Determinants of length of stay during post-stroke rehabilitation in community hospitals

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ABSTRACT

Introduction: Length of stay (LOS) in hospitals is the largest contributor of direct stroke care cost. Rehabilitation accounts for 16 percent of healthcare cost in the six-month post-stroke period. It is important to determine factors extending LOS in rehabilitation hospitals to identify focus areas of cost-control strategies. The aim of the study was to ascertain the predictors of LOS of post-stroke patients admitted into two community hospitals offering rehabilitation.

Methods: An observational cohort study was conducted on 200 stroke patients admitted from acute hospitals into two community hospitals. Data collected included baseline sociodemographical variables, and the National Institute of Health Stroke Scale, Abbreviated Mental Test, Geriatric Depression Scale and Barthel Index were used to assess neurological impairment, cognitive impairment, depressive symptoms and functional disability, respectively. Medical complications (defined as new or exacerbated medical problems that generated additional physician evaluation, a change in medication or additional medical intervention), after patients were admitted to the community hospitals until discharged, were recorded. The outcome variables measured were length and cost of stay.

Results: The mean LOS in our study was 34.4 (standard deviation [SD] 18.4) days, and the mean cost of hospital stay was S$2,410.83 (SD S$2,167.26). Length and cost of hospital stay were significantly correlated (r equals 0.52; p-value is less than 0.01). On multiple linear regression analysis, the significant variables positively associated with LOS were medical complications and functional dependence on admission. Significant variables negatively associated with LOS were unplanned discharge and recurrent strokes.

Conclusion: Medical complication is a key reversible determinant of increased LOS of post-stroke patients receiving rehabilitation in community hospitals. Strategies for prevention, early detection and treatment of medical complications during stroke rehabilitation are discussed.

Keywords: cerebrovascular accident, community hospital, length of stay, post-stroke rehabilitation, rehabilitation, stroke, stroke complications

Singapore Med J 2007; 48(5):400–407

INTRODUCTION

Stroke is a disease with considerable physical[1,2] and socioeconomical burden, accounting for 2%–4% of the direct cost of the healthcare sector in most developed nations.[3-5] Economic burden of stroke has direct, indirect and intangible components,[6] with direct cost alone being 70% of the total stroke cost.[7-12] The direct cost of stroke is largely determined by the length of stay (LOS) in hospitals.[7-9] Rehabilitation, an important component of the stroke therapy, also accounts for 16% of stroke care cost for the first six months.[6] With decrease in age-standardised mortality rate of stroke patients and increase in the greying population in developed nations, more stroke patients are expected to seek rehabilitation services in future.[13-17] This translates to increased healthcare costs spent on stroke rehabilitation.

In order to focus cost-control strategies to optimally use healthcare resources for stroke patients during inpatient rehabilitation, it is important to ascertain the significant determinants of LOS during in-patient rehabilitation. The aim of our study was to study possible variables that may influence the LOS of stroke patients in rehabilitation hospitals and determine which factors were significantly associated with LOS.

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METHODS

We identified 252 stroke patients who were consecutively admitted into two community hospitals in Singapore (i.e. Ang Mo Kio Hospital and St Luke's Hospital), which are intermediate care facilities offering stroke rehabilitation, during the period from April to September 2002. The patients recruited satisfied the World Health Organisation criteria for stroke (defined as a condition characterised by rapidly developed clinical signs of focal disturbance of cerebral function lasting more than 24 hours with no apparent cause other than vascular origin). All patients in the study gave informed consent for participation in the study. We excluded 48 patients with severe dysphasia because the measurement tools used required participants to be able to communicate. Another four patients refused to participate, and as a result, 200 patients fulfilled the inclusion criteria for enrolment into the study.

We obtained sociodemographical information which included age, gender, ethnicity, marital status and education level. We also assessed neurological variables, namely stroke lesion type (ischaemic versus haemorrhagic), location of stroke (cortical versus non-cortical), side and distribution (unifocal or multifocal, based on computed tomography scan of the head which was done on all patients) and whether the stroke was the first episode or recurrent.

The severity of neurological impairment was measured using the National Institute of Health Stroke Scale (NIHSS). The NIHSS assesses level of consciousness, horizontal gaze, visual fields, facial palsy, motor strength, ataxia, sensory system, language, dysarthria and extinction or inattention. The scale scores range from 0 to 42, with 42 denoting the most severe neurological impairment. The NIHSS has been shown to have high intra- and inter-rater reliability,[10] and to predict long-term stroke outcome[11] and post-acute care disposition among stroke patients.[12] Three categories of neurological impairment, namely mild, moderate and severe, were defined with the following cut-off values: mild impairment 1–6; moderate impairment 7–12; and severe impairment 13–42.

The 15-item short form version of the Geriatric Depression Scale (GDS-15) was used to assess depressive symptoms. The short-GDS has been found to be a suitable instrument to screen for depression in the general population,[18] and validated for use in the elderly population locally.[19] It has scores ranging from 0 to 15, with a score of 5–10 indicating mild depression, and a score of 11–15 indicating severe depression. Patients in this study were defined as depressed if their GDS score was ≥ 5. The Abbreviated Mental Test (AMT) was used to assess cognitive impairment. In elderly patients, AMT has been shown to give good predictive validity of cognitive impairment and dementia and has been validated in local settings by Sahadevan et al.[20,21] The ten-item scale gives scores ranging from 0 to 10 with a score of ≤ 7 indicating cognitive impairment.

Functional disability was assessed by the Barthel Index (BI) for independence in activities of daily living (ADL) (i.e. grooming, walking, bladder and bowel control, dressing, climbing stairs, feeding and bathing), which has been validated and is widely used in stroke patients.[22] The scores of the scale range from 0 to 100, with a score of 100 denoting complete independence. Three ordinal categories of functional disability were defined using the following cut-off values: severe 0–50; moderate 51–75; and mild to no impairment 76–100. ADL dependence upon admission was defined as BI score ≤ 50. Data was collected upon arrival of patients to rehabilitation hospitals from acute stroke units. Neurological and functional assessments were performed by a physician (SKS) and questionnaire interviews were administered by a trained research nurse, with translations for non-English speaking patients. Information on certain sociodemographical variables like marital status, living arrangement and presence of caregiver were obtained from the patients and/or their caregivers.

Cardiovascular risk factors (i.e. smoking, hypertension, hyperlipidaemia, diabetes mellitus, ischaemic heart disease and atrial fibrillation), visual impairment (assessed by the finger-counting method) and hearing impairment (assessed by the whisper test) were also recorded. Post-stroke urinary incontinence, dysphagia, aspiration pneumonia and seizures which were diagnosed in the acute hospital prior to transfer to the rehabilitation hospital were also studied as factors influencing LOS. The definition of medical complications used was adopted from previous studies and they were defined as new or exacerbated medical problems that generated additional physician evaluation, a change in medication or additional medical intervention during stay in rehabilitation hospitals.[23,24] We collected information on the occurrence of medical complications during community hospital stay from case-sheets and discussion with attending physicians.

A planned discharge was one where a patient who had completed inpatient rehabilitation and was electively discharged from rehabilitation hospitals. An unplanned discharge was one where a patient was transferred back to the acute care facility without completion of rehabilitation due to severe medical complications or unresolved medical problems. The total LOS in rehabilitation hospitals (in days) and total cost of treatment for the individual patients in rehabilitation settings were noted.

All the predictor variables were first examined by means of univariate analysis (t-test) to assess the importance of each of them on the LOS. A multivariate linear regression analysis was then done to determine factors with an independent influence on LOS. All the

variables of interest were entered as covariates in the model. The analysis was performed with the use of the forward selection procedure. Only values of $p < 0.05$ were considered significant. Although the dependent variable, LOS, was positively skewed, analysis without transforming the variable was still performed because of the large sample size of the study population (n = 200). The correlation between total number of hospital days and total cost of the hospital stay was ascertained by Pearson's correlation method.

RESULTS

The patients in the study were aged between 40 and 96 years, with a mean of 71.5 years (standard deviation [SD] 10.5 years). 54% were males; 88% were Chinese, 7% were Malays, and 5% were Indians. 50% were married, 7% were unmarried, and 43% were either widowed or divorced. Among the 200 participants, 10% were living alone and 12.5% did not have an identifiable caregiver. Visual and hearing impairments were present in 10% and 5% of the patients, respectively. The prevalence of cardiovascular risk factors and comorbidities were: hypertension (87%), diabetes mellitus (47%), smokers (45%), ischaemic heart disease (22%), atrial fibrillation (7%), and hyperlipidaemia (72%). The stroke lesions were haemorrhagic in 12.5% of the patients, cortical in 28% and multifocal 49%. 19% of patients had a recurrent stroke. Among the patients, 25% had post-stroke dysphagia, 59% had urinary incontinence, 5% had aspiration pneumonia and 2% had post-stroke seizures upon admission. Neurological impairment upon admission was assessed as mild in 47% of the patients, moderate in 36%, and severe in 16% of the patients. Upon admission, 53.5% of the patients were ADL-dependent (BI $\leq$ 50), 60% of the patients were depressed (GDS $\geq$ 5), and 54% were cognitively impaired (AMT $\leq$ 7).

22 patients (11%) were transferred to acute care settings from the rehabilitation hospitals for further management of their medical problems. 17 (8.5%) patients were discharged to nursing homes, and the remaining 161 (80.5%) to their own homes. Overall, 154 (77%) patients suffered one or more medical complications during their stay in rehabilitation units (Table I). The most common complication was body pain, followed by giddiness. 13 patients had to be catheterised in community hospitals because of urinary retention and two patients required nasogastric tube insertion. Of the 22 unplanned discharges, one patient was transferred to an acute care hospital on a non-emergency basis for an angiogram, and 21 patients were transferred on an emergency basis for further management of their medical problems. (Table II).

For all 200 patients, the mean total LOS was 34.4 (SD 18.4) days, and median was 32.0 days, with three and 136 days as the minimum and maximum LOS,

Table I. Medical complications during stay in community hospitals among 200 patients.

Complications (in order of decreasing frequency)	Frequency (%)
1. Pain	36 (11.9)
2. Giddiness and/or dizziness	33 (10.9)
3. Rashes and/or itch	32 (10.6)
4. Cough	29 (9.6)
5. Pressure sores (all stages, including sacrum, malleolar and heel)	21 (7.0)
6. Abdominal pain/discomfort	20 (6.6)
7. Fever	17 (5.6)
8. Conjunctivitis and other causes of eye redness	17 (5.6)
9. Limb swelling	14 (4.6)
10. Urinary retention requiring catheterisation in community hospital	13 (4.3)
11. Falls	12 (3.9)
12. Vomiting	10 (3.3)
13. Excoriation of perineal/scrotal skin	10 (3.3)
14. Restlessness	8 (2.6)
15. Diarrhoea	7 (2.3)
16. Non-specific distressing chest discomfort	5 (1.7)
17. Non-specific distressing breathlessness	3 (1.0)
18. Non-specific haematuria	2 (0.7)
19. Epistaxis	2 (0.7)
20. Tinnitus	2 (0.7)
21. Dysphagia requiring nasogastric tube insertion	2 (0.7)
22. Haemoptysis	1 (0.3)
23. Distressing numbness	1 (0.3)

Table II. Reasons for transfer to acute care facilities from community hospitals.

Reasons (n = 22)	Frequency (%)
1. Lower gastrointestinal bleeding	3 (13.6)
2. Upper gastrointestinal bleeding	3 (13.6)
3. Ischaemic heart disease	3 (13.6)
4. Sepsis	2 (9.1)
5. Recurrence of stroke	2 (9.1)
6. Decrease in blood pressure and giddiness	2 (9.1)
7. Aspiration pneumonia	2 (9.1)
8. Intestinal obstruction	1 (4.5)
9. Anaemia	1 (4.5)
10. Pulmonary embolism	1 (4.5)
11. Deep vein thrombosis	1 (4.5)
12. For further investigation (angiogram)	1 (4.5)

Table III. Univariate analysis of effect of sociodemographical, clinical and neurological variables on length of stay.

Variables		Mean (SD)	Median (minimum, maximum)	p-value
Sociodemographical variables				
Age	≤ 75 years	35.32 (21.10)	32.50 (3, 136)	NS
	> 75 years	32.70 (11.47)	32.00 (7, 62)	
Gender	Male	33.94 (15.65)	34.00 (6, 84)	NS
	Female	35.02 (21.35)	30.00 (3, 136)	
Ethnicity	Chinese	35.25 (18.81)	31.50 (3, 136)	NS
	Malay	40.79 (16.67)	46.50 (9, 62)	
	Indian	27.89 (8.89)	31.00 (13, 36)	
Marital status	Married	32.22 (14.90)	32.00 (3, 77)	NS
	Unmarried	29.15 (11.40)	30.00 (10, 55)	
	Divorced/widowed	37.80 (22.17)	33.00 (7, 136)	
Education	< Secondary level	36.60 (18.46)	33.50 (9, 136)	NS
	≥ Seccondary level	31.00 (18.40)	31.00 (6, 93)	
Living arrangement	Living with someone	34.45 (18.47)	32.00 (3, 136)	NS
	Living alone	34.20 (19.15)	32.50 (9, 84)	
Caregiver	Absent	33.40 (18.50)	31.00 (9, 84)	NS
	Present	34.58 (18.44)	32.00 (3, 136)	
Neurological variables				
Lesion type	Haemorrhage	31.60 (13.66)	33.00 (3, 58)	NS
	Infarction	34.84 (18.99)	32.00 (6, 136)	
Lesion location	Cortical	33.78 (15.55)	34.00 (3, 90)	NS
	Non-cortical	34.22 (19.00)	31.50 (6, 136)	
Lesion distribution	Focal	35.92 (21.93)	32.00 (6, 136)	NS
	Multifocal	32.05 (14.43)	31.50 (3, 90)	
Recurrent stroke	Absent	35.50 (18.85)	33.00 (6, 136)	< 0.05
	Present	28.31 (11.96)	26.00 (3, 55)	
Post-stroke dysphagia	Absent	34.48 (19.42)	31.50 (6, 136)	NS
	Present	34.27 (15.12)	34.00 (3, 77)	
Post-stroke urinary incontinence	Absent	32.32 (20.34)	30.00 (6, 136)	NS
	Present	35.93 (16.83)	35.00 (3, 100)	
Post-stroke aspiration pneumonia	Absent	34.19 (18.55)	32.00 (3, 136)	NS
	Present	38.90 (15.68)	39.50 (20, 77)	
Post-stroke seizure	Absent	34.30 (18.37)	32.00 (3, 136)	NS
	Present	40.50 (21.87)	36.00 (19, 71)	
Neurological impairment (National Institute of Health Stroke Scale)	Mild–moderate	34.36 (18.94)	32.00 (6, 136)	NS
	Severe	34.83 (16.10)	37.00 (3, 77)	
Clinical variables				
Visual impairment	Absent	33.89 (17.34)	31.00 93, 100)	NS
	Present	39.42 (26.51)	36.00 (10, 136)	
Hearing impairment	Absent	34.40 (18.78)	32.00 (3, 136)	NS
	Present	34.90 (9.30)	33.00 (18, 52)	
Hypertension	Absent	31.16 (17.84)	25.00 (9, 71)	NS
	Present	34.70 (18.49	33.00 (3, 136)	
Diabetes mellitus	Absent	34.91 (15.45)	34.00 (6, 92)	NS
	Present	33.87 (21.36)	30.00 (3, 136)	
Smoking	Absent	33.34 (20.49)	30.00 (3, 136)	NS
	Present	35.72 (15.58)	35.00 (6, 90)	

Variables		Mean (SD)	Median (minimum, maximum)	p-value
Ischaemic heart disease	Absent	33.97 (19.45)	31.00 (3, 136)	NS
	Present	36.07 (14.11)	34.00 (9, 42)	
Atrial fibrillation	Absent	34.52 (18.35)	33.00 (3, 136)	NS
	Present	33.14 (19.83)	29.00 (9, 77)	
Hyperlipidaemia	Absent	35.80 (22.28)	32.00 (3, 136)	NS
	Present	33.89 (16.89)	32.50 (6, 100)	
Medical complications	Absent	27.04 (13.02)	24.00 (6, 62)	< 0.01
	Present	36.61 (19.22)	34.00 (3, 136)	
Functional impairment (Barthel Index)	Mild–moderate	31.00 (18.40)	29.50 (6, 136)	< 0.05
	Severe	37.43 917.96)	37.00 (3, 100)	
Cognitive impairment (Abbreviated Mental Test)	Absent	32.20 (17.03)	31.00 (3, 92)	NS
	Present	36.34 (19.38)	32.50 (7, 136)	
Depression (Geriatric Depression Scale)	Absent	32.90 (18.06)	30.50 (3, 93)	NS
	Present	35.47 (18.64)	33.00 (7, 136)	
Discharge mode	Planned discharges	36.02 (18.42)	33.50 (6, 136)	< 0.01
	Unplanned discharges	21.05 (11.82)	19.00 (3, 42)	
Discharge destination	Own home	34.93 (18.12)	32.00 (6, 136)	< 0.05
	Nursing home	46.24 (18.69)	42.00 (18, 93)	

NS = Not statistically significant.

Table IV. Multiple linear regression analysis of length of stay (adjusted R^2 = 15.99; F = 9.27; p < 0.0001).

Variables	Unstandardised coefficients		Standardised coefficients	p-value
	Beta	SE	Beta	
Severe functional impairment ADL dependence	7.68	2.60	0.21	< 0.01
Medical complications Present	9.00	3.09	0.20	< 0.01
Recurrence of stroke Present	-8.13	3.35	-0.17	< 0.05
Discharge mode Unplanned	-18.82	4.11	-0.32	< 0.01

respectively. We were only able to obtain the total cost of hospitalisation data from one out of the two community hospitals studied because one of them declined to release their financial data. As a result, we only had information for 133 out of the 200 patients. The total mean cost of the hospital stay in our study was S$2,410.83 (SD S$2,167.26). The median was S$1,964.37, with S$419.60 and S$16,234.07 as the minimum and maximum cost of total hospital stay, respectively. The LOS and cost of the hospital stay were significantly correlated (Pearson's correlation coefficient = 0.52, $p < 0.01$).

On univariate analysis of 200 patients, the significant variables positively associated with LOS were functional impairment on admission, discharge to nursing home and medical complications occurring in rehabilitation hospitals. The significant variables negatively associated with LOS were unplanned discharges and recurrent stroke (Table III). Using multiple linear regression, the significant independent factors positively associated with LOS were functional impairment on admission and medical complications occurring in rehabilitation hospitals. Unplanned discharge and recurrent stroke were negatively associated with LOS in rehabilitation hospitals (Table IV). In the model, 16% of the variance (adjusted R^2 = 15.99) was explained by the model which was statistically significant. ($F = 9.27$; $p < 0.001$). It was also found that the mean total cost of hospitalisation of patients with complications was significantly higher than patients without complications (S$2,641.90 ± S$2,347.08 versus S$1,597.90 ± S$1,028.30, respectively. $p = 0.02$).

DISCUSSION

To our knowledge, there has been no published

comprehensive study on the possible factors that may affect LOS for post-stroke patients in inpatient rehabilitation settings. Most studies have used function as a baseline variable alone. Some authors have found that functional index measure scores, ambulation velocity using a two-minute timed walk test on admission and intensity of rehabilitation can predict the length of rehabilitation hospitalisation needed.[25-27] Our study supports earlier studies because we found that poorer functional status using BI score was associated with longer LOS. In contrast to medical complications, functional status upon admission to an inpatient rehabilitation unit is not easily amenable to prevention or amelioration during hospital stay.

Age, stroke type, lesion characteristics and comorbidities were not significant associates of prolonged LOS in our study, which is similar to findings in other studies.[7,28,29] Social factors like living alone and absence of caregiver are often thought to prolong the LOS in rehabilitation hospitals but our study did not support this hypothesis. Psychological variables like post-stroke depression[30-34] and cognitive impairment[35-37] have been demonstrated to determine functional recovery and potentially prolong LOS in rehabilitation hospitals. We did observe that depressed or cognitively-impaired patients stayed longer in rehabilitation hospitals with a mean LOS of three and four more days, respectively, compared to patients without depressive symptoms or impaired cognition. However, these differences were not statistically significant. A larger sample size may increase the power of the study to detect a significant difference between patients with psychological morbidity and those without.

Medical complications like post-stroke dysphagia, urinary incontinence, aspiration pneumonia and seizures before admission into rehabilitation hospitals were not associated with LOS. However, medical complications occurring during inpatient rehabilitation were found to be significant predictors of increased LOS. Similar to previous studies,[23,24,38] the frequency of medical complications suffered by stroke patients in our study was quite high (77%). Potentially preventable medical complications during rehabilitation identified include skin pressure care and falls. The majority of medical complications found are potentially treatable but it is still unknown if early detection and treatment will reduce LOS. The finding that urinary catheterisation and nasogastric tube insertion were associated with increased LOS is also supported by a study by Roth et al.[39] It should be noted that the medical complications found in our community hospital population were less serious than those reported in studies by Roth et al and Dromerick and Reding,[23,24] which were conducted in acute hospital settings. However, this is expected as our local community hospitals do not have on-site acute care facilities and patients who develop serious medical complications are transferred back to acute hospitals for further management, resulting in community hospital physicians tending to manage less severe medical complications. The fact that the 22 patients who were prematurely transferred back to acute facilities were included in our analysis on LOS, strengthens our findings that medical complications are associated with increased LOS.

Recurrent stroke was a significant factor associated with shorter hospital stay in our study as compared to first-time stroke patients. This is counter-intuitive as one would expect patients with recurrent strokes to be more functionally impaired and hence stay longer for rehabilitation. There are two possible reasons for this unexpected finding in our study: the number of subjects with recurrent stroke was much smaller than patients with first-time stroke (38 versus 162 patients) and patients with first-time strokes had higher level of functional impairment compared to patients with recurrent stroke (mean BI score = 44.9 [first-time stroke] versus 47.5 [recurrent stroke]). The finding that unplanned discharges led to shorter LOS is expected. The number of unplanned discharges was small (11%) and the reasons for transfers back to acute hospitals were all valid. A further study on unplanned discharges and their subsequent care could help rehabilitation hospital physicians better understand this special group of patients and perhaps prevent unplanned discharges.

The cost of hospital stay of patients with complications was expectedly higher than those without complications. However, in the Singapore context, the cost of hospitalisation is higher for full-paying patients than subsidised patients because of government subvention. Since we did not stratify our results by class of beds, these findings should be interpreted with care. In our study, patients discharged to nursing homes had a statistically significant prolonged hospital stay compared to the patients discharged to their own homes only on univariate analysis. Although not found to be significant on the final statistical model on multivariate analysis, similar findings have been reported in previous studies and the commonest reason was extended waiting times for nursing home admissions.[40,41]

There have been many suggested ways for treating single medical complications that occur during stroke rehabilitation. However, interventions that address multiple post-stroke complications and which have demonstrated reductions in LOS are mainly clinical pathways and protocols. Two previous non-randomised controlled studies have reported that adherence to clinical pathways and protocols for stroke care decreased cost of care, LOS and complications in stroke patients.[42,43] However, these studies were conducted in acute stroke

settings and further studies in rehabilitation settings are needed to determine if similar clinical pathways designed to detect medical complications early during stroke rehabilitation may reduce LOS and cost of care in inpatient rehabilitation settings.

This study has several limitations. Dysphasic patients were excluded and this population may potentially have more severe functional impairment and medical complications. Moreover, dysphasia was not studied as a factor that may increase the LOS. The patients in the study are mainly elderly (mean age 71.5 years) and the findings may not be extrapolated to inpatient rehabilitation settings with a younger population. Patients who are admitted to rehabilitation hospitals are usually more dependent and do not have the social support to return home or attend daily rehabilitation therapy. Hence, the study's findings cannot be applied to outpatient rehabilitation settings. Future research should be directed at determining if early detection and treatment of medical complications, by the use of clinical pathways or protocols, may reduce medical complication rate, LOS, unplanned discharges and cost of care. Another area of useful research would be to compare the on-admission characteristics of patients who develop medical complications during inpatient rehabilitation with those who do not, in order to identify patients at higher risk early for possible useful interventions.

In conclusion, medical complications are key preventable determinants of LOS during post-stroke rehabilitation in community hospitals. Many of the medical complications are potentially preventable and most are treatable. Further research into interventional studies involving clinical pathways and protocols are needed to determine if such measures can help reduce LOS and cost of care.

ACKNOWLEDGEMENTS

We wish to thank the staff of Ang Mo Kio Hospital and St Luke's Hospital for their support and assistance.

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