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Risk Factors for Nursing Home Use After Hospitalization for Medical Illness

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Background. Hospitalization, a sentinel event for many older persons, may mark a transition from independent living to either community-based or institutionalized long-term care. We determined the independent risk factors, including loss of function, of nursing home (NH) admission at hospital discharge and NH use at 3 months after hospital discharge among a diverse group of hospitalized older persons.

Methods. The subjects in this study were 1,265 noninstitutionalized persons from phase II of Hospital Outcomes Project for the Elderly. Using multiple logistic regression, we modeled NH admission with variables measured at the time of hospital admission as well as with length of stay (LOS) and decline in ADL independence from hospital admission to discharge. In addition, we modeled NH use at 3 months after hospital discharge with variables measured at the time of hospital discharge as well as with post-hospital measures of rehospitalization and decline in ADL independence following hospitalization.

Results. The independence risk factors of NH placement at discharge are geographic site, increasing age, living alone, and low baseline ADL independence, LOS, and decline in ADL independence during hospitalization. The independent predictors for NH use at 3-month follow-up are increasing age, living alone, mental status, low discharge ADL independence, LOS, and decline in ADL independence during the 3 months after discharge.

Conclusions. Simple but different clinical variables predict NH use at hospital discharge and at 3 months. Furthermore, functional loss during and after hospitalization is an important independent risk factor of nursing home use and is a clinical outcome that may be modified to decrease the likelihood of NH admission.

HOSPITALIZATION is a sentinel event for many older persons because it often is associated with the onset of increased disability (1). As such, it may mark a transition from independent living to either community-based or institutionalized long-term care. As the population ages and as health delivery evolves, the transition from hospital to nursing home (NH) will continue to gain in importance as an essential component of routine care for acute illness.

A thorough understanding of this transition is important if ways to improve the continuum of care for older persons are to be found. This includes elucidating the risk factors and outcomes of the transition from hospital to NH. Although much is known about risk factors for NH admission after hospitalization (2–15), many of the factors, such as age, gender, and race, cannot be acted upon. One factor, which is both an important risk factor of NH admission and potentially modifiable, is *function*.

Hospitalization for acute medical illness is frequently associated with functional losses. These losses have been attributed to a variety of cumulative and interactive effects, including acute illness, iatrogenic complications, and deconditioning. In spite of the well-established relationship between hospitalization and NH admission, little is known about how changes in functional status during and after a hospital stay influence the risks of short- and long-term institutionalization.

The purpose of this study was to determine, among a diverse group of older persons hospitalized for acute medical illness, the risk factors for nursing home admission at hospital discharge and NH use at 3 months following hospital discharge. This study answers two related questions: First, at the time of hospital admission, what are the demographic, medical, and functional risk factors for discharge to a nursing home? Are illness and hospital-related risk factors, specifically length of stay and loss of function, additional independent risk factors? Second, at the time of hospital discharge, what are the demographic, functional, illness, and hospital risk factors for living in a nursing home at 3 months after discharge? Are post-hospitalization factors — specifically loss in function and rehospitalization — additional independent risk factors?

METHODS

Sample

The sample comprised a subgroup of older persons who were enrolled at five hospitals participating in the Hospital Outcomes Project for the Elderly (HOPE). These sites are Cedars-Sinai Medical Center, Los Angeles, CA; University Hospitals of Cleveland, OH; Saint Mary's Medical Center, Madison, WI; Stanford University Hospital, Palo Alto, CA; and Yale New Haven Hospital, New Haven, CT. HOPE is a prospective multicenter pooled analysis of related, yet distinct clinical trials designed to improve the functional outcomes of acute hospitalization in older persons. The rationale and design of HOPE, as well as specific inclusion and exclusion criteria for each site, are described elsewhere (16).

Common exclusion criteria at each site included terminal illness, severe cognitive impairment, inability to obtain informed consent, and admission to an intensive care unit. Of the 1,823 persons enrolled in HOPE, the following were excluded from this analysis for these reasons: 49 were living in NHs prior to admission; 286 were admitted with a primary surgical diagnosis; 80 died during hospitalization; and 143 had either absent (n = 87) or incomplete ADL (n = 56) information. Thus, the resultant study sample (N = 1,265) consists of those older persons with ADL data who were not residing in a nursing home prior to the hospitalization and who were admitted to the hospital for medical illness.

Measures

The five participating hospitals prospectively collected data according to predetermined data collection protocols at three time points: at hospital admission, at hospital discharge, and at 3 months after hospital discharge. All data were obtained from the subjects by trained interviewers. If data could not be obtained from the subject, information was obtained from surrogates. Participant self-reports accounted for 90% of admission, 85% of discharge, and 85% of 3-month follow-up data.

All admission measurements were recorded within 48 hours of hospital admission after obtaining informed consent. One area of the admission assessment included baseline demographic information. This consisted of age (in years), gender, race (White vs non-White), hospital site, treatment group (yes vs no), and living arrangements (living alone or with others).

Another area of assessment included function. An entry assessment of neurocognitve function was obtained using an abbreviated form of the Mini-Mental State Examination [MMSE (17)] that excluded 9 items. This was done because of concern about the ability of acutely ill subjects, many of them encumbered by intravenous therapies, to adequately perform particular tasks in the MMSE (e.g., folding a piece of paper, writing a sentence, and copying a diagram). For this reason, the maximum possible score for the remaining orientation, registration, attention, and recall items was 21 instead of the standard 30. Spearman's rank order correlation between the 21-item MMSE and the standard 30-item MMSE at the Madison site was $r = .90$ ($p < .01$).

During this same time, a retrospective assessment of preadmission function was obtained. Subjects were asked to report whether, at 2 weeks prior to admission, they needed the help of another person to perform six activities of daily living (dressing, bathing, eating, toileting, transferring from bed to chair, and walking). For each of these activities of daily living (ADLs), subjects were classified as either independent or dependent, based upon the need for the assistance of another person. A similar assessment of pre-admission ability to perform instrumental activities of daily living (IADLs; telephoning, shopping, using transportation, preparing meals, doing housework, taking medication, and managing finances) was also recorded. For each of these IADLs, subjects were classified as dependent if they required help, were not performing the activity, or were unable to perform the activity.

Information was also obtained at the time of discharge. Discharge ADL function was assessed in a similar manner by asking subjects to report whether they needed the help of another person to perform the same six ADLs at the time of discharge. Information about the ability to perform IADLs was not collected at discharge because it would have required an assessment of activities not performed during the hospitalization.

However, illness- or hospital-related variables were collected at discharge. Of the many different possible variables, only three were collected and included in this work. Hospital length of stay (LOS) in days, primary diagnosis, and secondary discharge diagnoses were recorded at this time. All discharge diagnoses were classified by medical records abstractors according to the International Classification of Disease, 9th rev., Clinical Modification Codes (ICD-9-CM).

At 3 months post-hospital discharge, subjects or their families were contacted by telephone about survival status, rehospitalization (yes vs no), and current ADL status as measured previously. IADL data were not included at this time point because nursing home residents would be dependent in these activities regardless of their potential ability to perform these activities.

NH Admission

Both at hospital discharge and at 3 months, subjects were queried about residing in a nursing home. Those persons not living in a NH include those who went home, to an assisted living facility, or to any other place (not a NH). Those persons residing in a NH at 3 months could be either persons who were admitted into a NH at hospital discharge and remained there at 3 months or persons who were discharged to a site other than a nursing home, but who were later admitted into a NH.

Analyses

We summarized the data at each of the three time points. An ADL sum was calculated to indicate the total number of ADLs in which the person required no assistance. This results in an ADL sum ranging between 0 and 6. This sum was calculated for the pre-admission, discharge, and 3 months post-discharge time points. The IADL sum was calculated at the pre-admission time point. The IADL sums can range from 0 to 7. Thus, subjects with an ADL sum of 6 and an IADL sum of 7 were performing all 13 activities without assistance.

Net changes in ADL scores were determined by comparing the difference between sums at two time points. Because (a) functional loss may be related to NH admission, and (b) improvement in function may not be linearly related to NH admission, we chose to model dummy variables of loss of ADL functioning (coded as yes = 1) in the multiple logistic regression models described below.

Primary diagnoses were divided into 14 different categories, which had various numbers of subjects and which were based on similar coding. The top four categories, representing 65% of the total primary diagnoses, were included in the analyses; the other categories, each representing less than

5% of the sample, were combined into an "other" category. The number of secondary diagnoses was calculated as an indication of comorbidity. Because two sites recorded a maximum of 4 secondary diagnoses, the number of secondary diagnoses was dichotomized as less than 4 vs 4 or more.

Two sets of logistic regression models were used to identify potential independent adjusted risk factors for the NH admission at the two different time points. The first set of models uses the outcome variable defined as Discharged from hospital to a NH vs Other sites. Two models were constructed: one containing only variables that can be measured at the time of hospitalization, and the other containing, in addition, the intervening variables, namely LOS and a decline in ADL sum. The second set of models uses the outcome variable defined as Residing in a NH at 3 months vs Other sites. In a similar vein, the first model contains the variables measured at hospital discharge while the second model, in addition, contains the intervening variables of rehospitalization and ADL sum decline after hospitalization. Two-way interactions of variables were evaluated to ensure that significant factors were not excluded; none were statistically significant and are not included in the models for simplicity of presentation.

Results

Table 1 shows the summary statistics of the study population. As expected, a majority of the sample were women (62.1%) with an average age of 79.2 ± 6.3 years. Over one-third of the subjects lived alone, and the hospital sites were widely distributed. The primary diagnoses varied widely, with two-thirds of the diagnoses being either circulatory, respiratory, digestive, or cancer. The percentage of persons with 4 or more secondary diagnoses was 51.3%. The prehospitalization (retrospective) ADL sum was 5.3 ± 1.4, the IADL sum was 4.9 ± 2.2, and the MMSE at hospitalization was 17.1 ± 4.0.

Figure 1 shows the many different transitions over time in residence for the study sample. One hundred five (8%) of 1,265 persons were discharged to a NH after hospitalization. Of these 105 persons, only 45 (43%) persons remained in the NH at 3 months. An additional 42 (4%) persons entered a NH during the 3-month period after hospital discharge. Over the 3-month period, 131 (10.4%) persons from the study sample died; 19 (18%) of 105 subjects discharged to a NH died during the 3-month follow-up.

Table 2 shows the results of the first set of logistic regressions. The independent risk factors (adjusted odds

Table 1. Characteristics of Study Sample

Variable	
Age (mean ± *SD*)	79.2 ± 6.3 years
Gender (*n*, % female)	786, 62.1%
Race (*n*, % White)	766, 60.6%
Live alone (*n*, %)	473, 37.7%
Site (*n*, %)	
Cedars Sinai	126, 10%
Cleveland	517, 40.9%
Stanford	134, 10.6%
St. Mary's	234, 18.5%
Yale	254, 20.1%
Primary diagnosis (*n*, %)	
Circulatory	329, 26.6%
Respiratory	240, 19.4%
Digestive	179, 14.5%
Cancer	79, 6.4%
Other	411, 33.2%
Secondary diagnosis ≥4 (*n*, %)	606, 51.3%
ADL sum before hospitalization (mean ± *SD*)	5.3 ± 1.4
IADL sum before hospitalization (mean ± *SD*)	4.9 ± 2.2
MMSE at hospitalization (mean ± *SD*)	17.1 ± 4.0

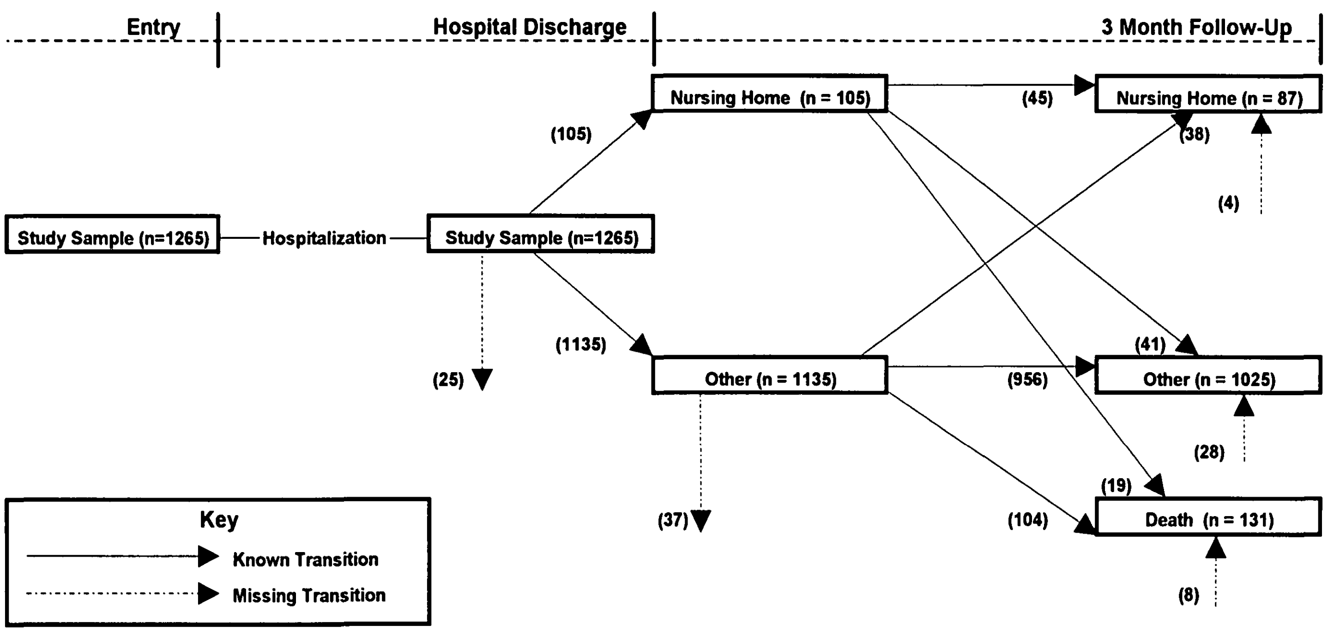

Figure 1. Transitions of subjects at hospital discharge and during the three months after discharge.

Table 2. Risk Factors for Being Discharged to a Nursing Home

Variable	Model 1† Predictors at Admission		Model 2‡ Predictors at Discharge	
	Odds Ratio§	95% C.I.	Odds Ratio§	95% C.I.
Age	1.09*	(1.04, 1.14)	1.07*	(1.02, 1.13)
Gender	1.02	(0.53, 1.96)	0.87	(0.42, 1.80)
Race (White vs other)	14.22*	(1.76, 115.11)	8.89*	(1.02, 77.53)
Living alone	3.03*	(1.58, 5.81)	4.08*	(1.96, 8.47)
Cleveland ‖	1.38	(0.34, 5.57)	2.44	(0.52, 11.54)
Stanford ‖	2.02	(0.47, 8.68)	4.72	(0.95, 23.49)
St. Mary's ‖	5.92*	(1.35, 26.01)	11.57*	(2.15, 62.30)
Yale ‖	35.60*	(3.11, 407.62)	31.38*	(2.49, 395.67)
Treatment (1 vs 0)	0.86	(0.48, 1.53)	1.00	(0.52, 1.90)
Circulatory	0.47	(0.22, 1.02)	0.54	(0.23, 1.28)
Respiratory	0.76	(0.34, 1.71)	0.83	(0.34, 2.04)
Digestive	0.52	(0.18, 1.46)	0.50	(0.15, 1.62)
Cancer	1.99	(0.64, 6.22)	0.70	(0.18, 2.69)
No. 2nd diagnosis ($\leq$ 3 vs $\geq$ 4)	0.43	(0.18, 1.01)	0.93	(0.36, 2.39)
Retrospective ADL sum	0.72*	(0.56, 0.91)	0.61*	(0.46, 0.81)
Retrospective IADL sum	0.96	(0.80, 1.15)	1.11	(0.90, 1.36)
Admission MMSE	0.83	(0.86, 1.00)	0.93	(0.85, 1.01)
Length of stay			1.13*	(1.08, 1.18)
Decline in ADL sum			5.42*	(2.69, 10.91)

†likelihood-ratio chi square = 98.548 with df = 17 (p = .0001).
‡likelihood-ratio chi square = 163.438 with df = 19 (p = .0001).
§adjusted odds ratio.
‖ Cedars - Sinai is referent.
*$p < .05$.

ratio) for NH admission at hospital discharge measured at the time of hospital admission are increasing age (O.R. = 1.09, 95% C.I.: 1.04–1.14), White race (O.R. = 14.22, 95% C.I.: 1.76–115.11), living alone (O.R. = 3.03, 95% C.I.: 1.58–5.81), hospital site (those persons at Yale and St. Mary's in Madison, WI, had a statistically higher likelihood of being admitted into a nursing home compared to Cedars-Sinai, Los Angeles), and prehospital ADL sum (O.R. = .72, 95% C.I.: .56–.91). As seen in the second model, the independent illness- or hospital-related predictors are LOS (O.R. = 1.13, 95% C.I.: 1.08–1.18) and decrease in ADL sum from admission to discharge (O.R. = 5.42, 95% C.I.: 2.69–10.91).

Table 3 shows the results of the second set of logistic regressions. The independent risk factors (adjusted odds ratio) for residing in a NH 3 months post-hospital discharge measured at hospital discharge are increasing age (O.R. = 1.07, 95% C.I.: 1.02–1.12), living alone (O.R. = 1.94, 95% C.I.: 1.03–3.64), a primary diagnosis of a digestive disorder (O.R. = .21, 95% C.I.: .05–.82), ADL sum at hospital discharge (O.R. = .76, 95% C.I.: .66–.87), MMSE at admission (O.R.: .88, 95% C.I.: .83–.95), and LOS (O.R. = 1.08, 95% C.I.: 1.04–1.13). The post-discharge factors are a decline ADL sum from discharge to 3-month follow-up (O.R. = 13.92, 95% C.I.: 5.98–32.36). It should be noted that in the last model, neither hospital site nor primary diagnosis was an independent risk factor for NH use at 3 months.

Discussion

The majority of subjects (89%) enrolled in this study did not enter a nursing home either at hospital discharge or during the 3 months after hospitalization. Those subjects who were directly admitted to the nursing home after hospitalization had very specific characteristics at the time of and during the hospitalization. They were older, White, living alone, and had lower prehospital ADL sums. The risk of discharge to a nursing home varied by site and was highest at hospitals in states such as Wisconsin, with high nursing home bed availability. Geographic site also may be related to unmeasured patient factors such as income and social support, to hospital processes of care, and to availability of formal community-based long-term care.

This same group of subjects entering a nursing home at hospital discharge was also found to have increased LOS, and, importantly, had deteriorated in ADL functioning during hospitalization. It is possible that longer hospital stays are serving as a proxy for a variety of factors such as increased severity of illness, processes of care, and iatrogenic complications. It may be that the risk for NH admission is just as dependent on particular patient characteristics, such as age and pre-admission functional status, as on what

Table 3. Risk Factors for Residing in a Nursing Home at 3 Months After Hospitalization

	Model 1† Predictors at Discharge		Model 2‡ Post-Discharge Predictors	
Variable	Odds Ratio§	95% C.I.	Odds Ratio§	95% C.I.
Age	1.07*	(1.02, 1.12)	1.06*	(1.003, 1.12)
Gender	1.60	(0.80, 3.18)	1.77	(0.77, 4.07)
Race (White vs other)	1.47	(0.54, 3.97)	1.22	(0.40, 3.74)
Living alone	1.94*	(1.03, 3.64)	2.35*	(1.11, 4.99)
Cleveland ‖	1.28	(0.40, 4.13)	2.21	(0.53, 9.19)
Stanford ‖	1.37	(0.35, 5.31)	3.38	(0.65, 17.55)
St. Mary's ‖	1.21	(0.35, 4.23)	2.08	(0.47, 9.19)
Yale ‖	2.56	(0.63, 10.42)	3.34	(0.63, 17.67)
Treatment (1 vs 0)	1.55	(0.84, 2.85)	1.20	(0.59, 2.42)
Circulatory	0.63	(0.29, 1.33)	0.76	(0.33, 1.77)
Respiratory	1.51	(0.69, 3.28)	1.13	(0.43, 2.98)
Digestive	0.21*	(0.05, 0.82)	0.37	(0.09, 1.48)
Cancer	0.28	(0.05, 1.67)	0.37	(0.04, 3.73)
No. 2nd diagnosis (≤ 3 vs ≥ 4)	0.91	(0.42, 1.97)	1.28	(0.49, 3.30)
ADL sum at discharge	0.76*	(0.66, 0.87)	0.64*	(0.53, 0.76)
Admission MMSE	0.88*	(0.83, 0.95)	0.92*	(0.85, 0.998)
Length of stay	1.08*	(1.04, 1.13)	1.07*	(1.02, 1.23)
Decline in ADL sum after hospital			13.92*	(5.98, 32.36)
Rehospitalization			0.995	(0.44, 2.26)

†likelihood-ratio chi square = 144.388 with df = 19 (p = .0001).
‡likelihood-ratio chi square = 119.874 with df = 17 (p = .0001).
§adjusted odds ratio.
‖ Cedars - Sinai is referent.
*$p < .05$.

occurs in the hospital as measured by LOS and decrease in ADL function.

Although specific DRGs were not evaluated because of small numbers, no major ICD-9-CM category of primary diagnosis was highly predictive of discharge to a NH. This underscores the variability of the likelihood of this transition within a major diagnostic category. This suggests that demographic and functional measures may be more important risk factors for NH admission than are major diagnostic categories. Also, this finding may imply that everyone is at risk of nursing home use, not just persons within specific diagnostic categories.

The subjects discharged to a nursing home represented 8% of the study population and were very likely the sickest subjects, since post-discharge mortality was the highest in this group. Nevertheless, almost 40% of subjects discharged to a nursing home returned to a community setting during the 3 months after discharge. Also, 44% of the subjects living in a nursing home at the 3-month follow-up had entered the nursing home after hospital discharge to a site other than a nursing home. As a result, the persons living in a nursing home at follow-up consisted of an almost equal number of subjects who had been discharged into the nursing home and had failed to recover pre-admission levels of functioning, and those who had been discharged to a community setting but had deteriorated in functioning. These findings illustrate the dynamics of multiple transitions in residence occurring after hospitalization, and emphasize the important role that illness and hospital-related loss of function play in these transitions.

Although there had been significant site differences in the rate of discharge to nursing homes, those site differences were no longer apparent at the 3-month follow-up. This suggests that the increased use of nursing homes for post-discharge care at some hospitals was not associated with an increased risk of longer term institutionalization. Short-term and long-term nursing home use are undoubtedly different processes.

Although ADL sum and decline in ADL sum were consistently associated with NH admission at all measurement intervals, IADL functioning was not an independent predictor of institutionalization in the first set of models. This finding can be explained by the fact that IADL disabilities can be more readily mitigated by either formal or informal supportive services. Compensating for ADL disabilities requires more intensive care associated with frequent and daily intervention by caregivers. In a separate analysis, we found that no single type of ADL disability was associated with a higher risk of admission to a nursing home at discharge or during the 3 months after discharge. This would suggest that the relationship between ADL disability and nursing home admission is most likely due to a cumulative burden of disability rather than disability in a specific activity.

One possible limitation of this study is the use of patient reports of pre-hospital function to establish baseline levels of functioning. Because many conditions, such as congestive heart failure or chronic obstructive pulmonary disease, leading to hospitalization are insidious and chronic, many subjects may have already suffered the loss of functioning at 2 weeks before hospital admission. However, the majority of our patient population (73%) reported independence in all of the six ADLs, suggesting that, if a decline in baseline functioning occurred prior to hospitalization, it occurred in only a small number of subjects. In addition, a decline in baseline function would have biased the functional change variables to be less correlated with NH admission. The fact that change in functioning using this pre-admission baseline was predictive of nursing home admission at all intervals indicates a strong predictive validity for the retrospective measurement.

The sequence of acute illness, hospitalization, functional decline, and nursing home admission was a recurrent theme in this study. Unfortunately, we were unable to identify those factors associated with acute illness or with hospital or post-hospital care that definitively influenced the changes in physical functioning leading to nursing home admission. Although it would be convenient to attribute the functional losses in the study population to the effects of acute illness, these subjects were hospitalized for medical illnesses which in younger populations are not typically associated with the development of disability or with the use of rehabilitation therapies. We do not know the extent to which subjects who developed disability during hospitalization received, for example, either physical or occupational therapies during hospitalization. We also do not know the extent to which post-discharge improvement in ADL function and discharge from the nursing home were influenced by the provision of rehabilitation services. It is possible that at least some of these subjects who were hospitalized for medical illness during short hospital stays developed disabilities that were unrecognized and untreated (18).

Although the number of subjects entering the nursing home in this study was relatively small, it nevertheless represents a significant change in a living situation and an expense to the health care system. This study suggests that, in addition to functional status, functional loss is a significant independent risk factor for NH use. Accordingly, efforts to maintain and improve function during and after hospitalization are paramount and have the potential to decrease NH use and improve outcomes of patients.

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