

# Effectiveness of Intensive Rehabilitation Therapy on Functional Outcomes After Stroke: A Propensity Score Analysis Based on Japan Rehabilitation Database

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*Aim:* To examine the association of the amount of rehabilitation with functional gains of elderly stroke patients at a convalescent rehabilitation ward using propensity score analysis methods and the Japan Rehabilitation Database.

*Methods:* This study was a retrospective cohort study. From the database, 6875 patients who were admitted to the convalescent rehabilitation wards with stroke were identified. After excluding 4586 patients, 2325 were eligible for the study. Intensive rehabilitation therapy (IRT) was defined as rehabilitation therapy of more than 15 hours per week by a physical therapist, an occupational therapist, and/or a speech therapist. Functional Independence Measure (FIM) gain, discharge rate to home, and FIM efficiency were examined using student's *t* test and the  $\chi^2$  test after inverse probability weighting (IPW).

*Results:* IRT was provided to 862 patients (37.1%). The unadjusted data showed that patients in the IRT group had a longer hospital stay, more physical therapy, occupational therapy, and speech and language therapy. After adjustment for IPW, the baseline characteristics were found to be closely matched between the 2 groups. The IRT group showed significantly higher motor FIM gain, cognitive FIM gain, FIM gain, and discharge rate to home.

*Conclusions:* The present study demonstrated that a longer rehabilitation time per week was associated with increased functional gain in elderly stroke patients at convalescent rehabilitation wards.

**Key Words:** Intensive rehabilitation therapy—stroke—propensity score—elderly  
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## Introduction

Rehabilitation therapy is important for stroke patients. The Centers for Medicare and Medicaid Services (CMS) reported that stroke patients need to receive a minimum of 3 hours of therapy for at least 5 days or a minimum of 15 hours over 7 days.<sup>1</sup> No study has yet been published that provides evidence to support the CMS 3-hour rule requirement. In Japan, convalescent rehabilitation wards are the main system providing inpatient rehabilitation facilities covered by the medical insurance system. Patients who still need assistance in activities of daily living, after acute treatment, are transferred to these rehabilitation wards.<sup>2</sup> The maximum length of stay (LOS) and amount of exercise with therapists covered by insurance are limited. In the Japanese medical insurance system, the maximum LOS for stroke patients is 180 days and the maximum rehabilitation time for stroke patients is 3 hours

of rehabilitation per day, including weekends (21 hours per week). Previous studies have demonstrated that the amount of therapy a patient receives is related to outcomes such as independence in ambulation and ambulation distance,<sup>3</sup> independence in activities,<sup>4</sup> and chances of discharge to home.<sup>5</sup> Several recent studies reported the positive effects of daily rehabilitation treatment time on functional improvement of patients, who suffered a stroke, at an inpatient rehabilitation hospital.<sup>6-8</sup>

However, the determination of the amount of rehabilitation is left to the discretion of the physician and/or the therapist. For example, patients with a low capacity of activities for daily living are more likely to have a decreased amount of rehabilitation and such patients are also more likely to have decreased functional gain. Thus, the selection treatment is confounded by patient factors that are also related to outcomes. Most of the studies cited were not able to adjust comprehensively for the variety of factors that influence the amount of rehabilitation. It appears difficult in practice to conduct a randomized controlled trial to examine the effects of increasing the amount of rehabilitation; instead, a large-scale retrospective cohort study, using the propensity score (PS) analysis methods, is a feasible alternative to a randomized controlled trial. We examined the associations of the amount of rehabilitation with functional gains in elderly stroke patients at the convalescent rehabilitation ward using the PS analysis methods and the Japan Rehabilitation Database.

## Methods

### *Data Source*

The Japan Rehabilitation Database was established with financial support from the Ministry of Health, Labor, and Welfare of Japan.<sup>9</sup> The database contains detailed data collected on patients who were admitted to the participating hospitals during the period between January 2005 and March 2016, and was constructed with voluntary samples, not random samples. It is divided into different sections based on the diagnosis, such as stroke, spinal cord injury, femoral neck fracture, and other disorders. The database for stroke patients includes the identifiers of the following patient characteristics: age, gender, LOS at the acute hospital and the convalescent rehabilitation wards, admission days from stroke onset, type of stroke, daily rehabilitation therapy, and Functional Independence Measure (FIM) scores. The medical staff at each participating hospital recorded the data and submitted them through the internet to the office of Japan Association of Rehabilitation Database. In total, data from 80 participating hospitals has been added to the structured data for 35,657 patients as of 2016. To preserve anonymity, personal data were coded and all individually identifiable information was removed. The study was approved by the Institutional

Review Board of the Japanese Association of Rehabilitation Medicine.

### *Subjects*

This study included patients admitted to the convalescent rehabilitation wards<sup>2</sup> of 42 participating rehabilitation hospitals with a diagnosis of stroke between January 2005 and March 2016, sourced from the Japan Rehabilitation Database. The inclusion criteria for the patients were: (1) they were aged more than equal to 65 years; (2) they stayed less than 180 days; (3) they had complete data.

### *Rehabilitation Program*

The intensive rehabilitation therapy (IRT) group was defined as the stroke patients who received more than 15 hours of rehabilitation therapy per week ( $\geq 15$  hours) by physical therapist, occupational therapist, and/or speech therapists. The subjects of the usual rehabilitation (UR) group received less than 15 hours of rehabilitation therapy per week ( $< 15$  hours). The Japanese public health insurance system reimburses rehabilitation performed by physical, occupational, or speech therapists when the patient receives rehabilitation therapy for 7 days a week.

### *Outcome Measurements*

The primary clinical outcome was the FIM gain (discharge FIM - admission FIM). The FIM is a reliable, validated indicator of activities of daily living that has 13 items regarding motor function and 5 items regarding cognitive function.<sup>10</sup> Each item is given 1-7 points, from "total assistance" to "complete independence". Total scores range from 18 to 126, with higher scores indicating greater independence. The secondary clinical outcomes were discharge rate to home and FIM efficiency (FIM gain/LOS).

### *Statistical Analysis*

The data are presented as mean and standard deviation. The demographic and clinical characteristics between 2 groups were compared using Student's *t* test or  $\chi^2$  test. The PS was calculated using a multivariable logistic regression model with the 2 groups as the dependent variables, and age, FIM at admission, motor FIM at admission, days from injury, past history of stroke, and affected sides as independent variables. The inverse probability weighting (IPW) was then calculated using PS. IPW is a method that uses weights based on the PS to create a synthetic sample in which the distribution of measured covariates is independent of the treatment assignment. IPW attempts to simulate a randomized experimental situation, in which both groups are comparable in observed prognostic factors. The C-statistic for goodness of fit was .72 in the propensity-score model. The IRT group was weighted by the inverse of the PS, and the UR group was weighted by the inverse of 1 minus the PS. The

descriptive statistics for all patients, either with or without IPW adjustment, were performed to check covariate balance and estimate influence. Student's *t* test and the  $\chi^2$  test were used to compare IRT and UR groups. A *P* value of  $<.05$  was considered statistically significant. All statistical analyses were performed using the SPSS 25.0 (IBM SPSS Inc., Armonk, NY).

## Results

From the database, 6875 patients who were admitted to the convalescent rehabilitation wards with stroke were identified. After excluding 4586 patients, 2325 patients were eligible for analysis (Fig. 1). Table 1 presents the clinical characteristics of the study patients, and for IRT and UR groups before and after IPW adjustment. IRT was provided to 862 patients (37.1%). The unadjusted data showed that patients in the IRT group had a longer hospital stay, more physical therapy, occupational therapy, and speech and language therapy. After adjustment for IPW, baseline characteristics were found to be closely matched between the 2 groups. Table 2 shows outcomes for the IRT group and UR groups. Compared to the UR group, the IRT group showed significantly higher cognitive FIM gain before IPW adjustment. After adjustment for IPW, the IRT group showed significantly higher motor FIM gain, cognitive FIM gain, and FIM gain. Compared to the UR group, the IRT group showed significantly lower motor FIM efficiency and FIM efficiency before IPW adjustment. In contrast, the IRT group showed significantly higher motor FIM efficiency and FIM efficiency after IPW adjustment. The IRT group had a higher rate of discharge to home than did the UR group before and after IPW adjustment.

## Discussion

The present retrospective cohort study was conducted to investigate the association of the amount of rehabilitation with functional gains of elderly stroke patients at convalescent rehabilitation wards using PS analysis methods.

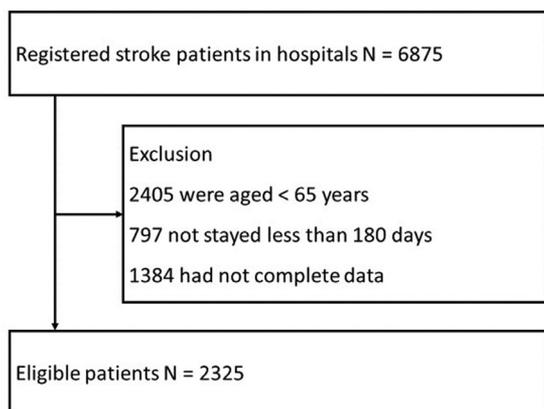


Figure 1. Flow chart of patient selection.

The result based on the database we used showed that longer rehabilitation time per week was associated with increased FIM gain. First, we assessed rehabilitation outcomes using a standard Student's *t* test analysis among all patients. Subsequently, we performed PS analysis (IPW method). The results were essentially unchanged, with IRT for elderly stroke patients at convalescent rehabilitation associated with good rehabilitation outcomes.

Many studies have showed the positive association between a longer rehabilitation treatment time per day and functional gains of stroke patients.<sup>7,11</sup> Wang et al<sup>12</sup> showed that the daily treatment time of physical therapy, occupational therapy, and speech and language therapy was also significantly associated with functional gains. Jette et al<sup>13</sup> reported that longer daily treatment durations of physical and occupational therapy were associated with increased FIM score and mobility function of patients who had suffered a stroke and that longer daily treatment durations of OT and SLT were associated with better improvement of cognitive function of patients who had experienced stroke, in skilled nursing facilities. However, these studies had small sample sizes and selection bias was not adjusted. Participation with rehabilitation time can be affected by patient characteristics, affected side, severity of medical conditions, and initial functional status. Previous study showed that the patients who received therapy less than 3.0 hours per day were older, had a higher percentage of men than were patients who received therapy more than equal to 3.0 hours per day.<sup>12</sup> Therefore, we performed PS analysis to reduce selection bias by IPW in the present study. PS analysis requires a large sample size to gain statistically reliable results<sup>14</sup>; this was made possible by the use of the Japan Rehabilitation Database, which contains a large proportion of the stroke rehabilitation population.

Although there is evidence of a dose-dependent relationship between intensity of rehabilitation therapies and functional recovery following stroke,<sup>15,16</sup> the optimal amount of therapy a given stroke patient should receive on a daily basis during inpatient rehabilitation remains unknown. Many national organizations have compiled variations of a best practice guideline document intended for use by healthcare providers. CMS reported that stroke patients are required to receive a minimum of 3 hours of therapy for at least 5 days or a minimum of 15 hours over 7 days.<sup>1</sup> In the UK guidelines for stroke, it is recommended that people with stroke should accumulate at least 45 minutes of each appropriate therapy every day.<sup>17</sup> In the Australian guidelines for stroke, it is recommended that rehabilitation therapy should be provided to stroke survivors for a minimum of 3 hours per day, with at least 2 hours of active task practice.<sup>18</sup> Our results supported the importance of the CMS 3-hour rule at convalescent rehabilitation wards.

Previous studies have demonstrated that inpatient stroke rehabilitation has been shown to positively affect

Table 1. Patients' characteristics

	Unadjusted				Adjusted by IPW			
	Total (n = 2325)	IRT group (n = 862)	UR group (n = 1463)	P value	Total (n = 2325)	IRT group (n = 862)	UR group (n = 1463)	P value
Age (y)	76.8 ± 7.1	77.1 ± 7.0	76.7 ± 7.0	.21	76.8 ± 7.1	76.8 ± 7.0	76.8 ± 7.1	.90
Female (n)	1117 (46.3%)	418 (47.4%)	699 (45.7%)	.42	1076 (46.3%)	679 (46.4%)	397 (46.1%)	.81
Time to admission after onset (d)	33.1 ± 21.4	33.5 ± 19.8	32.9 ± 22.2	.46	32.9 ± 21.1	32.7 ± 20.4	33.0 ± 21.8	.60
Motor FIM score at admission	40.9 ± 22.5	41.1 ± 22.7	40.7 ± 22.3	.69	40.9 ± 22.6	40.9 ± 22.9	40.9 ± 22.3	.95
Cognitive FIM score at admission	20.2 ± 8.9	20.1 ± 8.8	20.3 ± 9.0	.61	20.2 ± 8.9	20.2 ± 9.0	20.2 ± 9.0	.93
FIM score at admission	61.1 ± 29.0	61.2 ± 29.3	61.1 ± 28.8	.94	61.1 ± 29.2	61.0 ± 29.7	61.1 ± 28.9	.94
Past history of stroke (n)								
None	1688 (70.0%)	635 (72.1%)	1053 (68.9%)	<.05	1620 (69.7%)	594 (68.9%)	1026 (70.1%)	.64
1 time	497 (20.6%)	179 (20.3%)	318 (20.8%)		492 (21.2%)	192 (22.3%)	300 (20.5%)	
More than 2 times	161 (6.7%)	53 (6.0%)	108 (7.1%)		153 (6.6%)	57 (6.6%)	96 (6.6%)	
Unknown	64 (2.7%)	14 (1.6%)	50 (3.3%)		60 (2.6%)	19 (2.2%)	41 (2.8%)	
Affected sides (n)								
Right	1012 (43.5%)	379 (44.0%)	633 (43.3%)	<.05	1005 (43.2%)	367 (42.6%)	638 (43.6%)	.09
Left	931 (40.0%)	357 (41.4%)	574 (39.2%)		938 (40.3%)	362 (42.0%)	576 (39.4%)	
Both	200 (8.6%)	54 (6.3%)	146 (10.0%)		197 (8.5%)	57 (6.6%)	140 (9.6%)	
No paralysis	177 (7.6%)	70 (8.1%)	107 (7.3%)		181 (7.8%)	74 (8.6%)	107 (7.3%)	
Unknown	5 (0.2%)	2 (0.2%)	3 (0.2%)		4 (0.2%)	2 (0.2%)	2 (0.1%)	
Length of stay (d)	100.8 ± 40.4	109.2 ± 39.7	96.0 ± 39.9	<.001	101.1 ± 40.3	101.0 ± 40.3	101.3 ± 40.4	.83
Amount of rehabilitation, hours/week (h)	12.4 ± 4.9	17.5 ± 1.5	9.4 ± 3.5	<.001	13.5 ± 4.8	17.4 ± 1.5	9.5 ± 3.5	<.001
Amount of physical therapy, hours/week (h)	5.2 ± 2.3	7.2 ± 1.5	4.0 ± 1.8	<.001	5.6 ± 2.3	7.2 ± 1.5	4.0 ± 1.8	<.001
Amount of occupational therapy, hours/week (h)	4.7 ± 1.7	6.1 ± 1.0	3.8 ± 1.4	<.001	5.0 ± 1.7	6.1 ± 1.0	3.8 ± 1.4	<.001
Amount of speech and language therapy, hours/week (h)	2.5 ± 2.0	4.1 ± 1.7	1.6 ± 1.4	<.001	2.9 ± 2.0	4.1 ± 1.7	1.6 ± 1.4	<.001

Abbreviations: FIM, functional independence measure; IPW, inverse probability weighting; IRT, Intensive rehabilitation therapy; SD, standard deviation; UR, usual rehabilitation. Data are presented as mean ± SD.

**Table 2.** Outcomes of the intensive rehabilitation treatments and usual rehabilitation groups

	IRT Group (n = 862)	UR Group (n = 1463)	P value
Unadjusted			
Motor FIM score at discharge	61.0 ± 24.6	59.9 ± 24.6	.29
Cognitive FIM score at discharge	24.0 ± 8.5	23.6 ± 8.9	.22
FIM score at discharge	85.1 ± 31.5	83.5 ± 31.9	.24
Motor FIM gain	19.9 ± 16.3	19.3 ± 16.6	.37
Cognitive FIM gain	4.0 ± 5.2	3.3 ± 4.9	<.01
FIM gain	23.8 ± 19.5	22.6 ± 19.4	.12
Motor FIM efficiency	0.209 ± 0.232	0.233 ± 0.252	<.05
Cognitive FIM efficiency	0.039 ± 0.062	0.039 ± 0.065	.95
FIM efficiency	0.248 ± 0.270	0.272 ± 0.289	<.05
Discharge rate to home (%)	75.3%	71.4%	<.05
Adjusted by IPW			
Motor FIM score at discharge	61.0 ± 25.0	60.0 ± 24.5	.17
Cognitive FIM score at discharge	24.0 ± 8.5	23.5 ± 8.8	.07
FIM score at discharge	85.0 ± 31.9	83.5 ± 31.7	.12
Motor FIM gain	20.1 ± 16.9	19.1 ± 16.3	<.05
Cognitive FIM gain	3.8 ± 5.3	3.3 ± 4.9	<.01
FIM gain	24.0 ± 20.1	22.4 ± 19.2	<.05
Motor FIM efficiency	0.235 ± 0.270	0.220 ± 0.237	<.05
Cognitive FIM efficiency	0.041 ± 0.070	0.037 ± 0.062	.08
FIM efficiency	0.276 ± 0.313	0.257 ± 0.272	<.05
Discharge rate to home (%)	74.6%	71.5%	<.05

Abbreviations: FIM, functional independence measure; IRT, Intensive rehabilitation therapy; IPW, inverse probability weighting; SD, standard deviation; UR, usual rehabilitation.

Data are presented as mean ± SD.

the probability of home discharge.<sup>19,20</sup> The clinical importance of rehabilitation therapy for stroke has been well-established, but the debate on the most appropriate time of rehabilitation therapy per week continues to date. Suzanne et al<sup>21</sup> reported a consistent dose-response to rehabilitation therapies across discharge. However, the high intensity group was defined as patients who received therapy intensities of at least 60 minutes per day in this study. Similarity, Jette et al<sup>22</sup> showed that patients in skilled nursing facilities were 1.22 and 2.02 times more likely to be discharged to the community when therapy averaged 1-1.5 hours per day and more than 1.5 hours per day, respectively, as compared with less than 1 hour per day. Wodchis et al<sup>23</sup> also reported a greater likelihood for community discharge was present as dose increased. In the present study, the discharge rate to home in the IRT group was higher than the UR group before and after IPW adjustment. Our result suggests that IRT is associated with higher discharge rate to home in elderly stroke patients at convalescent rehabilitation wards.

The present study had several limitations. First, the Japan Rehabilitation Database consists of only voluntary samples, not random samples. Although the use of observational studies for assessment of treatment effects is controversial,<sup>24</sup> recent studies have suggested that observational studies, when appropriately conducted, are not likely to yield misleading or biased results.<sup>25,26</sup> Furthermore, we used propensity analysis to enable an even

more rigorous adjustment for selection bias and confounding factors. Nonetheless, it must be acknowledged that observational studies can only partially control the factors actually measured. As a result, application of these findings to all elderly patients with stroke undergoing rehabilitation might be limited. Second, we could not adjust the result to unmeasured confounders, including rehabilitation methods. Third, since no data were available after hospital discharge, the impact of IRT care at convalescent rehabilitation wards on long-term outcome of stroke remains unknown. Fourth, database we used have lacked information of the number of board-certified physiatrists and nurses and the detail of complications in each convalescent rehabilitation wards. Despite these limitations, to our knowledge, this study is the first to examine the association of the amount of rehabilitation with functional gains of elderly stroke patients at convalescent rehabilitation wards using PS analysis methods. In conclusion, the present study demonstrated that a longer rehabilitation time per week was associated with increased functional gain in elderly stroke patients at convalescent rehabilitation wards.

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points of view of the authors, not the official views of the Japanese Association for Rehabilitation Medicine.

### Declaration of conflicting interests

The authors declare no conflict of interest.

### References

- Johnston MV, Miller LS. Cost-effectiveness of the Medicare three-hour regulation. *Arch Phys Med Rehabil* 1986;67:581-585.
- Miyai I, Sonoda S, Nagai S, et al. Results of new policies for inpatient rehabilitation coverage in Japan. *Neurorehabil Neural Repair* 2011;25:540-547. <https://doi.org/10.1177/1545968311402696>.
- Fitzgerald JF, Moore PS, Dittus RS. The care of elderly patients with hip fracture. *N Engl J Med* 1988;319:1392-1397. <https://doi.org/10.1056/NEJM198811243192106>.
- Roach KE, Ally D, Finnerty B, et al. The relationship between duration of physical therapy services in the acute care setting and change in functional status in patients with lower-extremity orthopedic problems. *Phys Ther* 1998;78:19-24.
- Guccione AA, Fagerson TL, Anderson JJ. Regaining functional independence in the acute care setting following hip fracture. *Phys Ther* 1996;76:818-826.
- Kinoshita S, Momosaki R, Kakuda W, et al. Association between 7 days per week rehabilitation and functional recovery of patients with acute stroke: a Retrospective Cohort Study based on the Japan Rehabilitation Database. *Arch Phys Med Rehabil* 2017;98:701-706. <https://doi.org/10.1016/j.apmr.2016.11.004>.
- Horn SD, DeJong G, Smout RJ, et al. Stroke rehabilitation patients, practice, and outcomes: is earlier and more aggressive therapy better. *Arch Phys Med Rehabil* 2005;86(Suppl 12):S101-S114. <https://doi.org/10.1016/j.apmr.2005.09.016>.
- Hu MH, Hsu SS, Yip PK, et al. Early and intensive rehabilitation predicts good functional outcomes in patients admitted to the stroke intensive care unit. *Disabil Rehabil* 2010;32:1251-1259. <https://doi.org/10.3109/09638280903464448>.
- Kinoshita S, Kakuda W, Momosaki R, et al. Clinical management provided by board-certificated physiatrists in early rehabilitation is a significant determinant of functional improvement in acute stroke patients: a retrospective analysis of japan rehabilitation database. *J Stroke Cerebrovasc Dis* 2015;24:1019-1024. <https://doi.org/10.1016/j.jstrokecerebrovasdis.2014.12.026>.
- Chumney D, Nollinger K, Shesko K, et al. Ability of Functional Independence Measure to accurately predict functional outcome of stroke-specific population: systematic review. *J Rehabil Res Dev* 2010;47:17. <https://doi.org/10.1682/JRRD.2009.08.0140>.
- Schneider EJ, Lannin NA, Ada L, et al. Increasing the amount of usual rehabilitation improves activity after stroke: a systematic review. *J Physiother* 2016;62:182-187. <https://doi.org/10.1016/j.jphys.2016.08.006>.
- Wang H, Camicia M, Terdiman J, et al. Daily treatment time and functional gains of stroke patients during inpatient rehabilitation. *PMR* 2013;5:122-128. <https://doi.org/10.1016/j.pmrj.2012.08.013>.
- Jette DU, Warren RL, Wirtalla C. The relation between therapy intensity and outcomes of rehabilitation in skilled nursing facilities. *Arch Phys Med Rehabil* 2005;86:373-379. <https://doi.org/10.1016/j.apmr.2004.10.018>.
- Austin PC. An introduction to propensity score methods for reducing the effects of confounding in observational studies. *Multivariate Behav Res* 2011;46:399-424. <https://doi.org/10.1080/00273171.2011.568786>.
- Bhogal SK, Teasell R, Speechley M. Intensity of aphasia therapy, impact on recovery. *Stroke* 2003;34:987-992. <https://doi.org/10.1161/01.STR.0000062343.64383.D0>.
- Kwakkel G, Van Peppen R, Wagenaar RC, et al. Effects of augmented exercise therapy time after stroke: a meta-analysis. *Stroke* 2004;35(11):2529-2536. <https://doi.org/10.1161/01.STR.0000143153.76460.7d>.
- Intercollegiate Stroke Working Party. National clinical guideline for stroke, 5th edn. London: Royal College of Physicians; 2016.
- National Stroke Foundation. Clinical guidelines for stroke management. National Stroke Foundation; 2017 <https://informme.org.au/Guidelines/Clinical-Guidelines-for-Stroke-Management-2017> (last accessed June 19, 2019). Published 2017.
- Miller EL, Murray L, Richards L, et al. Comprehensive overview of nursing and interdisciplinary rehabilitation care of the stroke patient: a scientific statement from the American heart association. *Stroke* 2010;41:2402-2448. <https://doi.org/10.1161/STR.0b013e3181e7512b>.
- Raj G, Munir J, Ball L, et al. An inpatient rehabilitation service for deconditioned older adults. *Top Geriatr Rehabil* 2007;23:126-136. <https://doi.org/10.1097/01.TGR.0000270181.06027.7d>.
- O'Brien SR, Zhang N. Association between therapy intensity and discharge outcomes in aged medicare skilled nursing facilities admissions. *Arch Phys Med Rehabil* 2018;99:107-115. <https://doi.org/10.1016/j.apmr.2017.07.012>.
- Jette DU, Warren RL, Wirtalla C. Rehabilitation in skilled nursing facilities: effect of nursing staff level and therapy intensity on outcomes. *Am J Phys Med Rehabil* 2004;83:704-712. <https://doi.org/10.1097/01.PHM.0000137312.06545.D0>.
- Wodchis WP, Teare GF, Naglie G, et al. Skilled nursing facility rehabilitation and discharge to home after stroke. *Arch Phys Med Rehabil* 2005;86:442-448. <https://doi.org/10.1016/j.apmr.2004.06.067>.
- Pocock SJ, Elbourne DR. Randomized trials or observational tribulations? *N Engl J Med* 2000;342:1907-1909. <https://doi.org/10.1056/nejm200006223422511>.
- Concato J, Shah N, Horwitz RI. Randomized, controlled trials, observational studies, and the hierarchy of research designs. *N Engl J Med* 2000;342:1887-1892. <https://doi.org/10.1056/NEJM200006223422507>.
- Benson K, Hartz AJ. A comparison of observational studies and randomized, controlled trials. *N Engl J Med* 2000;342:1878-1886. <https://doi.org/10.1056/NEJM200006223422506>.