ORIGINAL ARTICLE

Clinical characteristic of a Haitian stroke cohort and a scoping review of the literature of stroke among the Haitian population

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Abstract

Background and aim: There are significant disparities in stroke care and outcomes between low- and middle-income countries compared to high-income countries. Haiti, a lower-middle-income country, suffers from a lack of resources for acute stroke management. This study is the first to report the epidemiological profile of the Haitian population presenting with stroke symptoms at the largest academic hospital in the nation.

Methods: This is an observational study conducted over a period of five months from April 2021 to August 2021 in the Internal Medicine Department of the State University Hospital of Haiti. There were 51 included patients who were suspected to have had an acute stroke. A descriptive statistical analysis was conducted. A scoping review of the literature was also conducted.

Result: Over 50% of included patients were between 19-65 years old. The mean age at presentation was 61 years, and patients were predominantly female (64.7 %). The prevalence of severe motor deficits was over 96 %. The mean National Institutes for Health Stroke Scale was 12. Only 15.7% of patients (8/51) had a CT scan during their hospitalization. The median time to CT scan was 84 hours after symptom onset. 80% of those with complications took more than 24 hours to arrive at the hospital after the onset of symptoms. Eleven percent of patients had complications, and the mortality rate was 3.9%. There was a significant association between the Modified Rankin Scale and the occurrence of complications (p=0.016). NIHSS score had a significant association with the Glasgow score (F=6.3; p<0.001) where an inversely proportional correlation was observed between them (r= -0.7; p<0.001) and a proportional correlation with the Rankin prediction score and the NIHSS (r=0.3, p=0.04). Little is known about the epidemiology of stroke patients in Haiti, and this limits the ability to develop targeted interventions to improve outcomes. In our scoping review, only three pertinent studies were identified over a 25-year period, this leads to a lack of data in regard to stroke care in Haiti mainly due to the absence of trained personnel.

Conclusion: In our cohort Stroke is mainly affecting female patients. The majority of stroke patients have moderate cerebral deficits and took more than 24 hours to arrive at the hospital. Urgent assistance is needed to strengthen personnel and infrastructure dedicated to stroke. Neurological assessment based on NIHSS and Rankin score should be systematic in stroke evaluation in Haiti.

Relevance for patients: This study is relevant for patients because it emphasizes the challenges of stroke management in Haiti due to the non-availability of reference drugs, the time to arrive at the hospital to start treatment, as well as the means of diagnosis which are limited, like the CT scan. While stroke prevalence is on the rise in the country, it is the highest in the Caribbean and Latin America region. This study is a wake-up call on the need for a stroke center in the country, with appropriate diagnostic equipment and well-trained staff, with an emphasis on continuing education and research.

1. Introduction

Haiti has the highest incidence of stroke in the Caribbean and Latin American region with 176 cases per 100.000 population, this is two times higher than the neighboring country of the Dominican Republic, [1] it and represents the most frequent cause of admission to the emergency room. [2], [3] However, little is known about the epidemiology of stroke in Haiti. In the Global Stroke Statistics 2019 report [4], Haiti was noted to have a low stroke mortality rate, but the authors acknowledge that the data is more than 18 years old. In a report from World Health Organization (WHO) in 2021 [5], 31% of mortality in Haiti can be accounted for by cardiovascular events. Acute stroke treatment is time-dependent,[6] and it includes intravenous thrombolysis, mechanical thrombectomy, or anticoagulation reversal depending on the stroke subtype. Early management has been shown to promote better outcomes. In Haiti, there are no data available on the time to hospital presentation for stroke patients, and there is no systematic use of the National Institutes for Health Stroke Scale (NIHSS) score to measure stroke severity, and unfortunately, thrombolysis and thrombectomy are not yet practical in Haiti, due to lack of availability and cost. Our study aims to describe the clinical characteristics of stroke patients in the largest hospital in Haiti and to highlight challenges associated with stroke management, including delays in presentation and challenges to imaging acquisition and treatment. We also conducted a scoping review of the literature about stroke in the Haitian population.

2. Methodology

This is an observational prospective cohort pilot study and a scoping review of stroke in Haiti. The cohort study was conducted over five months from April 2021 to August 2021 in the emergency department of the internal medicine of the State University Hospital of Haiti (HUEH), the main teaching hospital of the Faculty of Medicine of the Haitian State University. We wanted to extend the study over one year, but due the instability and repetitive strikes at the hospital we had to limit our observations on five months.

All stroke cases received and admitted to the emergency department of the internal medicine were included, sample were not considered for the study. We included stroke patients with complete neurological assessment with Glasgow, NIHSS and Rankin score. Patients referred to us did not often have these parameters, as neurological evaluation with Rankin score and NIHSS is not systematic in other internal medicine departments in the country, are not included without them. During this period, we identified 51 cases with a clinical diagnosis of stroke that were admitted to HEUH with neurological assessment. All stroke cases admitted were considered with any precision on subtype. Patient data was extracted from the medical record using a standardized collection form. Data extraction spanned from the time of admission discharge or death. Anonymity and confidentiality of patients were protected, and oral consent was obtained from relatives or responsible parents. The data collection form included details on demographic data such as age, sex, address, occupation, level of education and marital status; clinical data such as chief complaint, history and/or associated defects, date and time of symptoms onset, admission date, vital signs, time to computed tomography (CT) scan, length of stay, referral or not; and neurological deficits including language, motor and sensory deficits, NIHSS score on admission, Modified Ranking Scale (mRS), Glasgow score, state of consciousness, and outcomes such as complications, death or recovery. The NIHSS score was used to categorize stroke into mild (1-4), moderate (5-15), severe (16-20), and grave (>20). The mRS was used, at the first clinical evaluation at admission, to categorize stroke outcome as favorable (0 to 1 point) or unfavorable (2 to 5 points) depending on the newly considered mRS dichotomization [7]. Arrival

time was considered as the time of arrival to hospital after stroke onset. This was classified into five categories: <3 hours; [3-6];]6-12];]12-24]and >24 hours after symptom onset.

The data were then entered into Excel and exported to SPSS 26 for processing and analysis. A descriptive analysis of demographic and clinical parameters was performed and presented in table and graph form. Correlation analyses were performed between the NIHSS score and the variables age, time of arrival, SBP, DBP, Glasgow score, ranking score, and length of stay in hospital. Multiple regression analysis was used to identify significant correlations. An ANOVA test was used to verify associations, Student's t tests were performed for comparison of means, and the Levene test was used for homogeneity of variances. The significance level was set at $p<0.05$.

A scoping review of the literature was conducted (Table 2). The authors developed a search in PubMed/Medline, EMBASE, Scopus, clinical trials.gov and the Cochrane Library along with several grey literature sources. The searches were conducted from circa January 1997 to January 2022. The search was limited to English and French. Both subject headings and article text were searched for the following terms: "ischemic stroke", "cerebrovascular disease/stroke", "hemorrhagic stroke", "brain ischemia", "acute stroke", "acute ischemic stroke", "intracranial occlusion", or "arterial occlusion", "subarachnoid hemorrhage" AND "Haiti", "low to middle income countries", and "Haitian populations". Only three pertinent studies were identified over a 25-year period.

3. Results

3.1 Demographics

There were 51 included patients who were admitted for stroke based on clinical evaluation to the internal medicine department at HUEH from April 2021 to August 2021. Nearly two-thirds (64.7 %) of our patients were women, and the mean age was 61.60±16.13 years. More than 50% of our patients were between 19-65 years old, and there was a predominance of women in all age groups. However, males had a slightly higher mean age than females (62.94 vs. 60.88 years, respectively) (Figure 1).
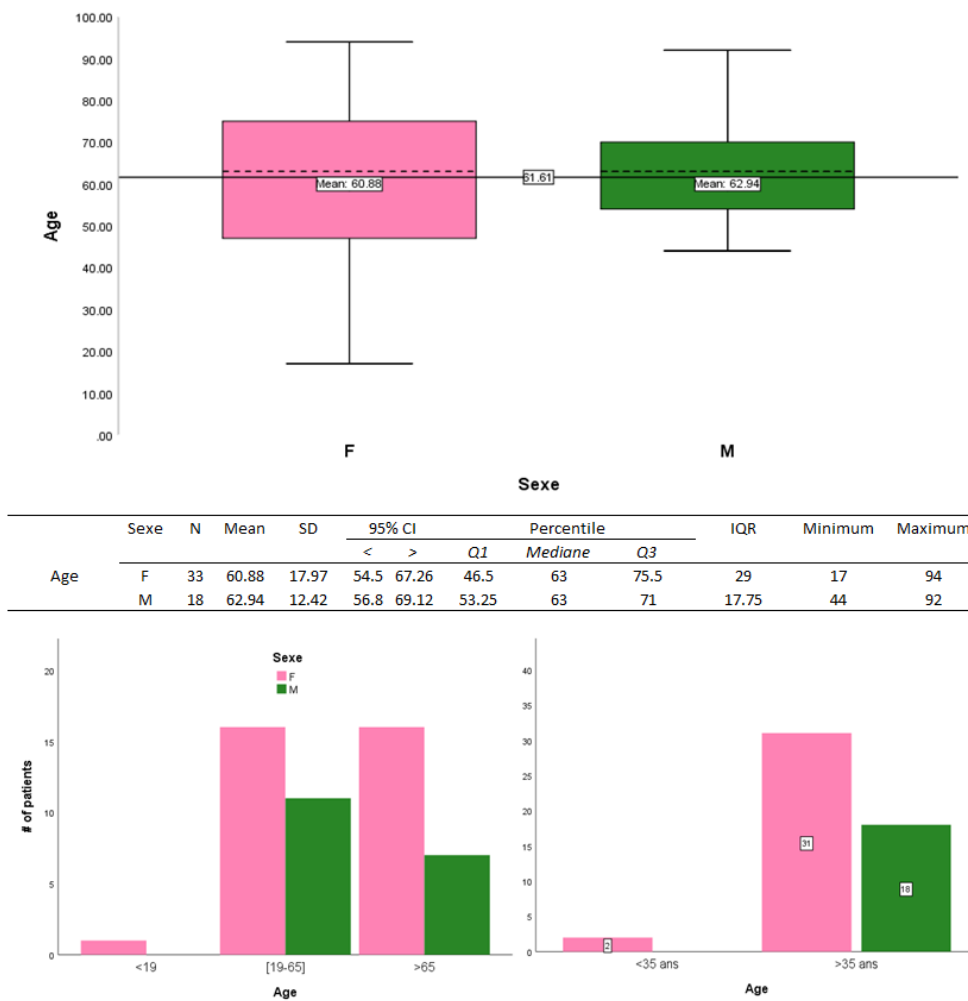

	Sexe	N	Mean	SD	95% CI		Percentile			IQR	Minimum	Maximum
					<	>	Q1	Mediane	Q3			
Age	F	33	60.88	17.97	54.5	67.26	46.5	63	75.5	29	17	94
	M	18	62.94	12.42	56.8	69.12	53.25	63	71	17.75	44	92

Figure 1. Bivariate analysis between age and sex for our 51 patients. Figure 1A: A box-and-whiskey plot of patient age stratified by sex. Figure 1B: A histogram showing number of patients by age category and sex. Figure 1C: A histogram showing number of patients above and below 35 years of age by sex.

The districts of Port-au-Prince and Carrefour (the closest to the HUEH) were the most represented, constituting 47% and 25% of included patients, respectively. The most common occupation was retail (49%).

3.2 Clinical Presentations

The three main chief complaints were: altered mental status (18 patients, 35.29%), hemiplegia (10 patients, 19.60%) and aphasia (13 patients, 25.5%). The findings of neurological examinations are described in Table 1.

Table 1. Clinical characteristics of patients presents with acute stroke symptoms to HEUH.

Demographics	Findings (n; %)
Age (Mean±SD)	61.60±16.13
<19 years	(1; 2%)
[19-35] years	(1; 2%)
]35-65] years	(26; 51%)
>65 years	(23; 45%)
Sex (%Female)	(33; 64.74%)
Chief Complaints	
Aphasia	(13; 25.50%)
Dysarthria	(15; 29.4%)
Facial drop	(34; 66.6%)
AMS	(20; 39.2%)
Hemiparesis	(15; 19.4%)
Limb ataxia	(1; 2%)
Hemiplegia	(28; 54.9%)
Monoplegia	(3; 5.8%)
Paraparesis	(1; 2%)
Hypoesthesia	(12; 23.5%)
Co morbid medical illnesses	
Hypertension	(33; 65%)
Diabetes	(2;4%)
Heart Disease	(1;2%)
Epilepsy	(1;2%)
None	(14; 27%)
Average arrival Time (Mean±SD)	75±108 hours
NIHSS (Mean±SD)	12±6 points
Minor	(4; 7.8%)

Moderate	(21; 41.2%)
Severe	(7; 13.7%)
Grave	(4; 7.8%)
Time to CT (Mean±SD)	84±44 hours
GCS (Mean±SD)	11.47±3.38
Severe	(10; 19/6%)
Moderate	(19; 37.3%)
Low	(22; 43.1%)
Average Length of Stay (Mean±SD)	10±7 days
Outcome	
mRS 0-2	(38; 74.50%)
mRS 3-5	(11; 21.60%)
mRS 6	(2; 3.90%)

Aphasia was present in 25.5% of the cases, dysarthria in 29.4%, facial paralysis in 66.7%, a motor deficit in 96.1% of the cases with right sided deficit in 41.1% and left sided 49.1%; and a sensory deficit in 23.5% of the cases. About 10% were referred from small urban clinics. Nearly two-thirds of the patients (65%) were known to have hypertension and 4% were diabetic. The mean time to arrival at the hospital after symptom onset was 75.14 hours. The NIHSS score was only valuable for 36/51 patients with a mean 12.58 points (Table 1). We found that 7.8% of patients had mild stroke, 41.2% had moderate stroke, and 13.7% had severe stroke. 74.5% of the patients had a baseline mRS between 0 to 2 (Table 1).

3.3 Outcomes

Only 15% of patients (8/51) had a CT scan during their hospitalization. The majority were delayed with a median time to CT of 84 hours after symptoms onset. The most common finding ischemia in one of the middle cerebral artery territories. Patients spent about 10 days in hospital after admission. Six complications were from aspiration pneumonia, and two in-hospital deaths were recorded (3.9%). The patients with complications were generally over 65 years of age (83.3%) with a mean age of 69.33±25.48 compared with 60.5±14.58 for uncomplicated cases. This was not a statistically significant difference (t=1.25; p=0.21). We observed that 80% of those with complications took more than 24 hours to arrive at the hospital after the onset of symptoms, on average 129.33±105.09 hours compared with 66.11±106.63 hours for uncomplicated cases. This also was not a statistically significant difference (t=1.34; p=0.18). All cases of complications were in the category of moderate stroke, with mean NIHSS scores of 17.33±14.46 point for complications vs 12.15±5.85 for uncomplication (t=1.28; p=0.20), and the variance was homogeneous according to Levene's test F=9.80; p=0.004. However, no association was found between complication and NIHSS score (F=1.65; p=0.20). Two-thirds (66.7%) of patients had a moderate Glasgow score (9-12). (Table 1) There was a significant association between the mRS and the occurrence of a complication (F=6.33; p=0.016). The mRS was higher in patients with complications with a score >3 vs. (0 to 2) in the patients without

complications, and the difference was significant (t=2.51; p=0.016). It should be noted that the variance in this group is not homogeneous when considering the Levene test F (5) =5.98; p=0.019. A mRS of 0.5 (cut off point) has a sensitivity of 60% and a specificity of 86% to predict the occurrence of a complication with an accuracy of 76% (AUC=0.76). (Fig.: 2)
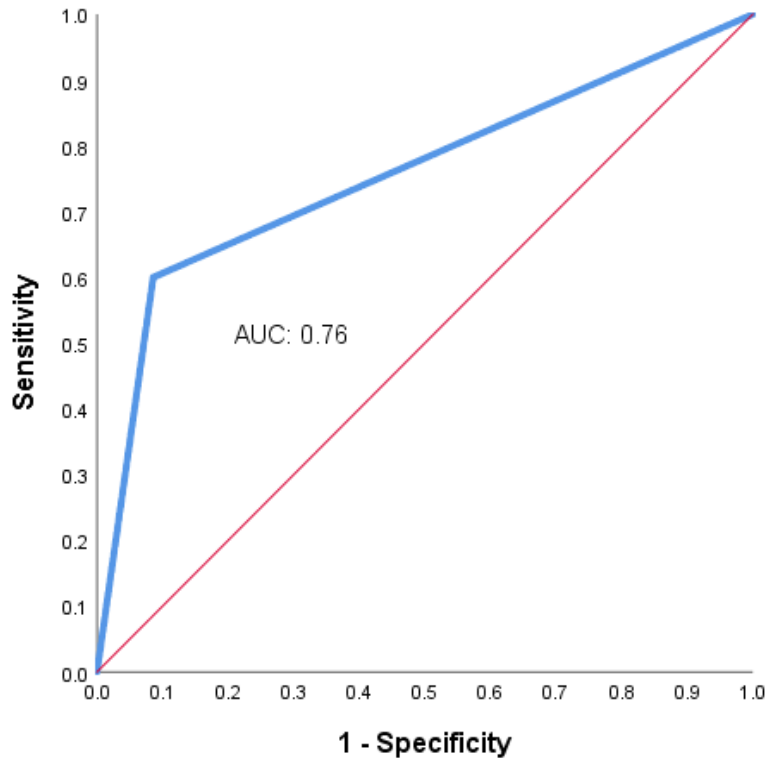

Figure 2. ROC curve analysis to assess the sensitivity and specificity of the Rankin score in the risk of complications.

4. Discussion

Stroke is one of the leading causes of death and disability in the world.[8] In Central America and the Caribbean, Haiti has the highest mortality rate from stroke.[1] To our knowledge, this is the first study describing sociodemographic and clinical characteristics of stroke patients in Haiti as well as the scarcity of human and material resources in terms of stroke care.

For the 51 patients of our study, a predominance of women was observed which is similar to international studies [9], [10] where 55,000 more annual cases of stroke were in women. [11] However, in our study, men were slightly older than women (62.94 vs 60.88 years). This is different from international observations where women with stroke are often older than men. [11]–[13] The mean age of our patients is 61.60 years compared with the global average age of stroke patients of 70 years. Strokes among Haitian patients are occurring an average of 10 years earlier than those in developed countries.[1] For instance, Abreu et al reported an average age of 70 years,[12] and Soto et al reported an average age of 75.39 years.[14] The average age of our study is close to some developing countries such as Jordan where Qawasmeh et al reported an average age of 66.5 years, and in Tanzania where Matuja et al reported an average age of 57.9 years [13], [15] Regarding occupation, almost half of included patients (49%) were retail merchant operating in the informal market. This demonstrates that stroke is affecting patients in their economic prime, which imposes a significant economic burden to the society. Moreover, 65% of included patients had hypertension which is a treatable risk factor for stroke. It has been shown that the incidence of stroke is increasing in low-income countries compared with high-income countries. [16], [17] One explanation for this is the impact of social determinants such as poverty, education, lifestyle, and stress on the cardiovascular system, including hypertension. [14], [18], [19] A 2021 report by the WHO reported that about one-third of mortality in Haiti is related to a cardiovascular event.

There is evidence that delay in seeking care compromises management, diagnosis and outcomes in stroke patients. [20], [21] Factors such as symptom onset, history, gender, and stroke severity are known to influence the time arrival at the hospital. [21] The mean time to hospital after symptom onset in our study was 75.14 hours, or 3.13 days. Approximately 39.2% of patients arrived after 24 hours, and more than half or 51% of patients arrived after 12 hours. These are much longer delays than reported elsewhere in the literature; for example, publications have reported a mean time to arrival at the hospital of 21.96 hours in China and 10.73 hours in the USA. [17] The recommended ideal time is less than 4.5 hours to allow for the use of intravenous thrombolysis and between six and 24 hours for endovascular thrombectomy,[21], [22] both treatments that are not available in Haiti. We observed wide variability in time to arrival based on sex (99.16 hours for women vs 7.45 hours for men), a difference was significant (t=-2.59, p=0.013). Similar findings are described in a study by Le et al, in which women faced greater delays than men. [21]

Immediate assessment, including neurological evaluation, is critical in the management of stroke patients. Several scores are used to assess the neurological status of stroke patients, including the Scandinavian Stroke Scale (SSS), the Canadian Neurological Score (CNS), the modified Rankin Scale (mRS), and the NIHSS score. [23] The NIHSS score is the most widely used because it allows estimation of the neurological impact, severity, complications, and prognosis of stroke with simplicity, rapidity, and good sensitivity and reproducibility. [24], [25] In our study, the NIHSS score, and the Glasgow score were used to assess and categorize stroke severity, and the modified Rankin score was used to establish pre-stroke functional level. In 80% of cases, patients who developed complications arrived after 24 hours from the onset of symptoms (129.33±105.09 hours, p=0.18). All of these had a moderate stroke according to the

NIHSS score (17.33 vs±14.46, p=0.20). Similarly, Schlegel et al observed an association between NIHSS score and complications (p<0.001). Garavelli et al made the same finding (p=0.048), and Bovim et al observed that 85.4% of the cases of complications had a delay of more than 24 hours after the onset of symptoms. [25]–[27] The mRS score was higher in patients with complications (1.20±1.64 vs 0.17±0.70), with a statistically significant difference (t=2.51; p=0.016). The Rankin score was significantly associated with the occurrence of complications in patients with stroke (p=0.016), such as aspiration pneumonia, with a sensitivity of 60% and a specificity of 86% (AUC=0.76) (Fig.: 3). Thus, the Rankin score can be used to predict the occurrence of complications in stroke patients. This is valuable because studies have shown that the occurrence of complications after stroke is a poor prognostic factor. [26] We observed that the NIHSS score has a very highly significant association with the Glasgow score (p<0.001) where an inverse proportional correlation was observed (r=-0.7; p<0.001) and a proportional correlation with the Rankin prediction score (r=0.3, p=0.04). This means that in the initial clinical assessment of stroke patients, the NIHSS score and the Rankin score can help predict which patients may develop complications. This has been proven by several previous studies.[23], [27], [28]

Little is known about the epidemiology of stroke patients in Haiti, and this limits the ability to develop targeted interventions to improve outcomes. In our scoping review, only three pertinent studies were identified over a 25-year period (Table 2).

Table 2. Scoping review of the literature.

Study	Year	Mean age / % sex	Mean NIHSS Reported	Arrival time	Key Finding
Stroke epidemiology among Haitians living in Miami (PMID 16103730)	2005[29]	60 Years/ 48% female	7	N/A	HTN was the most common stroke risk factor at 87 %
Head CT findings at public hospital in rural Haiti	2017[30]	60.8 ± 17 years / N/A	N/A	N/A	36% of stroke were hemorrhagic. AMS and focal deficit most common presentation
Protocolized emergency department observation care improves quality of ischemic stroke care in Haiti	2020[31]	62 ± 14 years / 59% Female	N/A	4.9 ± 7.1 Days	Reported mean numbers of comorbidities 0.7 ± 0.6

The first study was done by Koch et al on the Haitian population living in Miami, and does not provide information on the local resources, stroke treatments and outcomes in Haiti. [29] The other two studies were conducted in Haiti. Like our study, the mean age of stroke among these Haitian populations is 10

years younger than cohorts from developed countries, suggesting that stroke affects Haitians at their economic prime.[30], [31] Rouhani et. al also document delays in care including delays to arrival time and CT imaging. [31] Alongside our present study, this literature demonstrates the need for ongoing research and stroke interventions to save lives and prevent stroke-related disability among the Haitian population. The utilization of stroke-related metric such the use of NIHSS, modified Rankin scores, and time to intervention is not systematic even in the largest academic center in the metropolitan area. This leads to a lack of data in regard of stroke care in Haiti mainly due to the absence of trained personals.

3.1 Limitations

Our study has a small cohort of 51 patients. This may limit the generalizability of our findings. Unfortunately, due to challenges associated with socioeconomic barriers to care and limited stroke healthcare systems, none of the patients attended follow up appointment. Some potential bias might be present in the evaluation due to delay to care and lack of standard management regarding the length of stay, findings and complication. Those limits the evaluation of long-term outcomes. However, this study will serve as a foundation for future observational and interventional studies on stroke in Haiti.

Conclusion

In our cohort Stroke is mainly affecting female patient. The majority of stroke patient have moderate cerebral deficit based on the NIHSS score, and took more than 24 hours to arrive at hospital. Time to have a CT scan is 84 hours after stroke events, and only 15% of patient had a CT scan during their hospitalization. There is a salient lack of equipped healthcare facilities and appropriate treatment for stroke management. Factors such as low income, limited education, and long arrival time after onset of symptoms are associated with poor outcomes and are found across the board in our population. Neurological assessment based on NIHSS and Rankin score should be systematic in stroke evaluation. There is an urgent need for assistance in both human and infrastructural resources dedicated to stroke unit care, specialized training program for providers in Haiti. Further study is necessary to asset the stroke issues in Haiti

Ethic approval

This study has been approved for publication by the head directory of the Internal Medicine of the State University Hospital of Haiti as it is a teaching hospital. Verbal consent was obtained from patients or responsible person of patients.

Conflict of Interests

The Authors declare that there are no conflicts of interest.

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