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Predictors of Hospitalization Among Newly Admitted Skilled Nursing Facility Residents: Rethinking the Role of Functional Decline

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Abstract

Purpose: Hospital transfer from a skilled nursing facility (SNF) is costly, and many are potentially preventable. This study examines: 1) whether functional decline is a predictor of hospital transfer, and 2) the magnitude of relationships between predictors (functional impairment and chronic medical illness) and hospital transfer from SNFs.

Methods: We used Minimum Data Set (MDS) Version 2.0 in the state of Michigan between 2007 and 2009. In total, 196,662 new SNF admissions were observed. Multilevel generalized estimating equations and regression models were performed for each functional and clinical domain while adjusting for demographic variables and change in activities of daily living (ADL).

Results: 65% of recently admitted SNF residents experienced functional decline after SNF admission, and 58% were readmitted to a hospital. Residents who needed extensive assistance or were completely dependent in their functional domains had pressure ulcers, deteriorated mood or lower cognitive performance scale scores. These residents experienced higher chances of hospital transfer. However, a deteriorated ADL played a significant role in all multivariate models, indicating that a decline in ADL is a stronger predictor of hospital transfer than other functional or clinical predictors.

Conclusion: Although all functional impairments and chronic medical illness can be associated with hospital transfer, functional decline may be the most important predictor of hospital transfer in patients newly admitted to an SNF. (*J Patient-Centered Res Rev.* 2014;1:70-76.)

Keywords

hospitalization, Medicare, physical activity, skilled nursing facility

Introduction

Medicare spending on post-acute care is defined as payments for short-term care after a hospitalization. Such care is typically provided at skilled nursing facilities (SNFs), and the cost has more than doubled over the past 10 years.[1] SNF services comprise an increasing share of Medicare spending and accounted for $33 billion in 2011.[2] Hospital admission from an SNF is costly. Hospital stay and cost was, on average, 6.0 days and $9,200 for SNF residents compared to 4.9 days and $7,900 for community-dwelling elderly patients.[2] Reports show that one-fourth of SNF residents will return to the hospital within 30 days,[3] with an estimated cost of $14.3 billion in 2011.[4] That financial burden is then compounded by the added expenditure of transferring residents from SNF to the hospital. In total, 40% of hospital transfers from SNFs may be either unnecessary or avoidable, meaning that the resident could have been cared for safely at a lower level of care and at lower cost.[5] Approximately one-fourth of hospital admissions from SNFs were found to be attributable to ambulatory care-sensitive conditions, which were associated with potentially avoidable hospitalizations.[6] Several interventions have been suggested to achieve a reduction in hospital admissions from SNFs.[7,8]

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It is clear that a reduction in hospital admissions from SNFs would relieve the financial burden on public resources.[9] To achieve this goal, it is vital to understand who is vulnerable to hospital admissions from SNFs. Studies have reported that decisions regarding such hospital admissions vary by the specific characteristics of the SNF. In a short-stay SNF, acute illness is known to be a factor in the decision to transfer to a hospital,[10,11] but, in a long-term care facility, chronic illness (physical impairment, pressure ulcer or cognitive impairment) and primary diagnosis during SNF admission are found to be decisive factors.[12] This poses a dilemma in predicting hospital transfers from a short-stay SNF, because it is difficult to foresee who is more vulnerable to hospital admission until acute illness actually happens.

Functional decline during or after hospitalization occurs in at least one-third of community-dwelling elderly regardless of the type of acute illness.[13] Reasons for functional decline in older adults are often explained through the concept of "hazards of hospitalization."[14] Hospitalization, combined with the aging process, accelerates functional decline through hospital-associated adverse outcomes, such as enforced immobilization, deprived sensorium and malnutrition.[15] Previous studies found that functional recovery after hospitalization is more closely associated with the severity of functional impairment than other chronic clinical predictors.[16-18] Thus, hospitalization has been regarded as an intervening predictor of functional recovery or as a core contributor to functional impairment.[18,19]

However, the reasons behind hospital transfer from SNFs, except for acute illness, are largely unknown. To improve our understanding of hospital transfer among newly admitted SNF residents, our goal in this study was to determine the relationships between predictors (functional impairment and chronic medical illness) and hospital transfer. We hypothesized that hospital admission among newly admitted SNF residents would be less common in the absence of functional impairment. The magnitude of the relationship between predictors and hospital transfer is also compared.

Methods

Study Data and Design

We used Minimum Data Set (MDS) Version 2.0 in the state of Michigan between 2007 and 2009. The MDS, part of the federally mandated process for clinical assessment of all residents in Medicare- or Medicaid-certified SNFs, is a process that provides a comprehensive assessment of each nursing facility resident's functional capabilities. MDS assessment forms are completed for all residents in certified SNFs, regardless of source of payment, and are required for residents on admission to the nursing facility. Electronic MDS information from SNFs is compiled into state databases, which are then captured into the national MDS database at Centers for Medicare & Medicaid Services.

Among the 1,539,972 observations that were available during the period, we selected residents who held Medicare Part A, were newly admitted to SNFs and had completed an admission assessment. This population had an average length of SNF stay of 4 weeks. After excluding 10,956 observations because of incomplete data, 196,662 of 207,618 (94.7%) observations were used for the analysis (Figure 1). As each SNF admission was treated separately, this represented 149,143 individual patients.

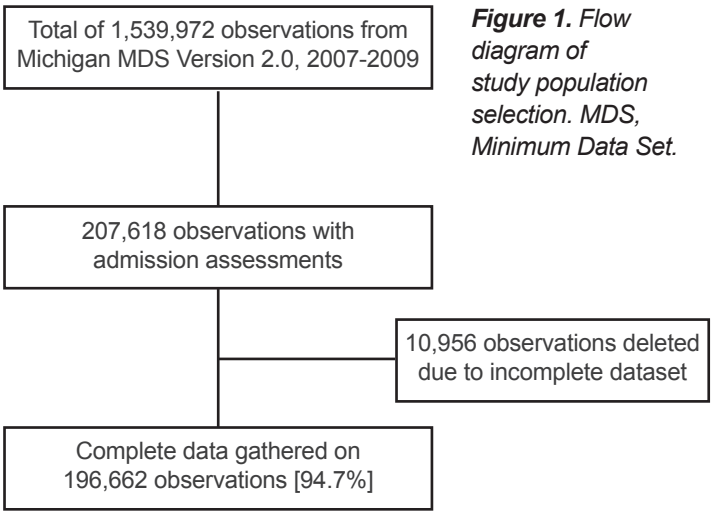

Figure 1. *Flow diagram of study population selection. MDS, Minimum Data Set.*

Hospitalization during SNF stay was considered as the dependent variable. Each new hospitalization of a particular patient was considered an independent case. With little known about the role of functional decline in hospital transfer, we elected to conduct an exploratory study of some potential indicators of functional decline and their effects on the likelihood of hospital transfer. Independent variables therefore included the following: 1) functional domains (transfers, dressing, eating and change in activities of daily living [ADL]); and 2) clinical domains (pressure ulcers, change in mood and cognition). Change in ADL was categorized by either "decline" or "no change or improved" in the last 90 days. Change in ADL was directly reported by the SNF resident. This variable was specifically explored because dynamic ADL status was previously reported as a predictor of nursing home placement and death of older adults.[20] Pressure ulcers included any type or severity. Change in mood was categorized into either "deteriorated" or "no change or improved" within 90 days. Cognition was divided

into either "mild or no dementia" (cognitive performance scale [CPS] score 0-3) or "moderate or severe dementia" (CPS score 4-6). Among preliminarily selected clinical domains, there was significant multicollinearity (defined as variance inflation factor ≥10) between: 1) pressure ulcers and bladder incontinence, 2) change in mood and weight loss, and 3) cognition and fall. We selected pressure ulcers, change in mood and cognition for our analysis. In order to investigate the pure effect of geriatric syndromes, we did not select common acute illnesses of hospital admission such as urinary tract infection or congestive heart failure. MDS data was not linked to hospital data. The Institutional Review Board of Michigan Institute for Clinical and Health Research approved this study.

Statistical Analysis

We used Pearson's chi-square test of independence to separately examine the level of association between each resident characteristic in the functional and clinical domains and the binary outcome of hospitalization. We also examined the effects of resident characteristics on hospitalization through the development of generalized estimating equation (GEE) models. With many small clusters, i.e. SNFs, included in our study, the use of GEE models allowed for greater efficiency in estimation of regression parameters while accounting for correlated responses from patients within clusters.[21] For each domain, we developed a global model of hospitalization that included all possible explanatory variables from within the domain. We also developed multiple submodels of hospitalization, each of which included a single functional or clinical domain variable and several resident demographic variables to control for the effects of age, race, education level and gender. In all models, the logit link was used to model the log of the odds, and an unstructured working correlation matrix was used to estimate within-cluster similarity of residuals. The best models and, hence, the best functional and clinical domain predictors of hospitalization were determined using the quasilikelihood-under-the-independence-model criterion (QIC) statistic to compare submodels with their respective global model. In both full and reduced models, resident demographic variables were included to control for the effects of age, race, education level and gender. We used SAS Version 9.3 (SAS Institute Inc., Cary, NC) unstructured covariance matrix for all calculations and analyses.

Results

Table 1 shows the characteristics of Michigan SNF residents during 2007-2009. In total, 53.5% (105,247/196,662) of new SNF admissions resulted in subsequent admission to the hospital and, in 22.5% of cases, individuals were admitted two or more times. Residents age >65 years, female, white and those with a college-level education accounted for most of the SNF utilization as well as hospitalizations.

Table 1. *Characteristics of study participants*

	Total		Hospitalization		No hospitalization		
	N	%	N	%	N	%	P-value
Total MDS observations	196,662	100%	105,247	53.5%	91,415	46.5%	<0.0001
Year							
2007	63,207	32.1%	34,149	32.4%	29,058	31.8%	<0.0001
2008	66,700	33.9%	35,225	33.5%	31,475	34.4%	
2009	66,755	33.9%	35,873	34.1%	30,882	33.8%	
Age							
<50	5,234	2.7%	3,392	3.2%	1,842	2.0%	<0.0001
50-64	20,456	10.4%	12,816	12.2%	7,640	8.4%	
≥65	170,972	86.9%	89,039	84.6%	81,933	89.6%	
Sex							
Male	68,378	34.8%	37,666	35.8%	30,712	33.6%	<0.0001
Female	128,284	65.2%	67,581	64.2%	60,703	66.4%	
Race							
American Indian/Alaskan Native	420	0.2%	229	0.2%	191	0.2%	<0.0001
Asian/Pacific Islander	562	0.3%	317	0.3%	245	0.3%	
Black	26,341	13.4%	12,955	12.3%	13,386	14.6%	
Hispanic	1,790	0.9%	868	0.8%	922	1.0%	
White	167,549	85.2%	90,878	86.3%	76,671	83.9%	
Education							
No schooling	18,894	9.6%	10,784	10.2%	8,110	8.9%	<0.0001
Up to high school	33,558	17.1%	18,851	17.9%	14,707	16.1%	
Some college	143,012	72.7%	75,030	71.3%	67,982	74.4%	
More than bachelor's	1,198	0.6%	582	0.6%	616	0.7%	

Note: Total number of residents was 149,143 [hospitalization (85,861, 57.6%), no hospitalization (63,282, 42.4%)]. Since unit of analysis is patient's each Minimum Data Set (MDS) observation in this study, univariate analysis was presented as each patient's MDS observations.

Table 2. *Bivariate analysis of functional and clinical domains*

	Total		Hospitalization		No hospitalization		
	N	%	N	%	N	%	P-value
Transfer self-performance							
Independent, Supervision, Limited Assistant	71,930	36.6%	32,516	30.9%	39,414	43.1%	<0.0001
Extensive Assistant, Total Dependent	124,732	63.4%	72,731	69.1%	52,001	56.9%	
Dressing self-performance							
Independent, Supervision, Limited Assistant	59,679	30.3%	27,710	26.3%	31,969	35.0%	<0.0001
Extensive Assistant, Total Dependent	136,983	69.7%	77,537	73.7%	59,446	65.0%	
Eating self-performance							
Independent, Supervision, Limited Assistant	170,243	86.6%	90,114	85.6%	80,129	87.7%	<0.0001
Extensive Assistant, Total Dependent	26,419	13.4%	15,133	14.4%	11,286	12.3%	
Pressure ulcers							
None	160,467	81.6%	85,165	80.9%	75,302	82.4%	<0.0001
Stage 1,2,3,4	36,195	18.4%	20,082	19.1%	16,113	17.6%	
Change in mood							
Improved or no changes	180,474	91.8%	95,476	90.7%	84,998	93.0%	<0.0001
Deteriorated	16,188	8.2%	9,771	9.3%	6,417	7.0%	
Cognition performance scale (CPS)							
CPS score [0-3]	176,994	90.0%	96,536	91.7%	80,458	88.0%	<0.0001
CPS score [4-6]	19,668	10.0%	8,711	8.3%	10,957	12.0%	
Change in activities of daily living							
Improved or no changes	69,102	35.1%	18,647	17.7%	50,455	55.2%	<0.0001
Deteriorated	127,560	64.9%	86,600	82.3%	40,960	44.8%	

Table 3. *Multivariate analysis of functional domains*

		Estimates	Odds ratio	P-value
Full model	Transfer self-performance			
	Extensive Assistant, Total Dependent	0.29	1.34	<0.0001
	Independent, Supervision, Limited Assistant			
	Dressing self-performance			
	Extensive Assistant, Total Dependent	0.06	1.06	0.043
	Independent, Supervision, Limited Assistant			
	Eating self-performance			
	Extensive Assistant, Total Dependent	0.02	1.02	0.626
	Independent, Supervision, Limited Assistant			
	Change in ADL function			
	Deteriorated	1.85	6.33	<0.0001
	Improved or no changes			
Model 1	Transfer self-performance			
	Extensive Assistant, Total Dependent	0.257	1.29	<0.0001
	Independent, Supervision, Limited Assistant			
	Change in ADL function			
	Deteriorated	1.842	6.31	<0.0001
	Improved or no changes			
Model 2	Dressing self-performance			
	Extensive Assistant, Total Dependent	0.140	1.15	<0.0001
	Independent, Supervision, Limited Assistant			
	Change in ADL function			
	Deteriorated	1.858	6.41	<0.0001
	Improved or no Changes			
Model 3	Eating self-performance			
	Extensive Assistant, Total Dependent	0.105	1.11	0.001
	Independent, Supervision, Limited Assistant			
	Change in ADL function			
	Deteriorated	1.878	6.54	<0.0001
	Improved or no changes			

Note: Adjusted for year, age, gender, race and education. ADL, activities of daily living.

Table 2 represents a bivariate analysis of the functional and clinical domains; 65% of recently admitted SNF residents experienced functional decline after hospitalization. Residents who needed extensive assistance or were completely dependent in their functional domains (transfers, dressing and eating) were more likely to be admitted to a hospital. In addition, SNF resident characteristics, such as having pressure ulcers, deteriorated mood and intact cognition or mild dementia, were associated with higher risk of hospitalization. While bivariate comparisons of all the aforementioned six items were highly statistically significant, in some cases the absolute difference was not clinically significant. This reflects the magnitude of the statistical power of this study. ADL decline (also statistically associated with hospitalization) exhibited the highest percentage risk differential. Those hospitalized following SNF admission were nearly twice as likely to have experienced deterioration of ADL as those not hospitalized.

The results of our multivariate analysis are presented in Table 3 (functional domains) and Table 4 (clinical domains). After adjusting for SNF residents' demographic features (admission year, age, gender, race and education) and change in ADL, we first examined the full model that included all variables of interest for each functional and clinical domain, then examined each functional and clinical domain. Our investigation suggested that regression estimates and adjusted odds ratios (OR) for the full model and each independent model were similar in terms of functional and clinical domain. Residents who needed extensive assistance or were completely dependent in their functional domains had higher chances of being hospitalized (OR=1.29, 1.15 and 1.11 for transfer, dressing and eating, respectively). Interestingly, ADL decline played the most significant role in all multivariate models, implying that the chances of a resident with ADL decline being hospitalized are much higher than that of other functional domain variables (OR=6.31, 6.41 and 6.54 for transfer, dressing and eating self-performance, respectively). The results from the multivariate analysis of clinical domains also resulted in similar trends. Residents with pressure ulcers, deteriorated mood, and mild or no dementia had higher odds of hospitalization (OR=1.36, 1.11 and 1.59, respectively). As noted, however, ADL decline had a higher impact on hospitalization than did clinical domains (OR=6.53, 6.50 and 6.47 for pressure ulcers, deteriorated mood and mild or no dementia, respectively).

Table 4. *Multivariate analysis of clinical domains*

		Estimates	Odds ratio	P-value
Full model	Pressure ulcer			
	Stage 1,2,3,4	0.334	1.40	<0.0001
	None			
	Change in mood			
	Deteriorated	0.122	1.13	0.001
	Improved or no changes			
	Cognition performance scale (CPS) score			
	CPS score [0-3]	0.495	1.64	<0.0001
	CPS score [4-6]			
	Change in ADL function			
	Deteriorated	1.860	6.42	<0.0001
	Improved or no changes			
Model 1	Pressure ulcer			
	Stage 1,2,3,4	0.307	1.36	<0.0001
	None			
	Change in ADL function			
	Deteriorated	1.877	6.53	<0.0001
	Improved or no changes			
Model 2	Change in mood			
	Deteriorated	0.102	1.11	<0.0001
	Improved or no changes			
	Change in ADL function			
	Deteriorated	1.871	6.50	<0.0001
	Improved or no changes			
Model 3	CPS score			
	CPS score [0-3]	0.465	1.59	<0.0001
	CPS score [4-6]			
	Change in ADL function	1.867	6.47	<0.0001
	Deteriorated			
	Improved or no changes			

Note: Adjusted for year, age, gender, race and education. ADL, activities of daily living.

Discussion

In this 3-year, exploratory, statewide observation study, we found that 57.6% of recently admitted SNF residents were admitted to a hospital at least once, and 22.5% were admitted two or more times. Approximately two-thirds of SNF residents experienced functional decline. Although all functional impairment and chronic medical illnesses were associated with hospital transfer, ADL decline was the strongest predictor of hospital admission.

The magnitude of association found between ADL decline and hospital admission in this study was higher than in prior research.[17,20,22] Compared to other studies in which this relationship was examined in a community-based setting, our study participants were more vulnerable to functional decline in a post-acute care setting.[17,20,22] Furthermore, contrary to other studies using more static disability or ADL decline,[17,18,20,22] we chose recent ADL decline as a variable reflecting dynamic change of functional status. Consistent with the findings of previous studies, moderate or severe dementia was negatively associated with hospital admission.[12,23] This may be because residents with moderate or severe dementia may have a less aggressive advance-care plan than those with mild or no dementia.

It has been suggested that reduced functional reserve can explain the occurrence of new or additional disability after hospitalization.[14,24,25] The interactions between hospitalization and aging lead to additional tiers in the cascade toward dysfunction and disability.[14,24,25] The results of our study indicated that reduced functional reserve would result in functional decline at post-acute care, which would result in higher vulnerability to acute illness and subsequent hospital admissions. On the basis of our findings, this explanation could be extended to health care utilization between hospitals and the post-acute care setting. However, the process of functional decline leading to vulnerability and acute illness still requires more explanation. Dysregulation of multiple physiological systems and their interrelations in the frailty model may reduce this gap.[14,24,25] By viewing functional decline as a multiphysiological systems dysregulation instead of a single system failure, the "traction effect" crosses functional domains and leads to greater vulnerability to acute illness and hospital admission.

This viewpoint is consistent with the findings of a recent longitudinal study that indicated functional impairment induced by acute illness and hospitalization persists and muscle strength does not change during or after hospitalization, regardless of the kind of functional impairment and despite recovery from the acute illness.[26]

Given these results, functional decline at SNFs has several practical implications. Functional decline may be used as a sensitive indicator of increased vulnerability to acute illness and concomitant hospital transfer. Functional decline, considered as geriatric syndrome, should be a particular focus for SNF clinicians to reduce the "revolving door" effect (transfers to and from the hospital).[4] These efforts could help to reduce Medicare-related financial burdens. Two studies about reducing the "revolving door" effect suggest the promising role of applying intensive rehabilitation therapy in functionally declining seniors in both acute hospital and post-acute care settings.[27,28] Rehabilitation therapy in these settings can reduce both transitions from hospital to post-acute care settings and hospital admissions from post-acute care settings.[27,28] These studies identified magnified effects of rehabilitation therapy in subsets of more physically impaired groups.[27,28]

Medicare payments to SNF were recently reformed to reduce incentives for unnecessary care and high costs.[29,30] One potential funding option is to bundle a range of post-acute care services together (SNF, home health, inpatient rehabilitation, and long-term care hospitals) into one payment that would cover all services within 90 days after a hospital discharge.[29,30] Our findings could inform large-scale policy changes that consider the dynamics of hospitalization for vulnerable older persons.

The main strength of the present study is the use of a large (>1 million observations), statewide, multiyear database with a low missing data rate (5.3%). In addition, to the best of our knowledge, this is the first study presenting dynamic functional decline as a stronger predictor of hospital admissions from SNFs than clinical predictors or individual functional impairment. Our study may have limited interpretations, as we did not validate the reproducibility of our findings across diverse acute illnesses (i.e. urinary tract infection and congestive heart failure). Another limitation is due to the nature of MDS Version 2.0; the data collected relied entirely on SNF resident statements, which may have contributed to a potential recall bias. Also, information was not available on the severity or type of hospital transfers from SNFs, and our analysis did not include time since last hospitalization or use time-dependent modeling. It is likely that certain hospital admissions would be nonemergent (e.g. restorative joint replacement for severe degenerative joint diseases), and therefore may have biased the data. Inclusion of repeated admissions of the same patient may have exaggerated or mitigated the apparent effects of certain variables.

Conclusion

In this exploratory study of the Michigan MDS, 65% of recently admitted SNF residents experienced functional decline after hospitalization and 58% were admitted to a hospital. Although all functional impairments and chronic medical illness were associated with hospital admissions, functional decline was the strongest predictor of hospital transfer. Practices and policies that focus on maintaining or improving patient ADL status may significantly prevent hospital readmission following SNF admission, thereby improving patient quality of life and saving millions of health care dollars.

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Conflicts of Interest

None.

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