

Full Length Research Paper

Inpatient rehabilitation outcomes in patients with stroke at Thailand's largest tertiary referral center: A 5-year retrospective study

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The objective of this retrospective study was to investigate rehabilitation outcomes according to type of rehabilitation program (intensive or non-intensive) in stroke patients admitted for rehabilitation at Siriraj Hospital during 2010-2014. Demographic data, Barthel Index (BI) at admission (BI_{ad}), Barthel Index at discharge (BI_{dc}), and length of stay (LOS) of all stroke admitted during the study period were recorded from chart review. Patients were categorized into the intensive or non-intensive rehabilitation groups. Efficacy (ΔBI) was calculated as $BI_{dc} - BI_{ad}$, and effectiveness was calculated as $\Delta BI / (BI_{max} - BI_{ad}) * 100$. Our subjects were 484 stroke patients with 569 rehabilitation admissions. Mean age was 64.5 ± 13.0 years, and 53% were male. Most (88%) patients were admitted for intensive rehabilitation. Mean efficacy score was 3.7 ± 3.5 , and mean LOS was 30.6 ± 18.4 days. Median percentage of effectiveness was 27.0 (-800, 100). Mean efficacy score was 4.1 ± 3.5 and 0.9 ± 1.9 ; median percentage of effectiveness was 33.3 (-800, 100) and 0 (-26.7, 31.3); and, mean LOS was 30.3 ± 16.9 days and 32.6 ± 27.2 days for the intensive and non-intensive groups, respectively. Mean LOS showed a decreasing trend from 2010 to 2014 (34.2 to 27.5 days). Efficacy and effectiveness showed an increasing trend, except for 2014. Our conclusions are that patients admitted for intensive rehabilitation had higher efficacy score, higher percentage of effectiveness, and shorter LOS than patients in the non-intensive group. During the 2010-2014 study period, mean LOS showed a decreasing trend, and efficacy and effectiveness showed an increasing trend.

Key words: Stroke, inpatient rehabilitation outcomes, efficacy, effectiveness, length of stay.

INTRODUCTION

Cerebrovascular disease or stroke is one of the common conditions in the elderly that increase healthcare burden, and adversely impact patient health and quality of life. Among those who survive, significant disability and loss of functions can occur, including impairment of movement, balance, cognition, communication, and executive functions. These residual disabilities can also impair social participation, over both the short and long term.

According to disability-adjusted life year (DALY) data

(National Statistical Office, 2011; International Health Policy Program, 2009), stroke rehabilitation is essential for reducing the degree of physical impairment and functional dependency, and increasing quality of life in this disabled population. Previous studies reported that inpatient rehabilitation programs have better outcomes relative to patient perception of improvement in patient functions with lesser complications, when compared with nursing home rehabilitation (Rønning and Guldvog, 1998), and home-based rehabilitation programs (Ozdemir

et al., 2001).

However, there are several limitations to providing inpatient rehabilitation for subacute stroke patients. Those limitations include a shortage of experienced health care providers, a shortage of dedicated rehabilitation units or centers, a required extensive LOS, and a high cost of treatment. Studies that focus on outcomes of stroke inpatient rehabilitation in terms of program efficacy, effectiveness, and LOS are, therefore, necessary to improve rehabilitation protocols and outcomes of treatment.

Our review of the literature revealed that previous studies of inpatient stroke rehabilitation had several different study variables, including different inclusion criteria and variable outcome measurements (Chow et al., 2014; Pinedo et al., 2014; Chen et al., 2013; Suputtitada et al., 2003; Kuptniratsaikul et al., 2009a, b). After completing their rehabilitation program, most stroke patients had an improved Barthel Index (BI) score or improved Functional Independence Measure (FIM) score.

The inpatient rehabilitation ward of Siriraj Hospital was established in 2004, and it has an average of 220 annual admissions. Stroke patients account for approximately 50% of those annual rehabilitation admissions. Data specific to program effectiveness and resource requirements would provide valuable information that would facilitate improved treatment, use of resources, and outcomes.

Accordingly, the primary aim of this study was to investigate rehabilitation outcomes, including efficacy, effectiveness, and LOS, according to type of rehabilitation program (intensive or non-intensive) in stroke patients admitted for rehabilitation at Siriraj Hospital during 2010-2014. The secondary objective was to study complications documented during the study period.

METHODOLOGY

This retrospective study included stroke patients admitted to the inpatient ward of the Rehabilitation Medicine Department, Siriraj Hospital during the 2010-2014 study period. Siriraj Hospital is Thailand's largest university-based national tertiary referral center. The protocol for this study was approved by the Siriraj Institutional Review Board (SIRB), Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand. This study complied with all of the principles set forth in the Declaration of Helsinki (1964) and all of its subsequent amendments. Medical charts of patients admitted for rehabilitation during the 5-year study period with a principle diagnosis of hemiparesis/CVA (ICD-10: I60-I69) were recruited. Demographic and admission data that was collected included age, gender, marital status, date of admission, and date of discharge. Included patients were divided by type of admission into either the

intensive rehabilitation group or the non-intensive rehabilitation group. In patients admitted for intensive rehabilitation, all rehabilitation criteria must be achieved. Those were stable medical and neurological status, good cognitive function assessed by ability to follow at least two step commands, ability to maintain upright for at least 2 h, and good recent memory within 24 h (Stein and Brandstater, 2010). Non-intensive rehabilitation included caregiver training, investigation, and treatment of serious complications. Patients' record in which discharge BI score could not be obtained (e.g. patient transferred to other ward because of complications) were excluded from the study.

Modified Barthel Index (BI) was recorded at both admission (BI_{ad}) and discharge (BI_{dc}). BI consists of 10 items relating to self-care and mobility, with a scoring range of 0-20. A higher score indicates a higher level of patient independence (Mahoney and Barthel, 1965; Wade and Hower, 1987). Stroke characteristics data that was collected included type of stroke and onset duration (duration from the most recent episode to admission for inpatient rehabilitation). Comorbidities of stroke, such as neglect syndrome, communication problems, and depression (evaluated by PHQ-9 as routine screening), were also recorded.

Regarding to our primary outcomes, efficacy (ΔBI) was calculated as $BI_{dc} - BI_{ad}$, and effectiveness was calculated as $\Delta BI / (BI_{max} - BI_{ad}) * 100$ (Shah et al., 1990; Koh et al., 2013). In cases where efficacy score is shown with a minus sign preceding it indicates that the patient had less functional ability when discharged, as compared to the patient's functional ability at the time of admission. Effectiveness was defined as the percentage of actual improvement (ΔBI) compared with potential improvement after completing the rehabilitation program ($BI_{max} - BI_{ad}$). Hospital length of stay (LOS) was also recorded and analyzed as a primary outcome of this study.

As the secondary objective of this study, complications that developed during inpatient rehabilitation were recorded, including urinary tract infection, delirium, gastrointestinal bleeding, pneumonia, sepsis, acute coronary syndrome, and recurrent stroke. Given that complications which occur during admission may delay physical improvement and, thus, affect the functional ability of these patients, the type and prevalence of complications was regarded as being an important outcome of this study.

Statistical analysis

Results are reported using descriptive statistics. Categorical data are shown as number and percentage, and continuous data are presented as mean \pm standard deviation or median (minimum, maximum). Rehabilitation outcome trends were compared using one-way ANOVA for continuous data with normal distributions, and

Table 1. Demographic and clinical data of 484 first admission stroke patients.

Variable	Total	2010	2011	2012	2013	2014
Number of patients	484	93	87	90	129	85
Age (years), mean±SD	64.5±13.0	65.0±11.6	64.6±13.0	64.4±11.3	64.8±14.3	63.4±13.7
Male gender, n (%)	257 (53%)	57 (61.3%)	41 (47.1%)	41 (45.6%)	65 (50.4%)	53 (62.4%)
Marital status, n (%)						
- Single	57 (11.8%)	9 (9.7%)	13 (14.9%)	11 (12.2%)	12 (9.3%)	12 (14.1%)
- Married	345 (71.3%)	75 (80.6%)	53 (60.9%)	63 (70.0%)	93 (72.1%)	61 (71.8%)
- Divorced / widowed	79 (16.3%)	8 (8.7%)	21 (24.1%)	14 (15.5%)	24 (18.6%)	12 (14.1%)
Intensive group, n (%)	426 (88.0%)	86 (92.5%)	80 (92.0%)	78 (86.7%)	108 (83.7%)	74 (87.1%)
Non-intensive group, n (%)	58 (12.0%)	7 (7.6%)	7 (8.0%)	12 (13.3%)	21 (16.4%)	11 (12.9%)
- Caregiver training	54 (11.2%)	6 (6.5%)	7 (8.0%)	12 (13.3%)	18 (14.0%)	11 (12.9%)
- Investigation	2 (0.4%)	1 (1.1%)	0 (0.0%)	0 (0.0%)	1 (0.8%)	0 (0.0%)
- Treat complication(s)	2 (0.4%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.6%)	0 (0.0%)
Onset time from the most recent episode to admission (days)						
- Mean (SD)	199.5 (647.0)	289.9 (577.7)	141.3 (334.9)	199.0 (1,002.3)	157.9 (471.0)	223.8 (712.8)
- Median (min, max)	60 (2, 9,500)	90 (4, 4,000)	45 (2, 2,190)	48 (3, 9,500)	30 (2, 4,000)	60 (2, 5,800)
Phase of stroke at admission, n (%)						
- Acute ^a	213 (44.0%)	27 (29.0%)	42 (48.3%)	39 (43.3%)	72 (55.8%)	33 (38.8%)
- Subacute ^b	121 (25.0%)	23 (24.7%)	21 (24.1%)	27 (30.0%)	29 (22.5%)	21 (24.7%)
- Chronic ^c	150 (31.0%)	43 (46.2%)	24 (27.6%)	24 (26.7%)	28 (21.7%)	31 (36.5%)
Type of stroke, n (%)						
- Ischemic stroke	346 (71.5%)	68 (73.1%)	62 (71.3%)	63 (70.0%)	92 (71.3%)	61 (71.8%)
- Hemorrhagic stroke	138 (28.5%)	25 (26.9%)	25 (28.7%)	27 (30.0%)	37 (28.7%)	24 (28.2%)
Neglect syndrome, n (%)	38 (7.9%)	7 (7.5%)	7 (8.0%)	7 (7.8%)	8 (6.2%)	9 (10.6%)
Communication problems, n (%)						
- Motor aphasia	37 (7.6%)	5 (5.4%)	6 (6.9%)	11 (12.2%)	10 (7.8%)	5 (5.9%)
- Sensory aphasia	4 (0.8%)	1 (1.1%)	0 (0.0%)	0 (0.0%)	1 (0.8%)	2 (2.4%)
- Global aphasia	62 (12.8%)	12 (12.9%)	13 (14.9%)	15 (16.7%)	15 (11.6%)	7 (8.2%)
Depression, n (%)	120 (24.8%)	27 (29.0%)	15 (17.2%)	20 (22.2%)	36 (27.9%)	22 (25.9%)

^a, Less than 30 days; ^b, within 3 months; ^c, more than 3 months

Kruskal-Wallis test for continuous data with non-normal distributions. Unpaired t-test and Mann-Whitney U-test was used to analyze the difference in normally distributed and non-normally distributed continuous rehabilitation outcomes

between the intensive and non-intensive admission groups, respectively. Results were considered statistically significant at a *p*-value less than 0.05. Data analysis was performed using PASW Statistics version 18.0 (SPSS, Inc.,

Chicago, IL, USA).

RESULTS

During 2010 to 2014, there were 1,252 patients

Table 2. Barthel Index_{ad}, Barthel Index_{dc}, efficacy, effectiveness, and LOS categorized by year of admission.

Year	N	BI _{ad} mean±SD	BI _{dc} mean±SD	Efficacy ^A mean±SD	Effectiveness ^B median (min, max)	LOS mean±SD
2010	96	7.8±3.8	10.3±4.7	2.5±2.9	14.4 (-15.4, 100.0)	34.2±21.7
2011	101	7.7±4.0	11.5±5.5	3.8±3.5	27.3 (-11.8, 100.0)	33.6±21.9
2012	103	7.2±4.1	11.1±5.5	3.9±3.7	25.0 (-26.7, 100.0)	29.8±13.5
2013	138	7.2±4.5	11.9±5.3	4.7±3.7	38.0 (-800.0, 100.0)	29.0±19.2
2014	118	7.4±4.4	10.9±5.3	3.5±3.2	24.0 (-33.3, 100.0)	27.5±13.7
<i>p</i> -value [#]	556	0.760	0.214	<0.001*	<0.001*	0.026*

[#]One-way ANOVA or Kruskal-Wallis test; *indicates statistical significance; Efficacy^A = $\Delta BI = (BI_{dc} - BI_{ad})$; Effectiveness^B = $[\Delta BI / (BI_{max} - BI_{ad}) * 100]$. **Abbreviations:** BI_{ad}, Barthel Index at admission; BI_{dc}, Barthel Index at discharge; LOS, length of stay; SD, standard deviation.

Table 3. Barthel Index_{ad}, Barthel Index_{dc}, efficacy, effectiveness, and LOS categorized by type of admission program.

Type of admission	n	BI _{ad} mean±SD	BI _{dc} mean±SD	Efficacy ^A mean±SD	Effectiveness ^B median (min, max)	LOS mean±SD
Total stroke	556	7.4±4.2	11.2±5.3	3.7±3.5	27.0 (-800.0, 100.0)	30.6±18.4
Intensive program	492	8.1±3.8	12.2±4.5	4.1±3.5	33.3 (-800.0, 100.0)	30.3±16.9
Non-intensive program	64	2.0±2.7	2.9±3.0	0.9±1.9	0.0 (-26.7, 31.3)	32.6±27.2
<i>p</i> -value [#]		<0.001*	<0.001*	<0.001*	<0.001*	0.519

[#]Unpaired t-test or Mann-Whitney U test; *indicates statistical significance; Efficacy^A = $\Delta BI = (BI_{dc} - BI_{ad})$; Effectiveness^B = $[\Delta BI / (BI_{max} - BI_{ad}) * 100]$. **Abbreviations:** BI_{ad}, Barthel Index at admission; BI_{dc}, Barthel Index at discharge; LOS, length of stay; SD, standard deviation.

admitted to the rehabilitation unit of Siriraj Hospital. Of those, 569 cases (45.5%) were stroke patients. Eighty-five of those were readmissions, as follows: 62 cases were admitted two times, 16 cases three times, and 7 cases were admitted four times or more. Four hundred and eighty-four (484) cases were first-time admissions. Also, there were five deaths during rehabilitation admission; three deaths resulted from recurrent stroke, one from myocardial infarction, and one from sepsis. Four cases were transferred to other wards for the following conditions: acute coronary syndrome (1 case), recurrent stroke (1 case), and pneumonia with respiratory failure (2 cases). Four stroke patients had BI_{ad} of 20; therefore, 556 cases with complete data at both admission and discharge were included in the final rehabilitation outcomes analysis.

Demographic and clinical data of 484 first admission stroke patients are shown in Table 1. Mean age was 64.5±13.0 years, and 53% were male. Most patients (345 cases, 71.3%) were married. Four hundred and twenty-six (88%) cases were admitted for intensive rehabilitation. Almost all patients in the non-intensive rehabilitation group were admitted to receive caregiver training. Median onset duration between the most recent episode of stroke and admission was 60 days (minimum 2 days, maximum 9,500 days). When grouped according to phase of stroke at admission for inpatient rehabilitation, 213 cases (44%) were admitted in the acute phase (within 30 days), 121

cases (25%) were admitted in the subacute phase (within 3 months), and 150 cases (31%) were admitted in the chronic phase (more than 3 months). Among all admitted stroke patients, 346 cases (71.5%) had ischemic stroke and 138 cases (28.5%) had hemorrhagic stroke. Neglect syndrome was diagnosed in 38 cases (7.9%). Communication problems occurred in 103 cases (21.3%), with global aphasia being the most common type (62 of 103 cases). One-fourth of patients developed depression (120 cases, 24.8%).

BI_{ad}, BI_{dc}, efficacy, effectiveness, and LOS categorized by year of admission are given in Table 2. The results showed an overall increasing trend for efficacy, with the exception of a slight decrease in 2014 (2.5±2.9, 3.8±3.5, 3.9±3.7, 4.7±3.7, and 3.5±3.2, respectively). A similar increasing trend was observed for effectiveness during the study period, except for a decrease in 2014 (14.4, 27.3, 25.0, 38.0, and 24.0%, respectively). Hospital LOS showed a decreasing trend over the entire 5-year study period (34.2±21.7, 33.6±21.9, 29.8±13.5, 29.0±19.2, and 27.5±13.7 days, respectively).

BI_{ad}, BI_{dc}, efficacy, effectiveness, and LOS categorized by intensive and non-intensive admission program are presented in Table 3. From the 556 stroke patients for whom we had complete data, the mean efficacy score was 3.7±3.5, and the median effectiveness percentage was 27.0% (-800%, 100%). Average LOS was 30.6±18.4 days. When considering our primary outcomes by

Table 4. Efficacy, effectiveness, and LOS categorized by Barthel Index at admission (BI_{ad}).

BI_{ad}	Score range	n	Efficacy ^A mean±SD	Effectiveness ^B median (min, max)	LOS mean±SD
Totally dependent	<4	109	3.0±3.8	10.0 (-11.8, 73.7)	38.3±29.7
Very dependent	4-7	165	4.4±3.8	23.1 (-26.7, 100.0)	30.7±17.3
Partially dependent	8-11	190	4.3±3.2	36.4 (-10.0, 100.0)	28.9±10.6
Requires minimal help	12-15	76	2.7±2.2	37.5 (-12.5, 100.0)	25.1±11.3
Independent	16-20	16	0.5±2.5	50.0 (-800.0, 100.0)	22.8±10.9
<i>p</i> -value [#]		556	<0.001*	<0.001*	<0.001*

[#]One-way ANOVA or Kruskal-Wallis test; *indicates statistical significance. Efficacy^A = $\Delta BI = (BI_{dc} - BI_{ad})$. Effectiveness^B = $[\Delta BI / (BI_{max} - BI_{ad}) * 100]$. **Abbreviations:** BI_{ad} , Barthel Index at admission; LOS, length of stay; SD, standard deviation

Table 5. Complications that developed among 569 patients admitted to the inpatient rehabilitation ward by year.

Variable	n (%)	2010 n (%)	2011 n (%)	2012 n (%)	2013 n (%)	2014 n (%)
Total patients	569	97	101	106	145	120
Patients with at least 1 complication	245 (43.1%)	42 (43.3%)	36 (35.6%)	46 (43.4%)	67 (46.2%)	54 (45.0%)
Urinary tract infection	167 (29.3%)	30 (30.9%)	27 (26.7%)	33 (31.1%)	47 (32.4%)	30 (25.0%)
Acute delirium	32 (5.6%)	8 (8.2%)	3 (3.0%)	7 (7.5%)	10 (6.9%)	4 (3.3%)
Gastrointestinal bleeding	29 (5.1%)	5 (5.2%)	6 (6.0%)	7 (6.6%)	9 (6.2%)	2 (1.7%)
Pneumonia	25 (4.4%)	1 (1.0%)	2 (2.0%)	6 (5.7%)	12 (8.3%)	4 (3.3%)
Sepsis	17 (3.0%)	3 (3.1%)	2 (2.0%)	4 (3.8%)	5 (3.4%)	3 (2.1%)
Acute coronary syndrome	4 (0.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	2 (1.4%)	2 (1.4%)
Recurrent stroke	11 (1.9%)	0 (0.0%)	2 (2.0%)	3 (2.8%)	3 (2.1%)	3 (2.1%)
- Ischemic	9 (1.6%)	0 (0.0%)	2 (2.0%)	2 (1.9%)	3 (2.1%)	2 (1.4%)
- Hemorrhagic	2 (0.4%)	0 (0.0%)	0 (0.0%)	1 (0.9%)	0 (0.0%)	1 (0.7%)

admission group, the mean efficacy score was 4.1 ± 3.5 and 0.9 ± 1.9 , the median effectiveness score was 33.3% (-800%, 100%) and 0% (-26.7%, 31.3%), and the average LOS was 30.3 ± 16.9 and 32.6 ± 27.2 days in the intensive and non-intensive groups, respectively.

When stroke patients were grouped according to their functional basic activities of daily living ability according to the criteria reported by Sinoff and Ore (1997), the efficacy results in patients with high baseline functional BADLs ability were lower than in those with low to moderate baseline functional ability. In contrast, effectiveness results were lowest in totally dependent patients (low initial BI) and highest in independent patients (high initial BI). Mean LOS was longest in the totally dependent group (38.3 ± 29.7 days) and shortest in the totally independent group (22.8 ± 10.9 days) (Table 4).

Regarding complications, 245 stroke patients (43.1%) developed at least one complication during inpatient rehabilitation. Of those 245 patients, 58 cases (10.2%) had two complications, and 32 cases (5.7%) had at least three complications (data not shown). The most common complication was urinary tract infection (167 cases, 29.3%), followed by acute delirium (32 cases, 5.6%), gastrointestinal hemorrhage (29 cases, 5.1%),

pneumonia (25 cases, 4.4%), sepsis (17 cases, 3.0%), and recurrent stroke (11 cases, 1.9%). In the cases with recurrent stroke, ischemic type was found in 9 cases (1.6%) and hemorrhagic type in 2 cases (0.3%; Table 5).

Mean efficacy and median effectiveness compared among total stroke patients, intensive rehabilitation patients, and non-intensive rehabilitation patients are shown in Figures 1 and 2. Those outcome results show an increasing trend during the study period, with the exception of a slight decrease in 2014 - the last of the 5 years. Hospital LOS showed a decreasing trend across all 5 years of the study period (Figure 3).

DISCUSSION

Stroke is the most common causative disease that necessitates admittance to the intensive rehabilitation ward at Siriraj Hospital. During our 2010-2014 study period, the number of stroke patients admitted annually increased each year, except in 2014 due to temporary closure (1 month) for ward renovation.

Among our study population, 88% of cases were admitted for intensive rehabilitation. In this study, mean

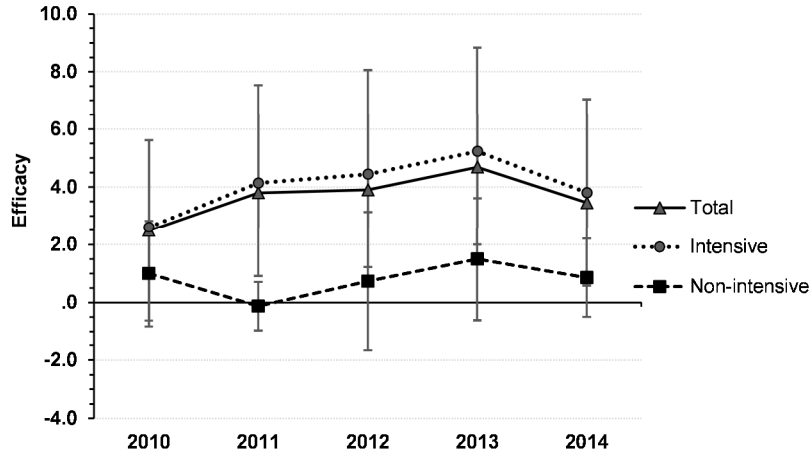


Figure 1. Mean efficacy compared among total stroke patients, intensive admission goal patients, and non-intensive admission goal patients by year.

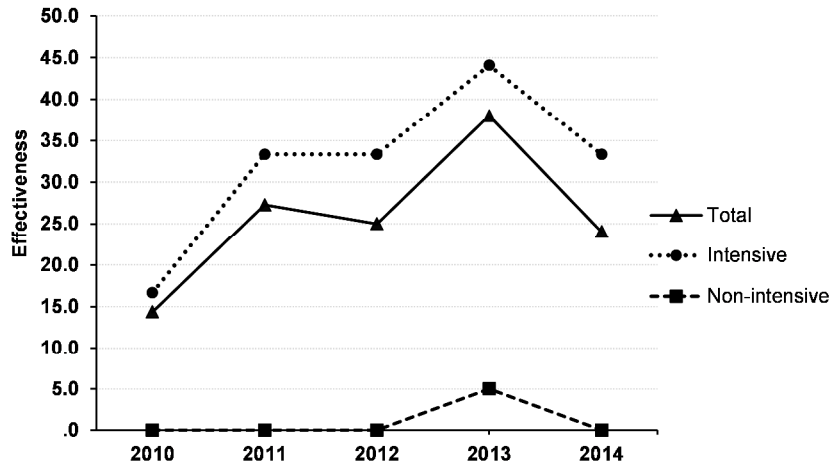


Figure 2. Median effectiveness compared among total stroke patients, intensive admission goal patients, and non-intensive admission goal patients by year.

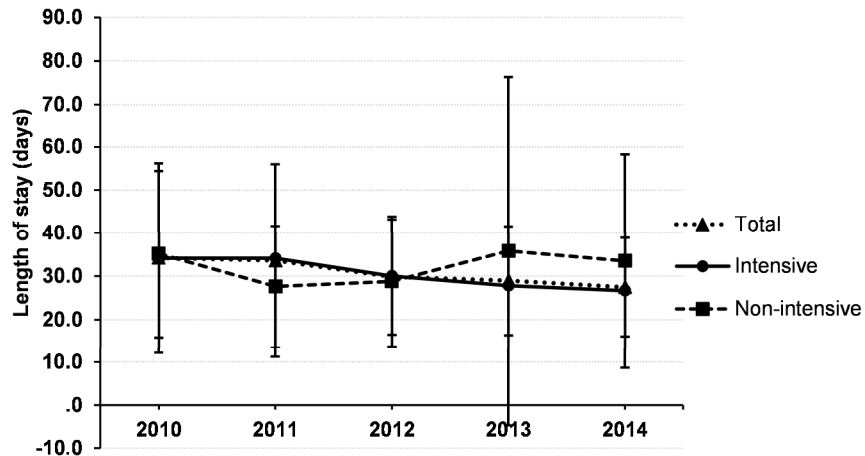


Figure 3. Mean length of stay (LOS) compared among total stroke patients, intensive admission goal patients, and non-intensive admission goal patients by year.

efficacy of 3.7 ± 3.5 was calculated by subtracting the mean BI at discharge from the mean BI at admission. This score included patients from both the intensive and non-intensive rehabilitation groups. However, the inclusion criteria used in previous studies had many characters similar to patients admitted for intensive rehabilitation in this study (Pinedo et al., 2014; Kuptniratsaikul et al., 2009a, b). For example, patients who had complications from medical or neurological status or diagnosed as dementia and psychosis would be excluded from the study (Kuptniratsaikul et al., 2009a, b), with the inclusion of patients who could follow one-step command and able to maintain upright for at least 30 min (Kuptniratsaikul et al., 2009a). Therefore, we prefer to select outcomes from the intensive rehabilitation group when compared with previous studies' results, with an average score of efficacy as 4.1 ± 3.5 . Efficacy of patients admitted in rehabilitation ward of Siriraj Hospital is less than the study of Kuptniratsaikul et al. (2009a) (5.79 ± 3.89) and Pinedo et al. (2014) ($\Delta BI = 6.5$ from maximum score of 20). One possible reason might be partly related with the criteria used in other studies which included more potential patients, for example, shorter onset of disease (Chow et al., 2014) and longer period of LOS (Pinedo et al., 2014). Nevertheless, this study has clearly revealed that an average score of efficacy from inpatient rehabilitation ward at Siriraj Hospital is less than an average score from overall nine-tertiary hospitals in Thailand (Kuptniratsaikul et al., 2009a). After benchmarking to other studies in Thailand, further research in depth should be considered to find out the opportunity for service improvement.

Outcomes measured by efficacy and effectiveness from an intensive group were obviously higher when compared with non-intensive group. This indicated successful of inclusion criteria used in selecting patients. Nevertheless, even though a main purpose of a non-intensive group was for caregiver training, not to improve functional ability of patients directly. This could also significantly provide better home-based program and help in reducing stress and anxiety of the patients and their families. These factors were not included in this study; although, with limited resources, the non-intensive group should be admitted only for a short period before discharge.

LOS was not significantly different between intensive and non-intensive groups, partly because of limited LOS in the hospital due to cost of treatment and a small number of beds available. Furthermore, there was a decreasing trend for LOS during these five years (Figure 3), accounting for 20% from 34.2 days in 2010 to 27.5 days in 2014. This reduction in LOS may be as a result from various reasons, including improvement in rehabilitation program, less complications and an increasing cost of treatment. However, this study had shown decreasing LOS while there was an increase in efficacy and effectiveness from 2010-2014. Therefore, improvement in rehabilitation program may be the most

likely explanation.

Additionally, this study showed the least improvement of efficacy in patients with high BI score at admission. However, if patient's outcomes were analyzed using effectiveness, these outcomes were found to be the best among other groups and also with the shortest LOS. Meanwhile, patient with minimal or average score of BI at admission had higher outcome in term of efficacy but also had less improvement when analyzed with effectiveness with longer LOS. This indicates that using efficacy as the only one outcome in order to demonstrate levels of patient functional improvement of rehabilitation has some limitations due to the ceiling effect of BI (Balu, 2009; Kwon et al., 2004; Dromerick et al., 2003; Weimar et al., 2002; Duncan et al., 2000). Efficacy cannot be used to reflect actual improvement for all patients especially for those with high functions at baseline. These patients would not likely to be able to gain higher score compared with patients who had lower level of independency and hence initial lower BI score. Using effectiveness as an outcome index in rehabilitation has major advantage over using only efficacy, as baseline BI or potential improvement would be concerned (Koh et al., 2013). It can, therefore, reflect actual improvement of individual patient and provide better comparison between each patient group according to their level of dependency which leads to more equalization.

As observed, efficacy (mean) and effectiveness (median value) had increasing trends in each year except for 2014. Though this was a retrospective study and the reasons of these findings could not be exactly explained, we recognized that in 2014, patient's demographic data included the highest numbers of patients with neglect syndrome (10.6%) and also large numbers of depression (25.9% respectively). Moreover, the number of chronic cases in 2014 was definitely more than the other years (36.5%). All of these factors could affect stroke patient's progression in rehabilitation program. Health care providers and physicians, therefore, needed to realize the importance of these factors and be able to recognize potential symptoms in an early stage.

The most common complications found in this study were urinary tract infection, similar to the previous studies (Kitisomprayoonkul et al., 2010; Chen et al., 2012; Domke et al., 2005). Risks for urinary tract infection included catheterization (Kitisomprayoonkul et al., 2010), and presence of post void residual urine (PVR) more than 50 ml (Chen et al., 2012). Therefore, proper caring of the urinary catheters and also prompt removing of the catheters when necessary should be emphasized in order to prevent infections. Acute delirium was the second most common complication found in this study. Delirium has been shown to be related with poor prognosis outcome (McManus et al., 2009), longer LOS, higher mortality rate and higher discharge rate to nursing home compared with patient who did not have this complication (Shi et al., 2012).

Previous study in Thailand concerning about complications during stroke rehabilitation in nine tertiary hospitals (Kuptniratsaikul et al., 2009c) demonstrated that musculoskeletal pain was the most common problem (32.4%), followed by bowel/bladder dysfunction (31.5%), whereas symptomatic urinary tract infection was found in 10.7% which was less than the incidence found in this study. Therefore, further research to identify causes of this problem during patient's admission in rehabilitation ward of Siriraj Hospital should be considered.

This study has several limitations. Firstly, because of the nature of a retrospective study, complete data collection was difficult to be achieved. Secondly, efficacy of rehabilitation outcome in this study was calculated mainly by modified BI, while some previous studies utilized other outcome measurement scales such as FIM or BI. Proper comparison, therefore, was difficult to be made among these studies. And lastly, outcome measurements used in this study, efficacy and effectiveness, were calculated from scales of modified BI which represented mainly for functional abilities in BADLs and quantities of ambulation, while it was not designated to measure other neurological recoveries such as dysphagia, communication problems or spasticity in direct way. Since these problems could also affect quality of life and independency of stroke patients, recovery and improvements of them should also be included in the outcomes of rehabilitation study, but without precise documentation during admission, data collection after discharge of the patient was not possible.

Conclusion

For eligible stroke patient, intensive rehabilitation provided better functional outcomes, as measured by efficacy and effectiveness, with shorter period of LOS. Moreover, there has been an increasing trend for efficacy and effectiveness with a decreasing trend for LOS during the 2010-2014 study period.

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