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Korean Brain Rehabilitation Registry for Rehabilitation of Persons with Brain Disorders: Annual Report in 2009

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This first annual report provides a description of patients discharged from rehabilitation facilities in Korea based on secondary data analysis of Korean Brain Rehabilitation Registry V1.0 subscribed in 2009. The analysis included 1,697 records of patients with brain disorders including stroke, traumatic brain injury, brain tumor and other disorders from 24 rehabilitation facilities across Korea. The data comprised 1,380 cases of stroke, 104 cases of brain injury, 55 cases of brain tumor, and 58 cases of other brain diseases. The functional status of each patient was measured using the Korean version of the Modified Barthel Index (KMBI). The average change in the KMBI score was 15.9 for all patients in the inpatient rehabilitation facility. The average length of stay for inpatient rehabilitation was 36.9 days. The transfer rates to other hospitals were high, being 62.4% when all patients were considered. Patients with brain disorders of Korea in 2009 and measurable functional improvement was observed in patients. However, relatively high percentages of patients were not discharged to the community after inpatient rehabilitation. Based on the results of this study, consecutive reports of the status of rehabilitation need to be conducted in order to provide useful information to many practitioners.

Key Words: Registries; Rehabilitation; Korea; Brain

INTRODUCTION

Brain disorders including stroke, brain injury, and brain tumor can lead to multiple medical, cognitive, and functional issues. In Korea, brain disorders account for large number of hospitalized patients in departments of rehabilitation medicine. Accordingly, there have been a number of reports by individual hospitals that have provided the general characteristics and functional outcomes of rehabilitation treatment of brain disorder. However, no large multi-center studies of rehabilitation of individuals with brain disorders have been conducted to date.

The Korean Brain Rehabilitation Registry V1.0 (http://www.kbrr.or.kr), which was developed by the Korean Society of Neurorehabilitation (KSNR) in 2005, is an online system for survey of the demographic information of patients with brain diseases in department of rehabilitation medicine in hospitals. Departments of rehabilitation medicine of general hospitals including rehabilitation facilities of university hospitals, and rehabilitation hospitals across Republic of Korea participated in the registry. The Korean version of Modified Barthel Index (KMBI) was developed by the KSNR prior to development of the Korean Brain Rehabilitation Registry V1.0 and its reliability and validity were established by a multicenter study (1). Previously, an analysis of data on stroke patients collected from 2006 to 2008 was report-

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ed in a domestic journal of Korea (2).

This is the annual report of patients with brain disorders discharged from inpatient rehabilitation programs in Korea that participated in Brain Rehabilitation Registry V1.0.

MATERIALS AND METHODS

A total of 24 hospitals across Korea participated in the Brain Rehabilitation Registry with 1,667 records of patients. All patients were classified with stroke, brain injury, brain tumor, or other brain disease based on pathogenesis. The demographic information and medical history relevant to brain diseases of patients were included: age, sex, onset of disease, information regarding hospital admission and discharge, period prior to admission to the rehabilitation medicine department, length of hospital stay, and discharge placement. Treatment outcome was measured by changes in score using the KMBI at admission and discharge. Functional recovery was assessed by changes of KMBI between admission and discharge was defined as KMBI gain with reference to existing definition. To standardize the effect of the length of hospital stay, KMBI efficiency was defined with reference to existing definition. Specifically, it was calculated by determining the difference in the MBI between admission and discharge and dividing this value by the length of stay (3). Mini-mental status examination (MMSE), a widely used, well –validated screening tool for evaluation of cognitive impairment, was administered at admission and discharge. Korean version of National Institute of Health Stroke Scale (KNIHSS) for stroke, Rancho Los Amigos Scale for brain injury and Karnofsky performance score for brain tumor were input into the registry.

All analyses were conducted using SAS statistical software, version 9.2 (SAS Institute, Cary, NC, USA). The change between admission and discharge was compared using paired t-test. The significance of comparisons among groups was determined using ANOVA. A multiple regression analysis was used to relationships between general characteristics and functional improvement of patients. A statistical significance was considered as $P < 0.05$.

Ethics statement

This study was approved by the institutional review board of Korea University Guro Hospital (IRB No. KUGH 11070-001). The informed consent was waived for this study since an observational research study, presenting no more than minimal risk to subjects.

RESULTS

General characteristics of subjects

A total of 1,597 of 1,667 patient records were analyzed for this study. Seventy records were excluded due to typing errors and missing information. The records of 1,339 hospitalized patients were taken from general hospitals and 258 cases were from rehabilitation hospitals. Overall 57 percent were male and 43 percent were female. Stroke, brain injury, and brain tumor accounted for 86.4 percent (1,380 cases), 6.5 percent (104 cases), and 3.4 percent (55 cases) of the cases, respectively. The average age at the initial onset of stroke, brain injury and brain tumor was 64.1, 50.8, and 47.9 yr, respectively (Table 1).

Admission and discharge information

The majority of patients admitted to the rehabilitation facilities were transferred from acute care units in the departments of neurology and neurosurgery. Patients with brain injury or brain tumor were transferred to the rehabilitation facility after a longer time after onset of disease when compared to patients with stroke. The average waiting time for stroke, brain injury, and brain tumor patients was 53.1, 100.5, and 133.1 days, respectively. Patients in rehabilitation hospitals had a significantly longer length of stay than those in general hospitals or university hos-

Table 1. Demographic data describing patients in the Brain Rehabilitation Registry database

Characteristics	All	Stroke	Injury	Tumor	Others
Number of patients	1,597	1,380	104	55	58
Percent of all cases	100	86.4	6.5	3.4	3.6
Mean age (SD) (yr)	62.4 (15.7)	64.1 (14.3)	50.8 (19.6)	47.9 (16.3)	56.1 (21.3)
Age (yr), %					
< 45	13.0	9.2	36.5	40.0	34.5
45-64	35.3	35.5	34.6	45.5	22.4
65-74	28.2	30.1	16.4	10.9	19.0
> 75	23.5	25.1	12.5	3.6	24.1
Sex (%)					
Male	56.9	55.7	77.9	50.9	55.2
Female	43.1	44.4	22.1	49.1	44.8
Type of hospital setting (%)					
University hospital	83.5	82.2	90.4	94.6	91.4
General hospital	0.3	0.4	0.0	0.0	0.0
Rehabilitation hospital	16.2	17.4	9.6	5.4	8.6

SD, standard deviation.

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pitals. However, there was no significant difference in the length of stay among patients with different disorders. Approximately 62 percents of patients did not return to the community, but were discharged to long term care facilities and other hospitals (Table 2).

Functional measurement of patients

The average score of KMBI at admission was 42.7 and significantly increased to 58.4 at discharge. KMBI gain and KMBI efficiency did not differ significantly among groups (stroke, injury, tumor) of patients. Analysis of KMBI score revealed that all of items were significantly improved upon discharge when compared to admission. The average mini-mental status examination (MMSE) was also significantly improved at the time of discharge when compared the time of admission. Changes in the MMSE between the time of admission and discharge did not

Table 2. Clinical course of patients

Characteristics	All	Stroke	Injury	Tumor
Admitted from (%)				
Neurology	57.4	60.5	33.3	21.2
Neurosurgery	36.8	33.8	62.1	73.1
Internal medicine	2.8	2.7	1.2	1.9
Others	3.0	3.0	3.5	3.9
Median transfer time after onset (days)	30.0	27.0	50.0	100.0
Mean transfer time after onset, days (SD)	61.1 (78.6)	53.1 (69.1)	100.5 (108.1)	133.1 (126.2)
Median length of stay (days)	27.0	28.0	27.0	21.0
Mean length of stay, days (SD)	36.9 (39.3)	37.9 (39.7)	37.5 (48.8)	21.8 (11.2)
Discharge placement (%)				
Home	35.7	34.9	32.7	52.7
Other hospitals	62.4	63.1	66.4	45.5
Transfer out to other departments	1.9	2.1	1.0	1.8

SD, standard deviation. In the median and mean transfer time after onset, the number of records included are all patients (n = 1,589), stroke patients (n = 1,373), brain injury patients (n = 103) and brain tumor patients (n = 55). In the median and mean length of stay, the number of records included are all patients (n = 1,559), stroke patients (n = 1,346), brain injury patients (n = 103) and brain tumor patients (n = 54). In the discharge placement, the number of records included are all patients (n = 1,576), stroke patients (n = 1,360), brain injury patients (n = 104) and brain tumor patients (n = 55).

Table 3. Functional status of patients

Characteristics	All	Stroke	Injury	Tumor
Admission KMBI	42.7 (28.1)	42.2 (27.8)	42.0 (30.2)	53.7 (30.3)
Discharge KMBI	58.4 (30.3)	58.0 (30.2)	61.2 (31.4)	66.9 (28.4)
KMBI gain	15.7 (25.5)	15.7 (25.6)	19.2 (26.0)	13.2 (25.3)
KMBI efficiency	0.3 (4.6)	0.3 (4.9)	0.8 (1.7)	0.6 (1.1)
Admission MMSE	20.3 (7.8)	20.4 (7.6)	18.7 (9.0)	22.4 (8.0)
Discharge MMSE	22.7 (6.9)	22.7 (6.8)	22.2 (8.5)	24.4 (6.5)

Values are mean (standard deviation); KMBI, Korean version of the Modified Barthel Index; MMSE, minimental status examination. In the admission KMBI, discharge KMBI, KMBI gain and KMBI efficiency, the number of records included are all patients (n = 1,408), stroke patients (n = 1,225), brain injury patients (n = 81) and brain tumor patients (n = 53). In the admission MMSE and discharge MMSE, the number of records included are all patients (n = 1,059), stroke patients (n = 918), brain injury patients (n = 57) and brain tumor patients (n = 45).

Table 4. Functional improvement of the KMBI

KMBI components	All		Stroke		Injury		Tumor	
	Admission	Discharge	Admission	Discharge	Admission	Discharge	Admission	Discharge
Personal hygiene	2.4 (1.7)	3.2 (1.6)*	2.4 (1.7)	3.2 (1.6)*	2.2 (1.8)	3.1 (1.7)*	2.7 (1.8)	3.4 (1.6)*
Bathing	1.4 (1.5)	2.1 (1.7)*	1.3 (1.5)	2.0 (1.7)*	1.6 (1.7)	2.4 (1.7)*	2.3 (1.8)	2.8 (1.6)*
Eating	5.2 (3.6)	6.6 (3.4)*	5.2 (3.6)	6.6 (3.4)*	4.7 (3.8)	6.6 (3.5)*	5.5 (3.9)	7.0 (3.2)*
Toileting	3.7 (3.4)	5.3 (3.7)*	3.6 (3.4)	5.3 (3.6)*	3.6 (3.7)	5.9 (3.8)*	5.0 (3.8)	6.3 (3.4)*
Staring	1.8 (3.0)	3.6 (3.8)*	1.7 (2.9)	3.5 (3.7)*	2.1 (3.3)	4.4 (4.0)*	3.1 (3.5)	4.5 (3.9)*
Dressing	3.8 (3.1)	5.6 (3.4)*	3.8 (3.0)	5.5 (3.3)*	3.8 (3.3)	7.6 (3.4)*	5.1 (3.4)	6.2 (3.1)*
Bowel control	6.6 (4.0)	7.6 (3.7)*	6.6 (4.0)	7.6 (3.7)*	6.0 (4.1)	7.7 (3.5)*	7.6 (3.7)	8.4 (3.2)
Bladder control	6.3 (4.0)	7.2 (3.7)*	6.4 (4.1)	7.4 (3.7)*	6.1 (4.0)	5.5 (3.7)	7.2 (3.8)	8.3 (3.1)*
Ambulation	4.8 (5.1)	8.0 (5.5)*	4.6 (5.1)	7.9 (5.5)*	4.9 (5.1)	8.4 (5.5)*	6.7 (5.2)	9.2 (5.3)*
Transfer	6.8 (5.1)	9.4 (5.1)*	6.7 (5.1)	9.3 (5.1)*	6.9 (5.2)	9.8 (5.1)*	8.6 (5.2)	10.9 (4.9)*

Values are mean ± standard deviation; KMBI, Korean version of the Modified Barthel Index. *P* values represent overall differences between admission and discharge as determined by paired t-test. *$P < 0.05$.

differ significantly among groups (Tables 3 and 4).

The average KNIHSS scores of stroke patients upon admission and discharge was 9.0 ± 6.5 and 7.0 ± 6.8, respectively. The average Rancho Los Amigos Scale of traumatic brain injury patients upon admission and discharge was 3.8 ± 2.7 and 4.1 ± 3.0, respectively and the average Karnofsky performance scores of brain tumor patients upon admission and discharge was 9.1 ± 4.4 and 8.5 ± 4.7, respectively. These scores all significantly improved in each of the three groups.

Mean transfer time of university hospital/general hospital and rehabilitation hospital was 51.6 days and 110.6 days, respectively. Functional improvement in terms of KMBI gain was significantly greater at university hospital/general hospital compared to rehabilitation hospitals. Also, mean length of stay was significantly shorter in university hospital/general hospital compared to rehabilitation hospitals (Table 5).

Functional outcome according to general characteristics of patients

Multi-variant linear regression analysis was utilized to evaluate the correlation of characteristics of patients and functional recovery with selected factors including the KMBI scores at discharge, KMBI gain, KMBI efficiency, and length of stay. Significant correlations were found between age of onset, time of transfer to rehabilitation facility after onset, the KMBI and MMSE scores at admission and the KMBI score at discharge. Age at the onset of disease and time of transfer after onset were negatively correlated with the KMBI scores at discharge, indicating that younger age and shorter time of transfer were associated with higher KMBI scores at discharge. Functional ability status determined by the KMBI and MMSE scores at admission had significant positive correlation with the KMBI score at discharge. However, the KMBI score at admission was not related to KMBI gain and KMBI efficiency. These findings indicated that patients with good functional status at the initial stage are likely to have good functional status at discharge (Table 6).

Table 5. Functional outcome according to hospital type

Characteristics	University & General hospital	Rehabilitation hospital	*P* value
Admission KMBI	41.6 (28.1)	48.3 (27.1)	< 0.001
Discharge KMBI	52.0 (34.1)	57.4 (30.2)	0.01
KMBI gain	16.5 (26.8)	12.6 (16.4)	0.003
KMBI efficiency	0.3 (5.1)	0.1 (0.5)	0.132
Admission MMSE	20.3 (7.8)	19.5 (7.9)	0.156
Discharge MMSE	21.8 (8.0)	20.5 (8.3)	0.071
Transfer time after onset	51.6 (73.3)	110.6 (86.1)	< 0.001
Length of stay	28.3 (29.6)	80.3 (51.6)	< 0.001

Values are mean (standard deviation); KMBI, Korean version of the Modified Barthel Index; MMSE, minimental status examination. *P* values represent overall differences across group as determined by t-test.

DISCUSSION

This is the annual report of Korean Brain Rehabilitation Registry V1.0 on brain disorder rehabilitation in Korea, providing information regarding patients with brain disorders discharged from rehabilitation facilities. The results presented herein may be useful as a standard for comparison of rehabilitation facilities. Although there had been great difficulty obtaining standard values of medical rehabilitation due to various characteristics of individual facilities and patients, we attempted to reduce this bias through participation of multiple centers and regions. Since a large number of hospitals are located in metropolitan areas due to their high population densities, more than half of the data were collected from hospitals in Seoul, and 86 percent of the data were collected from hospitals in Seoul and areas adjacent to Seoul (Gyeonggi and Incheon).

KSNR is an academic society representing physicians who are specialists in the neurorehabilitation field of physical medicine and rehabilitation in Korea. KSNR has made effort to define clinical practice patterns and guideline of brain rehabilita-

Table 6. Functional outcome according to general characteristics of patients

Characteristics	Discharge KMBI (n = 1,144)		KMBI gain (n = 1,144)		KMBI efficiency (n = 1,115)		Length of stay (n = 1,115)	
	Coef. (s.e.)	*P* value	Coef. (s.e.)	*P* value	Coef. (s.e.)	*P* value	Coef. (s.e.)	*P* value
Sex								
Male (ref)								
Female	1.09 (1.41)	0.439	1.09 (1.41)	0.439	0.38 (0.31)	0.211	3.75 (1.95)	0.054
Age (yr)	-0.21 (0.05)	< 0.001	-0.21 (0.05)	< 0.001	-0.02 (0.01)	0.022	-0.17 (0.07)	0.008
Time after onset	-0.03 (0.01)	0.009	-0.03 (0.01)	0.009	0.00 (0.00)	0.903	0.12 (0.01)	< 0.001
Admission MBI	0.54 (0.03)	< 0.001	-0.46 (0.03)	< 0.001	-0.05 (0.01)	< 0.001	-0.10 (0.04)	0.015
Admission MMSE	0.30 (0.10)	0.005	0.30 (0.10)	0.005	0.04 (0.02)	0.051	-0.26 (0.14)	0.069
Disease								
Stroke (ref)								
Injury	4.59 (3.13)	0.144	4.59 (3.13)	0.144	0.69 (0.68)	0.308	-7.33 (4.30)	0.089
Tumor	-1.58 (3.58)	0.659	-1.58 (3.58)	0.659	0.36 (0.78)	0.638	-26.0 (4.94)	< 0.001
Others	-3.47 (3.65)	0.342	-3.47 (3.65)	0.342	0.07 (0.80)	0.928	-18.8 (5.10)	< 0.001
Adj. R-square	0.347		0.193		0.045		0.089	

KMBI, Korean version of the Modified Barthel Index; MMSE, minimental status examination; Coef., coefficient; s.e., standard error.

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tion. The Barthel Index (BI) is most popular scale to evaluate activity of daily living in clinical practice and is used at all over the world (4). There have been several modifications of the original BI. KSNR developed KMBI by translating the 5th edition of the MBI (5) into Korean and took the standardization process (1, 5, 6). KMBI and its guidelines have been widely used in Korea.

Stroke accounted for the largest number of the Brain Rehabilitation Registry and had older age onset compared to brain tumor and brain injury. The patients of brain injury and brain tumor spent significantly longer time before admission to rehabilitation facilities compared to patients of stroke. It might be due to the fact that patients of brain injury and brain tumor had larger associated disease and surgical intervention. There is a big difference between median value (30 days) and mean value (61.1 days) of transfer time after onset. Most of our data were collected from the hospitals that are responsible for rehabilitation of acute stage. However, data from patients with subsequent admissions were seemed to be partially included due to lack of medical records. Therefore, time of transfer to rehabilitation facilities after onset of disease might be shorter than the one reported in this paper. In Korea, patients with brain disorder received long-term inpatient rehabilitation in several hospitals, in general because of convenience and low medical cost, which makes admission time after onset of disease rather than first admission or readmission an important factor for rehabilitation effectiveness.

Compared to previous report of KBRR, stroke rehabilitation from 2006 to 2008, there was no difference in median length of stay (28 days) (2). Functional improvement measured by KMBI had some improvement in our study compared to previous report with KMBI gain being 12.9+25.5 and 15.7+25.6 and KMBI efficiency being 0.26+0.88 and 0.3+4.6 at 2006 to 2008 and 2009, respectively.

Since 1983, the Uniform Data System for Medical Rehabilitation (UDSMR) has collected data on patients from medical rehabilitation hospital programs in the United States of America (3). This database has included stroke patients as well as those with orthopedic conditions, cardiac, pulmonary, debility and medically complex conditions. Analysis of the UDSMR data from 1994 to 2001 revealed that the median admission time to a rehabilitation facility for stroke and brain dysfunction patients was 7 and 14 days after onset, and median length of stay for stroke and brain dysfunction patients was 20 and 18 days, respectively (7). In the Brain Rehabilitation Registry of Korea, the median admission time to a rehabilitation facility for stroke and brain injury patients was 27.0 and 50.0 days and median length of stay in rehabilitation facility for stroke and brain dysfunction patients was 28 and 27 days, respectively. Also, more than 80 percent of patients with stroke and brain dysfunction were discharged home in the USA, whereas only 35.7 percent of patients were discharged home and 62.4 percent of patients are transferred to another hospital in Korea. In Korea, brain disorder patients received rehabilitation treatment from several hospitals rather than one rehabilitation facility due to health insurance issues and economic problems. Therefore, the length of stay reported here does not necessary reflect the entire period of hospitalization for rehabilitation. Actually, duration of hospital stay for rehabilitation treatment seems to be longer than that was reported here. In Korea, patients spent lot of time before admission to the rehabilitation facility and received rehabilitation treatment for a longer time compared to the USA. The low co-payments resulting from the national health care system in Korea might influence at these differences of the two countries. Long length of stay at the hospital might be due to environmental factors (e.g., family support, financial status etc.) as well as medical factors were found to influence a patient's ability to access many rehabilitation facilities. The functional independence measure has been used to define the functional status of patients in the UDSMR database, while the KMBI has been used in the Brain Rehabilitation Registry. Therefore, simple comparisons of functional status in these two datasets were not made. Nevertheless, comparison of these two countries should be conducted to further our understanding of the status of brain rehabilitation as well as the social costs in different cultures and societies.

In a study of racial differences in functional outcome after stroke rehabilitation in subacute stage of stroke rehabilitation patients by the UDSMR, there were no significant differences observed between Asians and people of other races (8). Therefore, it is not likely that the differences observed here between Korea and the USA are due to racial differences.

There was one study of stroke outcome to compare the Japan with USA. The average admission time after onset for Japanese patients with stroke was 74 days and average length of stay was 115.8 days, which was relatively longer compared to USA and Korea. However, the data were collected from one hospital and may not have been representative of Japanese stroke rehabilitation (9).

Length of stay benchmarks for inpatient rehabilitation after stroke were individualized using the functional status of motor and cognition of patient was studied in Canada (10). Length of study benchmarks were established using 0.75 FIM efficiency, FIM gain divided by length of stay. More severely affected patients were likely to have longer length of stay. Reduced length of stay was achieved without negatively impacting functional recovery of patient by using benchmarking strategy. In our study, lower MBI score at admission was associated with the longer length of stay. However, our data on length of stay did not include the whole length of stay during inpatient rehabilitation, because of lower discharge rate for home. In fact, Korea has longer length of stay compared to that of Canada. Efficient post-stroke rehabilitation with short length of stay can help to reduce the financial burden of healthcare system.

In a comparative study of freestanding rehabilitation unit and unit located in an acute care hospital in Australia, there was no difference in rehabilitation effectiveness of functional gain (11). In our results, functional improvement of patients in general hospitals was greater than that of patients in rehabilitation hospitals in terms of KMBI gain. However, it was not by hospital type (general hospital vs rehabilitation hospital), but was due to late transfer time after onset and higher admission KMBI score of rehabilitation hospitals.

In summary, the findings of this study revealed that the rehabilitation outcome measured by KMBI was significantly affected by age, functional status and transfer time to rehabilitation facilities at the time of admission. It was found that older age, worse functional status at the time of admission and later transfer time to the rehabilitation facilities are associated with longer hospital stay. Length of stay was relatively longer and home discharge rate was relatively lower when compared to other developed countries. Consecutive reports and further research based on Brain Rehabilitation Registry V1.0 will provide better understanding of the status of rehabilitation in Korea.

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REFERNECES

1. Jung HY, Park BK, Shin HS, Kang YK, Pyun SB, Paik NJ, Kim SH, Kim TH, Han TR. *Development of the Korean version of Modified Barthel Index (K-MBI): multi-center study for subjects with stroke. J Korean Acad Rehabil Med 2007; 31: 283-97.*
2. Jung HY, Kim IS, Rah UW, Kim YH, Paik NJ, Chun MH, Pyun SB, Park BK, Yoo SD, Park SW, et al. *Stroke rehabilitation report using the brain rehabilitation registration online database system in the years 2006 to 2008. Brain Neurorehabil 2010; 3: 34-41.*
3. Granger CV, Hamilton BB. *UDS report. The Uniform Data System for Medical Rehabilitation Report of First Admissions for 1990. Am J Phys Med Rehabil 1992; 71: 108-13.*
4. Quinn TJ, Langhorne P, Stott DJ. *Barthel index for stroke trials: development, properties, and application. Stroke 2011; 42: 1146-51.*
5. Shah S, Vanclay F, Cooper B. *Improving the sensitivity of the Barthel Index for stroke rehabilitation. J Clin Epidemiol 1989; 42: 703-9.*
6. Shah S, Muncer S. *Sensitivity of Shah, Vanclay and Cooper's modified Barthel Index. Clin Rehabil 2000; 14: 551-2.*
7. Ottenbacher KJ, Smith PM, Illig SB, Linn RT, Ostir GV, Granger CV. *Trends in length of stay, living setting, functional outcome, and mortality following medical rehabilitation. JAMA 2004; 292: 1687-95.*
8. Bhandari VK, Kushel M, Price L, Schillinger D. *Racial disparities in outcomes of inpatient stroke rehabilitation. Arch Phys Med Rehabil 2005; 86: 2081-6.*
9. Murakami M, Inouye M. *Stroke rehabilitation outcome study: a comparison of Japan with the United States. Am J Phys Med Rehabil 2002; 81: 279-82.*
10. Meyer M, Britt E, McHale HA, Teasell R. *Length of stay benchmarks for inpatient rehabilitation after stroke. Disabil Rehabil 2012; 34: 1077-81.*
11. Katrak PH, Black D, Peeva V. *Stroke rehabilitation in Australia in a freestanding inpatient rehabilitation unit compared with a unit located in an acute care hospital. PM R 2011; 3: 716-22.*

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