Original Article

Cost-effectiveness of Intensive Intermediate Care Rehabilitation for Stroke Patients in Nopparat Rajathanee Hospital: A retrospective Observational Study

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ABSTRACT

Objectives: To study the cost-effectiveness of intensive intermediate care rehabilitation using direct cost and effectiveness for inpatient and outpatient stroke patients in Nopparat Rajathanee Hospital.

Study design: Retrospective observational study.

Setting: The rehabilitation and stroke units, Nopparat Rajathanee Hospital, Bangkok, Thailand.

Subjects: Intensive intermediate care rehabilitation stroke patients during October 2021 - September 2022.

Methods: Demographic data, Barthel index at admission (BIA), and Barthel index at discharge (BID) were obtained from medical records. BI gain (BID-BIA) and percentage of rehabilitation effectiveness ((BID-BIA)/(BI max-BIA) x 100) were calculated. In addition, capital cost, labor cost, and materials cost of health care providers were determined.

Results: Thirty-four stroke patients were recruited into this study: 52.9% were males, 90.9% had an ischemic stroke, and the mean age was 56 years (SD 13.71). At discharge, the average BI had increased significantly over the value at admission ($p < 0.05$), with a mean BI gain of 5.09 (SD 2.30) in inpatient rehabilitation and 4.77 (SD 2.26) in outpatient rehabilitation. The mean rehabilitation effectiveness percentage was 47.4 in inpatient rehabilitation and 53.0 in outpatient rehabilitation. The average direct cost of inpatient rehabilitation was 21,000 THB (600 USD)/person/admission or 1,500 THB (43 USD)/day. The average direct cost of outpatient rehabilitation was 399 THB (11 USD)/person/day. The average direct cost per 1 point improvement in the Barthel index was 4,127 THB (118 USD) in inpatient and 1,171 THB (33 USD) in outpatient rehabilitation

Conclusions: Intensive intermediate care rehabilitation for stroke patients in Nopparat Rajathanee Hospital statistically significantly improved BI scores. Rehabilitation effectiveness in this study was close to the results in a previous study. The direct cost of inpatient and outpatient stroke rehabilitation in Nopparat Rajathanee Hospital should continue to be used to determine cost-effectiveness.

Keywords: Barthel index, cost-effectiveness, rehabilitation, stroke

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Introduction

Stroke is a major public health problem in Thailand. The National Health Security Office reported a new case incidence of 328 per 100,000 population in 2020, with the trend increasing yearly.[1] According to a 2017 study by the Burden of Disease Research Program Thailand (BOD Thailand), stroke was the leading cause of Disability-Adjusted Life Year (DALY) loss in females and the second leading cause in males.[2] Stroke patients also have a variety of impairments, including weakness, difficulty swallowing, as well as cognitive and communication problems, all of which are major causes of disability, including family, society, and community problems, as well as economic costs to the country.

The intermediate care (IMC) service system provides rehabilitation care for up to six months following the diagnosis of a disease. This service system is composed of multidisciplinary teams that collaborate and link healthcare facilities at all levels. Depending on their needs and readiness, patients and families will be offered various rehabilitation services, including inpatient, outpatient, community-based, and home visit services.[3] The IMC service plan is a new field of service developed by the Ministry of Public Health and is based on providing a “seamless service network” to fill the gap left by the lack of sufficient transitional care for acute care patients. Under the plan, the patients will be evaluated for admission and treated by the intermediate care services of the multidisciplinary teams. If the patient’s abilities remain inadequate for discharge after six months, he or she will be moved to long-term care. Rehabilitation aims to maximize patients’ functional ability to maintain the highest possible level of independence, improve their quality of life, and reduce the family burden.

Nopparat Rajathanee Hospital has been providing stroke IMC outpatient services since 2021. In fiscal year 2022, the hospital began intensive intermediate care in the OPD service and provided two IMC beds for stroke patients in the stroke unit intensive rehabilitation program for a period of two weeks after achieving stable medical and neurological signs without

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the need for readmission for rehabilitation. This system allows patients and their families to save energy as well as transportation costs. According to a study by Kuptniratsaikul et al., inpatient rehabilitation services have better outcomes than outpatient services, and intensive rehabilitation is the most efficient type of admission for stroke patients.[4] Salter et al. reported that patients admitted to stroke rehabilitation within 30 days of their first unilateral stroke experienced more significant functional gain and shorter lengths of stay than those admitted after 30 days.[5]

A study of intensive rehabilitation in stroke patients at Bangklam Hospital in Songkhla, Thailand, the first hospital to develop an intermediate care rehabilitation service following the Ministry of Public Health's plan, discovered that patients who were recruited into the IMC ward immediately after vital signs and neurological signs had stabilized showed a high BI gain of 0.4 points per day, with a total score of 20 points.[6] Additionally, according to Stefano Paolucci et al., starting treatment within the first 20 days is associated with a significantly higher likelihood of excellent therapeutic response. That study found a strong association between onset-admission interval (OAI) and functional outcome.[7] In this study, rehabilitation was started as early as possible.

Many studies of the economic impact of stroke have focused on short-term in-hospital care. For example, a 2017 study of the cost of acute care for ischemic stroke in Thailand reported that the average expense for acute ischemic stroke treatment per patient was 42,400 THB (1,211 USD). The hospital room and routine services accounted for most of the cost (57%), followed by imaging (23%). The average stay was 5.7 days. Rehabilitation costs were only 1.23% of the total expenses in that study.[8] However, the study was based on acute care rehabilitation costs rather than long-term care costs.

According to a 2009 multi-center study of inpatient rehabilitation services for stroke patients in Thailand, the average total cost for all treatment during rehabilitation was 28,399 THB (approximately 789 USD). The cost ratio of non-rehabilitation-related costs to rehabilitation costs was approximately 2:1. The average length of stay was 29.4 days (SD 17.9). The average number of stroke rehabilitation treatment units (1 unit of treatment = 20 minutes) was 319.5, with 205 units of nursing, 40 units of physical therapy, and 34 units of occupational therapy.[9] The total time required for rehabilitation was 24.66 hours. Thus, if the rehab is 3 hours per day, it takes only 8.2 days to complete intensive stroke rehabilitation.

This study aimed to identify cost components and to better estimate the total long-term costs of stroke rehabilitation treatment inpatient and outpatient service in Nopparat Rajathanee Hospital. The cost per unit of service is the most important information for the administrator when budgeting and managing.

Methods

Study design

The Ethics Committee of Nopparat Rajathanee Hospital approved this retrospective observational study (approval number 19/2566).

Participants

Stroke patients who were admitted to the stroke unit who met the inclusion criteria in the screening form and who were admitted to intensive intermediate care rehabilitation from October 2021 - November 2022 were recruited into the study. Inclusion criteria were onset < 6 months, stable medical and neurological conditions, BI < 15 or > 15 with more than one disability, able to follow a 2-step command, and no severe complications. All patients or immediate family members were asked for informed consent.

Data collection

Demographic and clinical data, e.g., sex, age, underlying diseases, type of stroke, Barthel index score from onset to entry into rehabilitation, and health care coverage were collected. The type of intensive rehabilitation, either inpatient or outpatient service, was determined by physiatrists, the patient's context, and the availability of beds in the stroke unit. The intensive rehabilitation program consisted of therapists' conventional physical and occupational therapies. The frequency of inpatient and outpatient rehabilitation services in the clinical practice guidelines for stroke rehabilitation published by Prasat Neurological Institute of Thailand, Ministry of Public Health, was 15 hours per week and 2-3 hours per day.[10] The standard inpatient length of stay for intensive rehabilitation in the stroke unit was two weeks, with a total rehabilitation time of 30 hours, the same as the outpatient intensive rehabilitation program.

The direct costs of rehabilitation services included capital costs, labor costs, and materials costs. The capital cost of the buildings was calculated using the straight-line method at a discount rate of 5% per year, and the capital cost of the equipment at a rate of 7%. Each factor's total cost was divided by the number of patients served by each center.

Outcome measurements

Rehabilitation effectiveness was assessed using the Barthel index gain, i.e., the difference between the Barthel index score at discharge (BID) and Barthel index score at admission (BIA) and the percentage of rehabilitation effectiveness. Percentage of rehabilitation effectiveness was calculated as (BID-BIA) / (BI max-BIA) x 100. The Barthel index is a reliable disability scale commonly used to assess disability and to track the functional recovery of stroke patients.

A retrospective review of direct cost records from service-provider centers such as the administrative section, stroke unit, rehabilitation service, human resources, finance department,

and computer center was performed. The conventional system of cost calculation was used. Under that system, direct costs are directly ascribed to a cost object and typically include three parts: capital cost, labor cost, and materials cost. Analysis of direct costs was conducted using a standard cost accounting approach. The capital cost was calculated using straight-line depreciation.[11]

Annual depreciation cost = total instrument costs/useful life of instruments in years

Depreciation cost per test = annual depreciation cost/ number of reportable patient tests performed per year

Labor costs included salaries and accommodation costs. Materials costs included all types of expendable material used during the study period, such as stationery, medical material, etc.

Statistical analysis

SPSS version 21 was used for data analysis. The demographic data were analyzed using descriptive statistics, i.e., frequency, mean and standard deviation (SD). The rehabilitation effectiveness as measured by BI gain was calculated and BI gain within groups was evaluated using the paired t-test. The difference in effectiveness among the different types of rehabilitation services was analyzed using the analysis of variance (ANOVA) test. Statistical significance was set at a $p < 0.05$.

Results

Thirty-five stroke patients were recruited into intensive intermediate care rehabilitation from October 2021 to September 2022. One patient was excluded due to relocating to another province, leaving 34 patients for analysis (Figure 1). Inpatient rehabilitation accounted for 11 patients, while outpatient rehabilitation accounted for 23.

Table 1 shows patient demographic data. Most patients were male (52.9%), 90.9% had had an ischemic stroke, and the average age was 56 years (SD 13.71). More than half the patients had more than one risk factor for stroke. The average time from onset of stroke to rehabilitation was 6.05 days (SD 0.77). Most of the patients (73.5%) were covered by the National Health Security Scheme (NHSS). The demographic data in the two groups were not statistically significantly different. There were no major complications; however, two inpatients experienced vertigo, and one experienced knee pain.

Table 2 shows a comparison between BI scores at admission (BIA) and BI scores at discharge (BID). Barthel Index at discharge increased significantly ($p < 0.05$) with a mean BI gain of 5.09 points (SD 2.30) in inpatient rehabilitation, 4.77 points (2.26) in outpatient rehabilitation, and an average of 4.88 points (3.16) in both groups combined.

Table 3 shows a comparison of inpatient and outpatient services. The mean BIA, BID, BI gain, and mean percentage of rehabilitation effectiveness in both groups were not statistically significantly different between the inpatient and outpatient services.

As shown in Table 4, the average direct cost of inpatient rehabilitation was 1,500 THB (43 USD) per day or 21,000 THB (600 USD) per person/admission. Outpatient rehabilitation had an average direct cost of 399 THB (11 USD) per person per day. Labor, capital, and materials costs, in descending order, were the most expensive. The average direct cost per 1 point of Barthel index improvement in inpatient rehabilitation

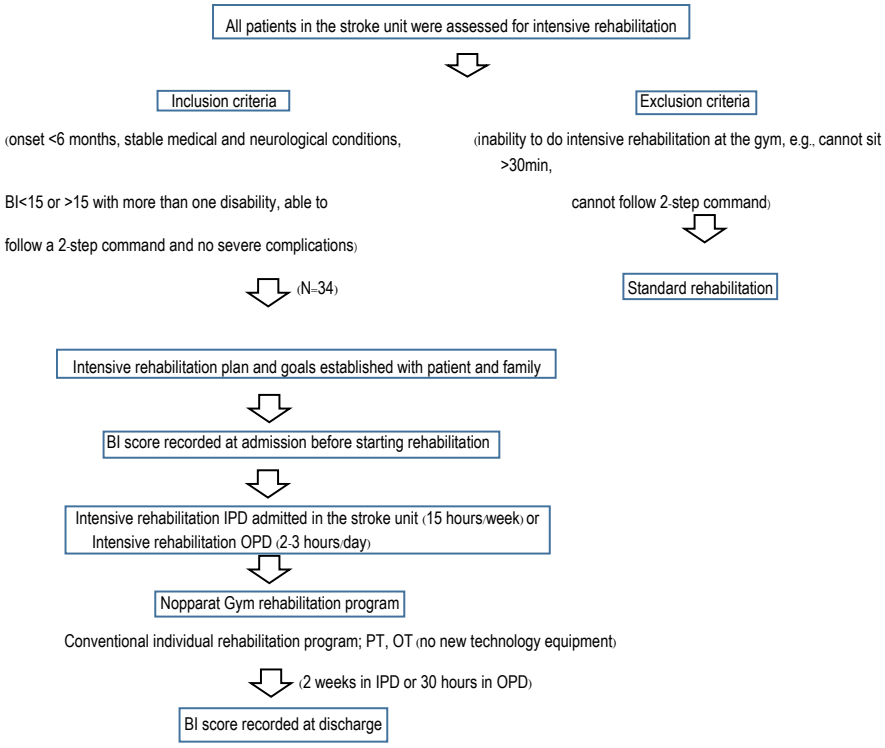

Figure1. Flow of the intensive rehabilitation study

Table 1. Demographic and clinical data

Characteristics	All participants	IPD (n=11)	OPD (n=23)	*p*-value
Age (years)[1]	56 (13.71)	61	54	0.233
Sex (male: female)[2]	18:16 (52.9: 47.1)	5:6	13:10	0.406
Etiology of stroke (ischemic, hemorrhagic)[2]	31:3 (90.9: 9.1)	9:2	22:1	0.239
Stroke risk factors[2]				
Hypertension	5 (14.7)	1	4	
Dyslipidemia	6 (17.6)	3	3	
Diabetes mellitus	2 (5.9)	1	1	
Smoking	3 (8.8)	2	1	
Alcohol	1 (2.9)	0	1	
> 1 risk factor	17 (50)	4	13	0.206
Interval to onset of rehabilitation (days)[1]	6.05 (0.77)	4.12	6.33	0.101
Health care coverage[2]				
Civil servant medical welfare	4 (11.8)	1	3	
National health security scheme (NHSS)	25 (73.5)	9	15	
Social security scheme (SSS)	5 (14.7)	1	5	0.266

[1]Mean (standard deviation, SD), [2]number (%); IPD, inpatient department; OPD, outpatient department

Table 2. Comparison of Barthel index scores at admission (BIA) and Barthel index scores at discharge (BID)

	BIA	BID	BI gains	*p*-value
IPD intensive rehabilitation (n=11)	9.27 (3.19)	14.36 (2.15)	5.09 (2.30)	< 0.001
OPD intensive rehabilitation (n=23)	11.00 (3.58)	15.77 (3.19)	4.77 (2.26)	< 0.001
Both groups of intensive rehabilitation (n=34)	10.44 (3.45)	15.32 (2.88)	4.88 (3.16)	< 0.001

Mean (standard deviation, SD); IPD, inpatient department; OPD, outpatient department

Table 3. Comparison of Barthel index scores between inpatient and outpatient service

	IPD (n=11)	OPD (n=23)	*p*-value
Barthel index at admission	9.27 (3.19)	11.00 (3.58)	0.519
Barthel index at discharge	14.36 (2.15)	15.77 (3.19)	0.721
Barthel index gain	5.09 (2.30)	4.77 (2.26)	0.708
Mean percentage of rehabilitation effectiveness	47.43 (31.11)	53.00 (34.21)	0.407

Mean (standard deviation, SD); IPD, inpatient department; OPD, outpatient department

Table 4. Service costs per patient per day (THB)

Service costs	IPD (n=11)	OPD (n=23)	*p*-value
Direct costs	1,500.39	399.20	
Capital costs	313.92 (20.92)	81.74 (20.47)	
Labor costs	1,138.52 (75.88)	296.21 (74.20)	
Materials costs	47.95 (3.20)	21.25 (5.33)	
Cost per 1 point of Barthel index gain	4,126.71	171.06	< 0.001

Mean (percentage); IPD, inpatient department; OPD, outpatient department

was 4,127 THB (118 USD) and was 1,171 THB (33 USD) in outpatient rehabilitation. The difference between groups was statistically significant. (1 USD = 35.04 THB on average in 2022)

Discussion

This study investigated the cost-effectiveness of intensive intermediate-care rehabilitation for stroke patients in Nopparat Rajathanee Hospital, a tertiary-level government hospital in Thailand. The study found the average inpatient BI gain was 5.09 points (SD 2.3), which was higher than outpatient service, which was 4.77 (SD 2.26), confirming the findings of previous studies.[4,12,13] However, there was no statistically significant difference between IPD and OPD in this study. This finding could be due to the system of case selection for intensive rehabilitation: the outpatient group had higher rehabilitation potential and anticipated level of compliance with rehabilitation compared to the IPD group. The higher level of compliance with outpatient intensive rehabilitation programs may have been due to early rehabilitation and prognostic evaluation. Both groups received the same rehabilitation program.

The Barthel Index at discharge increased significantly ($p < 0.05$) with a mean BI gain in inpatient rehabilitation of 5.09 (SD 2.30), which is lower than the 6.56 (SD 4.48) reported at Luangphorpern Hospital.[14] and the 5.79 (SD 3.89) in a 9-multicenter study4; but higher than the 4.4 (3.6) in a 14-multicenter study.[15] The average length of stay of those studies were 14,

35.65, 29.4, and 23.9 days, respectively. In this study, the mean percentage of inpatient rehabilitation effectiveness was 47.74. This duration was lower than a study at Luangphorpern Hospital, which reported an inpatient rehabilitation effectiveness of 56.62%. The reason for the differences could be the shorter length of stay (LOS) at Nopparat Rajathanee Hospital.

The average BI gain in inpatient rehabilitation was 0.36 points per day, with a 6.05-day onset to rehabilitation interval. This result was comparable to the BI gain of 0.4 points per day in a study at Bangklam Hospital, where patients were admitted to rehabilitation immediately after being discharged from the acute stroke ward. The LOS in the two studies was 14 days at Nopparat Rajathanee Hospital and 20 days at Bangklam Hospital. Although the National Health Security Office (NHSO) stated that the standard LOS for neuromuscular inpatient rehabilitation is 23.5 days, a shorter LOS can result in a positive outcome if patients receive early rehabilitation.

A study by Kuptniratsaikul et al. showed that intensive rehabilitation of stroke patients resulted in high BI gains of 0.23+0.32 points per day. Factors affecting the effectiveness of rehabilitation services, besides stroke and intensive types of admission, were shorter OAI (Onset-Admission Interval) < 3 months, lower BIA (< 10) and longer LOS (> 30 days).[14] Advantages of this study include early recruitment into intensive rehabilitation (average 6.05 days) and the mean BIA scores in both groups (10.44), but the LOS was only 14 days due to bed limitations.

Another tertiary hospital study of accessibility to medical rehabilitation services for acute stroke in Maharat Nakhon Ratchasima Hospital found that the LOS in the acute phase was four days, and the LOS in the rehabilitation phase was eight days. The short-term goal was to educate patients and their families and to prepare them for further rehabilitation.[16] Over 14 days, patients and families in this study learned together about intensive rehabilitation and a home program. The IMC bed service will be extended to the IMC ward.

According to Stefano Paolucci et al., early intervention, i.e., starting treatment within 20 days, is associated with a significantly higher probability of excellent therapeutic response and a fivefold lower dropout risk than with patients who start treatment later.[7] In this study, rehabilitation began as soon as the patients' and families' medical and neurological conditions were stable, the programs were on time provided in a timely manner, and the level of patient and family compliance was high. The only dropout was a patient who moved to a different area.

In the present study, the average direct cost of inpatient rehabilitation was 21,000 THB per person per admission or 1,500 THB per day, which is comparable to the 22,140 THB per person per admission or 1,089 THB per day reported in a cost analysis of rehabilitation service at the Sirindhon National Medical Rehabilitation Center17z and is lower than the unit cost of inpatient stroke rehabilitation in Siriraj Hospital of 3,251.53 THB per day.[18] The average inpatient direct cost per 1 point of BI improvement was 4,127 THB, less than Siriraj Hospital's cost of 7,761.73 THB.

The cost of investments in equipment and facilities represents primarily capital costs, so advanced-level hospitals could be expected to incur higher costs. The direct cost of stroke treatment is determined primarily by the length of hospital stay (LOHS). The duration of inpatient rehabilitation must achieve a balance between hospital resource constraints and patient benefits during hospitalization.

The average direct cost of outpatient rehabilitation in this study was 399 THB per person per day, less than that of outpatient rehabilitation at Sirindhon National Medical Rehabilitation Center of 562 THB per person per day. The higher cost at the Sirindhon Center may be due to having more modern equipment in specialized rehabilitation centers. Because rehabilitation necessitates a multidisciplinary team, labor costs account for the majority of costs in many studies, including those conducted by Sirindhon National Medical Rehabilitation Center, Siriraj Hospital, and the present study.

The present study found that both inpatient and outpatient intermediate intensive rehabilitation were effective, but that they had different capital and labor costs. Patient characteristics did not contribute to differences in costs, so promotion of community-based rehabilitation can be beneficial and, at the same time, can also help reduce healthcare costs.

The following are among the study's limitations: (1) the study only calculated the BI score; no other disabilities, such as communication, swallowing, or cognitive impairments, that can affect overall rehabilitation effectiveness were taken into account. (2) This study included only stroke patients with a high potential for rehabilitation due to bed limitations and early rehabilitation in a limited time frame. As a result, spontaneous functional recovery after a stroke may have overlapped with rehabilitation recovery. (3) The study only looked at direct costs; indirect costs were excluded because the hospital did not operate a supporting cost center that could provide the necessary information.

This study determined direct costs from the viewpoint of the health care provider only. Aspects of patient and family costs should be considered as well in further research.

Additional research is needed to develop a more complete picture of stroke intermediate care rehabilitation, including other functions that can influence rehabilitation effectiveness, e.g., swallowing impairment, cognitive function, psychosocial problems, and other aspects of care provision such as multidisciplinary discharge planning, long-term care planning, and total unit cost analysis, which would be helpful for materials and health economics management.

Conclusions

In both inpatient and outpatient services, intensive intermediate care rehabilitation for stroke patients in Nopparat

Rajathanee Hospital was associated with statistically significantly improved BI scores. The effectiveness of rehabilitation in this study was comparable to [*the previous study that found in previous studies at other institutions. The direct costs of inpatient and outpatient stroke rehabilitation in Nopparat Rajathanee Hospital can serve as a basis for determining cost-effectiveness in the future.

Disclosure

The author declares no conflicts of interest.

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