
Assessing the Direct Hospital Costs of Stroke in Libreville (Gabon)

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Abstract: Introduction: Gabon faces a double epidemiological burden, with persistent infectious diseases and an exponential increase in noncommunicable diseases such as stroke. The growing burden related to stroke is an additional challenge for our health care system. Massive amounts of money are spent annually in industrialized countries to improve stroke management. In contrast, the costs borne by the families and the society are both poorly evaluated in Africa. The objective of this study was to assess the direct hospital cost of stroke in Libreville, Gabon. Methods: By means of an economy-based prospective multicenter study, with descriptive and analytical focus, carried out from 1st March to 31st July 2020, data from all stroke inpatients on the different consumption functions was collected using the so-called Bottom-up method. The cost to society and the patient was considered; the CFA franc was the cost unit (1 EUR = 655 CFA francs). Multiple linear regression analysis was applied to identify the factors associated with cost. Results: The study included 50 patients, sex ratio was 2.1 in favor of men. Mean age was 54.8 (\pm 11.1) years. The NIHSS neurological score at admission ranged from 4 to 27 with a mean of 10.5 (\pm 5.1). Ischemic stroke was predominant in 70% of cases. The average length of hospital stay was 14.2 (\pm 8.6) days, and the mode of discharge was a return home for 45 patients (90%). During hospitalization, the total direct cost expenditure varied from 266.97€ to 3,376.74€ with a mean of 933.44€ \pm 611.13€ or (1,046.48 \pm 767.75USD). Factors associated with the average direct cost were the length of hospital stay (longer) and Rankin score (mRS) at discharge. Conclusion: This study highlights the heavy cost of stroke management in Libreville, but the National Health Insurance and Social Guarantee Fund (CNAMGS) is an asset since it reduces the cost of stroke by facilitating better financial management for the Gabonese population.

Keywords: Cost, Direct Cost, Stroke, Gabon

1. Introduction

Stroke is a major public health problem and is measured not only in terms of epidemiology, therapeutic management in the acute phase or in secondary prevention and prognosis, but also in terms of the individual and societal costs it generates. Stroke management has been improved in recent years, particularly in industrialised countries, by setting up an organised care system from the acute phase management through to rehabilitation [1]. Heavy use of health and social

resources are required in stroke management. The overall cost of stroke in Europe across 32 countries was estimated at €60 billion per year in 2017, of which €27 billion (45%) was funded by health services, accounting for 1.65% of health system budgets in these countries [2].

In sub-Saharan Africa, more remains to be done with a health system unable to meet the full needs of the population [3]. Studies in sub-Saharan Africa have shown that the average cost of stroke is higher than purchasing power. Indeed, health financing is provided by patients; the

governments have little involvement in health care in some sub-Saharan countries [4, 5]. Stroke costs, productivity drop due to acquired disabilities, stroke deaths, and lost working hours by caregivers contribute substantially to poverty where majority of the population driving forces are young. Preventing noncommunicable diseases is one target of the Millennium Development Goals. Costing studies are costs for more effective actions. We therefore conducted a study in Libreville to evaluate stroke management costs in hospitals and to determine factors related to hospital direct costs of stroke.

2. Methodology

This is a multicentre study conducted in 3 hospitals in Libreville (Gabon): Libreville University Hospital Center (CHUL), Omar Bongo Ondimba Army Instructions Hospital and Jeanne Ebori Hospital. This descriptive, analytical, economic-based prospective study, took place from March 1st to July 31st, 2020, and included inpatients with ischemic or haemorrhagic stroke confirmed on brain imaging. Data collection was done prospectively using a standardized survey form. The dependent variable was the direct health cost, which is a summation of different costs (care visits, transportation, treatment, paraclinical examinations, rehabilitation, hospitalization costs, other charges during hospitalization) and the monetary value of the time spent by the main carer. The independent variables were sociodemographic (age, gender, number of children [or dependents] and sector of activity), clinical (NIHSS neurological score at admission, blood pressure, blood glucose, type of stroke, time to admission), hospital (length of hospital stay, hospital ward), functional prognostic scores (mRS at discharge, NIHSS at discharge, mode of discharge), and aetiological (type of ischaemic stroke, type of haemorrhagic stroke). The data were entered with Microsoft Office Excel 2007, then processed and analyzed using SPSS (Statistical Package for Social Sciences) version 8 and Epi-info version 6.04. Quantitative variables were expressed as means and standard deviations, and qualitative data as percentages with their 95% confidence intervals. The total cost was equal to the sum of the different expenses (visits, transportation, medication, hospitalization, paraclinicals, carers and other expenses). The carers' cost was calculated as the product of the monthly income and the number of days, divided by 30.5. The paraclinical cost was calculated by adding the different costs of paraclinical examinations undertaken by the patient. Specific costs per type of stroke, according to the degree of neurological impairment, the mRS at discharge, and other clinical and sociodemographic parameters were calculated. Comparison of categorical variables was performed using the chi-2 test and of means by the student test. For the multivariate analysis, a multiple linear regression was used, using successive iterations of the stepwise descending type, and introducing all variables significantly associated with the cost in the univariate analysis. A final model of the equation with Beta coefficient,

standard error and p-value was determined. For these comparisons a $p < 0.05$ was considered statistically significant.

3. Results

During the study period, 100 patients with stroke were admitted to the different centers (Figure 1). The study included 50 patients with complete data, 68% were men, 32% were women. The sex ratio was 2.1. The age ranged from 32 to 79 years with a mean of 54.8 (± 11.1) years. Most of our patients had social security coverage, 12% (6) had 100% coverage, 36% (18) were covered by the National Health Insurance and Social Guarantee Fund CNAMGS for 80%, 1 had 30% coverage and 25 had no medical coverage. The NIHSS neurological score at admission ranged from 4 to 27 with a mean of 10.5 (± 5.1). Stroke was predominantly ischemic in 70% of cases, 35 patients. Patients with ischemic stroke had a less severe neurological score of 9.2 (± 4.1) than those with hemorrhagic stroke (NIHSS 13.5 (± 5.9)). The cost of stroke did not increase with increasing neurological score but according to the ischemic type of stroke. Table 1 sets out the cost and clinical data. The length of hospital stays ranged from 1 to 36 days with a mean of 14.2 (± 8.6) days, the median being 12.5 days. The mode of discharge was a return home for 45 patients (90%) and the remaining 5 patients (10%) were deceased. In terms of disability score (mRS), 27 patients (54%) were independent (mRS ≤ 2), 18 patients were dependent with an mRS between 3 and 5; five patients (10%) were deceased (mRS = 6). During the hospitalization period, the total direct cost expenditure varied from 266.97€ to 3,376.74€ with a mean of 933.44€ \pm 611.13€ or (1,046.48 \pm 767.75USD). Table 2 shows the distribution of stroke costs by consumption items. All patients had a principal carer. Based on the income of each caregiver and the number of days spent, the cost of time spent by caregivers ranged from €0 to €299.89 with a mean of €60.40 (± 81.52) and a median of €24.66. Eighteen patients (36%) were insured by the CNAMGS. The average direct cost was the sum of the different medical consumption functions, at 361.02€ (± 149.30 €) with extremes ranging from 133.97€ to 774.89€ and a median of 353.76€. In univariate analysis, the factors associated with mean direct cost were: ischemic stroke, length of hospitalization, and mRS at discharge. In multivariate analysis, only longer hospital stay and higher mRS remained factors associated with direct hospital cost of stroke (Table 3 and Table 4).

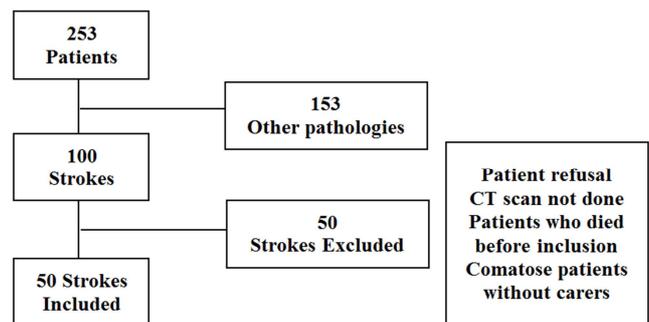


Figure 1. Flow chart showing the inclusion of patients in the study.

Table 1. Cost Breakdown by Clinical Data and Stroke Type. Univariate analysis.

	Mean (\pm SD)	P
NIHSS* at admission		0,521
<5	969 (\pm 471)	
5-10	862 (\pm 438,5)	
10-15	1104,9 (\pm 670,6)	
15-20	1124,6 (\pm 1147,7)	
>20	406,39 (\pm 123,9)	
Stroke subtypes		0,043
ischemic stroke	1044,6 (\pm 679,1)	
Hemorrhagic stroke	724,3 (\pm 337,29)	

National Institutes of Health Stroke Scale*

Table 2. Stroke Costs (in €) by Consumption functions.

Consumption functions	Mean (SD)	[Min-Max]	Median	Total cost %
Transportation	30,47 (\pm 72,89)	[0-480,38]	8,01	3,2
Visit to patients	9,70 (\pm 7,30)	[4,58-45,75]	7,63	1
Exams	366,86 (\pm 216,28)	[108,28-874,52]	295,09	38,7
Drugs	95,77 (\pm 80,02)	[18,30-427,01]	72,21	10,1
Hospitalization	320,93 (\pm 424,19)	[21,96-2196,03]	153,42	33,9
Physical medicine and rehabilitation (PMR)	11,26 (\pm 18,76)	[0-122]	11,21	1,2
Others	51,98 (\pm 64,32)	[0-285,94]	24,40	5,5

Table 3. Distribution of costs in euros according to the length of hospitalization and according to the hospitalization service. multivariate analysis.

Variables	Mean (SD)	P
Length of hospital stay		0,014
0-5	443,82 (\pm 176,90)	
5-10	766,60 (\pm 304,17)	
10-15	1074,75 (\pm 531,12)	
15-20	753,31,4 (\pm 358,96)	
>20	1331,10 (\pm 852,75)	
Hospitalization Department		0,0001
Neurology	733,81 (\pm 293,46)	
Cardiology and others	1619,95 (\pm 791,33)	
Intensive Care Unit	882,45 (\pm 617,53)	

Table 4. Costs (in €) related to disability grade (mRS) at patient's discharge. multivariate analysis.

Disability grade	Mean (\pm SD)	P
mRS		0,040
0-2	1 129,53 (\pm 736,55)	
3-5	802,40 (\pm 315,85)	
6	483,51 (\pm 193,08)	

4. Discussion

Non-communicable diseases are a leading cause of death in the world. Cost assessment allows better management and prevention strategies [6]. In Gabon, stroke is the main cause of hospitalization in neurology, accounting for 42.9% [7]. In our study, its direct cost varied from 266.97€ to 3,376.74€ with an average of 933.44€ \pm 611.13€ or (1,046.48 \pm 767.75USD) per patient. The main resource consuming items were paraclinical examinations with an average of 366.72€ (\pm 216.20) or (411.13 \pm 242.38 USD) and hospitalization with an average of 334.54€ (\pm 424.04) or 375.05€ \pm 475.39 USD. The cost/GNP (Gross National Product) per capita ratio in our study showed that the direct

cost of stroke per patient in acute phase was 1.7 times the GNP per capita, out of an estimated GNP of 10 000 USD. Health insurance therefore is needed to reduce medical costs by 2/3 to an average of €361.02 (\pm €149.30) for covered patients. The health insurance support, which can cover up to 85% of medical costs, still leaves low-income patients with great financial difficulties, having to make an impossible choice between spending their meager household resources on essential treatment and food, and creating the famous vicious circle of illness, reduced income and poverty known as the "medical poverty trap" [8]. There is great variability in stroke costs from one region to the next and from one country to the next [4, 9]. This variability can be explained on one hand by the cost of living, on the other hand by the health care system and the different methodological practices. According to comparative cost studies conducted in sub-Saharan Africa, direct hospital costs of stroke per patient are much higher than per capita incomes. In Benin, Adoukouou and al [4] and Agnon Ayélola and al in Togo [9] found a respective average cost of €482.97 with a GNP/capita 1.03 times higher and €590.66 with a GNP/capita 1.6 times higher [4, 9]. Gombert T. R. and al in Brazzaville reported an average direct hospital cost of 241.05€ (\pm 105.18€) per patient in the acute phase, which was 2.3 times the GNP [10]. In Cameroon, Kuate Teguet and al estimated a very high average cost of hospital stroke management, amounting to 17 times the minimum wages [5]. It is twice as high for hemorrhage treatments [5]. European and industrialized countries have higher purchasing power. In France, the healthcare system is administered largely by the public authorities. The government is deeply involved in the financing and organization of healthcare and medical-social services. The total cost of stroke is a heavy burden and amounts to 5.3 billion euros per year, or 3% of total healthcare expenditure. Per capita health care costs are

approximately €16,700 in the first year, 60% of which is hospital care [11]. In the USA, according to The American Heart Association, Americans spend an average of \$45.5 billion per year in direct and indirect stroke costs [12]. There is no national health insurance system in the United States as there is in France. Health care is extremely expensive for those who cannot afford private insurance [12]. In China, where stroke incidence is the highest in the world, there are disparities in healthcare availability. The large rural population lacks access to basic care. Because of financial constraints, 60% of the population has never visited a hospital and 40% has never consulted a health professional due to their high costs as a result of a reduced public contribution [8]. Moreover in urban population, in Guangzhou City, the largest and most developed city in southern China, the average hospitalization cost for stroke patients was CNY20,203.1 (USD3,212.10) [13]. Types of stroke, types of insurance, age, comorbidities, disease severity, length of stay, and hospitalization levels were significantly associated with stroke-related hospitalization costs [13]. In Brazil, the median cost of stroke per patient was US\$7470, it is under-funded by the Brazilian public healthcare system. The in-hospital cost of a patient with cerebral reperfusion was significantly higher than conservative treatment, up to 4 times higher for those with combined reperfusion [14]. Furthermore, it was found in our study that direct hospital costs for cerebral infarction, €1043.09 (\pm 678.19), were higher compared to intra-cerebral hemorrhage, €723.26 (\pm 336.81). This was not related to cerebral reperfusion treatment, but to the heavy costs of paraclinical examinations with an average of 366.72€ (\pm 216.20€) and accounted for 38.7% of the average direct hospital cost, but the type of stroke was not associated with the cost of the stroke. Further authors found an association with hemorrhagic stroke based on the longer average length of hospitalization for hemorrhagic stroke (12 ± 7.46 days) than for ischemic stroke [4, 5]. The average direct cost of stroke in our study was associated with a significantly longer duration of hospitalization and also by the loss of autonomy assessed by the Rankin score greater than 2. A longer hospitalization stay increased the overall cost of management ($p < 0.001$), which was also observed by other authors [13, 15]. Patients with a longer stay had more complications and a greater neurological deficit.

The direct cost of stroke decreased considerably with the increase in the level of disability of the patients. This situation could be explained by the fact that a high Rankin leads to a limitation of additional examinations and possibly poorer care. For deceased patients, there is a reduction in expenditure in relation to a short duration of hospitalization for death.

5. Conclusion

In addition to the physical, emotional, and cognitive impact of stroke, patients may also face financial challenges. The cost of stroke management can lead to delays in

diagnosis and treatment, which can result in recurrent strokes. In Gabon the average direct cost is 933.44€ \pm 611.13€ or (1,046.48 \pm 767.75USD). Longer hospital stay and higher mRS remained factors associated with direct hospital cost of stroke. The advent of a national health insurance fund (CNAMGS) has been beneficial to the population, since it has reduced costs by two-thirds in order to meet the country's health challenges. One of the Millennium Development Goals is to progress towards universal health coverage and reduce the financial impact of stroke.

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