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Cost-Effectiveness Analysis of Rehabilitation Services for Stroke Patients in Pranangklao Hospital, Fiscal Year 2011-2012

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Abstract: Stroke is one of the most frequent causes of morbidity and mortality. Nearly 60% of stroke patients had permanent disability. There is evidence that rehabilitation can significantly improve functional ability of stroke patients, however the comparison on cost-effectiveness between home-based rehabilitation services (HB) and outpatient rehabilitation services (OPD) in Thai health care setting is still unknown. The purpose of this study was to analyze the cost-effectiveness of rehabilitation services for ischemic stroke patients at the Stroke Corner of Pranangklao hospital under the Universal Health Coverage during the fiscal year 2011-2012. This study was a retrospective - prospective study that analyzed the cost-effectiveness of stroke rehabilitation services in Pranangklao Hospital under the provider and patient perspectives. Fifty ischemic stroke patients were recruited to the study, from 1 June 2011 to 30 November 2011 and followed up at 6 months after discharge. Effectiveness was defined as decreasing of Barthel index disability level.The study shows that outpatient rehabilitation had more cost-effectiveness than home-based rehabilitation (OPD 51,286.72 Baht vs. HB 66,936.01 Baht) for one lower disability level. Even though, the average Barthel index score at initial assessment of Outpatient rehabilitation showed a higher disability. The Stroke Corner procedures followed by Outpatient rehabilitation offers the best results in terms of effectiveness at an additional cost to both the hospital and patients perspectives.

Key words: **cost, effectiveness, rehabilitation, stroke**

Introduction

Stroke is one of the most frequent causes of morbidity and mortality worldwide[1,2] and is also the most common serious neurological disorder in Thailand. In 2010, 247.33 strokes per 100,000 Thai populations had been reported.[3] More than half of all neurological admissions was from stroke.[4] Although the availability of advanced medical technology and facilities, nearly 30% of those who suffered from stroke lost their lives, 10% of them became fully dependent and about 60% had permanent disability of varying degrees that created burdens on families and communities.[5-8]

Early rehabilitation program for patients with ischemic stroke within the first three months compared to non-rehabilitation or conventional care demonstrated better outcomes in improving function, reducing disability, increasing quality of life and reducing depression.[9-14] Moreover, an early-supported discharge with rehabilitation services has a beneficial effect on extended activity of daily life (ADL) 5 years after stroke for mildly to moderately Barthel-level impaired patients.[15] In developed countries as well as in Thailand, stroke units have been established in hospital care to provide a specialized stroke care team with early rehabilitation services.

Many studies had demonstrated that stroke unit care and early-supported discharge was an effective and cost-effective strategy with the main gains in years of life saved, although acute stroke care unit costs are generally higher.[15-17] In Thailand, stroke units had been widely implemented in public tertiary hospitals, general hospital and university hospitals. However, there was limited information on cost-effectiveness of stroke unit compared with other strategies of organized rehabilitation care under Thai health care setting. Cost-effectiveness analysis is a method of economic evaluation based on logic aids, the decision-making process by evaluation of costs and benefit explicit. In health care, maximizing beneficial outcome while minimizing costs has been emphasized in an attempt to help physician to select treatment that could provide the "best possible care" at the lowest cost.[18,19] This study was aimed to analyze the cost-effectiveness of rehabilitation services for stroke patients in two strategies of stroke unit care outpatient rehabilitation vs. home-based rehabilitation.

Materials and Methods

This study was a retrospective-prospective study that analyzed the cost-effectiveness of stroke rehabilitation services at Pranangklao Hospital in two strategies from June 2011 until June 2012.

There were two parts of data collection: (1) cost evaluation was performed in both provider and patient perspectives (recruitment period: June to November 2011) as a retro-prospective study consisted of data collection to identify resources used starting from the admission of a stroke patient at Stroke Corner until discharge and continued the rehabilitation until 6 months after discharge; and (2) outcome evaluation: a prospective study consisted of data collection on disability level assessed using Barthel index[20] performed at admission and at 6-month follow up after discharge.

Allocation of samples

There were 2 study populations in this study:

1. All patients who had first episode of stroke and no pre-existing disability admitted at Stroke Corner of Pranangklao Hospital within 3 days after the stroke

onset were recruited to the study. Ischemic stroke was confirmed by a computed tomography scan (cerebral infraction). All of them were under the universal health coverage scheme at Pranangklao Hospital. Patients who had co-morbidities which were diseases requiring continued treatment or stayed longer in the ward due to conditions or its cause interrupt rehabilitation training program such as osteoarthritis, arthroplasty, fracture, deep vein thrombosis, cardiac disease, COPD, severe asthma, cognitive problem and mental disorder or patients who died within 6 months after discharge were excluded from the study. There were two groups of rehabilitation after discharge depending on physician decision: 25 Outpatient rehabilitation group and 25 Home-based rehabilitation group;

2. Provider population was the multidisciplinary care team who involved with treating stroke patients in the study. They were 37 medical staff composed of physicians, physical therapist, nurse, pharmacy, medical technology staff (lab test and CT scan) and social medicine staff.

Both study populations had given information about the study and were willing to participate. This research had been reviewed and approved by the Ethics Review Committee for Human Research of Mahidol University, Thailand.

Rehabilitation program

Rehabilitation program was started in the morning of the following day after admission. During admission at the stroke corner, the duration of physical therapy was the same in both groups at about 1 hour per session and covered full scope of training activities used in practical daily life. Before discharge, physical therapist demonstrated home program exercise and mobility to all stroke patients as well as their caregivers or families. Every month, patients in both groups made a visit to a physician at outpatient department.

OPD group were those who attended the outpatient rehabilitation services two times or more. While the home-based rehabilitation (HB) group was those who received home visit services. Different interventions were differently assigned to each group. In OPD group, rehabilitation was performed by physical therapist and physical medicine and rehabilitation (PM&R) physician during OPD visit. Stroke patients were instructed by physical therapist to exercise and ambulation training about 1 hour at a time and continue the rehabilitation program at least once a week in the first 1 month after hospital discharge. Intensity of the rehabilitation depended on severity of disability from physician assessment with monthly follow-up.

In HB group, suggestions on personal care, exercise, ambulation, drugs and home environment adjustment were assigned to be performed at home by the home health care team support including social medicine staff and district nurse of Pranangklao Hospital.

Cost-Effectiveness analysis

Cost-effectiveness analysis is an economic evaluation method to measure the value of money used for health intervention compared to the clinical outcome gained.[18,19,21,22] The cost-effectiveness analysis (CEA) in this study defined as the average costs for decreasing disability level. Cost of rehabilitation services in this study was analyzed in both provider and patient perspectives. Effectiveness was assessed using change of Barthel index of disability level.

After collected data were analyzed, the outcome

measure was reported as total cost per additional Barthel Index score (level) that representing disability avoided by calculated from the following equation:

Cost-Effectiveness analysis (CEA) of Home-based Rehabilitation Group (HB rehab group) was calculated by the formula:

$$CEA_{OPD} = \frac{\text{Average total cost of provider and patient perspective of OPD group}}{\text{Average additional Barthel Index score of disability decreasing level of OPD group}}$$

Cost-Effectiveness analysis (CEA) of Outpatient Rehabilitation Group (OPD rehab group) was calculated by the formula:

$$CEA_{HB} = \frac{\text{Average total cost of provider and patient perspective of HB group}}{\text{Average additional Barthel Index score of disability decreasing level of HB group}}$$

The incremental cost-effectiveness ratio provides a way to compare the differences in their costs and divided by the difference in their effectiveness of two treatment options using the following formula:

$$ICER = \frac{C_{new} - C_{old}}{E_{new} - E_{old}}$$

The option with the lowest cost per unit of effectiveness is the most cost-effective.[18,19,23,24]

Outcome assessment

Major goal of rehabilitation among stroke patients was the achievement of maximum independent ADL and mobility. Barthel Index (BI) is a reliable assessment of motor recovery and functional independence for stroke patients that widely used.[20] BI consists of 10 items, 8 of which represent activities related to personal care and the remaining 2 items are related to mobility. Each item has 4 scores of 0, 1, 2, or 3 which is weighed differently in each item and hence reflects the relative importance of each type of disability in term of assistance required. Total BI score that ranges from 0 to 20 is classified into 5 disability categories (total BI score of 20 stands for independent, 15-19 for mild, 10-14 for moderate, 5-9 severe and 0- 4 for very severe).[23-28] Comparison of Barthel index between discharge day and 6 months after discharge was performed in both groups for outcome assessment.

Cost collection

Cost on provider perspective including labor cost, material cost and capital cost was collected retrospectively. Labor cost (LC) was the summation of salary, overtime wages, position allowance, children allowance, medical expense, tuition fees and house rent. LC was calculated per person and per activity of each services or time visit, then calculating by shared the cost according to the proportion of work in the respective activity. Material cost (MC) was from the total amount of materials purchasing such as medicine, medical material and laboratory cost. The sources of these data were from expense account of register medicine material and accounting and financial department of Pranangklao Hospital. Material cost for each stroke patient was calculated from material used in that patient recorded by Stroke Corner staff. For some medical equipment the prices were not available, cost per service was used. Capital

Cost (CC) was cost on all building use related to each stroke patient in Stroke Corner cost and land cost whose useful life of more than 20 years. Building in this study was excluded from CC due to expired building (durability period of each building property was determined by the Bureau of the Budget Office of Thailand is 20 years).

To collect cost in patient perspective, patient and family were interviewed about their personal data, direct and indirect treatment expenditure including informal caregivers, transport cost, food cost, and productivity loss of patient, the informal care costs which were estimated based on the Thailand minimum wage rate (300 Baht per day) and recorded and adopted for the economic evaluation. Approximate actual intervention costs after discharge were estimated based on time of rehabilitation and follow-up time. Cost in providers was collected using questionnaire on patient records.

Statistical analyses

Descriptive statistics were used to describe general characteristics of participants. The results were demonstrated as percentage, mean, ratio and standard deviation to, cost of provider and patient perspective; also the results were compared by cost-effectiveness ratio of both group analyses.

Results

Patient characteristics

Fifty stroke patients were recruited into the study. (25 in HB group and 25 in OPD group) Fifty six percent were men with a mean age of 58.4 years. Patient characteristics in both groups regarding side of weakness and occupation were similar. However, OPD group has higher disability level (BI score) than of HB group with the significantly longer average length of stay ($p = 0.012$) (Table 1).

Effectiveness assessment

Although, outpatient rehabilitation group was more disability than home-based rehabilitation group by lower BI score at initial assessment, the functional ability progression after 6 month followed-up was

Table 1 Characteristics of stroke patients in this study

Parameter	Home-based Rehab n=25		Outpatient Rehab n=25		All subjects	
Male, n (%)	13	(46.4%)	15	(53.6%)	28	(56.0%)
Female, n (%)	12	(54.6%)	10	(45.4%)	22	(44.0%)
Age, years, Mean (SD)	59.3	(9.9)	57.3	(11.1)	58.3	(10.4)
Length of stay, Mean (SD)	3.8	(1.7)	6.0	(3.8)	4.9	(3.1)
Left weakness, n (%)	15	(50.0%)	15	(50.0%)	30	(60.0%)
Right weakness, n (%)	10	(50.0%)	10	(50.0%)	20	(40.0%)
BI* score, Mean (SD)	11.64	(3.39)	9.68	(3.0)	10.66	(3.3)
BI* Level, Mean (SD)	2.88	(0.78)	2.4	(0.5)	2.64	(0.7)
Employed, n (%)	17	(68.0%)	17	(68.0%)	34	(68.0%)
Unemployed, n (%)	8	(32.0%)	8	(32.0%)	16	(32.0%)

* BI Barthel Index

showed improvement by more decreasing disability level. The average BI score of OPD group was changed by 9.68 to 16.64. Mean difference of BI level (before-after rehabilitation) among OPD group (95% CI lower, upper) was 1.48 (1.28, 1.68); paired t-test. While, mean difference of BI level (before-after rehabilitation) among home-based group was 0.88 (0.6, 1.16) (Table 2).

Cost analysis

Total cost of provide perspective of all 50 stroke patients in this study was 1,695,476 Baht. The provider perspective cost included all supplies of treatment in Stroke Corner of Pranangklao Hospital and rehabilitation intervention of both group from stroke onset during admitted to 6 months after discharge in fiscal year 2011-2012. The cost consisted of labor cost of 1,416,112 Baht and material cost of 279,363.5 Baht. The capital cost was excluded from the analyses because all 3 buildings involved in rehabilitation services were used for more than 20 years (The useful life of the buildings was 20 years). Also the overhead costs were excluded such as management, heating, stationery, telephone, vehicle maintenance and laundry. The average provider perspective cost per patient was 33,909.51 Baht.

Consideration in detail, labor cost of provider perspective was calculated from average salary cost per work time of all staff; physician, nurse, medical technique, physical therapist and social medical staff who involved with Stroke Corner and rehabilitation service. Researcher assumed the average time spent per patient in stroke corner as average salary staff per hour multiple with time spent per patient and LOS. Total labor cost was 543,807.66 Baht (SD= 9,811.89) and 872,304.47 Baht (SD=21, 503.12) of Home-based Rehabilitation Group and Outpatient Rehabilitation Group, respectively.

Material cost of provider perspective included medical equipment cost, drug cost, public utility cost, office material cost and laboratory cost. The prices of some medical equipment of laboratory cost could not be found, so the Researcher calculated from cost per service. Total material cost was 134,284.5 Baht (SD=392.642) and 145,078.9 Baht (SD=1,015.1) of Home-based Rehabilitation Group and Outpatient Rehabilitation Group, respectively.

Total cost of patient perspective in this study was 1,687,452 Baht. All stroke patients of both groups were covered by Universal Health Coverage Scheme (UHC) at Pranangklao Hospital, so the patients did not have to pay for direct cost from treatment in hospital. Patient perspective cost collected from indirect treatment expenditure of patient and family. The cost including productivity loss of patient and

Table 2 Outcome of BI score after 6 months followed-up

Barthel Index Assessment	Home-based Rehab (n=25)		Outpatient Rehab (n=25)	
	BI score	BI Level	BI score	BI Level
Admit Mean (SD)	11.64 (3.39)	2.88 (0.78)	9.68 (2.95)	2.40 (0.50)
6 month dischargeMean (SD)	16.72 (2.48)	3.76 (0.52)	16.64 (2.10)	3.88 (0.33)
Mean difference95% CI	5.08 (4.2-5.98)	0.88 (0.6-1.16)	6.96 (5.9-8.00)	1.48 (1.28-1.68)

* BI Barthel Index

family, caregivers cost, and transportation cost, during admitted to 6 months after discharge to their homes. The average cost of patient perspective was 33,749.04 Baht per patient.

The total productivity loss of all patients and family in this study was 1,194,000 Baht, calculated from salary of patient before admitting multiply with 6 month. Of total 50 stroke patients, 7 patients returned to work at the same salary rate, 23 patients were unemployed because of disability, 16 patients were unemployed before admitted and 4 patients were change work with decreasing salary rate because of disability.

Caregivers cost in this study calculated from employed caregiver cost per month or, if family left their work to take patient to the hospital for follow-up with the doctor the cost was estimated based on the Thailand minimum wage rate (300 Baht per day). Only 6 patients employed caregiver for providing help or supervision in activity daily life of patient, the other was taken care by the family. The total caregiver cost was 404,040 Baht.

The transportation cost in this study was estimated by taxi meter cost from their home to hospital and return to home. The cost approximated by the number of received rehabilitation intervention and number of follow-up with doctor that all patients came to hospital at least 2 times for follow up with doctor and to do rehabilitation at Pranangklao Hospital for Out-patient rehabilitation group. Total transportation cost was 89,412 Baht.

The total average cost per patient of home-based rehabilitation group was 58,903.69 Baht, of which the highest of cost was 36.7% of labor cost, 36.04% of productivity loss cost, 15.89% was caregiver cost, 9.06% of material cost, and 2.33% of transportation cost, respectively (Table 3).

For the Outpatient Rehabilitation Group, the total average cost per patient was 75,904.34 Baht, of which the highest of cost was 45.88% of labor cost, 34.71% of Productivity loss cost, 8.89% of Caregiver cost, 7.63% of material cost, and 2.89% of Transportation cost, , respectively (Table 4).

Cost-effectiveness analysis

According to effectiveness assessment and cost analysis of both group, we found that Outpatient Rehabilitation Group was more cost-effectiveness than Home-based Rehabilitation Group by CEA of OPD group was 51,286.72 Baht per disability level decreasing, whereas CEA of HB group was 66,936.01 Baht per disability level decreasing. The results demonstrated that OPD group was more effective intervention to decreasing disabled level of BI score

Table 3 Total cost of Home-based Rehabilitation Group (n=25)

Perspective cost		Amount	Average	Percent	SD
Provider Cost	Labor cost	543,807.66	21,752.31	36.70	9,811.89
	Material cost	134,284.50	5,371.38	9.06	392.64
Patient Cost	Productivity loss cost	534,000.00	21,360.00	36.04	28,948.06
	Transportation cost	34,500.00	1,380.00	2.33	487.98
	Caregiver cost	235,040.00	9,040.00	15.86	15,129.66
Total cost		**1,481,632.16**	**58,903.69**	**100.00**	

Table 4 Total cost of Outpatient Rehabilitation Group (n=25)

Perspective cost		Amount	Average	Percent	SD
Provider Cost	Labor cost	872,304.47	34,829.179	45.88	21,503.12
	Material cost	145,078.9	5,803.158	7.63	1,015.1
Patient Cost	Productivity loss cost	660,000	26,400	34.71	26,790.86
	Transportation cost	54,912	2,112	2.89	856
	Caregiver cost	169,000	6,760	8.89	15,616
	Total cost	**1,901,295.37**	**75,904.34**	**100.00**	

Table 5 Cost-effectiveness analysis of both rehabilitation interventions

Cost-effectiveness analysis of both rehabilitation intervention	Home-based Rehabilitation Group	Outpatient Rehabilitation Group
Overall Cost (Mean).....(1)	58,903.69	75,904.34
BI level gained (Mean).....(2)	0.84	1.48
Cost-Effectiveness Analysis.....(1)/(2)	**66,936.01**	**51,286.72**
BI score gained (Mean).....(3)	5.08	6.96
Cost-Effectiveness Analysis.....(1)/(3)	**11,595.21**	**10,905.8**

by the lower cost per disability avoided (Table 5).

Furthermore, the Incremental cost effectiveness analysis (ICEA) of both groups was calculated from the formula as follow:

$$ICEA = \frac{Cost_{OPD} - Cost_{HB}}{E_{OPD} - E_{HB}}$$

$$= \frac{75,904.34 - 58,903.69}{1.48 - 0.84}$$

$$= 26,563.5$$

The results found that the ICEA between intervention groups was 26,563.5 Baht of the addition cost per addition effectiveness or decreasing disability level from changing HB rehab group to OPD rehab group.

Discussion

Pranangklao Hospital, representation of hospital in Nonthaburi province was mostly under UHC for health services in both OPD and IPD patients. The Government of Thailand allocates budgets to Pranangklao hospitals for UHC as a fixed cost per registered patient, therefore Pranangklao hospital has to defray the expenses all treatment costs. If the rehabilitation intervention in the study can decrease disability level and prevent complication or recurrent stroke, it would save future costs of further disability care by the hospital. Although, the initial hospital costs were reduced by early supported discharge but disability of stroke was increasing the burden to patient and family for both direct and indirect cost.

Thus, this study was based on cost analysis in both provider and patient perspectives for calculating all accurate cost. Moreover, this study provides CEA to informed hospital administrators for making decisions regarding adopting Rehabilitation strategy.

The results of the study show that Outpatient rehabilitation group was more cost-effectiveness than HB group. Even though, the average Barthel index score at initial assessment of OPD group was higher disability, however after 6 month rehabilitation follow-up, OPD group had decreased average disability level than HB group. Moreover, total costs of HB group were lower than Outpatient Rehabilitation group by mean overall cost ratio of approximately 1:1.2. However, when compared cost with effectiveness by incremental cost effectiveness analysis (ICEA), it was found that the ICEA was 26,563.5 baht of addition cost CEA from changing HB rehab group to OPD rehab group. More than half of the total costs were incurred in the first few days admitted period. The cost of hospital care was in greatly proportion. The LOS was a key variable that had a substantial impact on the total cost. This study proved that the higher cost resulted in a greater number of patients avoiding disability level should be considered for worthwhile of payment. The study demonstrates that integrated provision of Stroke corner care followed by OPD rehabilitation had better outcomes of treatment in term of cost-effectiveness.

Suggestion for improvement HB rehabilitation group was that the details of the home program should be tailored to the particular patient and incorporated into the patient's daily routine. The home visit care team should include a consultant in rehabilitation and consists of key persons such as physiotherapists, physician and community nurses, however whose time might be contracted and overwhelmed by services according to demand. Clinically, greater intensity of stroke rehabilitation has been associated with improved outcomes. Moreover, stroke patient and family should be informed to estimate cost of illness from the study results.

Fortunately, the Ministry of Public Health, Thailand has currently accepted an intervention to be cost-effective by the intervention that adds 1 quality-adjusted life year (QALY) for less than 100,000 baht. Therefore, we would like to suggest further study should consider on this issue.

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โรคหลอดเลือดสมองเป็นสาเหตุที่ทำให้เกิดความพิการหรือเสียชีวิตที่พบได้มากที่สุด กว่า 60% ของผู้ป่วยจะมีความพิการหลงเหลืออยู่อย่างถาวร มีการศึกษาพบว่าการฟื้นฟูสมรรถภาพผู้ป่วยโรคหลอดเลือดสมองจะช่วยเพิ่มความสามารถในการเคลื่อนไหวและช่วยเหลือตนเองได้อย่างมีนัยสำคัญทางสถิติ แต่ยังไม่มีการศึกษาใดเปรียบเทียบการฟื้นฟูสมรรรถภาพแบบผู้ป่วยนอกกับการฟื้นฟูสมรรถภาพที่บ้านมาก่อน การศึกษานี้มีวัตถุประสงค์เพื่อวิเคราะห์ต้นทุนประสิทธิผลการฟื้นฟูสมรรถภาพผู้ป่วยโรคหลอดเลือดสมองประเภทตีบหรืออุดตันที่ใช้สิทธิประกันสุขภาพถ้วนหน้าที่โรงพยาบาลพระนั่งเกล้าในปีงบประมาณ 2554-2555 เก็บข้อมูลในรูปแบบสำรวจย้อนหลังและติดตามผลไปข้างหน้าเป็นระยะเวลา 6 เดือน หลังผู้ป่วยออกจากโรงพยาบาล โดยวิเคราะห์เปรียบเทียบต้นทุนต่อประสิทธิผลของผู้ป่วยทั้งหมด 50 ราย วิเคราะห์ต้นทุนในมุมมองของผู้ให้บริการและในมุมมองของผู้ป่วย ประเมินประสิทธิผลการฟื้นฟูสมรรถภาพจากระดับความพิการที่ลดลงด้วยแบบประเมินบาร์เทลอินเด็กซ์ ผลการวิจัยพบว่าการฟื้นฟูสมรรถภาพแบบผู้ป่วยนอกมีต้นทุนต่อประสิทธิผลดีกว่ากลุ่มฟื้นฟูสมรรถภาพแบบเยี่ยมบ้าน โดยต้นทุนต่อประสิทธิผลของกลุ่มฟื้นฟูสมรรถภาพแบบผู้ป่วยนอกและกลุ่มฟื้นฟูสมรรถภาพแบบเยี่ยมบ้านเท่ากับ 51,286.72 บาท และ 66,936.01 บาทตามลำดับต่อความพิการที่ลดลง 1 ระดับบาร์เทล อินเด็กซ์ แม้ว่ากลุ่มฟื้นฟูสมรรถภาพแบบผู้ป่วยนอกจะมีระดับความพิการแรกประเมินรุนแรงมากกว่ากลุ่มฟื้นฟูสมรรถภาพแบบเยี่ยมบ้าน จากการศึกษานี้แสดงให้เห็นว่าต้นทุนที่สูงขึ้นของกลุ่มฟื้นฟูสมรรถภาพแบบผู้ป่วยนอกคุ้มค่าต่อการลดระดับความพิการของผู้ป่วยหลอดเลือดสมองเมื่อเปรียบเทียบกับกลุ่มฟื้นฟูสมรรถภาพแบบเยี่ยมบ้านที่โรงพยาบาลพระนั่งเกล้า

คำสำคัญ: **ต้นทุน, ประสิทธิผล, ฟื้นฟูสมรรถภาพ, โรคหลอดเลือดสมอง**