

## Analysis of Direct Medical Costs of Acute Stroke among Patients in a Tertiary Hospital in Ibadan, South-West, Nigeria.

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### Abstract

**Background:** The medical costs of treating acute stroke represent a major burden for patients, especially in countries where out-of-pocket (OOP) payment is a major source of health care financing. This study used a micro-costing approach to estimate the direct costs of acute episode of stroke among 175 patients admitted between February and May 2015 in a tertiary hospital in Ibadan, Nigeria.

**Methods:** A 10% threshold with patients' household annual per capita income was used to ascertain the incidence of catastrophic health expenditure (CHE) among patients. A patient incurred CHE if the OOPs exceeded 10% of the annual per capita income of the households where they live. Bivariate analysis was carried out to evaluate the association between CHE and patient-level clinical characteristics.

**Findings:** Male respondents were 118 (67.4%), and the mean age of respondents was 60.9 ±13.7 years. A total of 156 (89.1%) respondents paid for their medical services through OOPs, while 19 (10.9%) paid through social health insurance. The average health care expenditure on acute stroke treatment for respondents who made OOPs was ₦195,672.20 ± ₦170,661.30 and ₦189,817.40 ± ₦77,114.00 for those whose OOPs was partly offset by social health insurance. The average annual income of the respondents was ₦696,685.70 ± ₦69,834.80. Expenditure on admission/consultation, and radiological services represent the highest costs contributing to patients' average direct medical cost, ₦30,822.90 (\$154.89) and ₦43,200 (\$217.09), respectively. This was followed by expenditure on drugs ₦27,088.00 (\$136.12). Overall, 29.1% of the respondents experienced CHE, of these, 94.1% used out-of-pocket, and 5.9% had some form of social health insurance. The incidence of CHE was significantly associated with low educational status, length of hospital stay, and co-morbidity.

**Conclusion:** Acute stroke patients experienced catastrophic health expenditure largely due to huge drugs and laboratory fees. Increasing financial risk protection for these patients would prevent them from impoverishment as a result of enormous medical costs.

**Keywords:** Acute Stroke, Catastrophic Health Expenditure, Cost-of-Illness, Social Health Insurance, Ibadan

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## Introduction

Morbidity and mortality from cerebrovascular accidents (stroke) remain one of the major concerns of public health globally. Annually, about 16 million first-ever strokes occur in the world, causing a total of 5.7 million deaths [1]. Consequently, stroke is the second leading cause of deaths and the third leading cause of disabilities worldwide [2-4].

Even so, stroke imposes enormous financial burdens on patients suffering from the condition in low-and-middle-income countries where there is predominantly sub-optimal health care infrastructure coupled with vastly under-developed social health care financing mechanisms [5]. A study conducted on the global burden of hemorrhagic stroke revealed that about 70% of morbidity due to strokes and 87% of stroke-related deaths occur in low- and middle-income countries (LMICs) [4].

In Nigeria, there are no national data on the prevalence and incidence rates of stroke, but a few community-based and hospital-based studies have shown that stroke represents a substantial public health problem in the country. For instance, some studies revealed that the prevalence of stroke increased from about 1.14 per 1,000 in 2008 [7] to 8.51 per 1000 in 2015 [8]. Likewise, a review of a number of studies carried out in Nigeria showed stroke mortality rate ranged from 21% to 45% in recent years [9-12].

Like in most developing countries, healthcare financing in Nigeria is majorly through out-of-pocket payments (OOP). A World Health Organization study revealed that over 74% of medical spending in Nigeria were through OOPs [13]. In the absence of effective financial protection mechanisms, stroke patients face increased risks of both catastrophic health expenditure (CHE) and severe financial hardship. Recently, there has been an increase in the number of studies on the risk factors associated with stroke in Africa, including Nigeria, but studies focusing on the costs of managing stroke in a low-resource setting such as Nigeria are few. Thus, this study estimated the direct medical costs borne by stroke patients and contributes to the ongoing discussion with regards to health care financing

programs for stroke patients.

## Methods

### Study Design and Population

This study was cross-sectional in design and was conducted among all 175 patients diagnosed with acute stroke between February and May 2015 at the medical out-patient and emergency departments of a tertiary hospital, the University College Hospital (UCH), in Ibadan, South West, Nigeria. This hospital receives referrals from various health care facilities and serves as a major provider of inpatient and outpatient care within the country.

### Data Collection

Socio-demographic characteristics and other relevant medical history were collected using a pre-tested, structured interviewer-administered questionnaire while a proforma was used to collect data on direct medical and non-medical costs of in-patient care. Costs such as admission fees, costs of radiological and laboratory investigations, physical therapy and medications, consumables such as syringes and needles, cannulas, pain relief creams/gels, and assistive devices were categorized as direct medical costs. Transportation costs were categorized as direct non-medical cost. Information on the income of the household of patients, access to medical insurance and the proportion of the total medical costs covered by health insurance were recorded for each patient and updated weekly until discharge with the assistance of study participants or patients' caregiver(s), where participants were too sick. Data quality was ensured by using patients' case notes and receipts of payments to validate information on direct medical and non-medical costs provided by stroke patients or their main caregivers.

### Costing Method and Analysis

A patient perspective micro-costing approach [13-17], was used to estimate the average direct cost, both medical and non-medical costs, of hospital admission for the 175 stroke patients. The medical costs of patients who paid entirely through OOP were separated from those who had any form of health insurance. Estimates are presented in Naira, the official currency in Nigeria. The dollar exchange rate

was \$1 to ₦199 as at the time of the study. In order to ascertain if patients experienced catastrophic health (CHE) as a result of OOPs, a threshold of 10% of per capita annual household income (i.e., income of the households where patients live) was used as cut-off [13,14]. This means that a patient's household incurred CHE if the OOPs exceeds 10% of the annual per capita income of the households where they live. Household income was conceptualized to mean the average reported monthly economic earnings of all active household members. This included all earnings after tax from formal or self-employment and other cash transfers from family and friends [18]. Bivariate analysis was carried to evaluate the association between CHE and patient-level clinical characteristics. Data were cleaned and analyzed using Stata V.14.

#### Ethical Consideration

Study protocol was reviewed and approved by the University of Ibadan/University College Hospital (UI/UCH) Ethics Review Committee. Informed consent was obtained from each respondent before the interview.

## Results

### Socio-Demographics of the Respondents

Table 1 shows that age of the patients ranged from 32 to 74 years, with a mean age of 60.9 ±13.7 years. About 130 (74%) stroke patients in the study were aged between 51 and 70 years. One hundred and eighteen (67.4%) respondents were males, 145 (82.9%) were married while 157 (89.7%) were engaged in some form of trade or profession. Majority of the respondents, 124 (70.8%) had at least secondary school education. Eighty-two (62.8%) patients had a fairly short length of stay of 13 days, and below in the hospital, 37 (21%) was admitted for a period between 14 and 27 days and only 16% stayed for over 28 days.

### Clinical Characteristics of Respondents (Table 2)

The mean length of stay was 13± 3 days. About 121 (69.1%) had hypertension as a comorbidity, while 11 (6.3%) had diabetes, and 4(6.3%) had some form of heart diseases. Only 28(16%) of the studied patients had no other morbid condition.

**Table 1: Socio-Demographics of the Respondents (N=175)**

Variable	Categories	Frequency	Percentage (%)
Gender	Male	118	67.4
	Female	57	32.6
Age class (years)	31-40	13	7.4
	41-50	27	15.4
	51-60	73	41.7
	61-70	57	32.6
	71-80	5	2.9
Marital status	Separated	4	2.2
	Married and living with spouse	145	82.9
	Widowed	26	14.9
Educational level	Primary	12	6.9
	Secondary	48	27.4
	Tertiary	76	43.4
Occupational Status	Skilled	129	73.7
	Unskilled	28	16.0
	Unemployed/Retired	18	10.3

**Table 2: Clinical characteristics of the respondents (N=175)**

Variable	Frequency	Percentage (%)
Length of stay (in days)		
1-7	66	37.7
8-14	46	26.3
15-21	25	14.3
22-28	13	7.4
29 and above	25	14.3
Other Morbid Conditions		
Diabetes	11	6.3
Hear Disease	4	2.3
Hypertension	121	69.1
No morbid condition	28	16.0
Others	11	6.3

**Direct Medical and Non-Medical Costs of Stroke Treatment (Table 3)**

The total direct medical and non-medical costs were N30,524,863.20 (\$153,391.27) (patients who paid through OOP) and N3,606,530.60 (\$18,123.27) (patients with some form of insurance). Also, the mean direct medical cost of acute stroke treatment for respondents who paid out-of-pocket was ₦195,672.20± ₦170,661.30 while it was ₦189,817.40 ± ₦77,114.00 for those who had some form of health insurance (p > 0.05). Expenditure on admission/consultation and radiological

services were the highest single costs contributing to patients' direct medical cost, ₦30,822.90 (\$154.89) and ₦43,200 (\$217.09), respectively; followed by expenditure on drugs ₦27,088.00 (\$136.12). During hospitalization, all patients underwent radiological studies such as computerized tomography (CT) scan, Magnetic resonance imaging (MRI), X-ray either singly or in some combination. All patients had costs from admission as well as purchased drugs and 108 (61.7%), 65 (37.1%) and 63 (36.0%) were provided with Physiotherapy, Echocardiography, and Carotid Doppler services, respectively.

**Table 3: Medical Costs of Stroke Treatment (in Naira), N=175**

Health Care Services	N	Minimum Cost (₦)	Maximum Costs(₦)	Median (₦)	Std. Deviation
Admission/Consultation	175	6,000.00	163,000.00	30,822.90	19,013.2
Radiological Services	175	1,200.00	67,000.00	43,200.00	19,243.5
Laboratory Fees	166	4,250.00	289,550.00	20,750.00	47,106.9
Echocardiography	65	15,000.00	45,000.00	16,080.80	7,092.2
Drugs	175	2,120.00	203,080.00	27,085.00	40,603.3
Physical Therapy	108	15,000.00	45,000.00	15,000.00	4,953.0
Carotid Doppler	63	5,200.00	5,200.00	5,200.00	0.0
Special Feeding	21	3,000.00	60,000.00	9,600.00	16,162.7
Transport	14	12,500.00	28,000.00	17,850.00	4,187.2
Others	103	1,350.00	193,410.00	12,890.00	40,017.8
Total direct medical and non- medical					
Patients with health insurance (19)		₦3,606,530.60			
Patients without health insurance (156)		₦30,524,863.20			
Average direct medical and non- medical costs					
Patients with health insurance (19)		₦189,817.40±77,114.00			
Patients without health insurance (156)		₦195,672.20±170,661.30			

#### Factors Associated with the Experience of Catastrophic Health Expenditure (Table 5)

Most respondents' households, 95 (54.3%), earned an annual income of less than ₦500,000 (Table 4). Out of 175 respondents, 51(29.1%) experienced CHE, while 124 (70.9%) did not. Further analysis revealed that though there were slightly more male respondents (29.7%) than female (28.1%) who experienced CHE, this was not significant( $p=0.828$ ). There was also no association between marital status and the experience of CHE ( $p=0.523$ ).

Table 5 shows that there is generally a higher occurrence of CHE among respondents with lower educational level (61.5%) compared to those with at least a secondary level education (29.2%) ( $p<0.001$ ). Also, there was a significant association between the length of hospital stay and the experience of CHE ( $p<0.001$ ). There was a significant association between the presence of a co-morbid condition and the experience of CHE ( $\chi^2= 10.35$ ,  $p=0.001$ ). Of the respondents who incurred CHE, 50 (98.0%) had other morbid conditions while only 1 (2.0%) of respondents with CHE had no other morbid health condition.

There is also a significant association between the incidence of patients who were discharged against medical advice and occurrence of CHE ( $p=0.041$ ). About 75% of those who were discharged against medical advice had already incurred CHE as at the time of discharge.

There was no association between respondents' mode of payments and

occurrence of catastrophic health expenditure ( $p=0.175$ ). However, a larger proportion (94.1%) of respondents who had CHE paid through out-of-pocket compared to 5.9% who paid through social health insurance.

#### Discussion

This study estimates the direct costs of acute episode of stroke among 175 patients consecutively admitted in a tertiary hospital facility. The average health care expenditure on acute stroke treatment for respondents who paid out-of-pocket was ₦195,672.20 (\$983)  $\pm$  ₦170,661.30 (\$858) and ₦189,817.40 (\$954)  $\pm$  ₦77,114.00 (\$388) for those whose OOP expenditure were subsidized by health insurance. These estimated medical costs are substantially lower compared to costs reported in other studies carried out in developed settings. For instance, a study conducted in Japan on the average cost of treating first episode of stroke revealed a mean cost of \$6887 [13]. A similar study conducted in Italy estimated the mean treatment cost of stroke at \$3289  $\pm$  \$1640 [13]. The lower average cost of managing first stroke episode in the study setting could be as a result of limited quality of health care services available. While it is intuitive to assume that the costs of medical services will be a function of the general quality of health care services in terms of better treatment technology, research has also shown that higher quality of medical services is generally related to higher medical expenditures [19].

**Table 4: Annual Income Distribution of Respondents' Households and Experience of Catastrophic Health Expenditure**

Annual Income (₦)	N	Percentage (%)
100,000-300,000	83	47.4
300,000-500,000	12	6.9
500,000-700,000	23	13.1
700,000-900,000	6	3.5
900,000-1,000,000	11	6.3
Over 1,000,0000	40	22.9
Incurred Catastrophic health expenditure	51	29.1
No catastrophic health expenditure	124	70.9

**Table 5: Factors Associated with the Experience of Catastrophic Health Expenditure (CHE)**

Respondents' Characteristics	Had CHE		Had no CHE		$\chi^2$	p-value
	n	%	n	%		
<b>Gender</b>					0.047	0.828
Male	35	29.7	83	70.3		
Female	16	28.1	41	71.9		
<b>Marital Status</b>					1.29	0.523
Separated/Divorced	1	25.0	3	75.0		
Married	40	27.6	105	72.4		
Widowed	10	38.5	16	61.5		
<b>Level of Education</b>					46.7	<0.001
No Formal Education	24	61.5	15	38.5		
Primary	8	66.7	4	33.3		
Secondary	14	29.2	34	70.8		
Tertiary	5	6.6	71	93.4		
<b>Length of Stay(days)</b>					23.44	<0.001
1-7	12	18.2	54	81.8		
8-13	20	45.5	24	54.5		
14-20	14	53.8	12	46.2		
21-27	0		11	100		
>28	5	17.9	23	82.1		
<b>Presence of Co-morbid Conditions</b>					10.55	0.001
Yes	50	34.0	97	66.0		
No	1	3.6	27	96.4		
<b>Discharged Against Medical Advise</b>					4.169	0.041
Yes	3	75.0	1	25.0		
No	48	28.1	123	71.9		
<b>Respondents' Mode of Payment</b>					1.54	0.175
NHIS	3	15.8	16	84.2		
Out of Pocket (self, family, friends)	48	30.8	108	69.2		

The Length of stay (LOS) has been a known predictor of cost of care in most studies because it affects the total medical cost of patients' admission [20]. More than half of the respondents in this study were admitted for over seven days. Usually, the LOS alongside the degree of severity of stroke should be significantly related to higher average medical costs among patients as shown in many studies [2, 3,21], but in some cases, medical costs could still vary among stroke patients with the same hospital stay [22-23]. In our study, the cost of medical treatment was significantly associated with higher LOS. The study revealed that fewer patients with LOS beyond 20 days experienced CHE. However, it is known that the overall experience of CHE in this study may not reflect the full extent of CHE as a result of the decision to include only patients

diagnosed of having stroke and admitted for the first time during the period of the study. This is plausible since the estimate the costs of the first acute episode of stroke had been set out. In order to do this, patients whose conditions were critical were excluded. The major co-morbidity observed is hypertension, indicating that this medical condition is the most common risk factor for having stroke. A related study among stroke patients confirmed hypertension as the major identifiable risk factor for stroke. The study reported that 85.2% of the stroke patients in the study also had hypertension as a co-morbid condition [7].

While some of the patients had some of the costs of treatment covered under the National Health Insurance Scheme (NHIS), their average medical cost was not significantly different from that of the patients whose

payments were made through OOP. Hence, the need to develop a more robust social health insurance scheme that will reduce the burden of OOP and increase access to affordable health care services. Among all the patients, the highest individual cost of service was from the purchase of drugs and laboratory fees, followed by the cost of other items which the patients also had to purchase such as walking aids and wheelchairs. However, the average cost for radiological services was the highest contributing cost to a patients' total healthcare expenditure, followed by the cost of admission. The reason was that almost all the patients had to undergo either the CT or MRI and in some cases, both. These expensive services were on a Public-Private Partnership arrangement and not subsidized in any way.

The occurrence of CHE was observed among only 51(29.1%) acute stroke patients. Generally, the experience of CHE is expected to be higher than what it is in this study considering that majority of the patients covered their medical bills through OOP. However, the costs here only captured medical bills for one acute stroke episode and would expectedly be higher if different stroke episodes within a year were considered. A study conducted in the United States on the lifetime costs of stroke showed that the costs incurred as a result of nursing home stays and long term ambulatory care services were quite substantial. This suggests that major costs are incurred beyond the first two years after stroke"[23]. Consequently, the experience of CHE will be higher if the long-term economic impact of stroke with on-going treatment, rehabilitation, and re-admissions to hospital were considered. Overall, the level of education and presence of other morbid conditions were independently associated with the experience of CHE.

In this study, there were more males 118 (67.4%) than females 57 (32.6%) as stroke patients. Until recently, in most African societies, men are mostly the breadwinners, and thus, the male gender is made to provide for almost all the financial needs of their respective families. As a result of this, they are more likely to develop medical conditions such as hypertension or stroke due to the excessive

stress that comes with the economic demands of the family, especially if the man has access to limited financial resources. Furthermore, studies have found that men are more likely to engage in more health risk behaviors that could increase the chances of ill-health [20, 24]. An hospital-based study of the care and costs of acute ischemic stroke in Japan also had a larger proportion of male patients (69%) compared females [12]. Also, some research has shown that men are likely to suffer stroke than women during ages from 85 years and above[25, 26]. However, an epidemiological model of stroke incidence developed from a review of literature by a study in the United States showed that the relative risks of having stroke differ with respect to stroke sub-types [19]. The study reported that the relative risk of having subarachnoid stroke was higher in women and the risk of intracerebral hemorrhagic stroke higher in men while the incidence rate of ischemic stroke was similar among both men and women during the review period [19]. The level of education among the patients appear to be quite high as 70.8% had at least a secondary education.

### **Conclusion and Recommendation**

This study showed that the cost of managing acute stroke is significant, especially for patients with low income. Also, there was inadequate level of insurance or other prepayment schemes that would have mitigated the high level of CHE that was found. Majority of payments for healthcare by consumers were made using out of pocket spending (OOPS). Considering that stroke often requires permanent dependence, long-term financial protection should be provided for acute stroke patients in Nigeria. Further studies are on indirect costs as well as the cost of rehabilitative care for stroke patients are suggested as this might provide detailed information on all aspects of costs of stroke management. Policy and decision makers will find such information useful particularly in increasing financial risk protection for stroke patients; thereby reducing their experience of catastrophic health expenditure and preventing them from impoverishment as a result of huge medical costs.

### Limitation

This study is not without limitations. First, only the 175 patients that were admitted and subsequently discharged during the period of data collection were included in the analysis. The study did not include stroke patients who failed to survive the indexed episode of acute stroke. As such, the direct costs reported might have been underestimated. Also, the sample size was not large enough to further evaluate the impact of covariates, such as patients' socio-demographic and clinical characteristics on the mean/median direct costs of stroke treatment.

### Competing Interests

Authors declare that there are no competing interests.

### References

1. Strong K, Mathers C, Bonita R. Preventing stroke: saving lives around the world. *The Lancet Neurology*. 2007;6(2):182-7.
2. Di Carlo A. Human and economic burden of stroke. *Br Geriatrics Soc*; 2009.
3. Chang K-C, Tseng M-C. Costs of acute care of first-ever ischemic stroke in Taiwan. *Stroke*. 2003;34(11):e219-e21.
4. Krishnamurthi RV, Moran AE, Forouzanfar MH, Bennett DA, Mensah GA, Lawes CM, et al. The global burden of hemorrhagic stroke: a summary of findings from the GBD 2010 study. *Global heart*. 2014;9(1):101-6.
5. Mapulanga M, Nzala S, Mweemba C. The Socio-economic Impact of Stroke on Households in Livingstone District, Zambia: A Cross-sectional Study. *Annals of medical and health sciences research*. 2014;4(8):123-7.
6. Njoku C, Aduloju A. Stroke in Sokoto, Nigeria: A five-year retrospective study. 2004.
7. Wahab KW. The burden of stroke in Nigeria. *International journal of stroke*. 2008 Nov;3(4):290-2.
8. Ezejimofor MC, Uthman OA, Maduka O, Ezeabasili AC, Onwuchekwa AC, Ezejimofor BC, Asuquo E, Chen YF, Stranges S, Kandala NB. Stroke survivors in Nigeria: A door-to-door prevalence survey from the Niger Delta region. *Journal of the neurological sciences*. 2017 Jan 15;372:262-9.
9. Desalu OO, Wahab KW, Fawale B, Olarenwaju TO, Busari OA, Adekoya AO, et al. A review of stroke admissions at a tertiary hospital in rural Southwestern Nigeria. *Annals of African Medicine*. 2011;10(2).
10. Komolafe M, Ogunlade O, Komolafe EO. Stroke mortality in a teaching hospital in South Western Nigeria. *Tropical doctor*. 2007;37(3):186-8.
11. Wahab K, Okubadejo N, Ojini F, Danesi M. Predictors of short-term intra-hospital case fatality following first-ever acute ischaemic stroke in Nigerians. *J Coll Physicians Surg Pak*. 2008;18(12):755-8.
12. World Health Organization (2005). Designing health financing systems to reduce catastrophic health expenditure.
13. Wagstaff A, Doorslaer Ev. Catastrophe and impoverishment in paying for health care: with applications to Vietnam 1993–1998. *Health economics*. 2003;12(11):921-33.
14. Van Doorslaer E, O'Donnell O, Rannan-Eliya RP, Somanathan A, Adhikari SR, Garg CC, et al. Effect of payments for health care on poverty estimates in 11 countries in Asia: an analysis of household survey data. *The Lancet*. 2006;368(9544):1357-64.
15. Yoneda Y, Uehara T, Yamasaki H, Kita Y, Tabuchi M, Mori E. Hospital-based study of the care and cost of acute ischemic stroke in Japan. *Stroke*. 2003;34(3):718-24.
16. Mamoli A, Censori B, Casto L, Sileo C, Cesana B, Camerlingo M. An analysis of the costs of ischemic stroke in an Italian stroke unit. *Neurology*. 1999;53(1):112.
17. Christensen M, Previgliano I, Capparelli F, Lerman D, Lee W, Wainsztein N. Acute treatment costs of intracerebral hemorrhage and ischemic stroke in Argentina. *Acta Neurologica Scandinavica*. 2009;119(4):246-53.
18. Tolla MT, Norheim OF, Verguet S, Bekele A, Amenu K, Abdisa SG, Johansson KA. Out-of-pocket expenditures for prevention and treatment of cardiovascular disease in general and specialized cardiac hospitals in Addis Ababa, Ethiopia: a cross-sectional cohort study. *BMJ global health*. 2017 Jul 1;2(2):e000280.
19. Baker L, Birnbaum H, Geppert J, Mishol D, Moyneur E. The Relationship Between Technology Availability And Health Care Spending: Attempts to address technology availability and rising costs could end up badly misguided if implications for quality are not considered. *Health Affairs*. 2003;22(Suppl1):W3-537.
20. Caro JJ, Huybrechts KF. Stroke Treatment Economic Model (STEM). *Stroke*. 1999;30(12):2574-9.
21. Caro JJ, Huybrechts KF, Duchesne I. Management patterns and costs of acute ischemic stroke. *Stroke*. 2000;31(3):582-90.



22. Taylor, TN, Davis PH, Torner JC, Holmes J, Meyer JW, Jacobson MF. Lifetime cost of stroke in the United States. *Stroke*. 1996;27(9):1459-66.
23. Pinkhasov RM, Wong J, Kashanian J, Lee M, Samadi DB, Pinkhasov MM, et al. Are men shortchanged on health? Perspective on health care utilization and health risk behavior in men and women in the United States. *International journal of clinical practice*. 2010;64(4):475-87.
24. Allgöwer A, Wardle J, Steptoe A. Depressive symptoms, social support, and personal health behaviors in young men and women. *Health Psychology*. 2011;20(3):223.
25. Bonita R. Epidemiology of stroke. *The Lancet*. 1992;339(8789):342-4.
26. McGowan B, Heerey A, Tilson L, Ryan M, Barry M. Cost of treating stroke in an Irish teaching hospital. *Irish medical journal*. 2003;96(8):234-6