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Factors Associated with Duration of Rehabilitation Among Older Adults with Prolonged Hospitalization

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Abstract

BACKGROUND/OBJECTIVES: Older adults are prone to functional decline during prolonged hospitalization. Although rehabilitation therapy is critical to preserving function, little is known about rehabilitation duration (RD) in this population. We sought to determine the extent of rehabilitation therapy provided to older adults during prolonged hospitalization, and whether this differs by sociodemographic and clinical characteristics.

DESIGN: Retrospective cohort.

SETTING: Single-site safety-net hospital.

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Conflict of Interest: The authors have no conflicts.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article.

PARTICIPANTS: Older adults (≥65 years) hospitalized for ≥14 days between 2016 and 2017.

MEASUREMENTS: The primary outcome was RD, defined as the average number of minutes of physical and occupational therapy per week. We used a multivariable generalized linear model to assess for differences in RD by sociodemographic and clinical characteristics. For a sub-cohort of hospitalizations with a baseline mobility assessment, we repeated analyses including mobility limitation as a covariate.

RESULTS: Among 1,031 hospitalizations by 925 unique patients (median age 72, 49% female, 79% non-white, 40% non-English speaking), the median RD was 61.3 minutes/week (interquartile range = 16.5–127.3). Covariates associated with lesser RD included black (57.2 fewer minutes/week; 95% confidence interval (CI) = 22.9–91.4) and Hispanic (75.6 fewer minutes/week; 95% CI = 33.8–117.4) race/ethnicity, speaking a language other than English or Spanish (51.7 fewer minutes/week; 95% CI = 21.3–82.0), prolonged mechanical ventilation (30.0 fewer minutes/week; 95% CI = 6.6–53.3), and do-not-resuscitate code status (36.0 fewer minutes/week; 95% CI = 17.1–54.8). The inclusion of mobility limitation among the sub-cohort (n = 350) did not meaningfully change the associations.

CONCLUSION: We found large disparities in RD for racial/ethnic and language minorities and clinically vulnerable older adults (mechanical ventilation and do-not-resuscitate code status), independent of clinical severity and functional and cognitive impairment. Greater RD for these groups may improve functional outcomes and narrow the disparity gap.

Keywords

rehabilitation; older adults; prolonged hospitalization

INTRODUCTION

Hospitalized older adults are highly vulnerable to functional decline. More than one-third of hospitalized older adults are discharged with a new major functional disability that was not present before admission,[1] while fewer than one-third of those that develop hospital-associated disability recover to their preadmission functional level within 1 year.[2] Loss of function is strongly associated with nursing home placement,[3] use of formal and informal home care services,[4] greater acute and post-acute care costs,[5] and mortality.[6] Together, the consequences of functional decline place a significant burden on patients, their caregivers, and the healthcare system.

An important cause of functional decline during hospitalization is decreased mobility.[7,8] Hospitalized older adults spend most of their time lying in bed,[9] and the majority do not walk at all during an acute care admission.[10] The risk of functional decline is further compounded by prolonged hospitalization, as increased length of stay (LOS) is associated with a greater likelihood of functional impairment.[11-13] 13 There is growing evidence that in-hospital rehabilitation interventions are safe, feasible, and effective in mitigating the functional decline associated with low mobility.[14-16] However, the provision of rehabilitation therapy to patients during hospitalization is unknown. Although the duration of rehabilitation services has been described in post-acute care settings such as skilled nursing facilities (SNFs) and inpatient rehabilitation facilities (IRFs),[17-24] we do not know

how much rehabilitation therapy older adults receive during prolonged hospitalization, nor do we know whether this differs among patients of different sociodemographic backgrounds or clinical characteristics. This is important because differences in rehabilitation duration (RD) could lead to differences in functional outcomes, such as racial disparities in functional recovery observed between older black and white patients after hospitalization.[25]

Therefore, we sought to determine the amount of rehabilitation therapy provided to older adults during prolonged hospitalization and examine whether the duration of rehabilitation therapy differed by sociodemographic or clinical characteristics.

METHODS

Study Design, Population, and Setting

We conducted a retrospective cohort study using electronic health record (EHR) data from an urban 862-bed safety-net acute care hospital in north Texas that serves as the primary provider of care for under- and uninsured patients of its county. We included consecutive hospitalizations from 2016 to 2017 by adults 65 years or older with prolonged hospital stays, which we defined as a LOS of at least 14 days, because this population is vulnerable to hospital-associated disability.[11,12] At the study hospital, nurses and patient care assistants help patients with transfers, but mobilization and rehabilitation are led by physical therapy (PT) and occupational therapy (OT). Although PT and OT evaluations require a consultation order from the clinician, therapy treatment plans and follow-up intervals are per the discretion of the therapist. During initial evaluation, PTs are encouraged to conduct a mobility assessment using the Activity Measure for Post-Acute Care Inpatient Mobility Short Form (AM-PAC). As we hypothesized that baseline mobility would influence how much rehabilitation patients received, we prespecified a sub-cohort of hospitalizations with an AM-PAC assessment.

Outcome

The primary outcome was RD, defined according to prior research as the average number of combined minutes of PT and OT received per week.[18-24] Minutes were documented in therapists' notes and included total time spent during initial evaluation as well as time spent in therapy.

Covariates

We included covariates of RD based on our team's multidisciplinary expertise and from prior literature that were available in the EHR.[19-24] These included sociodemographic characteristics (age, sex, race/ethnicity, language, primary payer, living situation) to evaluate for disparities in RD, and clinical characteristics that may influence RD. Clinical characteristics included impairment in activities of daily living (ADLs), home durable medical equipment (DME) use prior to admission, cognitive status, LOS, diagnosis (major diagnostic category (MDC), diagnosis related group (DRG) type, DRG weight), code status, procedures, intensive care unit LOS, and mechanical ventilation status. DRG weights are assigned multipliers by the Centers of Medicare and Medicaid Services that reflect the average resources required to care for cases within that DRG among Medicare beneficiaries.

Procedures were categorized as none, minor, or major based on the Agency for Healthcare Research and Quality Healthcare Cost and Utilization Procedure Classes tool.[26] Major procedures were further categorized as major-elective or major-nonelective.

For the sub-cohort of hospitalizations that had an initial mobility assessment performed by PT, we also included mobility limitation as a covariate. Mobility limitation was assessed using the AM-PAC "5-Clicks" or "6-Clicks" mobility assessment, a reliable and validated instrument used to characterize the level of assistance a patient requires in performing mobility tasks within six separate domains, such as bed mobility and transfers.[27-29] A raw score ranging from 6 to 24 (or 5 to 20 when using the AM-PAC "5-Clicks") was transformed to mobility limitation and expressed as a percentage ranging from 0% to 100% according to standard conversion,[27] with higher percentages indicating a greater impairment.

Most covariates were extracted from structured data fields in the EHR—except for ADL impairment, home DME use, and cognitive status, which were obtained through chart review using a standardized abstraction form. We used the following search terms to screen the EHR for cognitive dysfunction during the hospitalization: cognit*, confus*, deliri*, dement*, AMS, and altered. Language spoken was extracted from the EHR and subsequently confirmed via chart review. Two investigators (Makam and Nguyen) independently reviewed 10 hospitalization records without any discrepancies upon comparison of the extracted unstructured data. Thereafter, one investigator (Nguyen) reviewed the remaining charts.

Statistical Analysis

We assessed univariate relationships between covariates and RD using Kruskal–Wallis and Mann Whitney ranksum tests where appropriate. To evaluate the adjusted associations between covariates and RD, we conducted a multivariable generalized linear model. Model diagnostics suggested adequate fit, including normal distribution of residuals and homogeneity of variance. From this model, we estimated the adjusted absolute differences in RD for each covariate using marginal effects methods.[30] We repeated analyses for the sub-cohort of hospitalizations with an AM-PAC mobility assessment and included mobility limitation as an ordinal covariate.

To assess the robustness of our findings, we conducted five post-hoc sensitivity analyses. First, we restricted the cohort by excluding patients with a primary neurologic diagnosis (i.e., stroke), since this population has unique rehabilitation treatment. Second, we excluded patients who did not receive rehabilitation therapy to explore whether there was a referral bias by clinicians for PT/OT evaluation that could potentially account for the observed differences in RD. Third, among patients with at least one PT/OT session, we included time between admission and the first PT or OT session as a continuous covariate because delays in clinician referral could affect RD. Fourth, we included the number of attempted but missed days of PT or OT as a continuous covariate, as differential missed attempts might account for observed differences in RD. Lastly, since residual confounding was a concern due to inadequate adjustment of baseline functional and mobility impairment, we repeated our analysis among a subset of patients who received both a baseline AM-PAC mobility assessment by PT as previously described, and a functional assessment by OT using the self-

care subscale of the Functional Independence Measure (FIM), a reliable and validated instrument widely used to assess a patient's level of independence in performing ADLs.[31,32] For this analysis, we included AM-PAC mobility limitation as an ordinal covariate and the FIM self-care score as a continuous covariate.

The University of Texas Southwestern institutional review board approved this study. All analyses were performed using Stata/SE version 15.0 (Stata Corp, College Station, Texas).

RESULTS

Patient Characteristics

We included 1,031 prolonged hospitalizations among 925 unique older adults. The median age was 72 years (interquartile range [IQR] 68–78), 49.2% were female, 78.7% were non-white, 39.5% were non-English speaking, 68.0% had Medicare, and 48.0% had an ADL impairment prior to hospitalization (Table 1). The median LOS was 20.0 days (IQR 16.3–27.0), the most common diagnosis was an infection (16.2%), 22.3% had a do not resuscitate (DNR) order, 20.0% were mechanically ventilated, and 44.9% underwent a major procedure.

Patient characteristics stratified by race/ethnicity and language spoken are shown in Supplementary Tables S1 and S2, respectively. White, black, and English-speaking patients were far more likely to have Medicare, and more likely to live alone than Hispanic/other and non-English speaking patients, respectively. The prevalence of ADL impairment and prior DME use were similar across race/ethnicity and language groups, while admission from a nursing facility was significantly higher among white and English-speaking patients. The median comorbidity burden was lowest among white patients but similar across language groups. The median DRG weight was highest among patients of other race/ethnicity but similar across languages groups.

Among the sub-cohort (n = 350) with a baseline AM-PAC mobility assessment documented by PT, the median mobility limitation was 56% (IQR = 36–77%) (Table 1). Characteristics of the sub-cohort were otherwise similar to those of the overall cohort.

Rehabilitation Duration

The average number of PT and OT sessions per hospitalization were 6 (IQR = 3–10) and 5 (IQR = 2–9), respectively. The average duration of a PT and OT session were 25 (IQR = 22–38) and 25 (IQR = 17–40) minutes, respectively. Overall, 25.6% of the 15,889 days of attempted PT/OT sessions were unsuccessful in delivering rehabilitation therapy for various reasons (i.e., patient not in room, busy with another provider, declined).

The median RD was 61.3 minutes/week (IQR = 16.5–127.3) among the overall cohort (Table 2). Among patients who had at least one PT or OT session (n = 905), the median RD was 74.3 minutes/week (IQR = 29.3–138.6).

For the sub-cohort of hospitalizations with an AM-PAC mobility assessment, the median RD was 83.8 minutes/week (IQR = 33.8–144.2).

Differences in RD

Unadjusted analyses revealed significant differences in RD across a variety of patient characteristics, including race/ethnicity, language, mechanical ventilation status, code status, and diagnosis (Supplementary Table S3).

Differences in RD by Sociodemographic Characteristics—In our adjusted analysis, black and Hispanic race/ethnicity were associated with 57.2 (95% CI = 22.9–91.4) and 75.6 (95% CI = 33.8–117.4) fewer minutes/week of rehabilitation therapy, respectively (Table 3 and Figure 1A). Speaking a language other than English or Spanish was associated with 51.7 (95% CI = 21.3–82.0) fewer minutes/week of rehabilitation. We did not observe clinically meaningful differences in RD by other sociodemographic characteristics (Table 3; Supplementary Table S4 for adjusted estimates by covariate).

Differences in RD by Clinical Characteristics—Clinical characteristics associated with significantly less RD included admission from a nursing facility (73.2 fewer minutes/week, 95% CI = 55.0–91.3), prolonged mechanical ventilation (30.0 fewer minutes/week, 95% CI = 6.6–53.3), and DNR code status (36.0 fewer minutes/week, 95% CI = 17.1–54.8) (Table 3 and Figure 1A). We observed greater RD for certain diagnoses, including nervous system diagnoses (189.4 more minutes/week; 95% CI = 118.2–260.6) and musculoskeletal diagnoses (68.2 more minutes/week; 95% CI = 20.1–116.2) (Table 3; Supplementary Table S4). We also identified significant differences in RD by DRG weight and LOS; however, differences were small (<6 minutes/week).

Mobility Limitation—Among the sub-cohort with an AM-PAC mobility assessment, greater mobility limitation (>20% impairment) was associated with greater RD on the order of 39.8 to 130.0 more minutes/week when compared to patients with minimal mobility limitation (0–20% impairment) (Table 3). The inclusion of mobility limitation as a covariate did not meaningfully change the associations identified in the overall cohort for race/ethnicity, language, admission source, ventilation status, code status, or diagnosis, though estimates were less precise with wider confidence intervals owing to smaller sample sizes (Table 3, Figure 1B, and Supplementary Table S4).

Sensitivity Analyses

Findings were materially similar in sensitivity analyses that:

(1) excluded patients with a primary neurologic diagnosis; (2) excluded patients that did not receive rehabilitation therapy (to evaluate for potential clinician referral bias); (3) adjusted for time between admission and first PT/OT session (to evaluate for delays in clinician referral); (4) adjusted for the number of attempted but missed days of PT or OT; and (5) adjusted for both baseline mobility limitation (AM-PAC) and functional status (FIM self-care subscale) (Table 4).

DISCUSSION

This observational cohort study provides novel insights regarding the duration of rehabilitation provided to older adults during a prolonged hospitalization for a range of

diagnoses, and highlights large disparities in RD within a large safety-net hospital that may contribute to differences in clinical and functional outcomes.[25,33-39] We found that hospitalized older adults received about 1 hour of multidisciplinary rehabilitation per week. We also identified large disparities in RD independent of clinical severity and mobility impairment among black and Hispanic patients, individuals who spoke a language other than English or Spanish, and by mechanical ventilation and code status. Our secondary analyses exploring the potential mechanisms behind these differences did not suggest clinician referral bias or delay, differential missed PT or OT follow-up attempts due to a variety of patient or health system reasons, or residual confounding due to baseline ADL functioning as underlying causes.

Our findings on RD for hospitalized older adults extend upon prior studies focused on patients with selected diagnoses (strokes and hip fractures), largely in post-acute care settings where rehabilitation is a core element of the treatment plan.[18-21] Comparing RD between hospitals and post-acute care settings is challenging, since unlike in SNFs, IRFs, or long-term acute care hospitals, rehabilitation for a hospitalized patient may not be the primary goal during acute illness, nor may it be indicated for patients without functional impairment or impairment so severe that achieving meaningful recovery during the hospitalization is unrealistic. Furthermore, SNFs and IRFs have regulatory requirements and financial incentives to deliver intensive rehabilitation therapy. Appreciating these differences between settings, our cohort received significantly less RD (median of 61.3 minutes/week, or 8.8 minutes/day) than what has been described for patients in post-acute care settings after hip fracture (mean of 79.0 and 139.0 minutes/day in SNFs and IRFs, respectively),[19] or for patients in an IRF after stroke (mean of 190.3 minutes/day).[18] While differences in RD are expected, a recent single-center randomized controlled trial demonstrated that an in-hospital exercise intervention of 200–280 minutes/week was effective in reversing functional decline among ambulatory older adults during acute hospitalization compared to usual care offered on the acute care for the elders unit, which included standard rehabilitation.[14] Given that less than one-third of hospitalized older adults recover to their preadmission functional level after discharge, with a high rate of long-term nursing home placement,[2,40] increasing RD, whether through greater PT/OT or formal exercise programs led by fitness specialists, should be explored further as a way to mitigate this decline.

Our most notable findings were the strikingly large disparities in RD among racial/ethnic minorities and those with limited English proficiency, especially since our study was conducted in a safety-net hospital where 80% of patients were non-white and nearly 40% did not speak English as a primary language. Black and Hispanic individuals on average received nearly one fewer hour of rehabilitation therapy per week than white individuals, which is approximately two to three fewer PT/OT sessions per week. These findings are important because previous studies have identified racial/ethnic disparities in the use of rehabilitation services among community-dwelling older adults,[41,42] as well as racial/ethnic disparities in functional outcomes following total knee arthroplasty,[33,35] inpatient stroke rehabilitation,[20,43,44] and hospitalization for acute illness.[25] Thus, inordinately large disparities in RD may contribute to known disparities in functional recovery. With respect to spoken language, we did not observe significant differences in RD between English and Spanish-speakers, perhaps due to the ubiquity of both in-person and telephonic Spanish

interpreters at this hospital. However, speaking a language other than English or Spanish was associated with approximately one fewer hour of rehabilitation therapy per week than English speakers, which may suggest suboptimal interpreter services or limited language concordance between these patients and therapists. Interventions addressing language barriers have potential to improve uptake of recommended healthcare services.[45] Future studies should examine whether providing greater rehabilitation to racial/ethnic and language minorities can help narrow the disparity gap.

What accounts for these disparities in RD? In a series of sensitivity analyses, we did not find evidence for either delays in or bias in clinician's referral patterns for PT or OT, as our findings were unchanged after including time to first therapy evaluation as a covariate in our models, or after excluding patients who did not receive any rehabilitation therapy. Our findings also do not support differential acceptance of rehabilitation by patients or their caregivers, since our findings were unchanged after accounting for attempted, but ultimately missed days of PT or OT, which is a proxy for patients declining therapy or having burdensome symptoms precluding participation. One potential explanation for these disparities is residual confounding in our analyses that did not fully account for differences between functioning and mobility that stem from a lifelong experience of inequities. However, our findings were similar for the subset of patients who had a baseline assessment of mobility (AM-PAC) and ADL functioning (FIM self-care subscale). Alternatively, our findings may represent implicit or explicit racial bias among the therapists themselves since physical and occupational therapists determine RD. Further research is needed to understand the potential cause of these disparities, including replication of our finding in other hospitals, ethnographic and qualitative studies exploring therapists' and patients' perceptions of the need for rehabilitation services and potential biases.

Prolonged mechanical ventilation and DNR code status were associated with significantly less rehabilitation when compared to non-ventilated and full code status, respectively. Less rehabilitation for mechanically ventilated patients may very well be appropriate and reflect lower exercise tolerance among this population. However, prior studies have shown that early mobilization and rehabilitation for this population are safe and effective for improving functional outcomes.[46-48] DNR status may be a proxy for terminal illness with poor rehabilitation potential. For these patients, less intensive rehabilitation may be warranted and aligned with goals of care to maximize comfort. However, it is also important to recognize that DNR does not necessarily equate to "do not rehabilitate," as worsening functional impairment that may be potentially mitigated with greater RD can lead to worsened quality of life[49] and increased caregiver burden.[50]

Our findings should be interpreted in the context of several limitations. First, the generalizability of our findings beyond this hospital is unknown. However, we included a diverse sample of consecutive older adults hospitalized for a range of diagnoses. Also, considering that the mission of this safety-net hospital is to provide medical care for underserved and uninsured populations, there could be even greater disparities in RD in non-safety net settings, especially for patients with limited English proficiency where language translation services may be inadequate. The magnitude and scope of our findings are concerning and should be explored across other hospitals and health systems. Second, race/

ethnicity and language spoken was determined from the EHR, which may differ if self-assessed by patients or their caregivers. Misclassification in race/ethnicity or language however would bias our findings to the null of no difference. Third, our findings may not generalize to older adults with shorter hospital stays.

In this study, we identified large disparities in RD by race/ethnicity, language, code status, and ventilation status among older adults admitted to a safety-net hospital, independent of clinical severity and mobility impairment. Disparities in RD may contribute to known disparities in functional recovery. Therefore, increasing RD for racial/ethnic minorities, those with limited English proficiency, and clinically vulnerable older adults (mechanical ventilation and DNR status) should be explored as a way to achieve better functional outcomes and narrow the disparity gap. Further research is warranted to verify the consistency of our findings across other hospitals and health systems, and if confirmed, investigate the potential reasons for these disparities and their impact on functional status, mobility, return to independent living, and caregiver burden.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Key Points

- Among 1,031 prolonged hospitalizations, older adults received an average of approximately one hour of rehabilitation therapy per week
- Minority race/ethnicity, limited English proficiency, prolonged mechanical ventilation, and do-not-resuscitate code status were associated with less rehabilitation.

Why Does this Paper Matter?

Providing greater rehabilitation to racial/ethnic and language minorities and clinically vulnerable older adults (mechanical ventilation and do-not-resuscitate code status) may narrow the disparity gap in functional recovery after hospitalization.

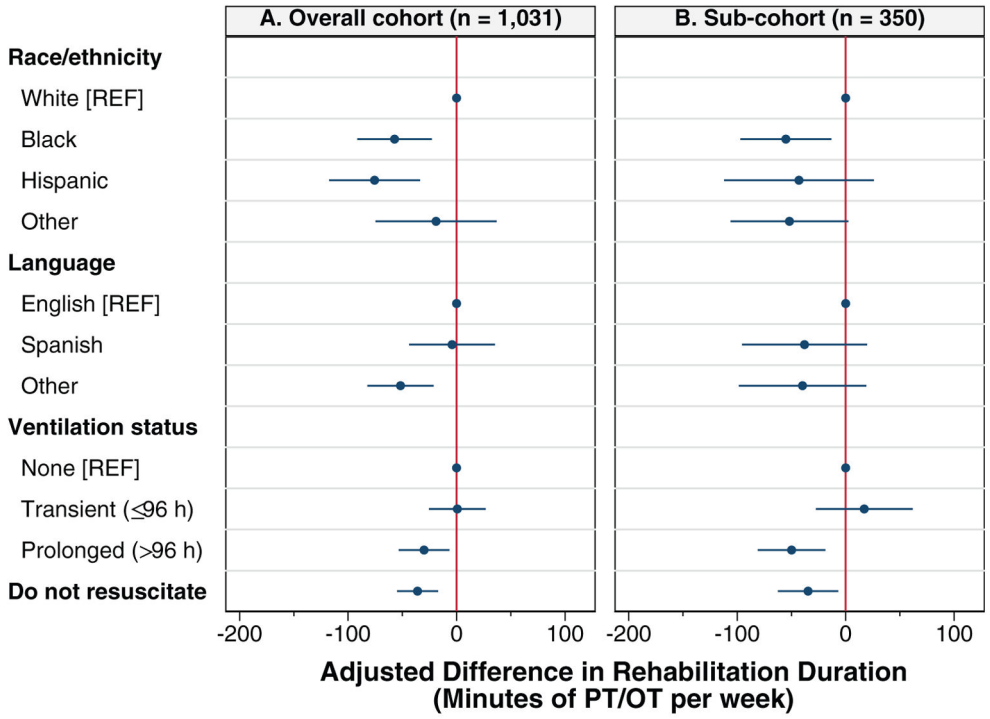

Figure 1.

Selected adjusted differences in rehabilitation duration. (A) Point estimates and corresponding 95% confidence intervals (CIs) shown are average marginal effects computed from a generalized linear model adjusted for race/ethnicity, language, age, sex, primary payer, living arrangement, any prior impairment in activities of daily living, home medical equipment use, admission source, hospital length of stay, intensive care unit length of stay, cognitive status during hospitalization, major diagnostic category, and diagnosis resource intensity. (B) Same analysis as the overall cohort with the addition of mobility limitation as an ordinal covariate. Abbreviations: OT, occupational therapy; PT, physical therapy.

Table 1.

Patient Characteristics

Characteristic	Overall cohort (n = 1,031)	Sub-cohort with mobility assessment (n = 350)
Sociodemographic		
Age in years, median (IQR)	72.1 (67.8–77.5)	72.5 (68.1–77.6)
Female, n (%)	507 (49.2)	165 (47.1)
Race/ethnicity, n (%)		
White	220 (21.3)	82 (23.4)
Black	342 (33.2)	108 (30.8)
Hispanic	393 (38.1)	137 (39.1)
Other	76 (7.4)	23 (6.6)
Language, n (%)		
English	624 (60.5)	210 (60.0)
Spanish	353 (34.2)	123 (35.1)
Other	54 (5.2)	17 (4.9)
Primary payer, n (%)		
Private/commercial	31 (3.0)	15 (4.3)
Medicare	701 (68.0)	236 (67.4)
Medicaid	222 (21.5)	70 (20.0)
Charity, self-pay, or other	77 (7.5)	29 (8.3)
Lives alone, n (%)	235 (22.8)	77 (22.0)
Clinical characteristics		
Any ADL impairment, n (%)[a]	495 (48.0)	159 (45.3)
Home DME use, n (%)[b]		
None	392 (38.0)	116 (31.1)
Cane or walker	339 (32.9)	131 (37.4)
Wheelchair or hospital bed	300 (29.1)	103 (29.4)
Admit from NH/SNF/IRF, n (%)	76 (7.4)	17 (4.9)
Non-elective admission, n (%)	928 (90.0)	311 (88.9)
Length of stay, days, median (IQR)	20.0 (16.3–27.0)	20.1 (16.2–25.9)
ICU length of stay, n (%)		

Characteristic	Overall cohort (n = 1,031)	Sub-cohort with mobility assessment (n = 350)
None	527 (51.1)	174 (49.7)
≤3 d	98 (9.5)	36 (10.29)
>3 d	406 (39.4)	140 (40.0)
Mobility limitation (%), median (IQR)[c]	-	56 (36–77)
Any cognitive dysfunction, n (%)[d]	691 (67.0)	227 (64.9)
Mechanical ventilation status, n (%)		
None	820 (80.0)	277 (79.1)
Transient (≤96 h)	75 (7.3)	30 (8.6)
Prolonged (>96 h)	131 (12.7)	43 (12.3)
Do not resuscitate, n (%)	230 (22.3)	71 (20.3)
Charlson comorbidity index, median (IQR)	4 (2–7)	5 (2–7)
MS-DRG type, n (%)		
Medical	546 (53.0)	164 (46.9)
Surgical	485 (47.0)	186 (53.1)
MS-DRG weight, median (IQR)	2.0 (1.5–3.9)	2.19 (1.5–3.8)
Select major diagnostic categories, n (%)		
Infectious	167 (16.2)	56 (16.0)
Circulatory system	133 (12.9)	53 (15.1)
Nervous system	108 (10.5)	35 (10.0)
MSK/connective tissue	82 (8.2)	37 (10.6)
Respiratory system	78 (7.6)	24 (6.9)
Procedure class, n (%)[e]		
None	129 (12.5)	34 (9.7)
Minor procedure	439 (42.6)	132 (37.7)
Major procedure	463 (44.9)	184 (52.6)

Abbreviations: ADL, activities of daily living; DME, durable medical equipment; ICU, intensive care unit; IQR, interquartile range; IRF, inpatient rehabilitation facility; MS-DRG, Medicare severity-diagnosis related group; MSK, musculoskeletal; NH, nursing home; SNF, skilled nursing facility.

[a] Requiring assistance with feeding, bathing, toileting, or overall activities of daily living.

[b] Patients with multiple types of home medical equipment were assigned to mutually exclusive categories using the following hierarchy: wheelchair/hospital bed > cane/walker > none.

[c] Calculated using either the AM-PAC “5-Clicks” Basic Mobility or AM-PAC “6-Clicks” Basic Mobility functional outcome tool.[27]

[d] Defined as patients with dementia, delirium, altered mental status, confusion, or cognitive dysfunction documented at any point during hospitalization.

[e] Categorized according to the Agency for Healthcare Research and Quality Healthcare Cost and Utilization Project's Procedure Classes.[26] If >1 procedure during the hospitalization, the most invasive one was used.

Table 2.

Rehabilitation Duration Among Hospitalized Older Adults with Prolonged Hospitalization

	Median minutes of PT/OT per week (IQR)	
	Overall cohort (n = 1,031)	**Sub-cohort with mobility assessment (n = 350)**
Total therapy	61.3 (16.5–127.3)	83.8 (33.8–144.2)
Occupational therapy	22.9 (0.0–59.3)	32.4 (8.3–69.0)
Physical therapy	35.4 (10.3–70.7)	51.3 (21.1–82.1)

Abbreviations: IQR, interquartile range; OT, occupational therapy; PT, physical therapy.

Table 3.

Adjusted Differences in Rehabilitation Duration[a]

Characteristic	Adjusted difference in minutes of PT/OT per week (95% CI)			
	Overall cohort (n = 1,031)	*P*-value	Sub-cohort with mobility assessment (n = 350)	*P*-value
Sociodemographic				
Age, per 10 years	16.6 (2.9, 30.3)	.017	−8.1 (−27.8, 11.7)	.425
Female sex	4.9 (−13.6, 23.4)	.605	16.6 (−9.6, 42.9)	.214
Race/ethnicity				
White	[REF]	—	[REF]	—
Black	−57.2 (−91.4, −22.9)	.001	−55.2 (−96.8, −13.6)	.009
Hispanic	−75.6 (−117.4, −33.8)	.000	−43.1 (−111.9, 25.8)	.220
Other	−18.9 (−74.8, 36.9)	.506	−51.9 (−106.0, 2.3)	.061
Language				
English	[REF]	—	[REF]	—
Spanish	−4.2 (−43.7, 35.4)	.837	−37.9 (−95.7, 19.8)	.198
Other	−51.7 (−82.0, −21.3)	.001	−39.8 (−98.4, 18.9)	.184
Primary payer				
Medicare	[REF]	—	[REF]	—
Commercial/private	44.5 (−10.7, 99.7)	.114	9.4 (−31.4, 50.2)	.652
Medicaid	19.9 (−8.5, 48.4)	.170	25.9 (−9.1, 61.0)	.147
Other	28.9 (−12.7, 70.5)	.173	30.3 (−19.1, 79.7)	.230
Lives alone	6.9 (−16.9, 30.6)	.571	13.5 (−18.3, 45.2)	.406
Clinical characteristics				
Any ADL impairment	−7.7 (−28.8, 13.4)	.474	−10.3 (−38.0, 17.5)	.468
Home DME use				
None	[REF]	—	[REF]	—
Cane/walker	41.0 (18.1, 63.9)	.000	19.9 (−11.4, 51.1)	.212
Wheelchair/hospital bed	25.6 (1.8, 49.4)	.035	−8.1 (−39.4, 23.3)	.614
Admit from NH/SNF/IRF	−73.2 (−91.3, −55.0)	.000	−38.7 (−93.5, 16.0)	.165
Mobility limitation (%)				
0–20	—	—	[REF]	—

Characteristic	Adjusted difference in minutes of PT/OT per week (95% CI) Overall cohort (n = 1,031)	*P*-value	Sub-cohort with mobility assessment (n = 350)	*P*-value
21–40	—	—	39.8 (15.2, 64.3)	.001
41–60	—	—	92.0 (65.5, 118.5)	.000
61–80	—	—	130.0 (88.0, 172.0)	.000
>80	—	—	95.4 (63.0, 127.8)	.000
Length of stay, per week[b]	−5.9 (−11.5, −0.3)	.040	−9.2 (−17.3, −1.0)	.028
ICU length of stay				
None	[REF]	—	[REF]	—
≤3 d	37.2 (−1.4, 75.7)	.059	−8.2 (−42.5, 26.1)	.640
>3 d	11.0 (−11.2, 33.1)	.333	−3.3 (−34.5, 27.9)	.837
Mechanical ventilation status				
None	[REF]	—	[REF]	—
Transient (≤96 h)	0.7 (−25.5, 26.8)	.959	17.1 (−27.5, 61.7)	.452
Prolonged (>96 h)	−30.0 (−53.3, −6.6)	.012	−49.9 (−81.2, −18.6)	.002
Cognitive dysfunction	13.9 (−6.7, 34.6)	.187	−2.9 (−32.8, 27.0)	.847
Do not resuscitate	−36.0 (−54.8, −17.1)	.000	−34.7 (−62.3, −7.1)	.014
MS-DRG type—surgical	37.4 (−65.1, 139.9)	.475	−160.0 (−329.0, 9.1)	.064
MS-DRG weight, per 1 unit	4.5 (1.2, 7.7)	.007	9.1 (4.0, 14.3)	.001
Select MDCs				
Other	[REF]	—	[REF]	—
Nervous system	189.4 (118.2, 260.6)	.000	167.5 (87.4, 247.5)	.000
Infectious	−18.6 (−39.0, 1.8)	.074	−8.2 (−40.9, 24.4)	.620
Circulatory system	−32.2 (−54.1, −10.2)	.004	−10.1 (−41.8, 21.6)	.532
MSK and connective tissue	68.2 (20.1, 116.2)	.005	48.2 (−7.4, 103.9)	.089
Respiratory system	−29.1 (−55.8, −2.5)	.032	−5.2 (−48.3, 38.0)	.814
Procedure type				
None	[REF]	—	[REF]	—
Minor	−68.8 (−134.7, −2.9)	.041	−59.6 (−119.1, −0.2)	.049
Major non-elective	−98.5 (−231.9, 34.9)	.148	49.3 (−106.2, 204.8)	.534
Major elective	−74.9 (−219.2, 69.3)	.309	169.6 (−90.9, 430.1)	.202

Abbreviations: ADL, activities of daily living; DME, durable medical equipment; ICU, intensive care unit; IRF, inpatient rehabilitation facility; MDC, major diagnostic category; MSK, musculoskeletal; MS-DRG, Medicare Severity-Diagnosis Related Group; NH, nursing home; OT, occupational therapy; PT, physical therapy; SNF, skilled nursing facility.

[a] Average marginal effects were computed from a multivariable generalized linear model that included all covariates listed in this table.

[b] Length of stay was modeled as a continuous variable and scaled per 7 days for ease of interpretation.

Table 4.

Sensitivity Analyses for Selected Adjusted Differences in Rehabilitation Duration

Characteristic	Adjusted difference in minutes of PT/OT per week (95% CI)					
	Overall cohort (n = 1,031)	Excludes neurologic diagnoses (n = 923)	Excludes no rehabilitation (n = 905)[a]	Time to first evaluation (n = 905)[b]	Missed sessions (n = 1,031)[c]	Mobility and functional assessment (n = 191)[d]
Race/ethnicity						
White	[REF]	[REF]	[REF]	[REF]	[REF]	[REF]
Black	−57.2 (−91.5, −22.8)	−52.8 (−84.0, −21.6)	−57.7 (−92.6, −22.8)	−49.9 (−79.5, −20.4)	−60.0 (−96.7, −23.4)	−60.4 (−121.0, 0.3)
Hispanic	−75.6 (−117.5, −33.7)	−69.9 (−107.8, −32.0)	−79.8 (−122.1, −37.6)	−63.9 (−99.4, −28.3)	−75.6 (−119.3, −31.9)	−80.5 (−231.2, 70.1)
Other	−18.9 (−74.8, 36.9)	−8.6 (−60.5, 43.3)	−12.6 (−71.3, 46.0)	−31.0 (−75.6, 13.7)	−32.3 (−90.3, 25.6)	−54.0 (−135.1, 27.1)
Language						
English	[REF]	[REF]	[REF]	[REF]	[REF]	[REF]
Spanish	−4.2 (−43.7, 35.4)	0.0 (−36.5, 36.4)	2.0 (−39.3, 43.3)	4.3 (−31.9, 40.5)	−0.8 (−43.5, 41.9)	−20.3 (−160.9, 120.4)
Other	−51.7 (−82.1, −21.2)	−41.9 (−68.4, −15.3)	−55.6 (−88.0, −23.2)	−43.5 (−76.1, −10.8)	−48.9 (−82.1, −15.7)	−30.9 (−123.5, 61.8)
Ventilation status						
None	[REF]	[REF]	[REF]	[REF]	[REF]	[REF]
Transient (≤96 h)	0.7 (−25.5, 26.8)	5.0 (−18.2, 28.3)	−7.2 (−31.6, 17.2)	−2.1 (−24.4, 20.1)	1.0 (−27.0, 29.1)	−0.8 (−62.6, 60.9)
Prolonged (>96 h)	−30.0 (−53.3, −6.6)	−22.5 (−44.0, −1.1)	−33.6 (−57.2, −10.1)	−19.6 (−41.1, 1.9)	−26.7 (−51.9, −1.6)	−83.5 (−122.2, −44.8)
Do not resuscitate	−36.0 (−54.9, −17.0)	−25.5 (−42.8, −8.3)	−30.7 (−50.5, −11.0)	−28.3 (−46.0, −10.6)	−42.6 (−62.4, −22.8)	−54.5 (−83.6, −25.5)

Abbreviations: AM-PAC, Activity Measure for Post-Acute Care; FIM, Functional Independence Measure; OT, occupational therapy; PT, physical therapy.

[a] Excluded hospitalizations during which no therapy was provided.

[b] Adjusted for the number of days between admission and first therapy session.

[c] Adjusted for the number of days in which a PT or OT session was attempted but missed.

[d] Adjusted for mobility limitation (AM-PAC) and functional status (FIM self-care subscale).