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The subsequent course of disability in older persons discharged to a skilled nursing facility after an acute hospitalization

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Abstract

Objectives—To evaluate the association between the type of acute hospitalization and subsequent course of disability in older persons discharged to a skilled nursing facility (SNF).

Design—Longitudinal study of 754 community-living persons aged 70 or older.

Participants—The analytical sample included 365 participants who had one or more admissions to a SNF after an acute hospitalization (n=520 index admissions).

Measurements—Information on hospitalizations, SNF admissions, and disability was ascertained over 15 years. The primary and secondary outcomes were disability burden and recovery of prehospital function, respectively, assessed monthly over a 6-month period. Index admissions were classified into four mutually exclusive groups based on the type of hospitalization: elective major surgery, non-elective major surgery, critical illness, and other.

Results—Disability worsened considerably after hospitalization for each of the four groups. Relative to elective major surgery, the disability burden over 6 months was significantly greater for non-elective major surgery, critical illness, and other hospitalizations, with adjusted rate ratios (RRs) of 1.37 (95% CI 1.19 to 1.59), 1.37 (95% CI 1.19 to 1.58), and 1.29 (95% CI 1.14 to 1.47), respectively. Overall, recovery to pre-hospital function was observed in only 132 (25.4%) admissions. Relative to elective major surgery, the likelihood of recovering pre-hospital function was considerably lower for each of the three other groups. The results were consistent for basic, instrumental and mobility activities.

Conclusion—Among older persons discharged to a SNF after an acute hospitalization, the functional course over 6 months was generally poor, with recovery to pre-hospital function observed in only one out of every four cases. Relative to elective major surgery, functional outcomes were worse for non-elective major surgery, critical illness, and other hospitalizations.

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Conflict of interest
None.

Keywords

older; skilled nursing facility; hospitalization; disability burden; functional recovery

1. Introduction

Illnesses and injuries leading to hospitalization are potent precipitants of functional decline and disability in community-living older persons (Covinsky and others 2011; Ferrucci and others 1997; Gill and others 2004). In addition, after an acute hospitalization, approximately 50% of disabled older persons are transferred to a nursing home (Gill and others 2009b), usually for Medicare-reimbursed subacute care (i.e. skilled nursing facility (SNF)) (Buntin 2007). Subacute care is designed to optimize functional status and address ongoing medical conditions. Prior research, however, has found that only a minority of older persons who were admitted to a SNF with new or worsening disability after an acute hospitalization returned home at (or better than) their premorbid level of function (Gill and others 2009b). Why some of these disabled older persons recover and others do not is not fully known. The paucity of data regarding this issue is problematic given the high rate of transfers between the SNF and other sites of care, including the community (Murtaugh and Litke 2002), and the importance of functional status to independent living.

Prior studies have suggested that older age, cognitive status, physical frailty, habitual physical activity, social support, depressive symptoms, and pre-hospital function are important determinants of functional recovery (Abrahamsen and others 2014; Al Snih and others 2003; Covinsky and others 2003; Gill and others 2004; Gill and others 2009a; Hansen and others 1999; Hardy and Gill 2005; Mudge and others 2010; Wojtusiak and others 2016; Young and others 2011). However, relatively little is known about the role of the intervening illness or injury leading to the hospitalization on the subsequent course of disability (e.g., functional recovery). We postulated that the likelihood of recovery after an episode of subacute care would vary considerably based on the type of intervening event leading to the hospitalization (e.g., critical illness, non-elective major surgery, elective major surgery, and others). If this hypothesis is confirmed, more aggressive efforts may be warranted to prevent the occurrence of these intervening events, to manage them more effectively, and to reduce subsequent complications.

Using data from a unique longitudinal study of older persons who have been followed monthly for about 15 years, we set out to evaluate the association between the type of acute hospitalization and subsequent course of disability in older persons discharged to a SNF.

2. Methods

2.1 Study population

Participants were drawn from the Yale Precipitating Events Project (PEP), a longitudinal study of 754 initially nondisabled, community-living persons, 70 years or older assembled between March 1998 and October 1999 (Gill 2014; Gill and others 2004; Gill and others 2001; Hardy and Gill 2004). In brief, potential participants were members of a large health

plan in greater New Haven, CT. Exclusion criteria included significant cognitive impairment (Gill and others 2002) with no available proxy, inability to speak English, diagnosis of a terminal illness with a life expectancy less than 12 months, or a plan to move out of the area. Significant cognitive impairment was defined either as recall of 0 of 3 items on short-term memory testing (from the Folstein Mini-Mental State Examination [MMSE] (Folstein and others 1975)) or as score < 20 on the MMSE and recall of 1 or 2 of 3 items on the short-term memory test (Gill and others 2002). The participation rate was 75.2%. The Yale Human Investigation Committee approved the study protocol, and all participants provided verbal informed consent.

2.2 Data collection

Comprehensive home-based assessments were completed at baseline and subsequently at 18-month intervals for 180 months (except at 126 months), and telephone interviews were completed monthly through June 30, 2014. During the comprehensive assessments, data were collected on demographic characteristics, body mass index, nine self-reported, physician diagnosed chronic conditions (i.e., hypertension, myocardial infarction, congestive heart failure, stroke, diabetes mellitus, arthritis, hip fracture, chronic lung disease, and cancer), physical frailty (Gill and others 2006), cognitive status (Folstein and others 1975), and depression symptoms (Kohout and others 1993). Deaths were ascertained from local obituaries or an informant during a subsequent interview. Through June 30, 2014, 613 (81.3%) participants had died after a median of 98 months, while 43 (5.7%) had dropped out of the study after a median of 26 months. Data were otherwise available for 99.2% of the 81,150 monthly interviews. Among those who have not dropped out of the study, completion of the comprehensive assessments ranged from 98.4% at 18 months to 100% at 180 months.

2.3 Assessment of disability

Complete details regarding the assessment of disability, including formal tests of reliability and accuracy, are provided elsewhere (Gill and others 2002). During the monthly telephone interviews, participants were asked, “At the present time, do you need help from another person to (complete the task)?” for each of 4 basic activities (bathing, walking, dressing, and transferring), 5 instrumental activities (shopping, housework, meal preparation, taking medications, and managing finances), and 3 mobility activities (walk ¼ mile, climb flight of stairs, and lift/carry 10 lb). For these 12 activities, disability was operationalized as the need for personal assistance (Gill and others 2013). Participants were also asked about a 4th mobility activity, “Have you driven a car during the past month?” Participants who respond “No” were deemed to have stopped driving. To maintain consistency with the other activities, these participants were classified as being “disabled” in driving (Gill and others 2012). The reliability of these assessments was high, with a kappa ranging from 0.75 to 1.0 (Hardy and Gill 2004).

2.4 Ascertainment of SNF admissions following a hospitalization

Hospitalizations through 2013 were identified using Medicare claims and monthly interviews with subsequent review of medical records, allowing us to capture both fee-for-service (FFS) and non-FFS admissions, respectively. About 406 (78%) of hospitalizations were identified from the Medicare claims. Information was collected on dates of hospital

admission and discharge, diagnoses on admission and discharge, major procedures, intensive care unit (ICU) stays, and discharge destination (e.g. SNF) (Inouye and others 1998). All diagnoses and procedures were coded using International Classification of Diseases, Ninth Revision. All SNF admissions following a hospitalization were identified using both Medicare claims and the Centers for Medicare and Medicaid Services (CMS) Minimum Data Set.

2.5 Assembly of analytic sample

The analytic sample included participants who were discharged to a SNF for subacute care immediately following an acute hospitalization (Figure 1). To ensure that participants were accurately characterized by key covariates, the analyses were restricted to the first qualifying admission (observation) within each 18-month interval, i.e. the time between the comprehensive assessments when the covariates were updated. As in prior studies (Ferrante and others 2015; Gill and others 2009a; Gill and others 2009b; Gill and others 2013), participants could contribute more than one admission to the analyses, thereby making full use of the longitudinal data. Among the 365 participants in the analytic sample, 249 had one qualifying admission, 85 had two, 24 had three, 6 had four, and 1 had five.

2.6 Type of acute hospitalization

According to prior studies (Cota and others 2005; Ferrante and others 2015; Haider and others 2015; Kurki and others 2003; Kwok and others 2011; Violette and others 2006), index admissions were classified into four mutually exclusive groups based on the type of hospitalization: elective major surgery, non-elective major surgery, critical illness, and other. Major surgery was defined using a restricted set of International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) procedure codes for surgeries occurring in an operating room, as described in an earlier report (Kwok and others 2011). Major surgeries identified from Medicare claims were categorized as elective or non-elective by a CMS indicator variable. Those identified by self-report were categorized as elective or non-elective based on review of the medical records. Critical illness was defined on the basis of admission to an ICU, including general, specialty, and coronary care units, but excluding psychiatric or intermediate critical (Ferrante and others 2015). The remaining hospitalizations were classified as “other”; and length of stay (LOS) was considered for this group (Gill and others 1999).

2.7 Statistical Analysis

The primary outcome was disability burden (i.e., no. of disabilities), based on 13 basic, instrumental and mobility activities over the 6 months following the hospitalization, adjusted for pre-hospital function (i.e., no. of disabilities) (Gill 2014; Gill and others 2015; Gill and others 2013). The secondary outcome was functional recovery, defined as time (in months) to return to the community within 6 months at (or beyond) the pre-hospital level of function, based on the 13 functional activities (Barry and others 2011; Gill and others 2009a). This was determined by comparing the number of disabilities during the first monthly interview completed after discharge from the SNF with that during the monthly interview completed immediately before the hospitalization (Gill and others 2009a). To determine whether our findings were consistent across the three functional domains, we also evaluated disability

burden and functional recovery in the 4 basic, 5 instrumental, and 4 mobility activities, respectively.

We evaluated the characteristics of the index admissions (observations) according to the type of hospitalization, using means ($\pm$ standard deviation [SD]) or counts (percentages). We then evaluated the disability burden over the 6-month follow-up period according to the type of hospitalization.

To evaluate the longitudinal association between the type of acute hospitalization and disability burden (primary outcome), we used a generalized estimating equation Poisson model with a first order autoregressive covariance structure to account for correlation among the monthly interviews within the same participant (Diggle and others 1994). Rate ratios (RR) and 95% confidence intervals (CI), representing the predicted number of disabilities over the 6 months, were estimated for non-elective major surgery, critical illness, and other hospitalizations, relative to elective major surgery (reference). Covariates in the multivariable model included age, sex, race, living alone (vs. with others), education, body mass index, nine self-reported, physician-diagnosed chronic conditions, and 3 other factors that have been strongly linked to disability in prior studies (Stuck and others 1999): physical frailty, cognitive impairment, and depressive symptoms. The time-varying covariates were updated using data from the comprehensive assessment that immediately preceded the hospitalization. As in prior studies (Gill and others 2012; Gill and others 2013), the number of months since the prior comprehensive assessment was included as a covariate. In addition, follow-up time (i.e. number of months after the acute hospitalization) was included to account for unmeasured factors that might affect the course of disability (Gill and others 2015). For the other hospitalization group, we evaluated whether disability burden differed based on the severity of the underlying illness as assessed by hospital LOS, using a value ≥ 7 days (median value) as the cut-off (Gill and others 1999; Sager and others 1996). The analyses were repeated for each of the three functional domains.

To evaluate the relationship between the type of acute hospitalization and functional recovery (secondary outcome), we used a competing risk Cox regression model for recurrent events (Fine and Gray 1999; Tinetti and others 2014; Vaz Fragoso and others 2012). To account for the correlation among the monthly interviews within the same participant, we used the robust sandwich variance estimators for standard errors of the coefficients (Lin and Wei 1989). The exact method was used to handle tied outcome times when two or more recovery events were observed in the same month. The multivariable analysis included the previous set of covariates. For the other hospitalization group, we evaluated the association between severity of illness (denoted by LOS) and functional recovery. These models were rerun for each of the three functional domains.

Because admissions accrued over the course of 15 years, we tested for the presence of a calendar time effect. A $P < 0.05$ (two-tailed) was considered to indicate statistical significance. All analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC).

3. Results

As shown in Table 1, the overall average age was approximately 85 years, and the majority were female and white. The average (SD) pre-hospital disability score was 5.3 (3.7). Of the 520 index admissions, 79 (15.2%) were categorized as elective major surgery, 71 (13.7%) as non-elective major surgery, 67 (12.9%) as critical illness, and 303 (58.3%) as other hospitalizations. The elective major surgery group generally had the most favorable characteristics, with the lowest prevalence of physical frailty (31.7%) and cognitive impairment (5.1%) and the lowest age and pre-hospital disability scores.

Figure 2 plots the longitudinal course of disability in all 13 functional activities over the 6-month follow-up period according to the type of acute hospitalization. Disability worsened considerably after hospitalization for each of the four groups and remained elevated, relative to pre-hospital function, throughout the 6-month follow-up period for all groups other than elective surgery. Cumulative mortality over 6 months was lowest in the elective major surgery group (5.1%) and highest in the critical illness group (19.1%). Similar results were observed for basic, instrumental, and mobility activities, respectively (Figure S1).

Table 2 provides the associations between the type of acute hospitalization and disability burden. Compared with elective major surgery, the burden of disability over 6 months was considerably greater in each of the three other groups, with adjusted RRs of 1.37 (95% CI 1.19 to 1.59) for non-elective major surgery, 1.37 (95% CI 1.19 to 1.58) for critical illness, and 1.29 (95% CI 1.14 to 1.47) for other hospitalizations. The results were comparable for each of the three functional domains. For the other hospitalizations, older persons with longer LOS had marginally higher disability burden (adjusted RR 1.06; 95% CI 1.00 to 1.13), as shown in Figure S2A. The results were generally consistent for the three functional domains.

Among the 520 index admissions, 364 (70.0%) returned to the community after a median duration of 3 months (interquartile range [IQR] 2–4). The corresponding values for the four groups were 75 (94.9%) and 3 months (IQR 2–3) for elective major surgery, 59 (83.1%) and 3 months (IQR 3–4) for non-elective major surgery, 44 (65.7%) and 3 months (IQR 2–3) for critical illness, and 186 (61.4%) and 3 months (IQR 2–4) for other hospitalizations. Overall, recovery to pre-hospital function was observed in only 132 (25.4%) admissions. Recovery was highest for the elective major surgery group ($n=32$, 40.5%) and was comparable in the other 3 groups: nonelective major surgery ($n=16$, 22.5%), critical illness ($n=16$, 23.9%), and other hospitalizations ($n=68$, 22.4%).

Table 3 provides the associations between the type of acute hospitalization and functional recovery. Compared with elective major surgery, the likelihood of recovering pre-hospital function was considerably lower for each of the three other groups, although the adjusted result for non-elective major surgery was only marginally significant. Similar results were observed for each of the three functional domains, although the adjusted result for mobility did not achieve statistical significance for non-elective major surgery. For the other hospitalizations, the likelihood of functional recovery was reduced in the setting of longer LOS, but these results were statistically significant for only basic activities (Figure S2B).

When calendar time was included in the multivariable models (for the primary and secondary outcomes), the results did not change appreciably.

4. Discussion

In this prospective study of community-living older persons discharged to a SNF for subacute care after an acute hospitalization, we found that the functional course over 6 months was generally poor, with recovery to pre-hospital function observed in only one out of every four cases. Furthermore, the type of acute hospitalization was strongly associated with the subsequent course of disability. Relative to those who were hospitalized for elective major surgery, older persons with non-elective major surgery, critical illness, and other hospitalizations had greater disability burden and a lower likelihood of recovering pre-hospital function. These findings provide new information about the deleterious effects of acute hospitalization on the disabling process and raise concerns about the effectiveness of subacute care in restoring premorbid function after an acute hospitalization.

Although the population at risk for costly subacute care is increasing (Spillman and Lubitz 2002), the course of disability among older persons who are discharged for subacute care after an acute hospitalization is not fully understood (Buurman and others 2016; Gill and others 2009b; Neuman and others 2014; Wojtusiak and others 2016). An earlier study found that the most common functional course among those who were discharged to a SNF with new or worsening disability was returning home with disability (46.3%), and only 32.4% returned home at (or beyond) the pre-hospital level of function (Gill and others 2009b). Although several prior studies have evaluated factors associated with poor functional outcomes after subacute care (Abrahamsen and others 2014; Gill and others 2009a; Wojtusiak and others 2016; Young and others 2011), none has evaluated the type of acute hospitalization leading to subacute care. The availability of monthly data on functional status and hospitalizations, combined with high quality data from CMS and medical records on hospitalizations and subsequent SNF admission, provided us with a unique opportunity to address this important gap in knowledge.

We found that functional outcomes were considerably better for older persons hospitalized for elective major surgery than those hospitalized for non-elective major surgery, critical illness, or other reasons, and that these differences persisted despite adjustment for a comprehensive set of potential confounders, including older age, cognitive status, physical frailty, and pre-hospital function (among others) (Al Snih and others 2003; Covinsky and others 2003; Gill and others 2004; Gill and others 2009a; Hansen and others 1999; Hardy and Gill 2005; Mudge and others 2010). We recognize, of course, that older persons having elective major surgery likely represent a selected group with better prognosis than those hospitalized for other reasons and that we could not fully account for potential confounders. Nonetheless, only about 40% of older persons who received subacute care after an acute hospitalization for elective major surgery returned home at (or better) than their pre-hospital level of function in this study. The likelihood of recovery was substantially worse for the other three groups, ranging from 45% lower for non-elective major surgery to 59% lower for critical illness.

These poor functional outcomes raise concerns about the effectiveness of subacute care in restoring pre-morbid function after acute hospitalization, even among older persons having major elective surgery. Evaluating the reasons for these poor functional outcomes was beyond the scope of the current manuscript, but should be the focus of future work. It's possible, for example, that functional recovery is impeded by the inability to tolerate or receive adequate rehabilitation during the subacute SNF stay. Additional research is needed to better understand how geriatric rehabilitation can be improved.

This study has several strengths. Through the use of Medicare claims, Minimum Data Set, monthly interviews and review of medical records, the ascertainment of acute hospitalizations leading to subacute SNF admissions was likely complete. The validity and generalizability of our results are strengthened by the monthly assessments of functional status, the high reliability and accuracy of these assessments, and the low rate of attrition and missing data due to losses to follow-up. Finally, the availability of data from comprehensive assessments that were completed every 18 months allowed us to adjust for a large array of pre-hospital factors that could have confounded the associations between type of acute hospitalization and functional course.

Our study has several limitations. First, because our study participants were members of a single health plan in a small urban area and were oversampled for slow gait speed (Gill 2014), the results may not be generalizable to older persons in other settings. This limitation is offset, at least in part, by our high participation rate (>75%) and the similar demographic profile of our cohort with the US population at large (Gill and others 2004). Second, despite 15 years of follow-up, the number of SNF admissions was not sufficiently large to detect statistically significant differences in outcomes among the non-elective major surgery, critical illness and other hospitalization groups. The quantitative differences in outcomes between these groups, however, were relatively small, especially for recovery to pre-hospital function. Indeed, for example, researchers have reported some differences in other outcomes between emergency and elective surgery (Haider and others 2015). Third, the other hospitalizations group was likely heterogeneous, since it included all acute hospitalizations other than critical illness and major surgery; furthermore, it might mix conditions that directly impair physical function (e.g., stroke) with conditions (e.g., pneumonia) where hospitalization can lead to deconditioning and loss of physical function. In addition to indicators like hospital LOS, granular information about the SNF stay would be needed to elucidate this important issue in future research.

In summary, among older persons discharged to a SNF after an acute hospitalization, the course of disability over 6 months is generally poor, with recovery to pre-hospital function observed in only one out of every four cases. Furthermore, relative to those who were hospitalized for elective major surgery, older persons with non-elective major surgery, critical illness, and other hospitalizations had worse subsequent course of disability. These findings provide additional evidence for the deleterious effects of acute hospitalizations, including major elective surgery, and highlight the need to evaluate the effectiveness of subacute/geriatric rehabilitation in restoring premorbid function after hospitalization.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights for review

- Functional course over 6 months was generally poor for persons discharged to a SNF
- Only about 25% cases had recovery to pre-hospital function after hospitalization
- The type of hospitalization was associated with the subsequent course of disability
- The findings above were consistent for basic, instrumental and mobility activities.

Figure 1.
Assembly of the analytic sample from the parent cohort.

									Cum Mortality(%)
Elective major surgery	No. at risk	79	79	79	77	76	76	75	
	# deaths	0	0	0	2	1	0	1	4 (5.1)
Non-elective major surgery	No. at risk	71	71	67	63	63	63	62	
	# deaths	0	0	4	4	0	0	1	9 (12.7)
Critical illness	No. at risk	67	67	64	60	58	57	56	
	# deaths	0	0	3	4	2	1	1	11 (16.4)
Other hospitalizations	No. at risk	303	303	283	270	260	252	244	
	# deaths	0	0	20	13	10	8	7	58 (19.1)

Figure 2.

The longitudinal course of disability in all 13 functional activities over the 6-month follow-up period according to the type of acute hospitalization. Values represent the mean number of disabilities, accompanied by 95% confidence intervals (CI). 0 on the x-axis denotes preadmission to the hospital. Data were missing for 1 admission (observation) at 6 months in the other hospitalizations group.

Table 1

Characteristics of qualifying SNF admissions in analytic sample according to the type of acute hospitalization

Characteristic	Total	Elective major surgery	Non-elective major surgery	Critical illness	Other hospitalizations
No.	520	79	71	67	303
Age (years), mean $\pm$ SD	84.7 $\pm$ 5.6	81.2 $\pm$ 4.6	86.1 $\pm$ 6.0	82.3 $\pm$ 5.0	85.8 $\pm$ 5.4
Female, n (%)	364 (70.0)	57 (72.2)	48 (67.6)	37 (55.2)	222 (73.3)
Non-Hispanic white, n (%)	468 (90.0)	71 (89.9)	69 (97.2)	62 (92.5)	266 (87.8)
Education (years), mean $\pm$ SD	11.8 $\pm$ 2.9	12.5 $\pm$ 2.6	12.4 $\pm$ 2.9	11.9 $\pm$ 2.9	11.5 $\pm$ 2.8
Living alone, n (%)	287 (55.2)	50 (63.3)	28 (39.4)	37 (55.2)	172 (56.8)
No. of chronic conditions ^a , mean $\pm$ SD	2.4 $\pm$ 1.3	2.3 $\pm$ 1.3	2.0 $\pm$ 1.3	2.3 $\pm$ 1.2	2.5 $\pm$ 1.4
Body mass index ^b 30 kg/m ² , n (%)	99 (19.0)	22 (27.9)	7 (9.9)	14 (20.9)	56 (18.5)
Physical frailty ^c , n (%)	312 (60.0)	25 (31.7)	39 (54.9)	32 (47.8)	216 (71.3)
MMSE score ^c <24, n (%)	132 (25.4)	4 (5.1)	16 (22.5)	17 (25.4)	95 (31.4)
CES-D score ^d 20, n (%)	125 (24.0)	15 (19.0)	15 (21.1)	11 (16.4)	84 (27.7)
No. of pre-hospital disabilities ^e , mean $\pm$ SD					
All activities (0–13)	5.3 $\pm$ 3.7	3.0 $\pm$ 2.8	4.1 $\pm$ 3.4	4.1 $\pm$ 3.4	6.4 $\pm$ 3.6
Basic activities (0–4)	0.6 $\pm$ 1.1	0.2 $\pm$ 0.7	0.4 $\pm$ 0.8	0.4 $\pm$ 0.8	0.8 $\pm$ 1.2
Instrumental activities (0–5)	2.4 $\pm$ 1.8	1.2 $\pm$ 1.3	1.9 $\pm$ 1.7	2.1 $\pm$ 1.8	3.0 $\pm$ 1.8
Mobility activities (0–4)	2.2 $\pm$ 1.4	1.6 $\pm$ 1.4	1.8 $\pm$ 1.3	1.7 $\pm$ 1.3	2.6 $\pm$ 1.4

MMSE, Mini-Mental State Examination; CES-D, Center for Epidemiologic Studies Depression scale; SD, standard deviation; SNF, skilled nursing facility. The study unit is a person-admission (or observation) rather than a participant.

^aBased on nine self-reported, physician-diagnosed conditions, including hypertension, myocardial infarction, heart failure, stroke, diabetes mellitus, arthritis, hip fracture, chronic lung disease, and cancer.

^bTime greater than 10 seconds to walk back and forth over a 10-ft [3-m] course as quickly as possible.

^cRange: 0–30.

^dSex-adjusted score on the CES-D, range: 0 to 60.

^eBased on the 13 functional activities during the monthly interview that was completed immediately prior to the hospitalization.

Table 2
Associations between type of acute hospitalization and disability burden in older persons discharged to a SNF

	Models	Non-elective major surgery		Critical illness		Other hospitalizations	
		Rate ratio (95% CI)	P	Rate ratio (95% CI)	P	Rate ratio (95% CI)	P
All activities	Unadjusted	1.60 (1.31 to 1.95)	<0.001	1.62 (1.33 to 1.96)	<0.001	1.84 (1.56 to 2.16)	<0.001
	Adjusted ^a	1.37 (1.19 to 1.59)	<0.001	1.37 (1.19 to 1.58)	<0.001	1.29 (1.14 to 1.47)	<0.001
Basic activities	Unadjusted	1.94 (1.39 to 2.72)	<0.001	2.14 (1.53 to 3.00)	<0.001	2.56 (1.91 to 3.41)	<0.001
	Adjusted ^a	1.54 (1.18 to 2.03)	0.002	1.67 (1.26 to 2.22)	<0.001	1.53 (1.18 to 1.98)	0.001
Instrumental activities	Unadjusted	1.61 (1.33 to 1.95)	<0.001	1.62 (1.34 to 1.96)	<0.001	1.77 (1.52 to 2.08)	<0.001
	Adjusted ^a	1.39 (1.20 to 1.60)	<0.001	1.38 (1.20 to 1.59)	<0.001	1.28 (1.13 to 1.46)	<0.001
Mobility activities	Unadjusted	1.47 (1.26 to 1.71)	<0.001	1.41 (1.21 to 1.65)	<0.001	1.61 (1.41 to 1.84)	<0.001
	Adjusted ^a	1.36 (1.21 to 1.52)	<0.001	1.33 (1.18 to 1.49)	<0.001	1.29 (1.16 to 1.43)	<0.001

SNF, skilled nursing facility; CI, confidence intervals.

As described in Method, Poisson models were run using generalized estimating equations with a first order autoregressive covariance structure to account for correlation among the monthly interviews within the same participant. Disability burden was operationalized as the mean number of disabled activities of daily living (e.g., from 0 to 13 for all activities). Rate ratio represents the predicted number of disabilities over the 6 months relative to elective surgery group (reference).

^a Adjusted for the following covariates: age, sex, race, education, living alone, number of chronic conditions, body mass index, physical frailty, mini-mental state examination score <24, Center for Epidemiologic Studies Depression scale score >=20, pre-hospital function (based on 13 functional activities, or relevant domain of activities), number of months since the prior comprehensive assessment, and follow-up time (i.e. number of months after the acute hospitalization).

Table 3
Associations between type of acute hospitalization and functional recovery in older persons discharged to a SNF

	Models	Non-elective major surgery		Critical illness		Other hospitalizations	
		Hazard Ratio (95% CI)	P	Hazard Ratio (95% CI)	P	Hazard Ratio (95% CI)	P
All activities	Unadjusted	0.45 (0.26 to 0.79)	0.005	0.32 (0.23 to 0.78)	0.006	0.39 (0.26 to 0.60)	<0.001
	Adjusted ^a	0.55 (0.30 to 1.00)	0.050	0.41 (0.22 to 0.77)	0.005	0.44 (0.27 to 0.72)	0.001
Basic activities	Unadjusted	0.50 (0.33 to 0.76)	0.001	0.40 (0.25 to 0.63)	<0.001	0.33 (0.24 to 0.45)	<0.001
	Adjusted ^a	0.64 (0.42 to 0.98)	0.040	0.44 (0.28 to 0.69)	<0.001	0.45 (0.32 to 0.64)	<0.001
Instrumental activities	Unadjusted	0.48 (0.28 to 0.83)	0.009	0.45 (0.26 to 0.79)	0.005	0.52 (0.35 to 0.76)	<0.001
	Adjusted ^a	0.55 (0.31 to 0.97)	0.039	0.43 (0.24 to 0.78)	0.006	0.57 (0.36 to 0.91)	0.020
Mobility activities	Unadjusted	0.54 (0.35 to 0.83)	0.006	0.40 (0.23 to 0.69)	0.001	0.48 (0.34 to 0.67)	<0.001
	Adjusted ^a	0.69 (0.43 to 1.11)	0.126	0.43 (0.24 to 0.75)	0.003	0.54 (0.37 to 0.79)	0.001

SNF, skilled nursing facility; CI, confidence intervals.

^a Adjusted for the following covariates: age, sex, race, education, living alone, number of chronic conditions, body mass index, physical frailty, mini-mental state examination score <24, Center for Epidemiologic Studies Depression scale score ≥20, pre-hospital function (based on 13 functional activities, or relevant domain of activities), and the number of months since the prior comprehensive assessment.