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Original Article

Public Health Section

Economic Aspects of Post-Stroke Rehabilitation: A Retrospective Data at a Traditional Medicine Hospital in Vietnam

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ABSTRACT

Introduction: Stroke is the leading cause of disability in the world and places an economic burden on the healthcare systems worldwide. About 200,000 stroke patients are diagnosed annually in Vietnam, with 50% mortality, and only 10% of stroke patients recover completely and return to normal life.

Aim: To evaluate the economic burden of stroke from a hospital perspective and to extrapolate these costs to southern Vietnam and the whole country.

Materials and Methods: A retrospective study was conducted from January 2014 to December 2016 at a public hospital. Patient information was taken from the hospital electronic medical records. The input was ICD-10 code and treatment year, the output was direct medical cost, which included consumer material, diagnosis, hospital bed, laboratory test, operation, medication and other services.

Results: Of 1134 patients examined during the period from 2014-2016, 57.9% were male. The average age of rehabilitation after stroke patient was 61.7±12.0 years old. The average hospital stay was 41.9±46.4 days. The most common disease after stroke was hypertension (50.4%). Total direct medical costs on 1,134 patients were 985,701.5 USD and average of 869.2±1,181.4 USD per patient per year. The costs between two patients group, living in rural and living in urban, was statistically different.

Conclusion: Rehabilitation after stroke places a severe economic burden in Vietnam. The probable economic value of rehabilitation after stroke management is significant. As such, there is a need for an updated evaluation of the economic impact of post-stroke rehabilitation in Vietnam that also includes more regions within the country and adheres to the new guidelines and recommendations.

Keywords: Direct cost, Economic analysis, Hospital, Rehabilitation, Stroke, Vietnam

INTRODUCTION

According to the World Health Organisation (WHO) in 2015, stroke is the second leading cause of death and is the leading cause of disability, with ten million deaths and permanent disabilities reported [1]. The aging of the general population and the increase in risk factors such as hypertension and obesity are expected to lead to a continued rapid rise in the number of stroke patients [2].

Approximately 70-85% of first strokes are accompanied by hemiplegia and only 60% of people with hemiparesis who need inpatient rehabilitation achieve functional independence in simple activities of daily living, such as toileting and walking short distances, six months after stroke [3,4]. In Vietnam, about 200,000 patients per year suffer strokes, with a 50% mortality and only 10% of patients showing complete rehabilitation and return to normal life after stroke [5]. In 2009, the American Association for Cardiovascular Association (AHA) estimated the total direct medical costs in the United States at 22.8 billion US Dollars (USD) (including inpatient and outpatient treatments), costs for each caregiver at 6,018 USD, medicine and rehabilitation costs in the first year after stroke at 11,145 USD and prescription medicines at then 3,376 USD and annual rehabilitation at 7,318 USD [6]. Gustavsson A et al., reported the economic burden of stroke at almost 26.6 billion Euro in 2010 in Iceland, Norway and Switzerland [7]. In the United States, Godwin et al. recorded an average cost of outpatient rehabilitation services of 11,689 USD and medicine costs of 5,392 USD from 2001 to 2015 [8].

At present, very few studies have examined the cost of acute stroke treatments. The research by Ngo T et al., on stroke treatment cost at 115 Hospital, Ho Chi Minh City (HCMC) provided an estimated mean cost per patient of about 848.2 USD, which included direct medical costs of 600.1 USD [9]. The aim of the present study was to draw attention to the important effects of post-stroke rehabilitation and the lack of information on the true burden of this disease.

MATERIALS AND METHODS

Study Design

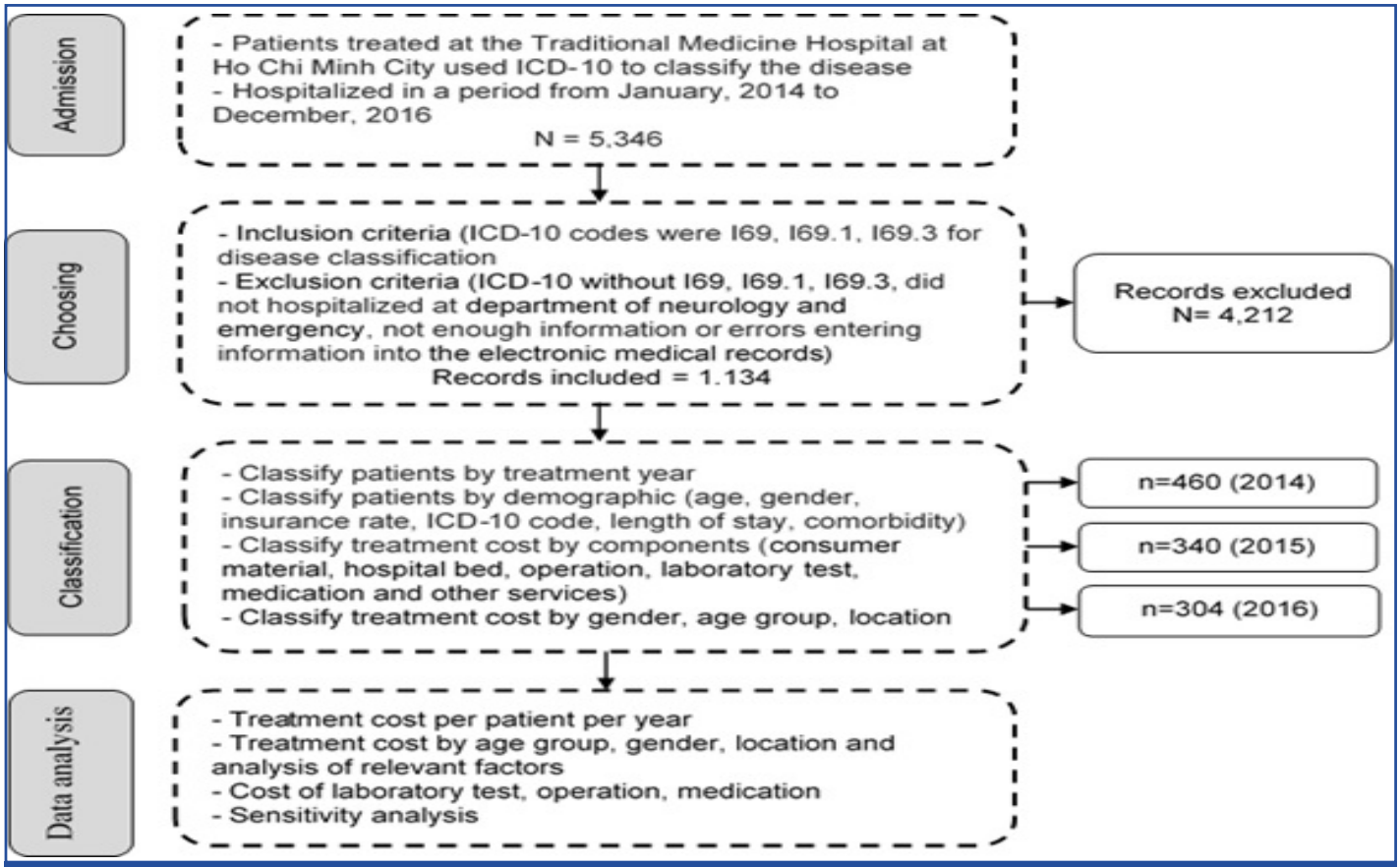
This study was a retrospective study and used an electronic medical records database to determine the direct medical cost from the hospital perspective of all post-stroke rehabilitation inpatients mandatorily admitted between January, 2014 and December, 2016 to the Traditional Medicine Hospital, Ho Chi Minh City.

Inclusion and Exclusion Criteria

We included all the hospitalised post-stroke rehabilitation cases, based on updated information from the electronic medical records from January 2014 to December 2016, and diagnosed by the International Classification of Diseases 10th Edition code I69, I69.1 and I69.3 {Sequelae of cerebrovascular disease (used to indicate post-stroke rehabilitation), sequelae of intracerebral haemorrhage (used to indicate haemorrhagic stroke rehabilitation), sequelae of cerebral infarction (used to indicate ischemic stroke rehabilitation), respectively}. We excluded cases not hospitalised in the neurology and emergency department, those without enough information and those with information errors entered into the electronic medical records [Table/Fig-1].

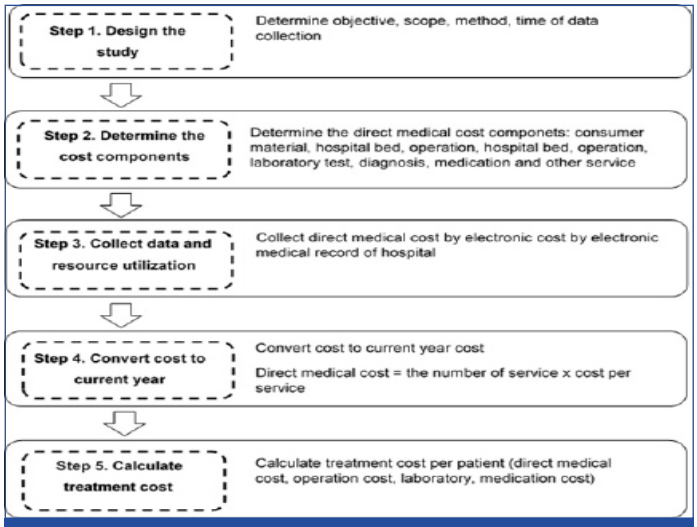
Data Collection and Sample Size

The sample size comprised of all patients diagnosed with post-stroke rehabilitation at the Traditional Medicine Hospital from January, 2014 to December, 2016 and corresponding to the inclusion criteria and exclusion criteria.



[Table/Fig-1]: Flowchart of study design.

The hospital database was divided into two categories: demographic characteristics and treatment costs. For the demographic characteristics, we considered the following variables: age, gender, length of stay, insurance rate and diagnosis. The direct medical costs were determined by examining the cost of consumer materials, hospital beds, operations, laboratory tests, medications and other services [Table/Fig-1]. We obtained the cost of each hospitalisation directly from the electronic medical records database.



[Table/Fig-2]: Five steps to analyse the cost.

STATISTICAL ANALYSIS

Data on the demographic characteristics, and treatment costs were summarised using descriptive statistics based on retrospective data. The costs of direct medical components (consumer materials, hospital beds, operations, laboratory tests, diagnoses, medications and other services) were calculated based on the number of services multiplied by the unit cost in 2017.

All analyses were conducted using descriptive statistics using Microsoft Excel 2013 to calculate the demographic characteristics, total costsand mean costs with Standard Deviation (SD) to describe the cost components. Descriptive statistics were employed to present the costs, which were classified by independent variables. An ANOVA test was used for multiple comparisons and a t-test to compare groups with two variables. A p-value <0.05 was considered statistically significant.

Estimating Cost and Cost Components

The unit cost of medical services was used to estimate the cost of medical services based on Trung VQ et al., [10]. Patients had to pay the cost of medicine equivalent to the purchase price from the hospital.

All costs were adjusted to the current year (2017) according to CPI values, which were initially calculated in the local currency (Vietnam Dong) and converted to US dollars (USD) using the average exchange rate of 1 USD=22.399 Vietnam Dong (VND) posted on February, 2017 by the State Bank of Vietnam [11].

Ethics Statements

The study protocols were approved by the Traditional Medicine Hospital. We ensured that all the information was used only for research purposes. During all data collection, we guaranteed anonymity by creating alphanumeric codes to identify each patient in the study.

RESULTS

Character of the Study Participants: Of the 1,134 post-stroke rehabilitation cases from 2014 to 2016, the overall mean age was 61.2±12.1 years. The number of patients aged 50-59 years was the highest (363, 32.0%), followed by the patients aged 60-69 years (332, 29.3%), >69 years (297, 26.2%), 40-49 years (101, 8.9%) and <40 years (41, 3.6%). [Table/Fig-3] shows a sudden increase in the number of patients aged over 50 years. The number of working-age patients, aged 15-60-year-old (working age under the Labour Law 2012), accounted for nearly 50% of the patients treated in the hospital (505, 44.5%) from 2014 to 2016. Male patients accounted

	2014 (n=460)	2015 (n=370)	2016 (n=304)	2014-2016 (N=1134)
Age (years)				
Mean±SD	61.9±12.3	61.8±11.7	61.2±12.1	61.9±12.3
<40	16 (3.5)	13 (3.5)	12 (4.0)	41 (3.6)
40-49	42 (9.1)	28 (7.6)	31 (10.2)	101 (8.9)
50-59	151 (32.8)	115 (31.1)	97 (31.9)	363 (32.0)
60-69	124 (27.0)	119 (32.2)	37 (12.2)	332 (29.3)
>69	127 (27.6)	95 (25.7)	75 (24.7)	297 (26.2)
Gender				
Male	270 (58.7)	212 (57.3)	175 (57.6)	657 (57.9)
Female	190 (41.3)	158 (42.7)	129 (42.4)	477 (42.1)
Length of stay (days)				
Mean (SD)	41.8±50.1	42.0±44.6	42.1±42.8	41.9±46.4
Median (IQR)	23 (13.8-48.3)	26 (15.0-55.8)	27 (14.8-52.3)	25 (14.0-51.0)
Min-Max	1-328	1-271	2-228	1-328
Health insurance reimbursement (%)				
0[1]	98 (21.3)	76 (20.5)	-	174 (15.3)
48	-	148 (40.0)	110 (36.2)	258 (22.8)
50	291 (63.3)	5 (1.4)	-	296 (26.1)
57	-	20 (5.4)	17 (5.6)	37 (3.3)
60	-	57 (15.4)	41 (13.5)	98 (8.6)
80	47 (10.2)	32 (8.6)	33 (10.9)	112 (9.9)
95	18 (3.9)	5 (1.4)	11 (3.6)	34 (3.0)
100[2]	6 (1.3)	27 (7.3)	92 (30.3)	125 (11.0)
Location				
HCMC	256 (55.7)	205 (55.4)	181 (59.5)	642 (56.6)
Other provinces	204 (44.3)	165 (44.6)	123 (40.5)	492 (43.4)
ICD-10[3]				
I69.0	437 (95.0)	364 (98.3)	299 (98.4)	1100 (97.0)
I69.3	18 (3.9)	5 (1.4)	4 (1.3)	27 (2.4)
I69.1	5 (1.1)	1 (0.3)	1 (0.3)	7 (0.6)

[Table/Fig-3]: Descriptive statistic of inpatient of post-stroke rehabilitation between 2014 and 2016 at Traditional Medicine Hospital, Ho Chi Minh City {n (%)}.
Notes:
[1]Out-of-pocket
[2]Free of charge
[3]I69.0: Sequelae of subarachnoid haemorrhage
I69.1: Sequelae of intracerebral haemorrhage
I69.3: Sequelae of cerebral infarction
Abbreviations: SD: Standard deviation; IQR: Interquartile range; HCMC: Ho Chi Minh City

for 57.9% (n=657). The average length of stay was almost equal among the study years, at 41.8±50.1 days, 42.0±44.6 days, 42.1±42.8 days and 41.9±46 days for 2014, 2015, 2016 and 2014-2016, respectively. The median length of stay was 23 (IQR, 18.8 to 48.3) days in 2014, 26 (IQR, 15 to 55.8) days in 2015, 27 (IQR, 14.8 to 52.3) days in 2016 and 25 (IQR, 14 to 51) days in 2014-2016.
Health insurance was the vital financial support for post-stroke rehabilitation patients. The result showed that most of patients were under 48% and 50% insurance reimbursement.

Comorbidity	2014 (n=460)	2015 (n=370)	2016 (n=304)	2014-2016 (n=1134)
Neuropathy[1]	16 (3.5)	20 (5.4)	28 (9.2)	62 (5.5)
Diabetes[2]	64 (13.9)	76 (20.5)	68 (22.4)	208 (18.3)
Respiratory disease[3]	33 (7.2)	40 (10.8)	34 (11.2)	106 (9.3)
Osteoarthritis[4]	31 (6.7)	47 (12.7)	56 (18.4)	134 (11.8)
Dyslipidaemia[5]	110 (23.9)	106 (28.6)	111 (36.5)	325 (28.7)
Hypertension[6]	194 (42.2)	209 (56.5)	169 (55.6)	571 (50.4)
Digestive disease[7]	28 (6.1)	28 (7.6)	21 (6.9)	77 (6.8)
Cardiovascular disease[8]	85 (18.5)	94 (25.4)	98 (32.2)	276 (24.3)
Depression/ insomnia[9]	15 (3.3)	31 (8.4)	47 (15.5)	93 (8.2)
Other disease[10]	85 (18.5)	98 (26.5)	65 (21.4)	247 (21.8)

[Table/Fig-4]: Comorbidity among post-stroke rehabilitation patients from 2014 to 2016 {n (%)}.
Notes:
[1]Diseases of the nervous system (G00-G99), disorder of vestibular function (H81)
[2]Diabetes mellitus (E10, E11)
[3]Diseases of the respiratory system (J00-J99), symptoms and signs involving the circulatory and respiratory systems (R00-R09)
[4]Disease of the musculoskeletal system and connective tissue (M00-M99)
[5]Disorders of lipoprotein metabolism and other lipidaemias (E78)
[6]Hypertensive disease (I10)
[7]Disease of the digestive system (K00-K93)
[8]Disease of the circulatory system (I00-I99)
[9]Neurotic, stress-related and somatoform disorders (F40-F48), sleep disorders (G47)
[10]Certain infectious and parasitic disease (A00-B99), malignant neoplasms (C00-C97), benign neoplasms (D00-D36), disease of the blood and blood-forming organs and certain disorders involving the immune mechanism (D50-D89), endocrine, nutritional and metabolic disease (E00-E90), cerebral infarction (I63), disease of veins, lymph nodes, not elsewhere classified (I80-I89), dental caries (K02), disease of liver (K70-K77), disease of the skin and subcutaneous tissue (L00-L99), disease of the genitourinary (N00-N99), symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified (R00-R99)

In general, the number of patients living in Ho Chi Minh City was higher than the number living in other provinces, and accounted for nearly three fifths of all post-stroke rehabilitation patients.

Most (97%) of the ICD codes were I69 with post-stroke rehabilitation, with only 3% of cases classified as rehabilitation after ischemic stroke or rehabilitation after haemorrhagic stroke.

[Table/Fig-4] shows that hypertension was the most common comorbidity, with a total of 571 cases (50.4%) in 2014-2016. Dyslipidaemia also accounted for a high percentage with 325 cases through the three-year period.

Direct Medical Costs

The total direct medical costs of stroke patients during the study amounted to 985,711.5 USD, of which, 37.5, 34.2 and 28.3% of these costs were incurred in 2014, 2015 and 2016 [Table/Fig-5].

The mean cost per patient was estimated at 869.2±1,181.4 USD per patient between 2014 and 2016. The mean cost per case tended to increase from 804.0±1,107.1 USD (in 2014) to 912.0±1,219.7 USD (in 2015) and up to 915.9±1,219.7 USD per patient (in 2016). Over the years, the cost of laboratory tests and consumable

Cost component	2014		2015		2016		2014-2016	
	Total cost	Mean±SD	Total cost	Mean±SD	Total cost	Mean±SD	Total cost	Mean±SD
Consumer material	2,812.9	8.7±17.1	1,447.2	6.1±3.3	607.5	4.0±7.4	4,867.6	6.8±12.3
Diagnostics	9,472.4	21.3±19.4	8,214.3	22.8±19.5	5,135.6	17.4±12.4	22,822.3	20.7±17.9
Hospital bed	89,553.5	194.7±314.3	70,770.4	191.3±337.4	61,858.2	203.5±289.8	222,182.0	195.9±315.5
Laboratory test	5,676.2	12.7±13.4	4,906.8	13.6±23.0	3,139.5	10.7±8.8	13,722.6	12.5±16.4
Operation	160,808.5	356.6±515.1	178,238.2	491.0±691.6	155,273.7	524.6±717.6	494,320.4	445.3±637.4
Medication	99,181.5	216.1±328.1	72,333.1	196.0±276.5	48,282.3	158.8±233.2	219,796.9	194.2±289.1
Others(*)	2,349.8	7.0±8.6	1,520.3	5.6±7.0	4,129.5	21.3±31.4	7,999.6	9.9±18.1
Total cost	**369,854.8**	**804.0±1,107.1**	**337,430.4**	**912.0±1,237.0**	**278,426.3**	**915.9±1,219.7**	**985,711.5**	**869.2±1,181.4**

[Table/Fig-5]: Economic burden of post-stroke rehabilitation between 2014 to 2016 at Central Hospital from hospital perspective (USD, 2017).
Notes: (*) Medical examination, decoction, transport

Characteristic	Total cost	%
Operation	**494,320.4**	**100.0%**
Acupuncture-infrared therapy	**254,504.0**	**51.5%**
Acupuncture	211,011.6	42.7%
Infrared	43,492.3	8.8%
Oxygen therapy	**2,311.1**	**0.5%**
Surgery-operation	**3,600.0**	**0.7%**
Injection/infusion	1,815.5	0.4%
Operation/procedure	1,604.3	0.3%
Surgery	180.1	0.0%
Physical therapy	**207,901.3**	**42.1%**
Exercise training	107,891.7	21.8%
Language therapy	12,267.2	2.5%
Massage	70,184.5	14.2%
Stretching	984.0	0.2%
Electrolysis-electricimpulses	11,473.6	2.3%
Ultrasound therapy	5,099.9	1.0%
Other operations(*)	**26,173.8**	5.3%
Laboratory test	**13,722.6**	**100.0%**
Biochemical test	**11,329.0**	**82.6%**
Blood glucose test[1]	2,254.2	16.4%
Cholesterol[2]	3,473.7	25.3%
Electrolytes[3]	1,363.5	9.9%
Inflammatory reaction[3]	11.1	0.1%
Kidney function test[4]	89.0	6.5%
Liver function test[5]	3,329.7	24.3%
Thyroid function test[6]	6.8	0.0%
Haematology test[7]	**1,594.3**	**11.6%**
Immunisation test[8]	**58.5**	**0.4%**
Microbiological test[9]	**17.1**	**0.1%**
Urine test[10]	**723.7**	**5.3%**

[Table/Fig-6]: Cost of operation and laboratory test between 2014 and 2016 (USD, 2017).
Notes:
[*]Change clothes, change bed sheets
[1]Blood glucose concentration, HbA1c
[2]Total cholesterol, LDL, HDL, triglyceride
[3]Na^+, K^+, Ca^{++}, Cl^-
[4]CRP, CRPhs, RF
[5]Acid uric, creatinine
[6]T3, T4, TSH
[7]Blood group (ABO), general blood cell analysis, coagulation time, bleeding time, Ferritin
[8]AFP, anti HBs, anti HCv, HBeAg, PSA
[9]ASLO (ASO), finding parasites in the stool, finding red blood cells, white blood cells in stool, finding malaria parasite in stool
[10]Urine 10 parameters, urine during 24h, general urinalysis

materials tended to decrease, whereas other service costs tended to increase.

[Table/Fig-6] shows the total cost for operationsand laboratory test during the period 2014-2016 was 494,320.4 USD. Operations used in treatment were divided into five groups, acupuncture/infrared therapy, oxygen therapy, surgery/operation, physical therapy, and other operations. Laboratory tests included biochemical tests, haematology tests, immunisation tests, microbiological tests, and urine tests.

[Table/Fig-7] shows that the medication group had a total number of 13,415 prescriptions, including 2,769 brand name and 10,646 generic counterparts. Cardiovascular medicines were the second most common prescription with a total of 2,005 times. Traditional medicines were prescribed 27,785 times, which was 2.07 times more than western medicines and 3.51 times more than functional foods.

[Table/Fig-8] shows that the patients aged 50-59 years had the highest total and mean costs (total 345,271.9 USD and average 951.2±1,219.5 USD per patient). The mean cost of treatment between male and female (829.3±1,114.8 USD) (924.2±1,266.6 USD) was not significantly different (p-value >0.05).

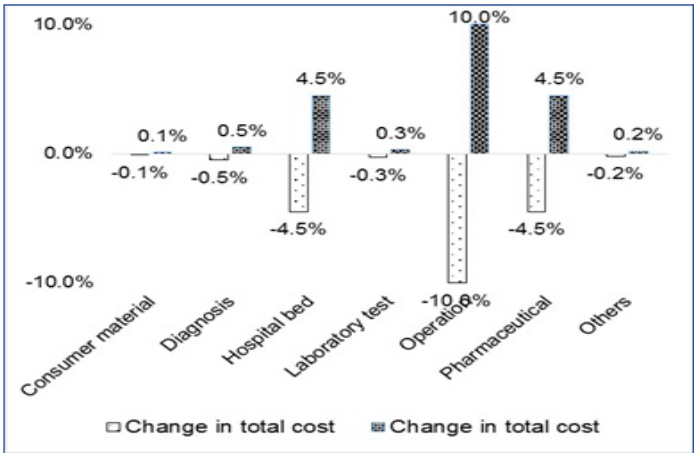
Medication	No.		Total cost (%)	
	Brand name	Generic	Brand name	Generic
Western medicine	**2,769**	**10,646**	**24,720.7 (11.2)**	**17,256.4 (7.9)**
Medicine for stomach ache	-	711	-	442.5 (0.2)
Diabetes medicine	552	936	3,622.5 (1.6)	890.6 (0.4)
Anti-inflammatory medicine	69	1,589	612.5 (0.3)	5,043.2 (2.3)
Respiratory medicine	-	150	-	25.9 (0.0)
Psychoactive medicine	192	166	5,928.5 (2.7)	270.2 (0.1)
Antihistamine medicine	11	219	16.6 (0.0)	181.7 (0.1)
Antibiotics	1	183	12.3 (0.0)	565.7 (0.3)
Dyslipidaemia medicine	-	1750	-	1,479.7 (0.7)
Antihypertensive medicine	1,523	2,223	10,537.0 (4.8)	3,661.8 (1.7)
Infusion solution	23	298	888.2 (0.4)	1,376.0 (0.6)
Gastrointestinal medicine	1	425	1.1 (0.0)	758.7 (0.3)
Cardiovascular medicine	279	1,726	2,238.6 (1.0)	2,036.7 (0.9)
Vitamin	-	139	-	193.7 (0.1)
Osteoarthritis medicine	118	92	863.4 (0.4)	45.9 (0.0)
Others (*)	-	39	-	284.2 (0.1)
Functional Food		**7,921**		**48,586.8 (22.1)**
Sedative		855		1,882.9 (0.9)
Tonic		2,515		11,020.7 (5.0)
Liver detoxification		420		3,378.7 (1.5)
Dyslipidaemia		66		260.5 (0.1)
Gastrointestinal		139		246.7 (0.1)
Strengthen circulation		3,174		29,471.9 (13.4)
Osteoarthritis		176		544.7 (0.2)
Others (**)		576		1,780.80 (0.8)
Traditional Medicine		**27,785**		129,232.9 (58.8)
TOTAL		**49,121**		219,796.9 (100.0)

[Table/Fig-7]: Information about costing and using medicine in Traditional hospital, Ho Chi Minh City from 2014 to 2016 (USD, 2017).
Notes: [*]Adrenaline, Medicine for varicose veins
[**]Functional food for sinusitis, massage

Sensitivity analysis was conducted for post-stroke rehabilitation to change the percentage of total costs [Table/Fig-9]. If the operation costs were reduced by 20%, the total direct medical costs would fall by 10.0%. If the diagnostic costs were reduced by 20%, the total direct medical cost was reduced by 0.5%. If the bed costs dropped by 20%, the total direct medical expenses would fall by 4.5%. If the costs of medicines decreased 20%, the total direct medical costs would fall by 4.5%. If the cost of

Year	2014 (n=460)			2015 (n=370)			2016 (n=304)			2014-2016 (N=1,134)		
Characteristic	Total cost	Mean±SD	P-value(*)	Total cost	Mean±SD	P-value(*)	Total cost	Mean±SD	P-value(*)	Total cost	Mean ± SD	P-value(*)
Age (years)												
<40	9,223.2	576.5±440.8		10,622.9	817.1±614.1		10,662.6	888.5±1,260.1		30,508.7	744.1±801.2	
40-49	30,311.8	721.7±837.1		27,175.8	970.6±1,167.2		25,479.7	821.9±864.0		82,967.2	821.5±943.1	
50-59	134,297.6	889.4±1,009.8	0.7097	117,542.7	1,022.1±1,542.8	0.8131	93,431.7	963.2±1,084.6	0.9434	345,271.9	951.2±1,219.5	0.5887
60-69	101,095.9	815.3±1,248.3		100,259.7	842.5±1,037.6		75,703.1	850.6±1,159.0		277,058.7	834.5±1,149.0	
>69	94,926.3	747.5±1,207.3		81,829.3	861.4±1,141.8		73,149.2	975.3±1,553.8		249,904.9	841.4±1,283.2	
All ages	**369,854.8**	**804.0±1,107.1**		**337,430.4**	**912.0±1,237.0**		**278,426.3**	**915.9±1,219.7**		**985,711.5**	**869.2±1,181.4**	
Gender												
Male	221,999.1	822.2±1,128.6	0.6725	169,900.2	801.4±953.0	0.6205	152,964.2	874.1±1,269.4	0.4809	544,863.6	829.3±1,114.8	0.1908
Female	147,855.6	778.2±1,078.2		167,530.2	1,060.3±1,528.8		125,462.1	972.6±1,151.3		440,847.9	924.2±1,266.6	
Location												
HCMC	239,341.7	935.1±1,309.1	0.0025	220,622.8	1,076.2±1,474.5	0.0025	200,995.7	1,110.5±1,440.3	0.0001	661,000.4	1,029.6±1,400.8	<0.001
Others	130,472.9	639.6±754.8		116,807.6	707.9±814.2		77,430.6	629.5±703.8		324,711.0	660.0±762.4	

[Table/Fig-8]: Cost of illness for different ages and genders between 2014 to 2016 (USD, 2017).
Notes:[*]Comparison of mean cost between 5 subgroups (<40 years, 40-49 years, 50-59 years, 60-69 years and >69 years); Comparison of mean cost between two subgroups: male and female; Comparison of mean cost between two subgroups: HCMC and others.0



[Table/Fig-9]: Sensitivity analysis was conducted for post-stroke rehabilitation to change the percentage of total costs .

testing and other costs decreased 20%, the total direct medical costs would be reduced by 0.2%, and if the costs of consumer materials were reduced by 20%, the total direct medical costs would only decreased by 0.1%. The cost components, procedure costs, bed dates and medications are the most sensitive and are the most important in stroke symptomatic inpatients. Lower sensitivity groups are the costs of diagnosis, testing, consumable supplies and other costs.

DISCUSSION

The mean age of post stroke rehabilitation in the present study was 61.7±12.0 years, which was lower than the mean age reported by Trinh V et al., in Khanh Hoa, at 64.9±11.5 years [12] and by Ngo T et al., in hospital 115 of HCMC, at 63.62±27.17 years [9], but it was consistent with the increasing rejuvenation trend of stroke patients around the world [13].

The proportion of males was always higher than females, with no significant difference in the proportion between years. The male:female ratio was 1.38, which was slightly higher than the ratio reported for the epidemiological study at the 115 HCMC hospital (male:female ratio was 1.28) [9], and it also agreed with the epidemiological study of the Vietnamese fraternity [14] showing that the male rate was higher than the female rate.

The median number of hospitalisation days was fairly even between the years and for the period 2014-2016 was 41.9±46.4 days. This coincided with the Meyer study in Canada, which reported 41.2±27.5 days in 2009 [15] but was lower than that reported by Ho KJ in Korea, at 118.6±219.0 days [16].

More than 80% of patients used insurance for the treatment of stroke at the hospital. This can be explained by the fact that the hospital treatment had a quite long duration. Therefore, to reduce the cost of patient care, more than 80% of patients had used insurance to reduce their costs of treatment.

The ICD-10 code accounted for 97.0% of patients (169 patients); this code does not clearly distinguish the type of stroke because the treatment of stroke is similar in patients with cerebral infarction and cerebral haemorrhage, so stroke classification is not as important as in the emergency phase. The statistical results indicated hypertension as the most common comorbidity.

Post-stroke rehabilitation imposes a substantial economic and disease burden for the patient. The total direct medical costs of stroke patients for the three years of the survey were 985,701.5 USD, with an average of 869.2±1,181.4 USD per capita. This was higher than the mean cost of stroke recovery at home, which, according to Akhavan Hejazi SM study in Malaysia, was 547.1 USD [17] and was significantly lower than the cost of rehabilitation in America in 2009, at 7,318 USD per patient [6]. It was also much higher than the cost of treatment of emergency stroke, according to research by Ngo T et al., at Hospital 115 HCMC, at 600.1 USD [9]. Post-stroke rehabilitation can therefore be seen to cause a great economic burden, so a policy of reducing the economic burden on the hospital as well as patients is needed.

Sensitivity analysis shows that, for the cost components, the cost of operations, hospital beds and medicines are the highest and are all very important components in the treatment of stroke. A policy should be put in place to reduce the costs for the operation group (especially the acupuncture/infrared and physiotherapy groups). The hospital should also reduce the cost of bed days when the patient undergoes long-term hospital treatment.

CONCLUSION

Costing evaluations provide critical data for economic evaluations. Direct medical costs of hospitalisation at the Traditional Medicine Hospital in Vietnam indicate a heavy economic burden on patients and their families. In order to reduce the burden of post-stroke rehabilitation at the hospital, policies are needed that will reduce the costs for the procedure group and bed days. The cost of testing can be reduced by reviewing the medical records before admission and only using laboratory tests when the patient's comorbidity is unclear.

DISCLOSURE

The Authors declare that they have no relevant conflicts of interest to disclose.

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