ± 323,634.3	1.48[0.3-2.9]	0.954
Cardiogenic shock	10	5	492,193.5 ± 295,753.8	0.97 [0.3-5.3]	0.510

DISCUSSION

The primary objective of this study was to assess the direct cost of inpatient management of HF at the Abidjan Heart Institute. The study demonstrated a mean direct hospitalization cost of 439,560.75 XOF per patient, with values ranging from 303,171 to 1,340,306 XOF. This finding illustrates the substantial economic burden associated with hospitalization for HF in our setting. This financial burden is particularly concerning given that 72.5% of our patients had no health insurance, while a substantial proportion reported a monthly income between 100,000 and 300,000 XOF (49%).

From a sociodemographic perspective, patients aged 46–74 years represented the largest age group (72%), and the mean age was 55 ± 15.2 years, ranging from 18 to 87 years. These findings are broadly consistent with those reported in several African studies. Baragou *et al*., in Togo reported a mean age of 57.42 ± 13.86 years [8], while Stewart *et al*., in South Africa reported a mean age of 55 ± 16 years [9]. In France, the mean age of patients hospitalized for HF was substantially higher, at 73.5 years [10]. This difference may be explained by the lower life expectancy in African populations, the earlier occurrence of cardiovascular risk factors, and limited access to specialized healthcare. In our cohort, nearly half of the patients (49%) had a monthly income between 100,000 and 300,000 XOF, while 26.5% had a monthly income below 100,000 XOF and 10.5% reported no income. Regarding health insurance coverage, the majority of patients (72.5%) were uninsured. These findings are comparable to those reported by Koffi KSA [11], in a study conducted at the Abidjan Heart Institute, in which 55% of patients were uninsured and 7% were classified as socially disadvantaged.

The Universal Health Coverage (UHC) system, a mandatory health protection mechanism established by the Ivorian government to protect the population against health-related risks, was introduced with the objective of improving access to quality healthcare. Its effective integration into the functioning of healthcare facilities and public health institutions could reduce patients' out-of-pocket contributions to the cost of care.

The mean direct cost of inpatient HF management at the Abidjan Heart Institute was 439,560.75 XOF. This cost appears high compared with several African studies. Baragou *et al*., [8], in Togo estimated the mean overall cost of inpatient HF management at 223,559 XOF. Similarly, Gombet *et al*., [12], in Brazzaville reported a mean cost of 81,900 ± 10,474 XOF for the emergency management of HF. These studies therefore reported substantially lower costs than those observed in our cohort. The higher cost in our setting may be explained by the large number of laboratory and imaging investigations performed both at admission and during hospitalization.

Furthermore, the study by Gombet *et al*., [12] focused on emergency care, with a substantially shorter hospitalization duration of approximately 45 hours. A more recent study conducted at the Abidjan Heart Institute in 2020 among 150 patients reported a mean cost of 490,500.8 XOF, which was relatively close to our estimate [13]. This similarity suggests that the direct cost of HF hospitalization remains high at the Abidjan Heart Institute despite differences in study periods and patient populations.

The economic burden of HF is not limited to low- and middle-income countries. In high-income settings, HF remains a major driver of healthcare expenditure, largely due to recurrent hospitalizations. In Europe, adjusted annual total costs per patient range from €3,452 to €23,335, while in the United States, medical costs remain substantial, with hospitalizations and recurrent care accounting for most expenditures [14, 15].

In France, where social health insurance provides broad access to healthcare, HF remains associated with a substantial economic burden. In a nationwide study, hospitalized HF patients had an annual hospitalization cost of €8,341.3 per patient, highlighting the major resource use driven by this condition [16].

The analysis of factors associated with healthcare costs constitutes an important component of our study. The mode of decompensation was not statistically associated with the mean hospitalization cost. Nevertheless, the mean cost of managing acute pulmonary edema was approximately 1.4 times higher than that associated with other modes of decompensation, reaching 523,742.9 ± 323,634.3 XOF. Although this difference was not statistically significant, the observed trend may be explained by the emergency nature of acute pulmonary edema, which requires close monitoring, parenteral treatment, and multiple complementary investigations.

In contrast, multivariable analysis identified ischemic heart disease (OR 3.2; 95% CI 1.6–6.5; p=0.001) and valvular heart disease (OR 4.08; 95% CI 1.1–14.4; p=0.029) as significantly associated with higher costs of HF management. These associations may be related to the greater diagnostic and therapeutic complexity of these underlying cardiac conditions. Ischemic heart disease may require more costly investigations, including coronary angiography, as well as antithrombotic and anti-ischemic therapies. Valvular heart diseases may require repeated echocardiographic assessments and specialist evaluation for potential surgical intervention. Like other cardiovascular diseases, HF remains associated with substantial hospitalization-related costs in sub-Saharan Africa **[17]**. Our findings therefore underscore the importance of preventive strategies and improved healthcare organization to reduce the economic burden of HF.

Study Limitations

Our Study Had Several Limitations:

- Indirect costs were not assessed.
- The study was conducted at a single center, which may limit the generalizability of the findings.

CONCLUSION

In conclusion, our study highlights the substantial financial burden associated with inpatient management of HF in Côte d'Ivoire. The mean total cost was 439,560.75 XOF (US$724.15), with diagnostic investigations (183,832.60 XOF) and pharmacological treatment (169,038.15 XOF) representing the main components of expenditure. This financial burden is of particular concern given that the majority of patients did not have health insurance coverage. The identification of ischemic and valvular heart diseases as factors associated with higher healthcare costs further emphasizes the importance of early diagnosis and appropriate management of underlying cardiac conditions. Strengthening cardiovascular disease prevention, therapeutic education, and health insurance coverage may contribute to reducing HF-related hospitalizations and, consequently, the associated economic burden in Côte d'Ivoire.

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