Research Article

Timing and Intensity of Rehabilitation Services During Acute Stroke Hospitalization: Impacts on Functional Recovery and Community Discharge

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Importance: Improving functional recovery and supporting safe discharge pathways after stroke are key priorities in acute care, yet the delivery of rehabilitation services during hospitalization remains poorly understood.

Objective: To examine the associations between rehabilitation service delivery factors and two outcomes, functional status at discharge and community discharge.

Design: Retrospective observational study using electronic medical record (EMR) data (2018–2021). Regression analyses were stratified by occupational therapy (OT) and physical therapy (PT) cohorts.

Setting: Thirteen-hospital health system in Colorado.

Participants: Adults hospitalized with ischemic stroke who received occupational therapy ($n = 713$) or physical therapy ($n = 979$).

Outcomes and Measures: Primary outcomes were (1) discharge function using Activity Measure for Post-Acute Care "6-Clicks" scores and (2) community discharge (yes or no). Independent variables included time to evaluation, time to treatment, and daily therapy intensity.

Results: Among OT recipients, each additional day of delay between evaluation and the first therapy session was associated with lower odds of community discharge (odds ratio [OR] = 0.927, $p = .032$) whereas greater therapy intensity was associated with higher odds (OR = 1.396, $p = .034$). These same factors were also associated with higher discharge function ($p < .05$). In the PT model, earlier evaluation was significantly associated with improved discharge mobility ($p = .006$), although no other therapy factors were significant.

Conclusions and Relevance: Findings suggest that timely and intensive OT services during acute hospitalization may improve functional outcomes and increase community discharge rates. EMR-derived therapy metrics provide clinically relevant insight and may inform hospital-based rehabilitation strategies.

Plain-Language Summary: This study looked at how early and intensive occupational therapy during a hospital stay for stroke affects a person's ability to function and return home. Using hospital records from more than 1,600 patients, the study found that patients who received earlier and more intense OT were more likely to regain independence and go home rather than to a facility. These results suggest that not just receiving therapy but how and when it is delivered plays a big role in recovery. This could help hospitals better support patients during stroke recovery.

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Optimizing recovery during acute hospitalization, defined as the period of immediate medical care delivered in a hospital setting after a health event, is critical for improving function and facilitating safe community discharges for individuals hospitalized after stroke. Functional status during acute hospitalization is a strong predictor of poststroke outcomes, including quality of life and psychological recovery (Roberts et al., 2016; Thorpe et al., 2018; Yao et al., 2023). Improving functional independence at discharge is a central aim of rehabilitation, because lower functional status is associated with higher rates of noncommunity discharge

(Bowles et al., 2019; Hoyer et al., 2019; Jette et al., 2014). However, despite its importance, many acute care hospitals lack clear benchmarks or strategies to support functional improvement within increasingly shorter lengths of stay (Siddique et al., 2021).

Discharge directly to the community has been linked to reduced medical complications, lower emergency department utilization, and fewer hospital readmissions, underscoring the importance of maximizing rehabilitation gains early in the continuum of care (Burke et al., 2020; Keswani et al., 2016; Leroux et al., 2020). These goals align with national health care priorities emphasizing patient-centered recovery, home-based care, and cost containment through models such as accountable care organizations and bundled payments (Chandra et al., 2013; McWilliams et al., 2017). Reflecting this shift, U.S. News & World Report now includes community discharge, alongside survival, as a key metric in hospital rankings. These two outcomes account for 37.5% of the total score (Harder & Ware, 2025). However, no one-size-fits-all discharge pathway exists after stroke. For many patients with severe deficits, complex medical needs, or limited support, institutional postacute care provides the most appropriate setting to optimize recovery and safety.

Relatively little is known about whether modifiable rehabilitation service delivery factors, such as the timing of therapy evaluation, time to treatment initiation, and therapy intensity, affect community discharge and function at the time of discharge from the hospital (discharge function) among individuals hospitalized for stroke. This gap in knowledge exists, in part, because prior studies often rely on general indicators of rehabilitation use, such as binary measures of receipt (yes/no) or revenue codes from Medicare datasets, which lack important clinical details and fail to capture how services are delivered (Bukhari et al., 2021; Kumar et al., 2019; Malcolm et al., 2022). These limitations are particularly problematic because patients who receive rehabilitation services during acute hospitalization tend to be older and have more complex medical needs; thus, simple indicators of service receipt can obscure the ways in which rehabilitation supports recovery for these higher risk populations and can even be associated with worse outcomes (Andrews et al., 2015). In particular, timing and intensity are critical features of therapy delivery that have not been well captured in prior studies of acute stroke care when evaluating community discharge and discharge function. A more comprehensive approach, beyond binary measures, examining rehabilitation delivery is needed to identify service delivery factors that increase the likelihood of community discharge and improved discharge function.

The purpose of this study was to examine the association between rehabilitation service delivery factors and two key acute care outcomes among individuals hospitalized for stroke: (1) discharge function and (2) community discharge. Findings may support the development of targeted rehabilitation strategies that begin early in hospitalization to optimize recovery trajectories and discharge outcomes.

Method

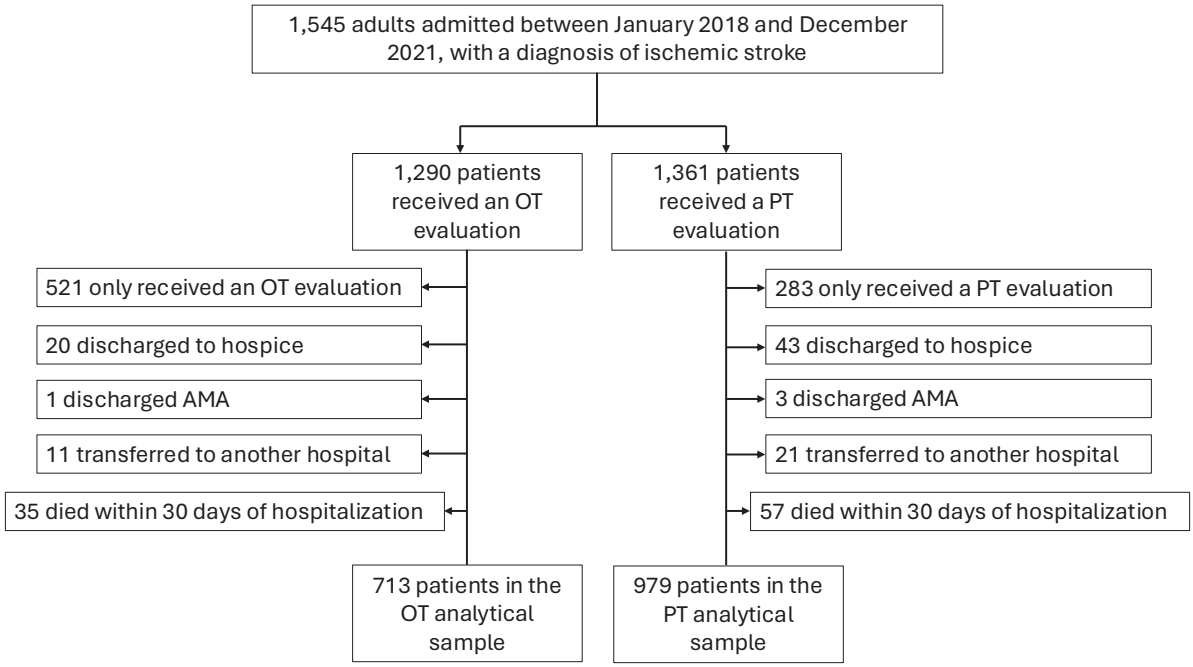
Data Source and Cohort Selection

This retrospective observational study used deidentified electronic medical records (EMRs) from a large Colorado health system composed of 13 hospitals, including a 678-bed Level 1 trauma center. The dataset included hospitalizations between January 2018 and December 2021. Inpatients with a primary diagnosis of ischemic stroke were identified by using *International Classification of Diseases, 10th Revision* (*ICD–10*) codes, resulting in an initial sample of 1,545 individuals (Figure 1); only the first qualifying admission during the study period was included. The sample was then separated based on receipt of occupational therapy (OT) and physical therapy (PT) services. Because most patients received both OT and PT during hospitalization, the OT and PT cohorts were not mutually exclusive; analyses were separated to allow examination of discipline-specific outcomes. Of the initial sample, 1,290 patients received OT and 1,361 patients received PT. We excluded patients who received evaluation only without any subsequent therapy treatment (521 OT-only evaluations; 283 PT-only evaluations), because these encounters typically represent screening and consultative assessments rather than delivery of therapy services. Additional exclusion criteria were (1) discharge to hospice (OT = 20; PT = 43), (2) discharge against medical advice (OT = 1; PT = 3), (3) transfer to another hospital (OT = 11; PT = 21), or (4) death within 30 days of admission (OT = 35; PT = 57). Some patients met multiple exclusion criteria. The final analytic samples included 713 patients for the OT analyses and 979 patients for the PT analyses. These data were deidentified, organized, and supported by the Health Data Compass Data Warehouse project (healthdatacompass.org), a partnership supported by the University of Colorado Anschutz Medical Campus. The Colorado State University Institutional Review Board determined that this study did not constitute human subjects research, because it used deidentified data that excluded all 18 HIPAA (Health Insurance Portability and Accountability Act of 1996) identifiers. A letter of determination was provided confirming this status.

Independent Variables

The primary independent variables in this study were rehabilitation service delivery factors, including time to evaluation, time to treatment, and therapy intensity. *Time to evaluation* was defined as the number of days from hospital admission to the initial therapy evaluation. *Time to treatment* was calculated as the number of days between the evaluation and the first therapy

Figure 1. Cohort selection of patients in OT and PT groups.



Note. Exclusion categories were not mutually exclusive; some patients met more than one exclusion criterion. Therefore, the summed counts across exclusions exceed the total number excluded. AMA = against medical advice; OT = occupational therapy; PT = physical therapy.

session. We identified evaluations and treatments by using template names within the EMR. Both time variables were measured in days. *Therapy intensity* was operationalized as the total number of units billed for both evaluation and treatment during the hospital stay, divided by the patient's length of stay in days. This variable captured the average daily therapy intensity and was calculated separately for OT and PT services. All analyses were separated by OT and PT.

Outcomes

The two primary outcomes were discharge function scores and community discharge. Discharge function was measured using the Activity Measure for Post-Acute Care (AM-PAC) "6-Clicks" scores, a standardized, performance-based assessment designed to evaluate daily activity and basic mobility of hospitalized patients, with scores ranging from 6 to 24 and higher scores indicating greater functional independence. The AM-PAC has demonstrated strong reliability and validity for use in acute care settings (Jette et al., 2014). For patients who received OT services, the discharge function score (continuous) was derived from the AM-PAC daily activity domain. For patients who received PT services, the discharge function score (continuous) was based on the AM-PAC mobility domain. The discharge function score is the last functional score recorded for the patient during their hospitalization. Community discharge was dichotomized as community discharge versus noncommunity discharge. *Community discharge* was defined as discharge to home or home with home health services. *Noncommunity discharge* included discharge to any institutional postacute care setting, such as an inpatient rehabilitation facility, skilled nursing facility, or long-term care facility. Outcomes were examined separately for OT and PT cohorts.

Covariates

To account for potential confounding factors, we included several demographic and clinical covariates in the analysis. Demographic variables consisted of sex (male, female), health insurance type (private, Medicaid/other, Medicare Advantage, Medicare fee-for-service), partner status (partner, single, other), ethnicity (non-Hispanic, Hispanic, other), race (White, non-White), and age (categorized as ≤64 yr, 65–74 yr, 75–84 yr, and ≥85 yr).

Clinical covariates included admission function, intensive care unit (ICU) stay during hospitalization (yes/no), total disease burden, and number of prior hospitalizations. Admission function was the first recorded AM-PAC score. For the OT models, the first AM-PAC daily activity domain score was entered for admission function. For the PT models, the first AM-PAC mobility domain score was entered for admission function. Disease burden was calculated as the total number of *ICD–10* codes recorded during the index hospitalization and categorized into quartiles (≤21, 22–32, 33–47, ≥48 codes; Lee & Park, 2025; Ording & Sørensen, 2013). Prior hospitalizations were treated as a continuous variable, representing the number of acute care admissions occurring before the index stroke hospitalization between 2018 and 2021. Discharge function and receipt of the other therapy

discipline (e.g., PT in the OT models) were not included as covariates, because both lie on the causal pathway of rehabilitation delivery rather than serving as baseline confounders; adjusting for them could introduce overadjustment bias and obscure discipline-specific associations.

Statistical Analyses

All analyses were separated by OT and PT services. Descriptive statistics were first used to summarize patient demographic and clinical characteristics, rehabilitation service delivery factors, and outcomes. Continuous variables were reported as means with standard deviations, and categorical variables were summarized by using frequencies and percentages.

We estimated separate models for each primary outcome: discharge function (continuous) and community discharge (binary). For the discharge function outcome, general linear models (GLMs) were used to estimate the association between rehabilitation service delivery factors and discharge function scores (OT: AM-PAC daily activity; PT: AM-PAC mobility). We identified the identity link function, treating the outcome as a continuous variable with no distributional transformation. Visual inspection of the discharge function variable indicated a bimodal distribution; however, residual diagnostics—including Studentized residuals, Cook's distance, and assessment of heteroscedasticity—did not reveal violations of model assumptions that warranted alternative distributional approaches. As a result, we retained the standard GLM to optimize interpretability of regression coefficients.

For the community discharge outcome, we used binary logistic regression models to assess the association between rehabilitation service delivery factors and the odds of discharge to the community (vs. noncommunity settings). For both sets of models (discharge function and community discharge), covariates were first entered into base models to account for demographic and clinical confounders. This stepwise approach allowed for the identification of significant covariates prior to evaluating the added explanatory value of the therapy-related independent variables. Covariates that were significantly associated with the outcome at $p < .05$ in the base model were retained in the final model, in which the three rehabilitation service delivery factors (time to evaluation, time to treatment, and therapy intensity) were entered as independent variables. Final models report unstandardized coefficients (for linear regressions) and odds ratios with 95% confidence intervals (CI; for logistic regressions). All analyses were conducted by using IBM SPSS Statistics (Version 28).

Results

The final analytic sample included 713 patients who received OT services and 979 patients who received PT services during their acute hospitalization for stroke. Among those in the OT cohort, 38.3% were discharged to the community after hospitalization, compared with 47.1% in the PT cohort (Table 1). Mean admission function scores were 14.27 ($SD = 5.39$) for OT and 15.39 ($SD = 5.72$) for PT, whereas discharge function scores were 16.51 ($SD = 5.18$) and 17.70 ($SD = 5.35$), respectively. Across both cohorts, about half of patients were age 64 or younger (OT: 50.1%; PT: 50.7%) and male (OT: 56.4%; PT: 56.8%), and most patients identified as White (OT: 81.9%; PT: 82.7%). Most patients were insured through Medicare (OT: 35.5%; PT: 34.5%), and approximately two thirds had experienced an ICU stay during their hospitalization (OT: 66.1%; PT: 67.9%). Almost half of patients in both groups reported being partnered (OT: 50.6%; PT: 50.0%). Disease burden was relatively high, with more than one third of both OT and PT patients (OT: 34.6%; PT: 37.2%) falling into the highest quartile (≥48 *ICD–10* codes). Prior hospitalization rates were low, with a mean of 0.14 ($SD = 0.51$) in the OT cohort and 0.16 ($SD = 0.57$) in the PT cohort.

Discharge Function—OT Model

In the base OT model, greater admission self-care function was significantly associated with higher discharge activities of daily living (ADL) scores ($B = 0.663$, 95% CI [0.61, 0.72], $p < .001$; Table 2). Moderate disease burden (22–32 *ICD–10* codes) was also associated with higher discharge function compared with the lowest burden group ($B = 1.555$, 95% CI [0.71, 2.40], $p < .001$), although this effect did not persist in the full model. In the full OT model, fewer days between evaluation and first treatment ($B = –0.091$, 95% CI [−0.16, –0.02], $p = .013$) and higher therapy intensity ($B = 0.482$, 95% CI [0.04, 0.92], $p = .031$) were each associated with higher discharge function, controlling for admission ADL and disease burden. Days to evaluation was not significantly associated with discharge function in the OT model ($p = .797$).

Discharge Function—PT Model

In the base PT model, greater admission mobility scores were significantly associated with higher discharge mobility function ($B = 0.612$, 95% CI [0.56, 0.66], $p < .001$; Table 2). All three categories of reduced disease burden were associated with higher discharge function in the base model compared with the highest burden group (all ps $< .05$), with a clear gradient. In the full PT model, earlier therapy evaluation was significantly associated with better discharge mobility outcomes ($B = –0.129$, 95% CI [−0.22, –0.04], $p = .006$), and younger age (≤64 yr) was also significantly associated with higher mobility function compared with adults ages ≥85 ($B = 2.215$, 95% CI [0.73, 3.70], $p = .003$). Therapy intensity and days to treatment were not statistically significant in the PT model.

Table 1. Characteristics of Participants

Variable	*n* (%)	
	Occupational Therapy (*n* = 713)	Physical Therapy (*n* = 979)
Discharged to the community	273 (38.3)	461 (47.1)
Age		
≤64 yr	342 (50.1)	315 (50.7)
65–74 yr	185 (27.1)	166 (26.7)
75–84 yr	130 (19.0)	116 (18.7)
≥85 yr	26 (3.8)	24 (3.9)
Sex		
Female	311 (43.6)	280 (43.2)
Male	402 (56.4)	368 (56.8)
Race		
White	520 (81.9)	791 (82.7)
Non-White (e.g., Black, Asian)	115 (18.1)	165 (17.3)
Ethnicity		
Non-Hispanic	612 (85.8)	548 (84.6)
Hispanic/other	101 (14.2)	100 (15.4)
Insurance type		
Private insurance	182 (25.5)	169 (26.1)
Medicaid	149 (20.9)	136 (21.0)
Managed Medicare	129 (18.1)	119 (18.4)
Medicare	253 (35.5)	224 (34.6)
Intensive care unit stay, yes	471 (66.1)	440 (67.9)
Partner status		
Partnered	361 (50.6)	324 (50.0)
Single	279 (39.1)	257 (39.7)
Other (e.g., divorced, widowed)	73 (10.2)	67 (10.3)
Disease burden quartiles		
≤21	125 (17.5)	101 (15.6)
22–32	155 (21.7)	134 (20.7)
33–47	186 (26.1)	172 (26.5)
≥48	247 (34.6)	241 (37.2)
Admission function score, *M* (*SD*)	14.27 (5.39)	15.39 (5.72)
Discharge function score, *M* (*SD*)	16.51 (5.18)	17.70 (5.35)
Number of prior stays, *M* (*SD*)	0.14 (0.51)	0.16 (0.57)

Note. Community discharge = discharge to home or home with home health; disease burden = total number of unique *International Classification of Diseases, 10th Revision* codes during index stroke stay, grouped into quartiles; admission and discharge function scores were measured by using Activity Measure for Post-Acute Care "6-Clicks" (daily activity domain for occupational therapy; mobility domain for physical therapy), range = 6–24, with higher scores indicating more independence; number of prior stays = number of acute care admissions in the same health system (2018–2021) before index stroke. Counts may not sum to column totals because of missing data for some demographic variables.

Community Discharge—OT Model

In the OT base model, higher admission function scores were significantly associated with greater odds of community discharge (OR = 1.303, 95% CI [1.252, 1.356], $p < .001$; Table 3). Individuals with Medicaid had significantly higher odds of community discharge compared with those with private insurance (OR = 2.507, 95% CI [1.461, 4.301], $p < .001$), and those with greater disease burden (33–47 *ICD–10* codes and ≥48) had significantly lower odds compared with individuals with the least disease burden (OR = 0.540, 95% CI [0.322, 0.905], $p = .019$; OR = 0.504, 95% CI [0.302, 0.841], $p = .009$, respectively). In the OT full model, these associations persisted for admission function (OR = 1.279, 95% CI

Table 2. **Linear Regression Models Examining Factors Associated With Discharge Function (Base, OT Model, and PT Model)**

	OT				PT			
Variable	**Base *p***	**Base *B* [95% CI]**	**Full *p***	**Full *B* [95% CI]**	**Base *p***	**Base *B* [95% CI]**	**Full *p***	**Full *B* [95% CI]**
Days to evaluation	—	—	.797	−0.008 [−0.07, 0.05]	—	—	.006*	−0.129 [−0.22, −0.04]
Days to treatment			.013*	−0.091 [−0.16, −0.02]	—	—	.067	−0.088 [−0.18, 0.01]
Therapy intensity	—	—	.031*	0.482 [0.04, 0.92]	—	—	.639	0.113 [−0.36, 0.58]
Admission ADL score	<.001	0.663 [0.61, 0.72]	<.001**	0.642 [0.58, 0.70]	—	—	—	—
Admission mobility score	—	—	—	—	<.001**	0.612 [0.56, 0.66]	<.001**	0.534 [0.48, 0.59]
Disease burden								
22–32 vs. ≤21	<.001	1.555 [0.71, 2.40]	.363	0.442 [−0.51, 1.40]	<.001**	1.832 [1.05, 2.62]	.285	0.538 [−0.45, 1.52]
33–47 vs. ≤21	.099	0.635 [−0.12, 1.39]	.541	−0.256 [−1.08, 0.57]	<.001**	1.619 [0.91, 2.33]	.174	0.593 [−0.26, 1.45]
≥48 vs. ≤21	.554	0.215 [−0.50, 0.93]	.079	−0.683 [−1.44, 0.08]	.002*	1.113 [0.42, 1.80]	.374	0.365 [−0.44, 1.17]
Age, yr								
≤64 (vs. ≥85)	—	—	—		.019*	1.6 [0.27, 2.93]	.003**	2.215 [0.73, 3.70]
65–74 (vs. ≥85)	—	—	—		.189	0.825 [−0.41, 2.06]	.343	0.735 [−0.78, 2.26]
75–84 (vs. ≥85)	—	—	—		.694	0.252 [−1.01, 1.51]	.779	0.222 [−1.33, 1.77]

Note. Models are separated by therapy type (OT vs. PT) and model stage (base model with only significant covariates from the full base model vs. full model with therapy variables). Dashes indicate that the variable was not included in the specified model. Base models include only covariates significantly associated with the outcome, whereas full models include retained covariates plus rehabilitation service delivery variables. Admission ADL scores were included only in OT models, and admission mobility scores were included only in PT models. ADL = activities of daily living; disease burden = total number of unique *International Classification of Diseases, 10th Revision* codes during index stroke stay, by quartiles; OT = occupational therapy; PT = physical therapy.
*$p < .05$. **$p < .001$.

Table 3. Logistic Regression Models Examining Factors Associated with Community Discharge (Base, OT Model, and PT Model)

	OT				PT			
Variable	**Base OR [95% CI]**	**Base *p***	**Full OR [95% CI]**	**Full *p***	**Base OR [95% CI]**	**Base *p***	**Full OR [95% CI]**	**Full *p***
Days to evaluation	—	—	1.024 [0.974, 1.078]	.353	—	—	0.991 [0.938, 1.047]	.744
Days to treatment	—	—	0.927 [0.865, 0.993]	.032*	—	—	0.966 [0.911, 1.025]	.257
Therapy intensity	—	—	1.396 [1.026, 1.900]	.034*	—	—	1.098 [0.851, 1.417]	.471
Admission function score	1.303 [1.252, 1.356]	<.001**	1.279 [1.220, 1.341]	<.001**	1.230 [1.192, 1.269]	<.001**	1.191 [1.150, 1.234]	<.001**
Insurance								
Medicaid vs. private	2.507 [1.461, 4.301]	<.001**	3.321 [1.892, 5.828]	<.001**	1.623 [1.017, 2.591]	.042*	2.204 [1.340, 3.627]	.002*
Managed Medicare vs. private	1.337 [0.690, 2.591]	.389	0.779 [0.423, 1.434]	.422	1.241 [0.699, 2.205]	.461	0.915 [0.546, 1.534]	.736
Medicare vs. private	1.220 [0.675, 2.203]	.510	0.694 [0.414, 1.166]	.167	0.925 [0.553, 1.546]	.765	0.699 [0.446, 1.095]	.117
Disease burden								
22–32 vs. ≤21	0.630 [0.381, 1.042]	.072	0.744 [0.404, 1.370]	.342	0.694 [0.446, 1.080]	.106	0.770 [0.461, 1.285]	.317
33–47 vs. ≤21	0.540 [0.322, 0.905]	.019*	0.709 [0.380, 1.321]	.279	0.554 [0.353, 0.869]	.010*	0.625 [0.370, 1.057]	.080
≥48 vs. ≤21	0.504 [0.302, 0.841]	.009*	0.893 [0.471, 1.694]	.728	0.378 [0.241, 0.592]	<.001**	0.516 [0.298, 0.890]	.017*

Note. Models are separated by therapy type (OT vs. PT) and model stage (base model with covariates only vs. full model with therapy variables). Dashes indicate that the variable was not included in the specified model. Disease burden = total number of unique *International Classification of Diseases, 10th Revision* codes during index stroke stay, by quartiles; OT = occupational therapy; PT = physical therapy.
*$p < .05$. **$p < .001$.

[1.220, 1.341], $p < .001$) and Medicaid insurance (OR = 3.321, 95% CI [1.892, 5.828], $p < .001$). In addition, earlier initiation of therapy treatment (OR = 0.927, 95% CI [0.865, 0.993], $p = .032$) and higher therapy intensity (OR = 1.396, 95% CI [1.026, 1.900], $p = .034$) were significantly associated with increased odds of community discharge. Disease burden was no longer significantly associated with the outcome in the full model.

Community Discharge—PT Model

In the PT base model, admission function remained a strong predictor of community discharge (OR = 1.230, 95% CI [1.192, 1.269], $p < .001$; Table 3). Individuals with Medicaid were more likely to be discharged to the community compared with those with private insurance (OR = 1.623, 95% CI [1.017, 2.591], $p = .042$), and higher disease burden—particularly in the ≥48 *ICD–10* code group—was associated with decreased odds of community discharge (OR = 0.378, 95% CI [0.241, 0.592], $p < .001$). These findings were consistent in the PT full model, with admission function (OR = 1.191, 95% CI [1.150, 1.234], $p < .001$), Medicaid insurance (OR = 2.204, 95% CI [1.340, 3.627], $p = .002$), and highest disease burden (OR = 0.516, 95% CI [0.298, 0.890], $p = .017$) remaining significant. Therapy-related variables, including days to evaluation, days to treatment, and intensity, were not significantly associated with community discharge in the PT model.

Results for the full base models with all covariates, including nonsignificant covariates, can be found in Supplemental Tables A.1 and A.2 (available online with this article at https://research.aota.org/ajot). Only covariates that were significantly associated with the outcomes are presented in Tables 2 and 3.

Discussion

This study adds to a growing body of literature demonstrating the critical role of rehabilitation service delivery during acute stroke hospitalization in shaping patient outcomes. Consistent with prior research (Askew et al., 2020; Capo-Lugo et al., 2020; Johnson et al., 2021; Kumar et al., 2022), we found that higher therapy intensity and earlier initiation of treatment were significantly associated with improved functional outcomes and increased likelihood of community discharge in the OT cohort. In addition, earlier PT evaluation was significantly associated with better discharge mobility outcomes in the PT cohort. These findings highlight the importance of not only providing hospital-based rehabilitation but also optimizing how and when these services are delivered to maximize recovery during the acute phase of stroke care.

Previous studies have reported similar associations between rehabilitation dosage and outcomes. Kumar et al. (2022) reported a dose–response relationship between the amount of hospital-based rehabilitation and the likelihood of community discharge following joint replacement surgery. By using Medicare claims, they found that patients who received higher levels of therapy intensity during acute hospitalization were significantly more likely to be discharged to the community, regardless of hospital participation in value-based payment models. However, Kumar et al. (2022) did not stratify by OT and PT services; therefore, the results reflect the collective amount of rehabilitation received during hospitalization. Similarly, Johnson et al. (2021) found that, among hospitalized patients with COVID-19, greater PT visit frequency and longer visit duration were associated with improved mobility at discharge from the hospital and increased odds of community discharge (Johnson et al., 2021). Although these studies focused on nonstroke populations or used comprehensive definitions of rehabilitation services, their findings are consistent with our results and suggest that intensive rehabilitation services in the acute phase may enhance functional status after hospitalization and promote community transitions across a range of diagnoses.

However, many prior studies have relied on administrative claims data and revenue codes to estimate therapy exposure, which may lack the granularity needed to capture how services are actually delivered (Kumar et al., 2019; 2022). For example, minutes of therapy estimated from revenue codes do not necessarily reflect the quality, timing, or clinical intent of therapy. In addition, research that examines only whether a patient received rehabilitation services has yielded inconsistent findings, with some studies reporting no improvement—or even lower rates—of community discharge among patients who received therapy during hospitalization (Bukhari et al., 2021; Malcolm et al., 2022). These counterintuitive results may reflect the fact that patients who receive therapy services are often older, have more severe illnesses, and present with more complex discharge needs. Such studies highlight the limitations of using binary therapy receipt as a proxy for rehabilitation exposure and underscore the need to look more closely at how therapy is delivered among patients who receive it. In contrast, our study used EMR documentation to calculate daily therapy intensity and the number of days to evaluation and treatment, offering a more nuanced and clinically informed view of service delivery. Although our approach is still missing quality of therapy, clinical intent, and specific content of sessions, we are progressing toward calls in the literature, most recently by Freburger et al. (2025), for more detailed data to understand disparities and outcomes in rehabilitation care (Freburger et al., 2025). Our findings suggest that such detailed data can yield important insights into when and how rehabilitation services can most effectively support recovery during the hospital stay.

The PT-specific models revealed fewer significant associations between therapy factors and discharge mobility outcomes compared with the OT models. However, earlier PT evaluation was significantly

associated with improved discharge mobility, underscoring the importance of timely initiation of PT services during the acute hospital stay. This finding aligns with prior research suggesting that early PT engagement can enhance functional recovery, particularly in mobility domains (Askew et al., 2020). The more limited number of significant associations in the PT model may reflect differences in clinical focus, where PT emphasizes mobility restoration, whereas OT is more directly involved in training for self-care activities relevant to community reintegration (American Occupational Therapy Association, 2020; American Physical Therapy Association, 2023). It is also possible that unmeasured confounding, variations in documentation, or team workflow differences influenced these findings. Future research should continue to explore discipline-specific therapy contributions and consider stroke severity as a potential moderating factor in therapy effectiveness.

Overall, our findings support the development of hospital-based protocols that prioritize timely initiation and high dosing of rehabilitation services during hospitalization for patients after stroke. In addition, these results may help to inform targeted rehabilitation strategies that begin early in hospitalization to optimize recovery trajectories and discharge outcomes. Such strategies align with broader health system goals to reduce preventable postacute care utilization, improve functional independence, and promote equitable recovery pathways, while also beginning to address the current lack of benchmarks to guide functional improvements in acute care hospitals for stroke survivors.

Limitations

This study had several limitations. First, the use of EMR data, which are collected for clinical rather than research purposes, introduced potential for measurement error and variability in documentation practices. Key variables such as therapy evaluation and treatment dates, intensity measures, and AM-PAC scores may be influenced by differences in clinician documentation or system-level workflows. Second, this study was conducted within a single health system in Colorado, which may limit the generalizability of findings to other regions or health care settings with differing patient populations, care models, or resource availability. Third, although analyses were separated by discipline, the OT and PT cohorts were not mutually exclusive. This overlap reflects the multidisciplinary nature of stroke rehabilitation and makes it challenging to fully disentangle the independent contributions of each discipline. Moreover, cotreatments—in which OT and PT are delivered jointly—were not accounted for and may have influenced total therapy exposure and/or outcomes. Fourth, patients who received an evaluation only were excluded, and many of these individuals were likely higher functioning and discharged home. Their exclusion may have led to an underestimation of the proportion of patients discharged to the community, although it ensured consistency in functional outcome measurement. We also did not control for stroke severity, only disease burden, because clinical scales such as the NIH Stroke Scale were not consistently available in the EMR dataset. Finally, although we adjusted for disease burden and ICU stay, other unmeasured confounders—such as social determinants of health, level of family support, or provider-level factors—may have affected functional recovery and discharge decisions. These limitations highlight the need for future prospective, multisite studies to validate and expand on these findings.

Implications for Occupational Therapy Practice

Occupational therapy provided during acute stroke hospitalization may influence recovery trajectories and discharge outcomes. In this study, among people who received OT, earlier initiation of OT treatment after evaluation and greater average daily OT intensity were each associated with better discharge function and higher odds of discharge to the community. These findings suggest that OT service delivery processes, not only whether OT is provided, may be important targets for improving functional recovery and supporting safe discharge planning during the acute phase of stroke care. Implications for occupational therapy practice include the following:

- OT teams may improve outcomes by prioritizing timely initiation of OT treatment after the initial evaluation during acute stroke hospitalization.
- Delivering greater average daily OT intensity during the hospital stay may support higher functional status at discharge and a greater likelihood of community discharge among OT recipients.
- Acute care OT service planning may benefit from monitoring and using EMR-derived metrics (e.g., days from evaluation to first treatment, daily therapy intensity) to identify delays and guide workflow improvements.
- Because OT and PT showed different patterns of association with outcomes in this study, hospitals may consider discipline-specific optimization strategies (e.g., improving OT treatment initiation and intensity while also supporting early PT evaluation for mobility outcomes).

Future work should test whether strategies to reduce delays to OT treatment and increase feasible OT intensity can be implemented consistently across hospitals and patient subgroups and whether these changes translate into improved outcomes in other health systems and care contexts.

Conclusion

This study provides evidence that the timing and intensity of rehabilitation services during acute stroke

hospitalization are important factors associated with improved functional outcomes and increased odds of community discharge, particularly among patients receiving OT services. By leveraging detailed EMR data, we were able to move beyond binary indicators of therapy receipt to better understand how rehabilitation delivery influences recovery and discharge disposition. These findings support the need for hospital protocols that prioritize early and high-dose rehabilitation services during acute stroke care. Future research should build on this work by incorporating stroke severity and expanding to multisite studies to guide broader implementation of best practices.

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