The Relation Between Therapy Intensity and Outcomes of Rehabilitation in Skilled Nursing Facilities

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Objective: To examine the relation between therapy intensity, including physical therapy (PT), occupational therapy (OT), and speech and language therapy (SLT), provided in a skilled nursing facility (SNF) setting and patients' outcomes as measured by length of stay (LOS) and stage of functional independence as measured by the FIM instrument.

Design: A retrospective analysis of secondary data from an administrative dataset compiled and owned by SeniorMetrix Inc.

Setting: Seventy SNFs under contract with SeniorMetrix health plan clients.

Participants: Patients with stroke, orthopedic conditions, and cardiovascular and pulmonary conditions (N=4988) covered by Medicare+Choice plans, and admitted to an SNF in 2002.

Interventions: Not applicable.

Main Outcomes Measures: LOS and improvement in stage of independence in the mobility, activities of daily living (ADLs), and executive control domains of function as determined by the FIM instrument.

Results: Higher therapy intensity was associated with shorter LOS ($P<.05$). Higher PT and OT intensities were associated with greater odds of improving by at least 1 stage in mobility and ADL functional independence across each condition ($P<.05$). The OT intensity was associated with an improved executive control stage for patients with stroke, and PT and OT intensities were associated with improved executive control stage for patients with cardiovascular and pulmonary conditions ($P<.05$). The SLT intensity was associated with improved motor and executive control functional stages for patients with stroke ($P<.05$). Therapy intensities accounted for small proportions of model variances in all outcomes.

Conclusions: Higher therapy intensity was associated with better outcomes as they relate to LOS and functional improvement for patients who have stroke, orthopedic conditions, and cardiovascular and pulmonary conditions and are receiving rehabilitation in the SNF setting.

Key Words: Occupational therapy; Physical therapy; Rehabilitation; Skilled nursing facilities; Speech therapy.

COMMON GOALS OF REHABILITATION are to decrease individuals' impairments and to improve their functioning in mobility, activities of daily living (ADLs), and/or cognition. Physical therapy (PT), occupational therapy (OT), and speech and language therapies (SLT) play a role in providing services that address those goals. Over the past decade, with Medicare's shift to a prospective payment system (PPS) for skilled nursing facilities (SNFs) and encouragement of incentives for health maintenance organizations (HMOs) to provide care under contract with Medicare (Medicare+Choice), there has been a decrease in the duration and intensity of therapy provided to patients in SNFs.[1]

Although patients in SNF settings must receive daily rehabilitative services such as PT, OT, or SLT, no time requirement for that therapy is imposed.[2] Because there is no time requirement, decisions about how much therapy to provide and how long a patient stays in an SNF are largely determined by the health care professionals in the institution. These decisions are based not only on patients' rehabilitation needs, but also on reimbursement. Given cost constraints, a need exists to understand the dosage or intensity of therapy that is associated with outcomes, such as cost and function, that are relevant to both providers and patients.

In 1997, Keith[3] proposed that examination of treatment specifications, including intensity, was central to understanding rehabilitation outcomes. Reports since that time, and before, on the relation between therapy intensity in rehabilitation settings and patients' outcomes are few and are not entirely consistent in their findings. Chen et al[4] found that, for patients treated in the subacute rehabilitation setting, the relation between therapy intensity and improvement in function as measured by scores on the FIM instrument differed depending on patients' medical conditions and the FIM domain examined. Regardless of the medical condition, however, therapy intensity (total 15-min units of therapy divided by the length of stay [LOS]) was related to improvements in cognition but not to improvements in mobility. Additionally, for patients receiving SLT, intensity of SLT was not related to cognitive gains. Alternatively, Kirk-Sanchez and Roach[5] found that, for patients with orthopedic conditions, total hours of PT and OT, controlled for LOS, predicted FIM mobility scores at discharge from an acute rehabilitation setting. Chiodo et al[6] found that patients in nursing homes who received more than a minimal amount of PT (ie, at least once weekly or duration >4wk) were more likely to have improvement in strength, endurance, or ADLs than those patients with less therapy. In a randomized controlled trial examining the effect of therapy intensity on impairments and function in patients with stroke, Kwakkel et al[7] found that patients who received more therapy improved to a greater extent than those who received less. In studies in which patients' outcomes have varied by reimbursement type[8] or rehabilitation setting,[9,10] the variations have been partly attributed to differences in therapy intensity. In other studies, however, a relation between therapy intensity and outcomes has not been demonstrated for patients receiving rehabilitation for traumatic brain injury (TBI),[11,12] spinal cord injury (SCI),[11,12] or stroke.[12-14]

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The studies cited above not only provide conflicting results, but also exhibit some limitations. For example, although many were published at later dates, they used data from periods prior to the Congressional Balanced Budget Amendment of 1997 (BBA).[4-6,11,12,15] Some of the studies relied on data from patients in comprehensive acute rehabilitation settings,[5,7] some did not fully control for comorbid illnesses,[11,12] some examined outcomes as they relate to only 1 type of medical condition,[7,13,15] or did not use actual therapy time.[4,14] Recent changes in the health care system (including the BBA), incentives for HMOs to provide care under contract with Medicare, increasing acuity of patients discharged from acute care settings, and shorter rehabilitation LOSs suggest that previous findings may not be able to be extrapolated to the current environment.

Given the need for clinicians and payers to make evidence-based decisions about provision of therapies and rehabilitation LOS, the purpose of this study was to examine the relation between the intensity of PT, OT, and SLT provided in the SNF setting and outcomes as measured by LOS and changes in patients' functional independence.

METHODS

Design

This study is a secondary data analysis using data from an administrative dataset compiled and owned by SeniorMetrix Inc, Nashville, TN. The company is privately held and has contracts with health plans to assist them to improve the delivery of rehabilitation services in SNFs for patients covered under Medicare+Choice reimbursement plans. Medicare+Choice is a plan that allows Medicare beneficiaries to choose among HMOs, provider-sponsored organizations, and other fee-for-service (FFS) plans that provide care under contract to Medicare. Under that program, HMOs contract with Medicare to provide the full range of Medicare benefits in return for monthly per-person payment rates. Managed care organizations (MCOs) providing Medicare+Choice programs must provide, at a minimum, the same skilled services and coverage to patients in SNFs as outlined in the federal Medicare program. They do have the choice, however, to add other benefits. As of June 2002, of nearly 40 million Americans enrolled in Medicare, 13% had chosen to be in a Medicare+Choice managed care plan.[16] Over 400,000 of the Medicare+Choice population are under care by providers contracting with SeniorMetrix health plan clients. This study was approved by the Institutional Review Board of Boston University.

Sample

The sample was derived from 9357 patients covered by Medicare+Choice plans who were admitted for short-term rehabilitation for the first time in 1 of 70 SNFs that were associated with SeniorMetrix in 2002. All facilities were in urban areas and all but 3 were located in nursing home–based, free-standing SNFs. Thirty-eight sites were in the northern Pacific region of the United States, 17 were located in the southern Pacific region, 11 were in the mountain region, and 4 were in the mid-Atlantic region.

We excluded 1064 patients who died during their SNF stay or who were admitted to an acute care facility from the SNF because, in our opinion, these patients likely had acute medical conditions that would affect their ability to engage in therapies. We also excluded cases with negative values indicating time from onset of the impairment to admission to SNF, cases with episode lengths of more than 100 days, and cases with an average of more than 4 hours a day of any 1 of the types of therapy. We then selected patients with stroke (n=993); orthopedic conditions, amputation, or arthritis (n=2896); and cardiovascular and pulmonary conditions (n=1099) based on the Uniform Data Set for Medical Rehabilitation impairment codes contained within the dataset. We grouped patients with orthopedic conditions, amputation, and arthritis into 1 group because, in our opinion, these conditions reflect impairments in the musculoskeletal system and are likely to result in limitations in locomotion (table 1).

Procedure

Data were collected for all patients regarding demographic, episode and disease characteristics, and functional status at the patient's rehabilitation admission and discharge. Data that characterized episode characteristics included time from onset of health condition to admission to the SNF ($\leq$1wk vs $>$1wk), time from admission to the SNF to the initiation of therapy ($\leq$1d vs $>$1d), and the SNF LOS in days. Disease data included a medical complexity score and condition for which the patient was admitted. The medical complexity score was based on clinicians' evaluation of the patient's medical conditions and whether the conditions were active or limited function. The scale is scored from 0 to 5, with 0 being no disease other than the primary condition and 5 being moribund. Concurrent validity of the scale is suggested, albeit weakly, by the fact that in patients with stroke, function-related group[17] was negatively related to medical complexity score (Spearman $\rho=-.23$, $P<.001$). Reliability has not been formally tested; however, each clinician collecting data was trained and credentialed by SeniorMetrix in determining the medical complexity score.

Functional status data included FIM scores on admission and discharge. Clinicians were trained and credentialed by SeniorMetrix in administering the FIM. The FIM is a measure of function in 13 motor areas and 5 cognitive areas. There are 18 items, each rated on a 7-level scale. Each item is scored according to how much assistance is required for performance of an activity, with a score of 1 equated with total dependence and 7 equated with total independence. The instrument has good internal consistency reliability (Cronbach $\alpha>.90$ for admission and discharge total FIM), temporal responsiveness, and interrater reliability (intraclass correlation coefficient $>.90$).[18] The validity of the FIM has been supported by its ability to discriminate among patients on the basis of age and comorbid status, and among patients with different levels of SCI and amputation level. Discharge destination is also related to discharge FIM score.[19]

Dependent measures. Dependent variables included LOS in days and whether a patient improved at least 1 stage of independence in the mobility, the ADL, or the executive control domains of function as defined by Stineman et al.[20]

Stineman et al[21,22] described 7 functional independence stages across 4 domains. The domains include ADL (eating, grooming, bathing, dressing upper body, dressing lower body, toileting), sphincter management (bladder management, bowel management), mobility (bed, chair, wheelchair transfer, toilet transfer, tub or shower transfer, walking or wheelchair mobility), and executive control (comprehension, expression, social interaction, problem-solving, memory). Each stage is based on FIM item scores and approximates the average amount of assistance needed by the patient and the amount of effort required by the patient. For example, stage 4 in any domain indicates a minimal amount of assistance from another person and an effort of 75% on the part of the patient. A patient must receive a designated minimum score on each item in the

Table 1: Patient Characteristics by Condition

Characteristic	Stroke (n=993)	Orthopedic (n=2896)	Cardiovascular and Pulmonary (n=1099)
Mean age (95% CI) (y)	74.5 (73.9–75.2)	76.5 (76.1–77.0)	78.5 (77.9–79.1)
Male, n (%)	431 (43.4)	871 (30.1)	476 (43.3)
White, non-Hispanic, n (%)	729 (73.4)	2519 (87.0)	963 (87.6)
Living in community before event, n (%)	965 (97.2)	2816 (97.2)	1046 (95.2)
Complexity, n (%)			
No other disease	9 (.9)	59 (2.0)	1 (.1)
Inactive or irrelevant disease	27 (2.7)	116 (4.0)	3 (.3)
Active but not limiting disease	211 (21.2)	586 (20.2)	86 (7.8)
Active and limiting disease	502 (50.6)	1502 (51.9)	594 (54.0)
Active and severely limiting disease	236 (23.8)	606 (20.9)	392 (35.7)
Moribund	8 (.8)	27 (.9)	23 (2.1)
≤1wk from onset to SNF admission, n (%)	781 (78.7)	2416 (83.4)	659 (60.0)
Mean total admission FIM score (95% CI)	56.2 (54.9–57.5)	69.2 (68.6–69.8)	66.4 (65.3–67.6)
≤1d from admission to start of therapy, n (%)	890 (89.6)	2544 (87.8)	968 (88.1)
Median LOS (interquartile range)	17.0 (14.0)	13.0 (8.0)	12.0 (9.0)
PT intensity,* n (%)			
None	11 (1.1)	13 (.9)	12 (1)
>0 and <.25	53 (5.3)	88 (3.0)	80 (7.3)
.25–.50	316 (31.8)	822 (28.4)	374 (34.0)
.51–.75	429 (43.2)	1324 (45.7)	441 (40.1)
>.75	184 (18.5)	649 (22.4)	192 (17.5)
OT intensity,* n (%)			
None	62 (6.2)	370 (12.8)	240 (21.9)
>0 and <.25	109 (11.0)	356 (12.3)	140 (12.7)
.25–.50	369 (37.2)	356 (35.7)	367 (33.4)
.51–.75	370 (37.3)	943 (32.6)	295 (26.8)
>.75	83 (8.4)	192 (6.6)	57 (5.2)
SLT intensity,* n (%)			
None	384 (38.7)	2777 (95.9)	908 (82.6)
>0 and <.25	174 (17.5)	69 (2.4)	76 (6.9)
.25–.50	281 (28.3)	40 (1.4)	89 (8.1)
.51–.75	118 (11.9)	9 (.3)	24 (2.2)
>.75	36 (3.6)	1 (.03)	2 (.2)

Abbreviation: CI, confidence interval.
*Total hours of therapy divided by LOS in days

domain to be classified at a particular stage. The sensitivity to change as well as the construct and predictive validity of applying functional independence stages to patients in the acute rehabilitation setting have been reported.[22]

We used improvement in stage of functional independence and LOS as outcome measures because they are likely to be affected by therapy interventions that have meaning for patients, caregivers, providers, and payers, and may suggest the amount of health services to be used in the future.[23,24] We did not examine improvement in the sphincter management domain because, in our opinion, PT, OT, and SLT interventions do not focus on this domain.

Independent measures. Independent measures of interest consisted of the intensities of each type of therapy that the patient received. We defined intensity as the average hours of therapy provided per day across the entire SNF LOS. Treating clinicians recorded data on therapy time for each patient through daily treatment logs. The time recorded included only time for evaluation or treatment of patients, and excluded documentation or meeting time. The variables representing therapy intensity were categorized to allow determination of odds ratios (ORs) to assist in their interpretation, and because, practically speaking, most therapy treatment sessions are scheduled in quarter hour increments.

Data Analysis

Descriptive statistics were used to describe the characteristics of the patients across each of the 3 conditions. To determine whether LOS, a proxy for cost, was related to therapy intensity, we examined the LOS across each level of therapy intensity for each condition, using the intensity of all relevant therapies added together. For example, for patients with stroke we added the total PT, OT, and SLT hours and divided that sum by the LOS (in days). Because very few patients with orthopedic or cardiovascular and pulmonary problems received SLT, for patients with those conditions, we added the total PT and OT hours only and divided by the LOS. Patients did not need to receive all therapies to be included in these analyses. We categorized total therapy intensity into 3 groups: less than 1 hour a day, 1 to 1.5 hours a day, and more than 1.5 hours a day. We used general linear models, controlled for facility; demographic variables, including patient's age, sex, and ethnicity (white, non-Hispanic vs other); and variables that the literature suggests might be confounding or necessary to adjust for case mix, including medical complexity,[10,25] LOS (natural log transformation),[4,9,11,25] length of time from onset to SNF admission (>1wk vs ≤1wk), living setting before admission (community vs other), length of time from SNF admission to

Table 2: Therapy Intensity and LOS*

Total Therapy Intensity†	Stroke LOS‡	Orthopedic LOS‡	Cardiovascular and Pulmonary LOS‡
<1	21.4 (19.7–23.3)	14.9 (14.3–15.6)	14.0 (13.1–15.0)
1–1.5	16.9 (15.7–18.1)	12.4 (11.9–12.9)	11.9 (10.9–12.9)
>1.5	15.5 (14.2–16.9)	10.8 (10.1–11.6)	9.5 (8.3–11.0)

NOTE. Values are mean (95% CI).
*General linear model controlled for patient's age, sex, ethnicity, living situation before admission, medical condition, medical complexity, days from onset to admission, days from admission to start of therapy, admission FIM score, and facility. The dependent variable was the natural log of LOS; means have been converted.
†Total hours of therapy divided by LOS in days; stroke includes hours for PT, OT, and SLT; orthopedic and cardiovascular and pulmonary conditions include hours for PT and OT only.
‡If the CI does not include the mean in the cells above it; the means differ ($P<.05$).

start of any therapy (0–1d vs >1d),[4,9,11,26,27] and admission FIM score.[4,9,11,26] Due to its skewed distribution, LOS was transformed for the analysis, using natural logarithm. Adjusted means for LOS and confidence intervals (CIs) were determined for levels of therapy intensity.

To determine whether therapy intensity was related to change in functional stage, we used separate logistic regression models within each condition, to examine the relation between intensity of each therapy and change in functional stage, controlling for the same potentially confounding variables as well as whether the patient received another type of therapy (PT, OT, SLT) in addition to the therapy being examined. Only data from patients receiving a particular therapy were included in the model examining the relation between the intensity of that therapy and the outcome. Because so few patients with orthopedic or cardiovascular and pulmonary conditions received SLT, we examined only the relation between the intensity of SLT and outcomes in patients with stroke. Further, each analysis included only those patients who had room for improvement in the domain under consideration; that is, they were not in stage 7 of functional independence for that domain. We calculated intensity by dividing the total hours of each therapy by the LOS in days. Four categories of intensity were determined: (1) more than 0 and less than .25 hours a day, (2) .25 to .50 hours a day, (3) .51 to .75 hours a day, and (4) more than .75 hours a day. ORs and 95% CIs were determined for each level of therapy intensity, with the lowest intensity as the reference category. Use of a reference category, against which all other levels of a variable are tested, is consistent with the conventional application of logistic regression. This approach enabled us to estimate ORs for each level of a variable relative to that of the same referent group, and aided in interpretation of the ORs for each level of the independent variable.[28(p48-52)]

RESULTS

Length of Stay

The mean adjusted LOS was shorter for each increasing level of therapy intensity for patients with each condition (table 2). For patients with stroke, LOS was 21.4, 16.9, and 15.5 days, respectively, for patients receiving on average less than 1 hour, 1 to 1.5 hours, and more than 1.5 hours of therapy a day for all therapies combined across the total SNF stay. The LOS differed between patients receiving less than 1 hour of therapy per day and the other 2 levels of therapy intensity ($P<.001$) for patients with stroke. There was no difference in LOS between patients receiving 1 to 1.5 hours of therapy a day and those receiving more than 1.5 hours a day ($P=.07$). For patients with orthopedic conditions, the LOS values were 14.9, 12.4, and 10.8 days for each level of intensity, respectively. LOS differed significantly across all levels of intensity ($P<.001$). For patients with cardiovascular and pulmonary conditions, the LOS was 14.0, 11.9, and 9.5 days for each level of therapy intensity, respectively. LOS values differed significantly across all levels of intensity ($P<.01$)

Functional Independence

The proportion of patients improving in functional independence stage varied by functional domain and condition. The majority of patients improved at least 1 stage in the mobility and ADL domains (68% and 78%, respectively). The majority of patients remained at the same stage for executive control (54%).

Overall, the independent variables in the models explaining change in functional independence stage accounted for 21% to 38% of the variance. Across all conditions, the variation in outcomes explained by adding the therapy intensity variables to the models was small, ranging from less than 1.0% to 13.5%.

Mobility domain. ORs and their CIs for the relation between therapy intensity and change in functional independence in the mobility domain are provided in table 3.

For patients with all types of conditions, the odds of improving at least 1 stage in mobility functional independence were greater for each increasing level of PT intensity and OT intensity above the reference level. Intensity of SLT up to an average of .75 hours a day was associated with improvement in functional independence in mobility for patients with stroke.

ADL domain. ORs and their CIs for the relation between therapy intensity and improvement in functional independence in the ADL domain are provided in table 4.

For patients with all types of conditions, the odds of improving at least 1 stage in ADL functional independence were greater for each increasing level of PT intensity and OT intensity above the reference level. The intensity of SLT was not associated with improvement in functional independence in ADL for patients with stroke.

Executive control domain. ORs and their CIs for the relation between therapy intensity and improvement in functional independence in the executive control domain are provided in table 5.

The odds of improving at least 1 stage in functional independence in the executive control domain were greater with increasing intensity of PT for patients with cardiovascular and pulmonary conditions, and with increasing intensity of OT for patients with stroke. Only the highest level of intensity of SLT was associated with improvement in functional independence in executive control for patients with stroke.

DISCUSSION

Our analyses support a premise that higher intensities of therapy can yield greater gains in functional independence with shorter LOS. These findings have important implications for delivering cost-effective care.

Table 3: Therapy Intensity* and Odds of Improving Functional Independence in Mobility†

Therapy	.25–.50 Hours a Day‡	.51–.75 Hours a Day‡	>.75 Hours a Day‡
PT			
Stroke (n=977; R^2=.34)	**3.36 (1.48–7.64)**	**8.27 (3.52–19.39)**	**8.09 (2.95–22.22)**
Orthopedic (n=2869; R^2=.29)	**6.88 (3.93–12.05)**	**11.07 (6.25–19.59)**	**20.36 (10.65–38.93)**
Cardiovascular and pulmonary (n=1083; R^2=.34)	**8.49 (4.27–16.89)**	**18.03 (8.73–37.22)**	**23.50 (9.73–56.77)**
OT			
Stroke (n=927; R^2=.34)	**2.20 (1.24–3.91)**	**3.92 (2.04–7.51)**	**4.75 (1.79–12.60)**
Orthopedic (n=2514; R^2=.24)	**1.98 (1.42–2.77)**	**2.90 (1.95–4.32)**	**4.54 (2.45–8.42)**
Cardiovascular and pulmonary (n=857; R^2=.32)	**2.11 (1.26–3.55)**	**4.01 (2.15–7.45)**	**4.96 (1.88–13.03)**
SLT			
Stroke (n=606; R^2=.38)	**2.08 (1.18–3.69)**	**3.67 (1.64–8.22)**	3.12 (0.94–10.29)

NOTE. Values are OR (95% CI).
*Total hours of therapy divided by LOS in days.
†Logistic regression model controlled for facility, age, sex, ethnicity, medical complexity, days from onset to admission, days from admission to start of therapy, having another therapy, admission FIM score, and log LOS. Patients were included only if they received a particular therapy and were at stage 6 or less for a given domain at admission.
‡Boldface ORs and CIs indicate significance at $P<.05$. The referent category is >0 and <.25 hours a day.

Length of Stay

LOS was lower for each increasing level of total therapy intensity in our sample. Our findings differed somewhat from those of Johnston et al[12] who found that direct therapy staff (PT plus OT) per patient day correlated positively with LOS. Our findings also differ from those of Brosseau et al[14] who found that the intensity of rehabilitation did not play a role in predicting LOS. Neither study, however, measured therapy time directly. The relation between reduced LOS and therapy intensities is important, because most SNFs providing care to patients under Medicare+Choice receive a per diem payment for each patient from the health plan. This method of payment provides the incentive for longer LOS with less therapy time each day, that is, low therapy intensity. A similar incentive exists under the Medicare PPS. Our findings suggest that this approach to providing rehabilitation may not result in the best outcomes for patients and may be associated with increased costs to payers.

Functional Independence

Mobility domain. Improvement in mobility is an important goal for patients and decreases their reliance on caregivers. Our findings show that the intensities of PT and OT are related to improvement in functional independence in the mobility domain for patients with stroke, orthopedic conditions, and cardiovascular and pulmonary conditions. Additionally, intensity of SLT is related to change in mobility functional independence for patients with stroke. Contrary to our findings, Chen et al[4] found that gains in the FIM mobility score were not predicted by total daily units of therapy. Their model, however, combined factors (PT + OT + SLT) and they used change in FIM score as their outcome of interest. Heinemann et al[11] also found no significant relations between average units per day of PT, OT, or SLT and motor discharge FIM or motor FIM gain. Heinemann, however, examined patients with SCI and TBI, 2 groups that were not included in our dataset. Similar to our findings, Kirk-Sanchez and Roach[5] found that increased intensity of PT and OT combined in patients with orthopedic conditions was associated with FIM mobility score at discharge, and Johnston[12] found a small relation between motor FIM gain and total direct therapy staff per patient day. In our data, PT and OT intensities were correlated (Spearman ρ=.45); however, each model examined the contribution of each therapy, controlling for the intensity of the other therapies provided.

Although gains in functional independence in mobility might be expected to be related to PT and OT intensities, our finding that improvements are also related to intensity of SLT are somewhat surprising. We did not find high correlations between the intensity of PT and SLT (ρ=.04) or the intensity of

Table 4: Therapy Intensity* and Odds of Improving Functional Independence in ADL†

Therapy	.25–.50 Hours a Day‡	.51–.75 Hours a Day‡	>.75 Hours a Day‡
PT			
Stroke (n=974; R^2=.29)	**3.60 (1.59–8.14)**	**10.14 (4.36–23.60)**	**14.18 (5.17–38.89)**
Orthopedic (n=2865; R^2=.33)	**6.78 (3.79–12.12)**	**13.99 (7.70–25.44)**	**20.34 (10.32–40.08)**
Cardiovascular and pulmonary (n=1080; R^2=.33)	**4.45 (2.296–8.64)**	**7.55 (3.77–15.13)**	**9.14 (3.93–21.22)**
OT			
Stroke (n=925; R^2=.28)	**3.16 (1.79–5.60)**	**9.41 (4.83–18.33)**	**18.29 (6.54–51.16)**
Orthopedic (n=2512; R^2=.21)	**2.75 (1.90–3.98)**	**5.45 (3.49–8.50)**	**4.05 (2.13–7.72)**
Cardiovascular and pulmonary (n=855; R^2=.30)	**2.65 (1.51–4.64)**	**4.88 (2.52–9.44)**	**7.79 (2.79–21.74)**
SLT			
Stroke (n=603; R^2=.31)	1.58 (0.91–2.73)	1.53 (0.72–3.24)	2.41 (0.77–7.56)

NOTE. Values are OR (95% CI).
*Total hours of therapy divided by LOS in days.
†Logistic regression model controlled for facility, age, sex, ethnicity, medical complexity, days from onset to admission, days from admission to start of therapy, having another therapy, admission FIM score, and log LOS. Patients were included only if they received a particular therapy and were at stage 6 or less for a given domain at admission.
‡Boldface ORs and CIs indicate significance at $P<.05$. The referent category is >0 and <.25 hours a day.

Table 5: Therapy Intensity* and Odds of Improving Functional Independence in Executive Control†

Therapy	.25–.50 Hours a Day‡	.51–.75 Hours a Day‡	>.75 Hours a Day‡
PT			
Stroke (n=881; R^2=.23)	2.12 (0.97–4.63)	**2.62 (1.19–5.77)**	2.49 (0.99–6.24)
Orthopedic (n=1819; R^2=.21)	1.39 (0.70–2.77)	1.63 (0.80–3.30)	2.03 (0.94–4.39)
Cardiovascular and pulmonary (n=849; R^2=.28)	**2.98 (1.32–6.71)**	**3.95 (1.72–9.05)**	**5.66 (2.13–15.01)**
OT			
Stroke (n=838; R^2=.25)	**3.13 (1.74–5.63)**	**3.67 (1.93–6.97)**	**4.14 (1.74–9.88)**
Orthopedic (n=1600; R^2=.21)	1.27 (0.82–1.95)	1.55 (0.96–2.51)	1.61 (0.86–3.03)
Cardiovascular and pulmonary (n=682; R^2=.31)	1.64 (0.85–3.18)	**2.78 (1.32–5.85)**	**2.86 (1.03–7.92)**
SLT			
Stroke (n=569; R^2=.30)	1.21 (0.71–2.08)	1.79 (0.88–3.66)	**3.70 (1.33–10.26)**

NOTE. Values are OR (95% CI).
*Total hours of therapy divided by LOS in days.
†Logistic regression model controlled for facility, age, sex, ethnicity, medical complexity, days from onset to admission, days from admission to start of therapy, having another therapy, admission FIM score, and log LOS. Patients were included only if they received a particular therapy and were at stage 6 or less for a given domain at admission.
‡Boldface ORs and CIs indicate significance at $P<.05$. The referent category is >0 and <.25 hours a day.

OT and SLT ($\rho=-.01$). Improvements in mobility may accompany small improvements in executive control that are accomplished through SLT, and for which the functional independence staging system is not a sensitive measure.

ADL domain. Our findings suggest that increases in both PT and OT intensity contribute to the likelihood that patients with stroke, orthopedic conditions, and cardiovascular and pulmonary conditions will improve in functional independence for ADLs. Similarly, a meta-analysis examining the effects of rehabilitation intensity on stroke outcomes, conducted by Kwakkel et al,[29] supported small improvements in ADLs (Barthel Index) as a result of more intense rehabilitation. Across the studies they examined, the experimental group received on average 48.4 minutes of PT and 44 minutes of OT daily; whereas the control group received 23.4 minutes of PT and 18.5 minutes of OT daily. The studies by Chen[4] and Kirk-Sanchez and Roach[5] also support this finding.

Executive control domain. Our findings suggest that increased intensity of PT is associated with the likelihood that patients with cardiovascular and pulmonary conditions will improve in functional independence in the executive control domain. OT intensity was positively associated with improvements in this domain for patients with stroke. Only the highest intensity of SLT was associated with improvement in executive control for patients with stroke. The FIM items contributing to the executive control domain include items that one might associate with interventions provided by occupational and speech therapists rather than physical therapists for many patients. Similar to the influence of SLT on mobility noted above, patients may benefit from various types of stimulation to the executive functions, including interactions with physical therapists. Our findings are supported by those of Chen[4] and Johnston[12] and colleagues.

The fact that only the highest intensity of SLT was associated with gains in executive control for stroke may be explained by the fact that patients receiving SLT have lower admission FIM scores and less change in FIM scores than do patients without SLT (data not shown), suggesting that SLT is provided to the most disabled patients who may need high levels of therapy to show meaningful improvement in function. Similarly, Chen[4] found that SLT intensity alone was not associated with FIM gain.

Despite the statistical relation between outcome variables and therapy intensity found in this study, therapy intensity contributed very little to the variability in outcomes. Moreover, the complete models predicted only moderate amounts of the variability in outcomes. Similarly, Keith et al[9] reported that total hours a day of all therapies combined accounted for only approximately 10% of the variance in discharge FIM score. Given that the process of care is likely an intermediary between therapy intensity and outcome,[30] one might not expect strong direct relations between them. Variables such as use of clinical guidelines or specific therapeutic interventions are likely to have an effect on the patient outcomes that we measured. Additionally, Reker et al[15] demonstrated the effect of variables on outcomes of patients with stroke that we did not measure, including staff diversity, availability of comprehensive services, and therapist availability for team rounds. On the patient level, specific impairments (eg, balance, strength, endurance),[14] coping skills, depression, and locus of control[31] are likely to contribute to patients' functional outcomes and LOS.

The limitations of the present study also include the use of secondary data. The major purpose for generating these data was to inform clinical and utilization management decision making, and using them for modeling outcomes requires cautious interpretation. The limits of external validity must also be considered. The study sample consisted only of patients covered under Medicare+Choice for their SNF stay. The patients appeared to have basic demographic characteristics similar to a large national sample of patients treated in SNFs in 1998[32]; however, the patients in the national sample were more functional at admission (mean FIM score, 74.8) and had longer LOS (mean, 19d) than our sample, perhaps reflecting general trends for patients to be discharged from both acute care and rehabilitation settings more quickly. There are reports that patients covered in Medicare MCOs receive less therapy,[8,33] have smaller changes in function,[8] have shorter LOS,[8,33] and are less likely to be discharged to the community[8] than patients reimbursed under FFS. The data on which this study's results are based were derived from Medicare+Choice providers who were under agreement with SeniorMetrix. The role of the company was to assist health practitioners in the SNFs in analyzing patients' functional and medical conditions and measuring patients' progress to make timely and effective decisions about moving patients to community-based settings. As a result, the utilization patterns seen in this study might demonstrate a lower LOS than that found on average under PPS and a greater number of therapy hours per day than average for patients covered by Medicare+Choice. Further, the SNFs represented in the study sample are from only 4 regions of the United States and intensity of therapy provided in those SNFs may reflect local market tendencies.

Future avenues of research suggested by this study include examination of the relation between therapy intensity and other

rehabilitation outcomes, such as discharge setting. Another possible avenue of future research includes clinical trials to examine the effect of therapy intensity on outcomes such as those measured here. This avenue of research has been accomplished in patients with stroke.[7]

CONCLUSIONS

Therapy intensity is related to shorter LOS and to improvements in patients' functional independence. In general, LOS is shorter for each level of increasing total therapy intensity across all conditions. This finding has important implications for the total cost of rehabilitative care. In general, better outcomes in the mobility domain of function are associated with increased intensity of PT, OT, and SLT. Better outcomes in the ADL domain of function are associated with the intensities of both PT and OT. Better outcomes in the executive control domain are associated with increased intensity of PT for patients with cardiovascular and pulmonary conditions and with OT and SLT intensity for patients with stroke. These findings suggest the importance of adequate intensity of therapies in attaining outcomes that are important to patients as well as providers and payers.

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