

# Factors associated with stroke direct cost in francophone West Africa, Benin example\*

Dieu Donn  Gnonlonfoun<sup>1#</sup>, Thierry Adoukonou<sup>2</sup>, Constant Adjien<sup>1</sup>, Emma Nkouei<sup>1</sup>, Dismand Houinato<sup>1</sup>, Dossou Gilbert Avode<sup>1</sup>, Pierre Marie Preux<sup>3</sup>

<sup>1</sup>Department of Neurology, CNHU-HKM, Cotonou, Benin

<sup>2</sup>Department of Medecine, CHD, Parakou, Benin

<sup>3</sup>Research Institute of Tropical Neurology Diseases, Limoges, France

Email: #[dignon2002@yahoo.fr](mailto:dignon2002@yahoo.fr)

Received 31 August 2013; revised 30 September 2013; accepted 10 October 2013

Copyright   2013 Dieu Donn  Gnonlonfoun *et al.* This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

**Background:** In sub-Saharan Africa, stroke constitutes a public health issue. Few studies were conducted to assess the cost involved in its treatment. **Objective:** To determine the factors involved in direct cost of stroke in Cotonou-Benin. **Method:** It consists in a transversal and prospective research of economic type with analytical and descriptive aim. It was conducted from 20<sup>th</sup> February 2011 to 30<sup>th</sup> September 2011. The research dealt with 122 stroke patients. With regard to the economic approach, bottom-up was the data collection technique which was adopted. Cost was estimated not only based on the patient himself/herself but considering societal aspect. Cost estimation period was hospitalization period. Data analysis was conducted via software such as Epi info and SPSS. **Results:** Overall expenses in terms of direct cost varied from \$144.9 to \$9393.9; average expenses were \$1030.1  $\pm$  \$101.7. Patients aged 50 and above had higher stroke hospitalization cost (\$1277.4) than those aged below 50 (\$857.4)  $p = 0.001$ ; male patients made more expenses than females (FCFA 1157.5 against \$831.8)  $p = 0.01$ ; direct cost of stroke was increased in proportion to neurological deficit (score NIHSS)  $p = 0.043$ . This cost was higher in cases of hemorrhagic stroke than ischemic stroke (FCFA \$1375 against \$1098)  $p = 0.002$ . Stroke direct cost was also increased in proportion to severance of disability level of patients. Stroke type (hemorrhagic) and RANKIN score were firmly correlated to stroke hospitalization cost. **Conclusion:** Stroke is very expensive for patients in Benin and they constitute a burden for both patients and their family. There is a great need to increase awareness regarding risk factor control in order to

reduce the cost involved in treating this malady.

**Keywords:** Stroke; Cost; Benin

## 1. INTRODUCTION

In sub-Saharan Africa, stroke constitutes a public health hazard putting the perspective into its incidence and morbidity [1,2]. The quasi inexistence of social security system, together with the delay in providing coverage and the lack of proper screening in terms of stroke risk factors worsen the situation. An approach to the global changes in respect of a disease takes into account data such as DALY<sub>s</sub> (Disability Adjusted Life Years) or economic study estimating the cost of the disease in question [3]. Schematically, the cost of the disease comprises both direct and indirect cost. Direct cost encompasses medical treatment and various mobilized resources in order to improve and stabilize the disease (hospitalization cost in acute stage, rehabilitation care, ambulatory care, care from relatives and next of kin [4]). Estimating indirect cost is pretty complex, however, it globally comprises the socio-professional effects on the disease (lost of productivity, absenteeism, work or activity cessation, social aid, adjustment to social life, incentives in compensation to the disability etc.) [5,6]. Lots of researches were conducted in Benin hospitals with regard to stroke. However, none of them dealt with the cost involved in treating the disease. Therefore, this research was conducted and aimed at determining factors associated with direct cost of stroke hospitalization.

## 2. METHOD

It consists in a transversal and prospective research of economic type with analytical and descriptive aim. It was

\*Conflict of interest: the authors declare no conflict of interest.

#Corresponding author.

conducted from 20<sup>th</sup> February 2011 to 30<sup>th</sup> September 2011. The research was conducted on all stroke patients who were hospitalized in CNHU-HKM Cotonou (Neurology and Intensive Care Department) as well as in some selected denominational hospitals in Cotonou (Ménontin hospital, Saint Luc hospital) irrespective of the outcome. During the research period, a systematic and exhaustive enrollment was conducted on all patients who fulfilled inclusion criteria and accepted to take part in the research. Any stroke patient (based on WHO criteria) aged 20 and above, hospitalized in one of the hospitals cited above and who consented (or one of his/her next of kin consented) to take part in the research. Data collection was carried out in prospective manner. Patients were integrated from the time they were admitted to the hospital. The data collection technique implemented was that of research through questionnaire.

The variables studied were:

- Dependent variables: they encompass direct hospitalization cost which is calculated by adding up costs per category (consultation, transportation, treatment, para-clinical exams, rehabilitation, hospitalization charges, other expenses incurred during hospitalization) as well as the monetary value of the time spent by the main care giver.

- Independent variables: there were fundamentally socio-demographic (age, sex, ethnic group, profession), clinical (NIHSS neurological score upon admission, type of stroke, duration of hospitalization), clinical (duration of hospitalization, hospitalization services), etiological (type of ischemic stroke, type of hemorrhagic stroke).

### 2.1. Method of Collection

Prospective monitoring of incorporated patients by investigators from the time of admission through hospitalization period.

### 2.2. Economical Approach

The data collection technique adopted was Bottom-up approach. It's an individual approach with regard to each patient's expenses through a set of questionnaires wherein all expenses are systematically noted. Cost assessment was done not only on the patient's view but also on societal view. Cost was estimate in \$US and the period estimation was hospitalization period.

### 2.3. Data Processing and Analysis

All data collected were processed and analyzed using Epi-info version 6.04d. and SPSS (Statistical Package for Social Sciences) version 8. Quantitative variables were expressed in average with their typical variance, qualitative data in percentage and their confidence gap rated at 95%. The comparison of qualitative variables was ef-

fectuated via chi-2 test (or Fisher exact test as the case may be) and average comparison via Student test, Mann-Whitney or that of Wilcoxon as the case may be. For multifaceted analysis, a multi linear regression was used while carrying out successive iterations of descending step by step and introducing simultaneously all variables associated to the cost of unvaried analyses. So, we set out a final model of the equation with Beta coefficient, standard error as well as p value. The equation goes like  $C = \beta_0 + \sum \beta_i X_i + \epsilon$ ,  $X_i$  being interest co-variables and C representing cost,  $\beta_0$  constant or intercept of the formulae. One  $p < 0.05$  was considered as statistically significant.

### 2.4. Ethical Consideration

The project was tabled before each hospital director and was granted approval. Each patient and or his/her next of kin consented through a written statement to take part in the research upon explaining to them the goal and modalities set out.

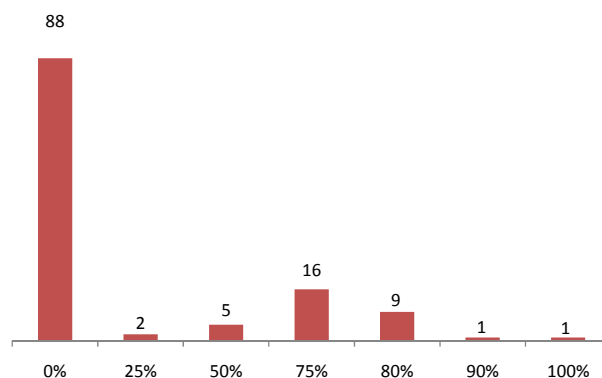
## 3. RESULTS

The research was conducted on 122 patients. There were 87 males (71%) and 35 females (28.7%). They were aged between 34 and 85 years giving an average of 56.4 years  $\pm$  12.2 years. Median was 55 years, 88% of those patients had no health insurance. **Figure 1** shows the classification of patients as per health insurance cover rate.

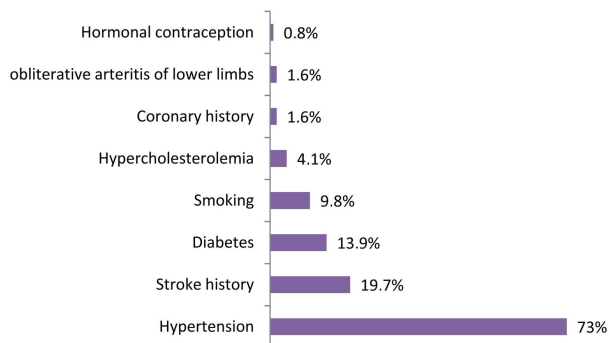
With regard to past records, blood pressure was the predominant risk factor (73%), followed by stroke (19.7%) and diabetes (13.9%). **Figure 2** shows risk factors associated with our patients.

Clinically, average NIHSS score of hemorrhagic stroke patients ( $20.1 \pm 7.5$ ) is higher than that of ischemic stroke patients ( $18.5 \pm 7.4$ )  $p = 0.0004$ . **Table 1** shows NIHSS scores as per type of stroke.

Considering stroke cost, during hospitalization period, overall expenses in terms of direct cost varied between



**Figure 1.** Classification of patients as per health insurance coverage, Cotonou 2011.



**Figure 2.** Rate of patients as per stroke risk factor, Cotonou 2011.

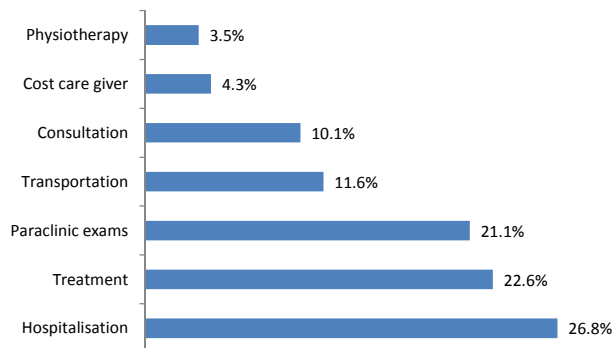
**Table 1.** Neurological score (NIHSS) as per type of stroke, Cotonou 2011.

	Mean (stand deviation)	[Min - Max]	p
Ischemic stroke	18.5 ± 7.4	[8 - 40]	
Hemorrhagic stroke	20.1 ± 7.5	[10 - 37]	10 <sup>-4</sup>
Undetermined stroke	15.8 ± 7.39	[8 - 38]	

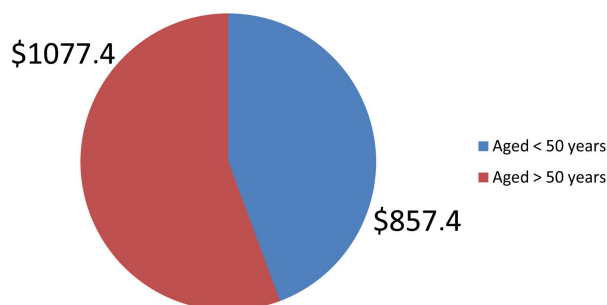
\$144.8 and \$9393.8 making an average of \$1030.1 ± \$101.6 and a median of \$813.7. The average cost of transportation was \$119.3 ± \$19.9. Paraclinical exams represented 21.1% of total cost making an average of \$217 ± \$13.1. Cost of hospitalization was \$275.9 ± \$70.8 which represented the highest source of expenses rated at 26.8% of global cost. Cost classification per source of expenses is shown in **Table 2**. The **Figure 3** shows the classification of cost proportion as per source of expenses considering global cost of stroke. It is to be noted that all patients had a main care giver. Considering each care giver's income and the number of days spent, the cost of time spent by the care giver varied between \$2.5 and \$498.7 making an average of \$44.8 and a median of \$30.

Patients aged 50 and above had higher stroke treatment cost (\$1077.4 ± \$562.4) than those aged below 50 (\$857.4 ± \$452.3) p = 0.001; the **Figure 4** shows stroke cost classification as per age. Male patients spent (\$1157.5 ± \$370.8) than female patients (\$831.8 ± 370.8) p = 0, 0.1. The **Figure 5** shows stroke cost classification as per sex. During stroke cost increased in proportion to neurological deficit (NIHSS score) p = 0.043. This cost was higher in case of hemorrhagic stroke (\$1374.9) than in case of ischemic one (\$1098.6) p = 0.002 (**Figure 6**).

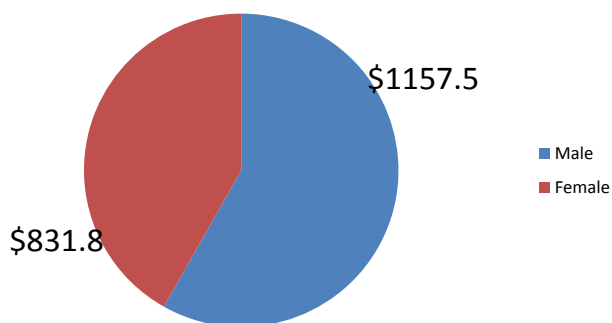
Direct stroke cost increased tremendously and in a parallel manner with an increase in the level of patient disability. Direct stroke cost was \$724.5 ± \$42.3 for a RANKIN score of 1 and \$1526.8 ± \$101.7 when RANKIN was 6 (**Table 3**). On top of unvaried analyses, the following factors were associated with cost: hospitalization



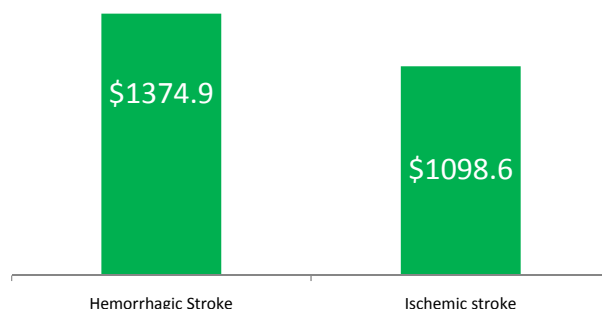
**Figure 3.** Classification of cost proportion as per source of expenses considering global cost of stroke, Cotonou 2011.



**Figure 4.** Stroke cost classification as per age, Cotonou 2011.



**Figure 5.** Stroke cost classification as per sex, Cotonou 2011.



**Figure 6.** Stroke cost classification as per type of stroke, Cotonou 2011.

duration (longer duration), stroke type (hemorrhagic stroke), NIHSS score upon admission (higher) disability level (higher RANKIN), entry mode apart from direct

**Table 2.** Stroke cost (in \$US) per source of expenses, Cotonou 2011.

	(Mean ± stand deviation)	[Min - Max]	Median	Total cost in %
Transportation	\$119.3 ± 19.9	[8 - 2060]	80.0	11.6
Consultation	\$103.7 ± 21.8	[0 - 1424]	24	10.1
Paraclinical exams	\$217 ± 13.1	[0 - 803]	234.9	21.1
<b>Hospitalization</b>	<b>\$275.9 ± 70.8</b>	<b>[0 - 7200]</b>	<b>100</b>	<b>26.8</b>
Treatment	\$213.2 ± 29.9	[67.3 - 3199.2]	183.9	22.6
Physiotherapy	\$36.3 ± 3.9	[0 - 180]	30	3.5
cost care giver	\$44.8 ± 5.9	[2.5 - 498.4]	30	4.3

**Table 3.** Stroke cost (in \$US) classification as per disability level, Cotonou 2011.

RANKIN	N	Mean	Stand deviation	Minimum	Maximum	p
<b>1</b>	5	727.5	42.3	195.8	1283.9	0.047
<b>2</b>	36	782.4	41.5	144.9	2221.9	
<b>3</b>	43	957.0	85.1	250.1	4775.8	
<b>4</b>	8	949.2	49.5	301.0	1775.7	
<b>5</b>	1	851.1	42.8	851.1	1851.1	
<b>6</b>	29	1526.8	164.8	410.4	9393.8	
<b>Total</b>	122	1030.1	101.7	144.9	9393.8	

entry and the evacuees from a clinic or a hospital. These data are set out in **Table 4**.

Upon multi-varied analyses with a multiple linear regression, the final model equation is set out in **Table 5**. This model helped prevent all elements of confusion, thus only the stroke type (hemorrhagic) and the RANKIN were closely associated with stroke direct cost of hospitalization.

#### 4. DISCUSSION

The research enabled us determine economic cost of treating stroke in neurology and intensive care department in CNHU-HKM Cotonou and in some denominational hospitals. The study took into account direct expenses incurred from February to September 2011, meaning a duration of seven months.

Through a prospective research in different departments, we were able to identify the different sort of services and resources required for stroke treatment. In our methodological approach, we defined the pathology, determined the type of hospitalization cost, data collection method (Bottom-up) and valorization of volumes collected. This way, volumes collected from this approach enabled us determine the disease cost during hospitalization period. Let's bear in mind that the research in question was conducted on 122 patients of which 87 males and 35 females aged 35 to 85. Among the 122 patients,

88% had no health insurance.

The global direct cost of treatment varied between \$144.8 and \$ 9393.8 making an average of \$1030. The coverage of stroke patients was done in line with a characteristic process which consists first of all of a consultation then an exploration depending on each case. Indeed, most patients are hospitalized in view of enjoying maximum exploration. The motives are principally the search for a curable cause on which the therapeutic indication will relate, so as to improve patients functional and vital prognostic.

Among others, during their stay neuroradiological exploration (tele-heart, echocardiography and blood vessel echodoppler), biological and electrophysiology (electrocardiogram) were conducted. In fact, these explorations aim at finding out a particular etiology especially cardiac one if case of stroke. These explorations require services therefore costs in terms of personnel and material which are most at times high.

Almost all authors are of the belief that cerebral scanner formally finds out its indication in stroke coverage. Sure enough, the brain CT scan has become indispensable for stroke patients simply because all therapeutic decisions depend on these results [7]. Once again, this shows the importance of this exam in the coverage of such malady. Unfortunately, the issue of financial accessibility still prevails as treatment cost in Cotonou re-

**Table 4.** Outcome of unvaried analyses, Cotonou 2011 (in \$US).

	Mean	Stand deviation	Minimum	Maximum	p
Age	1277.4	562.4	301.0	1776.8	0.755
Sex (male)	1046.8	112.4	250.1	9393.8	0.776
Profession	1688.1	225.4	255.0	9393.8	0.338
NIHSS > 38	1816.6	254.5	651.1	9393.8	0.043*
Type of Stroke (AVCH)	1375.0	146.5	568.5	9393.8	0.002*
Hospitalization duration (>25j)	1664.4	188.0	482.9	9393.8	0.038*
Rankin (>6)	1526.8	164.8	410.4	9393.8	0.047*
Entry mode	1777.8	1145.8	714.6	4775.7	0.011*

\*significant result.

**Table 5.** Final model of equation in linear regression, with regard to factors associated with stroke cost (in \$US), Cotonou 2011.

	Non standardized Beta	Standard error	Beta Coefficient	P
Constant	1201.9	300.9		
stroke type	-365.0	105.3	-0.292	0.001*
RANKIN	162.6	537.6	0.253	0.003*

\*significant result.

mains high (\$160 in CNHU-HKM).

Stroke direct cost during hospitalization is evaluated between \$144.8 and \$9393.8 making an average of \$1030 based on our research. The ratio cost/GDP per inhabitant in our research shows that direct cost per patient represents in Benin 1.3 times the GDP per inhabitant. Even though comparing these researches is pretty delicate, they all converge to the same point meaning economic impact of stroke coverage is pretty considerable. For example, in Sweden about 1306 million USD is spent for stroke that means 70,330 USD per patient [8]. In the USA, in 2006 30 billion USD was spent for patients' coverage of which 17 billion constitute direct expenses [9]. In Taiwan, median cost per day was estimated between 650 USD and 2000 USD per day depending on the stroke severity, of which 38% constitutes expenses made towards personnel and hospitalization [10]. In Britain, the figure is £15,306 per patient [11]. Meanwhile in France, average direct cost is €17,799 comprising 42% for acute hospitalization, 29% for rehabilitation care and 8% for ambulatory care [12]. Direct cost of coverage based on research conducted in Senegal for one full year was estimated at \$65228.8[13].

The length of hospitalization [14,15] and stroke initial severity [16] are the most powerful prognostic factors of global high cost observed. The size of the cerebral infarction is yet another factor. In fact, global carotid infarction increases because this type of infarction leads to a more acute disability and therefore a longer length of hospitalization [17,18]. Once out, patients' destination also influences global costs. Thus the transfer of patients to a rehabilitation centre increases costs whilst a return

home decreases costs [19]. Social support and care from relatives lessens the length of hospitalization therefore decreasing costs, and this justifies why in certain research, male hospitalization period is shorter than that of female simply because the latter are often widow at stroke occurrence. Sudden death also accounts for lower costs as hospitalization length is short [18]. Age is not a determining factor in many research conducted (except for the Italian research [4]) and so is not related to high cost [20,21]. The different results above explain the significant stroke economic charges in those countries where purchasing power is low.

Moreover, in advance countries, the rate is more considerable but in agreement with the standard of living which is also high. It's also worth mentioning that 88% of patients pay for their own treatment, hospitalization and paraclinical checkup which constitute the major source of expenses in terms of resources because health insurance system is not yet developed in our country.

To sum up, it comes out clearly that stroke patients in Benin spent less than patients did in advance countries in terms of gross cost. But in reality, they spent more than patients from advance countries while having a low purchasing power. Putting these findings in perspective and considering the current economic crisis, will Benin government be able to continue subsidizing health care? Certainly, they have to do so because stroke cost of coverage is high and can't be borne by the grassroots. To better control stroke direct cost, it's imperative to monitor risk factors through reach out programs, blood pressure checking annually, metabolism screening and combating obesity and physical inactivity. The program will



aim at reducing to a minimum level the malady in Benin.

## 5. CONCLUSION

Stroke treatment is astronomically expensive for patients in Benin and it constitutes an important charge for both patient and his/her family. In light of the economic crisis and considering stroke high cost of coverage, there is a great need to raise awareness for controlling risk factors so as to minimize the malady cost of coverage.

## REFERENCES

- [1] Sène Diouf, F., Basse, A.M., Ndao, A.K. and Ndiaye, M. (2006) Stroke functional prognostic in developing countries: Sénégal. *Annales de Réadaptation et de Médecine Physique*, **89**, 100-104. <http://dx.doi.org/10.1016/j.annrmp.2005.11.006>
- [2] Smadja, D., Olindo, S. and Cabre, P. (2002) Stroke among Blacks in tropical zones. *Neurology*, **5**, 211-215.
- [3] Patel, A., Knapp, M., Evans, A., Perez, I. and Kalra, L. (2004) Training care givers of stroke patients: Economic evaluation. *BMJ*, **328**, 1102-1108. <http://dx.doi.org/10.1136/bmj.328.7448.1102>
- [4] Mamoli, A., Corsori, B., Casto, L., Sileo, C., Cesana, B. and Camerlingo, M. (1999) An analysis of the costs of ischemic stroke in an Italian stroke unit. *Neurology*, **53**, 112-116. <http://dx.doi.org/10.1212/WNL.53.1.112>
- [5] Claesson, L., Gosman-Hedstrom, G., Johannesson, M., Fagerberg, B. and Blomstrand, C. (2000) Resource utilization and costs of stroke unit care integrated in a care continuum: A 1-year controlled, prospective, randomized study in elderly patients: The Goteborg 70+ Stroke Study. *Stroke*, **31**, 2569-2577. <http://dx.doi.org/10.1161/01.STR.31.11.2569>
- [6] Demaerschalk, B. and Durocher, D.L. (2007) How diagnosis-related group 559 will change the US Medicare cost reimbursement ratio for stroke centers. *Stroke*, **38**, 1309-1312. <http://dx.doi.org/10.1161/01.STR.0000260185.74694.a7>
- [7] Keita, A.D., Touré, M. and Diawara, A. (2005) Stroke epidemiological aspects in ct scan department at point G hospital in Bamako, Mali. *Tropical Medicine*, **65**, 453-457.
- [8] Jorgensen, H.S., Nakayama, H., Raaschou, H.O. and Olsen, T.S. (1997) Acute stroke care and rehabilitation: An analysis of the direct cost and its clinical and social determinants. The Copenhagen stroke study. *Stroke*, **28**, 1138-1141. <http://dx.doi.org/10.1161/01.STR.28.6.1138>
- [9] Brown, D.L., Boden-Albala, B., Langa, K.M., Lisabeth, L.D., Fair, M., Smith, M.A., *et al.* (2006) Projected costs of ischemic stroke in the United States. *Neurology*, **67**, 1390-1395. <http://dx.doi.org/10.1212/01.wnl.0000237024.16438.20>
- [10] Chiu, L., Shyu, W.C. and Chen, T.R. (1997) A cost-effectiveness analysis of home care and community based nursing homes for stroke patients and their families. *Journal of Advanced Nursing*, **26**, 872-878. <http://dx.doi.org/10.1046/j.1365-2648.1997.00410.x>
- [11] Beech, R., Rudd, A.G., Tilling, K. and Wolfe, C.D. (1999) Economic consequences of early inpatient discharge to community-based rehabilitation for stroke in an inner-London teaching hospital. *Stroke*, **30**, 729-735. <http://dx.doi.org/10.1161/01.STR.30.4.729>
- [12] Launois, R., Giroud, M., Mégribêto, A.C., Le Lay, K., Présenté, G., Mahagne, M.H., *et al.* (2004) Estimating the cost-effectiveness of stroke units in France compared with conventional care. *Stroke*, **35**, 770-775. <http://dx.doi.org/10.1161/01.STR.0000117574.19517.80>
- [13] Touré, K., Ndiaye, N.M., Sène Diouf, F., Ndiaye, M., Diallo, A.K., Ndao, A.K., *et al.* (2005) Assessing the cost of stroke in Dakar-Sénégal. *Tropical Medicine*, **65**, 458-464.
- [14] Smurawska, L.T., Alexandrov, A.V., Bladin, C.F. and Norris, J.W. (1994) Cost of acute stroke care in Toronto, Canada. *Stroke*, **25**, 1628-1631. <http://dx.doi.org/10.1161/01.STR.25.8.1628>
- [15] Gladman, J., Whyne, D. and Lincoln, N. (1994) Cost comparison of domiciliary and hospital based stroke rehabilitation. DOMINO Study Group. *Age Ageing Stroke*, **23**, 241-245. <http://dx.doi.org/10.1093/ageing/23.3.241>
- [16] Patel, A., Knapp, M., Perez, I., Evans, A. and Kalra, L. (2004) Alternative strategies for stroke care: Cost-effectiveness and cost-utility analyses from a prospective randomized controlled trial. *Stroke*, **35**, 196-203. <http://dx.doi.org/10.1161/01.STR.0000105390.20430.9F>
- [17] Saka, O., McGuire, A. and Wolfe, C. (2009) Cost of stroke in the United Kingdom. *Age and Ageing*, **38**, 27-32. <http://dx.doi.org/10.1093/ageing/afn281>
- [18] Fagerberg, B., Claesson, L., Gosman-Hedstrom, G. and Blomstrand, C. (2000) Effect of acute stroke unit care integrated with care continuum versus conventional treatment: A randomized 1-year study of elderly patients: The Goteborg 70+ Stroke Study. *Stroke*, **31**, 2578-2584. <http://dx.doi.org/10.1161/01.STR.31.11.2578>
- [19] Teasell, R.W., Foley, N.C., Bhogal, S.K. and Speechley, M.R. (2003) Early supported discharge in stroke rehabilitation. *Topics in Stroke Rehabilitation*, **10**, 19-33. <http://dx.doi.org/10.1310/QLFN-M4MX-XEMM-2YCO>
- [20] Dewey, H., Thrift, A., Mihalopoulos, C., Carter, R., Macdonell, R. and McNeil, J. (2003) Lifetime cost of stroke subtypes in Australia: Findings from the North East Melbourne stroke incidence study (NEMESIS). *Stroke*, **34**, 2502-2507. <http://dx.doi.org/10.1161/01.STR.0000091395.85357.09>
- [21] Evers, S., Strijs, J., Ament, A., van Genugten, M., Jager, J. and van den Bos, G. (2004) International comparison of stroke cost studies. *Stroke*, **35**, 1209-1215. <http://dx.doi.org/10.1161/01.STR.0000125860.48180.48>