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Original Article

Comparison between convalescent rehabilitation hospitals participating in the stroke liaison critical pathway with respect to the gain of Nichijo-seikatsu-kino-hyokahyo score

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ABSTRACT

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Purpose: To clarify the difference in mean gain of the Nichijo-seikatsu-kino-hyokahyo (NSKH; English translation: Functional Assessment of Daily Living Table) scores between the convalescent rehabilitation hospitals (CRHs) participating in the stroke liaison critical pathway.

Methods: The mean gain of NSKH score differs depending on patient type. Therefore, stroke patients were stratified according to their total NSKH scores on admission to CRHs and the gains were calculated. Then adjusted mean gain was calculated for each hospital by correcting the mean gain assuming that the severity distribution in each CRH is the same as the severity distribution in all CRHs.

Results: The patients were stratified into 10 groups based on the total NSKH scores on admission divided into intervals of two points. The number of patients in the group with 0−1 point was the largest, while the gain was generally large in the groups with 6 to 13 points and was the largest in the group with 8−9 point. The adjusted mean gain exceeded the mean gain in Hospital B that had more mildly impaired patients, while the adjusted mean gain was below the mean gain in the remaining hospitals that had many critically ill patients.

Conclusion: It is possible to make comparisons between hospitals, regions or years using the adjusted mean gain of NSKH score. Thus, this parameter seems to be useful in the assessment of outcome in CRHs participating in the stroke liaison critical pathway.

Key words: Nichijo-seikatsu-kino-hyokahyo, adjusted mean gain, inter-hospital comparison, standard severity distribution, clinical indicator

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Introduction

The community liaison critical pathway (liaison path) was first introduced in the course of division of functions of medical institutions and enhancement of cooperation between them. The liaison path for fracture of the femoral neck was approved as health insurance-eligible treatment in 2006, followed by the liaison path for stroke in 2008. Since then, liaison paths for stroke have been adopted in various regions in Japan. If the data derived from these regional attempts are clearly reported, they are expected to serve as important data

Table 1. Nitchijo-seikatsu-kino-hyokahyo (NSKH)

	Patients' Conditions etc.	0 point	1 point	2 points
1	Instruction of bed rest	None	Present	
2	Either right hand or left hand can be raised up to the chest	Possible	Impossible	
3	Rolling over	Possible	Possible if there is something to hold on to	Impossible
4	Sitting up	Possible	Impossible	
5	Maintaining the sitting position	Possible	Possible if there is any supporting tool.	Impossible
6	Transferring from the bed to the wheelchair	Possible	Watching/partial assistance needed	Impossible
7	Transferring method	Moving requiring no assistance	Moving requiring assistance	
8	Oral hygiene care	Possible	Impossible	
9	Having meals	No assistance	Partial assistance	Total assistance
10	Putting on/taking off the clothes	No assistance	Partial assistance	Total assistance
11	Communicating with others	Possible	Occasionally possible and occasionally impossible	Impossible
12	Understanding treatment/healthcare instructions	Yes	No	
13	Dangerous behavior	None	Present	

for various purposes such as demonstration of the efficacy of the liaison path for stroke, inter-regional and inter-hospital comparisons, and establishment of high-quality efficient healthcare system [1].

In order to evaluate the outcome of stroke, we need to attempt to stratify the patients according to severity and degree of impairment that have great influence on prognosis [1]. A large variety of methods are available for rating severity and degree of impairment of stroke [1]. The liaison path, however, requires the participating hospitals to use Nichijo-seikatsu-kino-hyokahyo (NSKH; English translation: Functional Assessment of Daily Living Table) (Table 1) for this purpose [2]. The calculation of convalescent rehabilitation ward (CRW) admission charge I requires meeting of the following condition: critically ill patients (patients with total NSKH score of 10 points or higher) constitute more than 20% of newly admitted patients. Moreover, the calculation of additional convalescent ward admission charge for critically ill patients requires meeting of the following condition: more than 30% of critically ill patients show improvement in total NSKH score by more than 3 points at discharge. Our search of literature found no report of comparison between hospitals with a CRW (convalescent rehabilitation hospitals; CRHs) participating in the liaison path with respect to the NSKH gain in stroke patients, after correction for severity.

The objective of the present study was to clarify the difference in mean NSKH gain between CRHs participating in the stroke liaison path. Mean NSKH gain, however, differs depending on patient type. Therefore, stroke patients were stratified according to the total NSKH score on admission to CRHs and the gain was calculated. Then, adjusted mean gain was calculated for each hospital by correcting the mean gain assuming that the severity distribution in each hospital is the same as the severity distribution in all CRHs.

Methods

A total of 2,063 stroke patients admitted to acute hospitals in Kumamoto Prefecture were registered in the electronic community liaison critical pathway of Kumamoto Seamless Stroke Referral Associates for CVD Amelioration (K-STREAM) [3] for the period between January 1, 2009 and December 31, 2010. Of these, 1,722 stroke patients were transferred to CRHs for rehabilitation. Registration forms with complete entries including total NSKH score could be obtained from 467 of 1722 stroke patients. Of 467 stroke

patients, 8 died in the CRHs and 50 were transferred to acute hospitals. The remaining 409 stroke patients were enrolled as subjects for the present study. Their mean age was 71.2 ± 13.3 years. The mean length of stay (LOS) in acute hospitals was 20.0 ± 10.8 days. The mean LOS in CRHs was 87.3 ± 52.3 days. The K-STREAM consists of the following medical institutions in Kumamoto Prefecture: 10 acute hospitals, 34 CRHs, 33 medical long-term care sanatoriums, 18 geriatric health service facilities, and 37 clinics. For patients who are eligible for treatment by the stroke liaison path, the patients and their families are notified and explained during admission to an acute hospital that their clinical data will be used in a clinical study, and written informed consent is obtained.

Assessment 1: Mean gain of total NSKH score at each hospital

We investigated the total NSKH score on admission to CRH (score on admission) and the total NSKH score at discharge (score at discharge). The total NSKH score ranged from 0 to 19 points, and more critically ill patients had higher scores. As the symptoms improve, the gain obtained by subtracting the score on admission from the score at discharge is thus expressed by a negative value. We were concerned that the expression of gain by a negative value might be mistaken as aggravation of symptoms. Therefore, in the present study, we attempted to express the gain as a positive value and defined the gain as follows. We subtracted the score at discharge from the score on admission and obtained the mean difference for the hospital. This mean difference was regarded as the mean gain of the hospital. CRHs were ranked in descending order according to the number of patients treated as follows: Hospital A (146 patients), Hospital B (115 patients), and a group of the remaining 18 hospitals with less than 30 patients per hospital (148 patients in total). The mean gains were obtained from all hospitals, Hospital A, Hospital B, and the remaining hospitals.

Assessment 2: Gains in 10 groups stratified by admission NSKH score divided into 2-point intervals

All patients were stratified into 10 groups according to the total NSKH scores on admission divided into 2-point intervals (0−1, 2−3, ----, 18−19 points). We investigated the number of patients in each group and the mean gain in each hospital. We also obtained these data for Hospital A, Hospital B, and the remaining hospitals. The severity-specific distribution of number of patients was defined as severity distribution, and the overall severity distribution in all the hospitals was defined as "standard severity distribution."

Assessment 3: Adjusted mean gain corrected using the standard severity distribution

Different severity distributions were recognized in Hospital A, Hospital B, and the remaining hospitals. Therefore, we obtained the "adjusted mean gain" in each hospital assuming that the severity distribution in each hospital was the same as the standard severity distribution. For example, in the case of Hospital B, the gain in the 0−1 point group (0.029 point) was multiplied by the standard severity distribution for the 0−1 point group (0.249, 102 of 409 patients), while the gain in the 2−3 point group (1.810 point) was multiplied by the standard severity distribution in the 2−3 point group (0.137, 56 of 409 patients). The values thus obtained from the 0−1 point group to the 18−19 point group were summed and the total sum was regarded as the adjusted mean gain of Hospital B (Table 2).

Results

The hospitals were ranked in descending order according to mean gain as follows: the remaining hospitals, Hospital A, and Hospital B (Table 2 and Fig. 1).

Table 2. Number of patients and gain in 10 groups stratified by total Nitchijo-seikatsu-kino-hyokahyo (NSKH) score on admission to convalescent rehabilitation hospitals divided into two-point intervals

Number of patients

	0−1	2−3	4−5	6−7	8−9	10−11	12−13	14−15	16−17	18	Total	NSKH≧10
Hospital A	37	22	14	18	16	12	12	9	6	0	146	0.267
Hospital B	34	21	13	11	10	6	5	6	6	3	115	0.226
Remaining hospitals	31	13	12	13	20	15	12	11	18	3	148	0.399
All the hospitals	102	56	39	42	46	33	29	26	30	6	409	0.303
severity distribution	0.249	0.137	0.095	0.103	0.112	0.081	0.071	0.064	0.073	0.015	1	—

Gain

	0−1	2−3	4−5	6−7	8−9	10−11	12−13	14−15	16−17	18	Mean gain	Adjusted mean gain
Hospital A	0.11±0.52	1.77±1.07	3.64±1.01	4.39±3.20	4.88±4.08	3.58±3.48	2.50±3.37	4.00±4.58	2.50±2.26	—	2.57±3.05	2.56
Hospital B	0.03±0.76	1.81±1.25	3.23±1.83	4.64±3.26	5.70±2.83	5.17±3.06	7.00±4.80	1.00±4.15	2.50±2.35	3.33±3.21	2.49±3.08	2.89
Remaining hospitals	0.23±0.50	1.77±2.20	3.33±1.87	3.54±3.82	5.15±3.23	5.80±3.73	4.67±5.99	4.09±5.70	4.39±6.05	0.67±0.58	3.30±4.18	2.95
All the hospitals	0.12±0.60	1.79±1.44	3.41±1.57	4.19±3.37	5.17±3.41	4.88±3.57	4.17±4.96	3.35±4.99	3.63±4.92	2.00±2.53	2.81±3.52	2.81

The mean gain, adjusted mean gain and standard severity distribution are as explained in the section Subjects and Methods. Gain is expressed as mean ± standard deviation.

The patients were stratified into 10 groups according to the total NSKH score on admission divided into 2-point increments. The numbers of patients in these 10 groups are shown in Table 2 and Fig. 2, and the mean gains are presented in Table 2 and Fig. 3. Because there was no patient with a total NSKH score of 19 points on admission, the "18–19 point group" was replaced by "18 point group." In all hospitals, the number of patients in the 0–1 point group was the largest, while the gain was generally large in the groups ranging from 6 to 13 points with the largest in the group with 8–9 points. We also obtained the hospital-specific results. The percentage of critically ill patients with total NSKH score on admission exceeding 10 points was higher in the remaining hospitals (39.9%) than in Hospital B (22.6%) (Table2). According to the data of all hospitals, the gains of the 10 groups distributed in a bell shape. However, large differences in gain between adjacent pairs of NSKH score groups were observed as follows: between 12–13 point and 14–15 point in Hospital B, and between 16–17 point and 18 point in the remaining hospitals.

The hospitals were ranked in descending order according to the adjusted mean gain as follows: the remaining hospitals (2.95 points), Hospital B (2.89 points), and Hospital A (2.56 points). The adjusted mean gain was larger than the mean gain in Hospital B, while it was smaller than the mean gain in the remaining hospitals (Table 2 and Fig. 1).

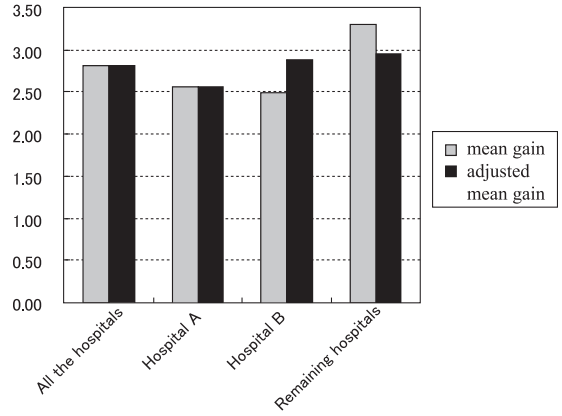

Figure 1. Mean gain and adjusted mean gain.

Discussion

Researchers have attempted to select meaningful parameters of healthcare processes or outcomes as clinical indicators, and use them to evaluate the quality of healthcare provided by a hospital. Such clinical indicators should be objective, allow simple evaluation, and have standard values. "Adjusted mean gain of NSKH score" obtained in this study allows comparisons between hospitals, regions or years with different severity distributions. Thus, it can be called the CRH clinical indicator. The investigation items are the total NSKH scores on admission to and at discharge from CRHs, which are incorporated in the health insurance treatment of the stroke liaison path, and are objective and easily attainable data. Our search of literature found no similar reports, and we believe that the present study is useful for outcome assessment in the CRHs participating in stroke liaison path.

Differences between mean gain and adjusted mean

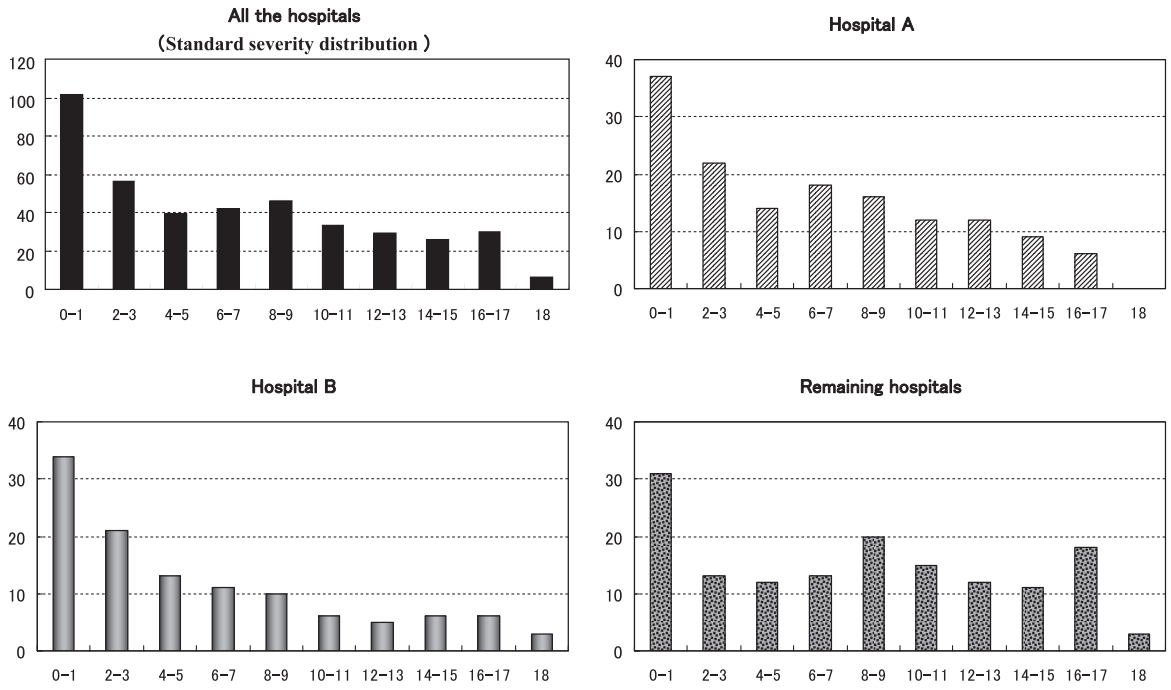

Figure 2. Numbers of patients in 10 groups stratified by total Nichijo-seikatsu-kino-hyokahyo (NSKH) scores on admission divided into 2-point intervals (severity distribution).

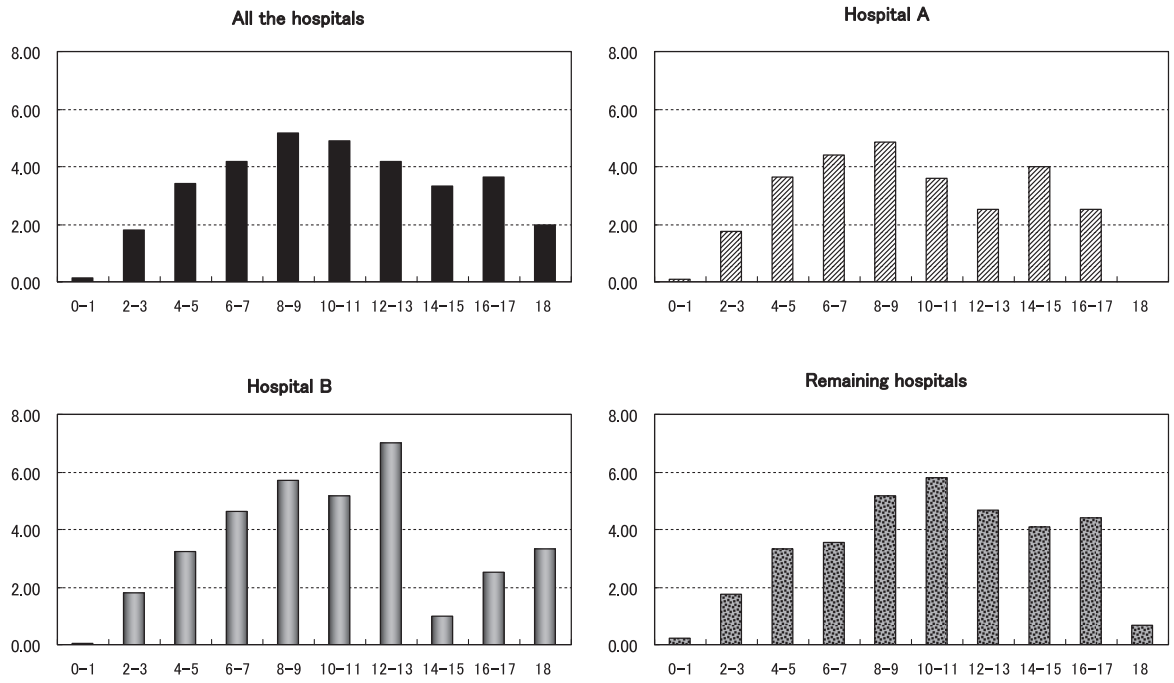

Figure 3. Mean gains in 10 groups stratified by total Nichijo-seikatsu-kino-hyokahyo (NSKH) scores on admission divided into 2-point intervals.

gain were observed in Hospital B and the remaining hospitals. Hospital B accepted many mildly impaired patients with total NSHK scores ranging from 0 to 3 points. The mean gain was small because of the strong influence of the small gain in the 0–3 point groups. The adjusted mean gain, however, seemed to increase by correcting severity. On the contrary, in the remaining hospitals, many patients had total NSKH score ranging from 10 to 17 points. The mean gain was large because of the large gain in the 10–17 point groups. The adjusted mean gain, however, seemed to decrease by correcting severity. These results suggest that the hospitals should not use mean gain but should use adjusted mean gain if the severity distribution of the hospitals differ from the standard severity distribution.

The result of the survey conducted by the Kaifukuki Rehabilitation Ward Association [4] demonstrated that the rehabilitation system in the CRW differed markedly depending on hospital. Each hospital is required to employ the following rehabilitation staff specifically for the ward: 2 physical therapists (PTs) and one occupational therapist (OT). Fifty-two percent of the hospitals investigated met this requirement. More than 10 hospitals in Japan employed more than 30 rehabilitation specialists, including one hospital that employed as many as 51 rehabilitation specialists including PTs, OTs and speech language hearing therapists. A patient receives on average 4.45 units of rehabilitation per day. In 8.5% of hospitals, a patient receives more than 7 units of rehabilitation per day. In 7.7% of hospitals, however, a patient receives less than 2 units of rehabilitation per day. Besides the number of rehabilitation staff and the units of rehabilitation, the improvement of severity should also be investigated in stroke patients. The distribution of severity among stroke patients differed depending on hospital. Prognosis prediction has not been improved sufficiently to be used for individual prediction [5]. These situations make analysis difficult.

The Japanese Association of Rehabilitation Medicine developed the guidelines for stroke rehabilitation community liaison path [1] and recommends using age, number of comorbidities, acute severity (rating based on NIH stroke scale etc.), impairment, and activities of daily living (ADL) for stratification of acute stroke patients. No concrete example of stratification is presented in the guidelines because of many issues, such as how to divide patients according to their ages, how many groups to be created to reflect the patients' generations, how to evaluate not only the number of comorbidities but also their severity, and how many groups of stroke patients to be created in total to reflect many items selected. In the present study, we stratified stroke patients on the basis of their total NSKH scores on admission. It was difficult to accurately predict the total NSKH score at discharge from the total NSKH score on admission in each patient. Thus, NSKH score on admission is not perfect for prognosis prediction of individuals [6, 7]. The "adjusted mean gain of NSKH score" which is obtained by correcting the mean gain by standard severity distribution, however, will enable us to make an inter-hospital comparison.

The present method, which was developed by correcting the mean gain, was based on the concept of age-adjusted mortality. The unadjusted mortality

(crude death rate) can be obtained by dividing the number of deaths by the population. If we use the unadjusted mortality in an inter-prefecture comparison, as a result of the difference in age distribution between prefectures, the mortality is higher in the prefectures with a larger elderly population and lower in the prefectures with a larger young population. If we desire to make a comparison between regions or years having different age distributions, we need to adjust the age distribution of each prefecture to match the standard population distribution. The mortality obtained through this process is age-adjusted mortality. Even if there is a difference in severity distribution between hospitals, we can make comparisons between hospitals or years by using the adjusted mean gain. In the present study, we used the data obtained from all the convalescent hospitals in Kumamoto Prefecture as the standard severity distribution. If we use the data obtained from all the convalescent hospitals in Japan, we can make an interregional comparison.

The requirements of an assessment method can be summarized as follows: is able to measure what should be measured (validity), consistent results are obtained in repeated measurements or in measurements performed by different examiners (reliability), can be adopted by many institutions (adoption rate), and is able to detect differences (sensitivity). The high adoption rate of NSKH attracts our attention because all the acute hospitals and CRHs participating in the stroke liaison path use NSKH to rate severity. The NSKH is assessed by nurses who have completed the training course for NSKH assessors and nurses who participated in training programs organized by assessors who have completed the NSKH training course. This training system assures reliability. Although some researchers have pointed out that the twenty-grade evaluation does not precisely reflect the effects of rehabilitation, the severity distribution and gain obtained in the present study demonstrated a certain degree of sensitivity of this instrument. However, this method was originally developed as an evaluation of the degree of nursing needs [8]. It was later adopted as a required evaluation for health insurance treatment of the stroke liaison path, and its use as a method for rating severity was started under the new name "Nichijo-seikatsu-kino-hyokahyo". As shown by its brief history, the validity of this method for assessing severity is not so high [6, 7]. Sonoda et al. [6] observed somewhat high correlation between the total NSKH score and the total score for motor function in Functional Independence Measure (FIM), a representative ADL rating scale. However, they also reported that the interchangeability of these two methods could not be regarded as high because for a given NSKH score, the FIM scores varied by a range of some tens of points. Furthermore, even if the symptoms of a bed rest patient classified as grade 5 according to modified Rankin scale (mRS 5) were improved to mRS 4, the degree of nursing needs was occasionally increased. Thus, the degree of nursing needs is not always consistent with the ADL of a patient. In Japan, however, a system that allows evaluation of severity of stroke patients on the basis of the degree of nursing needs has been established and the use of NSKH for evaluation of severity of stroke seems to be inevitable. In the future, development of an infrastructure that allows evaluation of severity using ADL measurement is anticipated.

The adjusted mean gain was higher in the remaining hospitals with smaller numbers of patients than in Hospital A with many patients. Therefore, we could not conclude that "hospitals with more patients achieve better gain." We noticed a tendency that the gain in the 10−17 point groups was higher in the remaining hospitals than in Hospital A. This phenomenon contributed to the increase in mean gain. Whether ADL gain is also high in the remaining hospitals remains to be investigated in future studies.

The difference in adjusted mean gain between the remaining hospitals with high gain and Hospital A with low gain was only 0.39 point. Because we adjusted the mean gain, we were not able to perform statistical analysis of significant difference. Considering the error associated with obtaining the adjusted mean gain, we can conclude that the liaison path has raised the overall standards of CRHs in Kumamoto Prefecture, which has resulted in no difference in the adjusted mean gain of NSKH score between hospitals.

The "adjusted mean gain of NSKH score" obtained from the present study has the following limitations. First, the rehabilitation capacity of individual hospital remains unknown. Second, the results obtained from hospitals with small numbers of patients tend to be inaccurate. Creation of ten groups compromises the accuracy of gain in each group. Actually, a large difference in gain between two adjacent NSKH score groups was observed in the remaining hospitals and Hospital B. A large sample size is indispensable for stratification. Around 400 patients per hospital are probably necessary, as demonstrated by the bell-shaped severity distribution data from all the hospitals (n = 409). Third, if the NSKH was scored incorrectly, analysis of those scores will not yield meaningful results. Fourth, the quality of CRHs should be evaluated using a large variety of methods and the present indicator is only one of them. Fifth, if a new indicator that can be used for prediction of prognosis of individual stroke patient is developed in the future, the new indicator should be used for making inter-hospital comparisons. Sixth, in hospitals with many mildly impaired patients and many rehabilitation staff and nurses, more time can be spent to care for critically ill patients and the adjusted mean gain is likely to exceed the intrinsic gain reflecting the actual capacity of the hospital. Seventh, the adjusted mean gains cannot be compared statistically for significant

differences.

In the future, we have planned to conduct the following projects: analysis of the data obtained from CRHs across Japan, inter-hospital comparison by correcting various parameters including the outcomes of CRHs and length of stay in CRHs using the standard severity distribution, and assessment of outcomes in acute hospitals using the NIH stroke scale in place of NSKH.

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