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Premorbid Activity Limitation Stages Are Associated with Post-Hospitalization Discharge Disposition

Ling Na, PhD^a, Sean Hennessy, PharmD, PhD^{a,b}, Dawei Xie, PhD^a, Debra Saliba, MD, MPH, AGSF^{c,d,e}, Qiang Pan, MA^a, Pui L. Kwong, MPH^a, Jibby E. Kurichi, MPH^a, Hillary R. Bogner, MD, MSCE^a, and Joel E. Streim, MD^f

^aCenter for Clinical Epidemiology and Biostatistics, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania

^bCenter for Pharmacoepidemiology Research and Training, University of Pennsylvania, Philadelphia, Pennsylvania

^cU.S. Department of Veterans Affairs, Geriatrics Research Education and Clinical Center, Los Angeles, California

^dBorun Center, UCLA Department of Medicine, University of California, Los Angeles

^eRAND, Santa Monica, California

^fGeriatric Psychiatry Section of the Department of Psychiatry, Perelman School of Medicine, University of Pennsylvania, Philadelphia, Pennsylvania

Abstract

Objective—Activity of daily living (ADL) stages and instrumental activity of daily living (IADL) stage have demonstrated associations with mortality and health service utilization among older adults. This cohort study aims to assess the associations of premorbid activity limitation stages with acute hospital discharge disposition among community-dwelling older adults.

Design—Study participants were Medicare beneficiaries aged 65 years and older who enrolled in the Medicare Current Beneficiary Survey (MCBS) between 2001 and 2009. Associations of premorbid stages with discharge dispositions were estimated with multinomial logistic regression models adjusted for covariates.

Results—The proportions of elderly Medicare patients discharged to home with self-care, home with services, post-acute care facilities, and other dispositions were 59%, 15%, 19%, and 7%, respectively. The adjusted relative risk ratios (RRR) and 95% confidence intervals of post-acute care facilities versus home with self-care discharge increased with higher premorbid activity limitation stages (except non-fitting stage III): 1.7 (1.5–2.0), 2.4 (2.0–2.9), 2.4 (1.9–3.0), and 2.5 (1.6–4.1) for ADL stages I–IV; a similar pattern was found for IADL stages. The adjusted RRRs

Corresponding author: Ling Na lingna2000@gmail.com.

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of discharge to home with services also increased with higher premorbid activity limitation stages compared to no limitation.

Conclusions—Routinely assessed activity limitation stages predict post-hospitalization discharge disposition among older adults, and may be used to anticipate post-acute care and services utilization by elderly Medicare beneficiaries.

Keywords

ADL; IADL; post-acute care; hospital discharge disposition; older adults

Introduction

Medicare's Prospective Payment System (PPS) has incentivized hospitals toward early discharge of Medicare patients for cost containment.^{1,2} Many of these patients are discharged to post-acute care providers,² creating challenges in arranging for the delivery of appropriate post-acute care, and complicating care transitions from the hospital to the community. Post-acute care commonly includes rehabilitation services that beneficiaries receive after a stay in an acute care hospital.³ Post-acute care may refer to a stay in a facility (skilled nursing facility (SNF), nursing home (NH), long-term care hospital (LTCH), or inpatient rehabilitation facility (IRF)), ongoing outpatient therapy, or care provided at home. After a hospitalization that results in functional impairment,⁴ rehabilitation services are often provided in a SNF or IRF by a multidisciplinary team.⁵ Costs and lengths of stay vary widely across discharge locations. For instance, longer hospital stays were associated with discharge to SNF versus home,⁶ and insurance type was associated with discharge to SNF versus other rehabilitation facilities.⁷ It is thus important to forecast the post-discharge placement and resource utilization among elderly Medicare beneficiaries using readily assessed patient characteristics to inform policy and planning for population-level health care management.

Premorbid baseline functional status helps providers identify a patient's maximal rehabilitation potential, and thus should be incorporated into the goal-setting for post-discharge rehabilitation. It is important to note that ADL performance prior to the onset of acute illness is strongly associated with functional status at discharge, and has demonstrated face and predictive validity with respect to post-hospitalization outcomes such as hospital discharge placement.^{8,9} Routinely assessed ADL limitation has important implications for discharge planning and making predictions of post-hospitalization resource utilization. Despite the importance of cause-specific hospitalizations in individual discharge planning, identifying the pattern of discharge placement that addresses all-cause hospitalizations would inform health care management at the population level, and is essential for developing healthcare policy and resource planning. Post-acute care use has been inadequately examined pertaining to all-cause hospitalizations. In the Post-Acute Care Payment Reform Demonstration Final Report,¹⁰ authors found severe premorbid functional limitation was associated with higher odds of using home health care, whereas having some limitations was associated with slightly lower but positive odds of using home health care among the Medicare population. Having some limitations was associated with SNF use, but severe limitations were not significantly associated with SNF use.

Previous research shows that discharge to SNFs or other rehabilitation facilities is commonly observed among hospitalized patients who had hip fracture,¹¹ suffered a stroke,^{12,13} heart failure,⁶ or traumatic brain injury,¹⁴ or were critically ill.¹⁵ Physical function was among the most studied factors influencing post-discharge disposition. Mobility impairment identified within 3 days of hospitalization was a determinant of discharge to a care facility among patients hospitalized for critical illness.¹⁵ Among stroke survivors, functional status upon admission and presence of walking problems predicted discharge to a rehabilitation center or long-term care facility versus home.¹³ More recent research on “6-Clicks,” referring to short forms created from the Activity Measure for Post-Acute Care (AM-PAC) instrument, also found that basic mobility and daily activity scores at initial physical therapist visit accurately predicted discharge destinations from acute care hospitals.¹⁶

By convention, functional status is measured with counts of ADLs or IADLs, which obscures the pattern of specific activity limitation. In response to the call for a population health approach to optimizing the health of people residing in the community, and the need to address the magnitude of disability in the U.S. population, Stineman and colleagues have recently derived activity limitation stages based on International Classification of Functioning, Disability and Health (ICF) terminology and concepts.¹⁷ Stineman’s stages incorporate not only the severity but also the types of disability by describing patterns of limitation in ADLs and IADLs separately, with each stage defined by preserved ability to perform specific activities (Supplementary Table 1). ADL stages capture self-care abilities to eat, toilet, dress, bathe/shower, move in/out of chair/bed, and walk. IADL stages describe autonomy in domestic tasks, e.g., to use the telephone, manage money, prepare meals, do light housework, shop for personal items, and do heavy housework. Within each domain, stages 0 to IV were designed to represent no (stage 0), mild (stage I), moderate (stage II), severe (stage III), and complete activity limitation (stage IV). Each stage indicates specific tasks an individual is able to perform without difficulty. Higher ranked stages reflect more severe disabilities and qualitatively different limitations. Because activity limitation stages capture the type of disability, not just severity measured as a linear variable, there are patterns of activity limitation that are “non-fitting,” i.e., that don’t fit preserved activity requirements for assignment to Stage II, nor do they represent the complete activity limitation that defines Stage IV. Stage III is therefore designed as a non-fitting stage, which accommodates irregular limitation patterns that are not strictly hierarchical.

ADL and IADL stages have been validated with the nationally representative sample of community-dwelling older adults in the Medicare Current Beneficiary Survey (MCBS). Stages showed ordered associations with mortality, hospitalization, long-term care use, and receipt of recommended care.^{18–21} In this paper, we aim to study the association of routinely assessed functional status with hospital discharge dispositions, with a focus on post-acute care (with availability of rehabilitation services) and in-home services compared to self-care at home. The unique contribution of this study is to demonstrate that pre-morbid disability measurement using the recently developed staging systems that incorporate both the severity and types of activity limitation is associated with discharge disposition after an acute hospitalization. Use of pre-morbid activity limitation stages may better inform service planning than the ADL/IADL counts used in previous research, as the latter do not contain information about the types of resources that will be needed by disabled individuals or

populations. We hypothesized that older adults at higher activity limitation stages are more likely to be discharged to post-acute care facilities or home with services after hospitalization.

Methods

Study sample

Our data were drawn from the MCBS, a weighted, multistage, area probability sample of Medicare enrollees.²² The MCBS respondents or proxies are usually interviewed in the fall of each year over a four-year period about their sociodemographics, health and functional status, health service utilization, and access to care. The survey was replenished annually. Medicare claims data are available for three consecutive years starting on January 1st of the year after survey induction. The MCBS releases annual MCBS Cost and Use files, which include Medicare claims data that can be directly linked to the survey. To account for the complex survey design, non-response and differential probabilities of selection, the MCBS supplies survey weights, strata, and clusters.²³

The initial sample was comprised of the 2001–2009 entry panels of the MCBS, including 28,465 community-dwelling Medicare beneficiaries who were aged 65 years and older enrolled in the fee-for-service program. Inpatient hospital claims were used to identify the participants who were hospitalized at least once within the subsequent year following an annual survey. Only the initial hospitalization per participant in the follow-up year was included. Since claims data were available over three years, each year following an annual survey, a beneficiary may contribute up to three hospitalizations in the final sample.

This study was approved by the University of Pennsylvania Institutional Review Board. MCBS requires patient consent prior to survey participation. Consent was not required for our study, which used de-identified data. This study conforms to all STROBE guidelines and reports the required information accordingly (see Supplementary Checklist).

Outcome

Our main outcome of interest was the first hospital discharge disposition during the subsequent follow-up year after the annual survey. Discharge dispositions were identified from the patient discharge status code in the inpatient hospital claims data. All discharge placement records were grouped into four categories: home with self-care, home with services (home with organized home care services, home with hospice, home with intravenous drug therapy), post-acute care facilities with available rehabilitation services (e.g., SNF, IRF, swing bed, long-term care hospital, Medicaid nursing facility), and other dispositions (e.g., short-term hospitals, intermediate care facility, expired or left against medical advice).

Primary exposures

Self- or proxy-reported ADL and IADL stages were the primary exposures. Respondents were asked about their ability to perform six self-care activities in the ADL domain and six household management skills in the IADL domain. Each respondent was classified into an

ADL and IADL stage derived by the method described previously.¹⁷ Five stages were developed for ADL and IADL separately, with stage III as a non-fitting stage. ADL and IADL stages were ascertained prior to the start of the follow-up year. Due to high collinearity between ADL and IADL stages, they were studied as separate domains in analyses.

Covariates

Baseline sociodemographic covariates included age groups (65–74, 75–84, and ≥85 years of age), gender, race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, and non-Hispanic other), living arrangement (living alone, with spouse, with children, and with others), education (less than high school, high school and above), dual eligibility for Medicare and Medicaid, and residence location (metropolitan vs. non-metropolitan residence). Self-reported pre-existing medical comorbidities indicated history of Alzheimer's disease, amputation, broken hip, cancer (excluding skin cancer), chronic heart disease (CHD), chronic obstructive pulmonary disease (COPD), diabetes, heart failure, hardening of the arteries, heart rhythm problem, heart valve problem, hypertension, incontinence, mental disorder, myocardial infarction, osteoporosis, paralysis, Parkinson's disease, rheumatoid arthritis, non-rheumatoid arthritis, mental retardation, and stroke. Smoking status was identified as non-smoker, ever a smoker, or recent smoker. Cohort entry year (integers 1 to 9 representing year 2001 to 2009) was initially treated as a categorical variable. Upon observing a linear trend in its effect over time, we entered it as a continuous variable (cohort effect) in the final models.

To account for hospitalization related characteristics, Diagnosis-Related Groups (DRGs) in the inpatient claims data were mapped onto 25 Major Diagnostic Categories (MDCs).²⁴ Unmapped DRGs and MDCs with very low frequency numbers by discharge dispositions (<11 per disposition) were combined into the category "other." In total, 11 MDCs were derived in our analysis as shown in Supplementary Table 2.

Statistical analysis

We used a repeated measures design to increase sample size and statistical power. Each participant may contribute up to three records, and each record consisted of ADL/IADL stages and covariates from the annual interview and the first hospitalization discharge disposition during the subsequent follow-up year. Our analysis was based on 9,909 complete cases (no missing values on exposures, covariates and outcomes), out of the initial sample size of 10,002 records (99.1%). The analysis was carried out in several steps. In the first step, ADL or IADL stages and covariates were aggregated over all records and compared across the four categories of hospital discharge dispositions using Chi-Square tests. Subsequently, association of activity limitation stages with hospital discharge dispositions (reference: home with self-care) was assessed with a multinomial logistic regression model in separate ADL and IADL domains, accounting for all covariates. Since time from stage assessment (survey date) to hospital admission may potentially affect functional status at admission (shorter time interval may indicate the stage at hospital admission more accurately), and possibly subsequent discharge dispositions, in the following step, we tested the interaction effect of time from stage assessment to hospital admission with pre-morbid

stages on the hospital discharge destinations. Based on the distribution of time in months, the time variable was categorized as a binary variable, with 0 representing 0–5 months (45% of all hospitalizations), and 1 representing 6 or more months (55% of all hospitalizations). With covariate adjustment, the interaction terms of time with stages were examined in a multinomial model in ADL and IADL domains separately. Model results were expressed as relative risk ratios (RRRs) and 95% confidence intervals (CIs). The analyses applied MCBS complex survey design (sampling weights, clustering, and strata), and accounted for within-individual correlation. Analyses were conducted using SAS 9.4 (SAS Institute, Cary, NC).

Results

Patient characteristics compared across hospital discharge dispositions

Out of the total 9,909 complete records in the final sample, 5,738 beneficiaries had one, 1,604 had two, and 321 had three annual records. Out of all records, 59% ended in discharge to home with self-care, 15% to home with services, 19% to post-acute care facilities, and 7% to other dispositions.

Table 1 displays the weighted distribution of pre-hospitalization ADL stages by hospital discharge dispositions. For ADL stages, the proportion of home with self-care discharge decreased with activity limitation stages from 67% at stage 0 to 33% at stage IV. The proportion for stage III, as the non-fitting stage, was similar to stage II. The proportion of hospital discharge to home with services increased with stages of greater activity limitation (except stage III), from a low of 13% at stage 0 to a high of 30% at stage IV. The proportion of discharges to post-acute care facilities also increased from stage 0 to stage II (14% to 27%), remained stable at stage III (27%), and slightly decreased at stage IV (24%). Similar patterns of hospital discharge to home with self-care and home with services were found in the IADL domain; interestingly, we observed an incremental increase in discharge to post-acute care facilities from 13% to 32% across IADL stage 0-IV, except for the non-hierarchical increase at stage III.

The percentage of hospital discharges to home with self-care discharge decreased with older age, female gender, not living with a spouse, dual eligibility in Medicare and Medicaid, metropolitan location, and most baseline comorbidities. Smoking, myocardial infarction, COPD, and hardening of the arteries, however, tended to predispose patients to home with self-care. Use of post-acute care facilities was more common with older age, female gender, non-minority ethnicity, living alone, dual eligibility, metropolitan location, and among patients with Alzheimer's disease, broken hip, incontinence, mental disorder, mental retardation, osteoporosis, Parkinson's disease, rheumatoid and non-rheumatoid arthritis, and stroke.

Pertaining to MDCs, use of post-acute care facilities vs. home services was more prevalent among patients with diagnostic categories of the eye, circulatory system, hepatobiliary system and pancreas, musculoskeletal system and connective tissue, and infectious and parasitic diseases.

Association of activity limitation stages with hospital discharge dispositions

Table 2 displays the results from the multinomial logistic regression model estimating the association of pre-hospitalization ADL stages with initial hospital discharge dispositions in a year. As shown in the ADL model, after adjusting for covariates, the likelihood of hospital discharge to a post-acute care facility increased at stages I and II, and became flat across stages II-IV, with RRRs and 95% CIs at 1.7 (1.5–2.0), 2.4 (2.0–2.9), 2.4 (1.9–3.0), and 2.5 (1.6–4.1) across ADL I-IV compared to ADL-0. Among covariates associated with higher likelihood of discharge to a post-acute care facility were older age, dual eligibility for Medicare and Medicaid, living alone or with others compared to living with a spouse, Alzheimer's disease, and osteoporosis. The baseline covariates associated with decreased likelihood of hospital discharge to a post-acute care facility were racial or ethnic minority status, having lower than a high school education, chronic heart diseases, hardening of the arteries, myocardial infarction, COPD, and diabetes (other than type I).

Furthermore, the likelihood of hospital discharge home with services increased with ADL stages (except stage III), with RRRs and 95% CIs as 1.3 (1.1–1.6), 1.9 (1.6–2.3), 1.7 (1.3–2.2) and 3.6 (2.4–5.5) for stages I-IV as compared to stage 0, as well as with baseline covariates such as older age, living alone or with others compared to living with a spouse, metropolitan location, Alzheimer's disease, and type 1 diabetes. We also observed an increased likelihood of being discharged to a post-acute care facility and home with services (RRR=1.05) with each increased year of survey entry (the cohort effect), compared to discharge home with self-care.

The hospital discharge dispositions across IADL stages demonstrated an ordered pattern shown in Table 3. In the risk adjusted model the likelihood of being discharged to a post-acute care facility increased with higher IADL stages (except stage III), with RRRs and 95% CIs at 1.7 (1.4–2.0), 2.3 (1.9–2.8), 2.0 (1.7–2.4), 3.4 (2.5–4.8) for IADL stages I-IV respectively, compared to stage 0. The likelihood of being discharged to home with services also increased with higher IADL stages (except stage III) with RRRs and 95% CIs as 1.4 (1.2–1.7), 2.1 (1.8–2.6), 1.7 (1.4–2.1) and 2.7 (2.0–3.8) across IADL stages I-IV.

The interaction effects of premorbid activity limitation stages with time from stage assessment to hospital admission on hospital discharge destinations were not significant (all p 's > 0.05) for either ADL or IADL.

Discussion

Summary and Implications

Our study used a nationally representative sample of older adults and their hospital discharge records to examine the association of routinely assessed activity limitation stages with hospital discharge dispositions. We categorized four discharge dispositions: home with self-care, home with services, post-acute care facilities, and other dispositions. Our criteria for assigning discharge dispositions to one of these four groups was based on placement (e.g., home or health care facility) *and* the availability of support or rehabilitation services in various placements. However, we recognize that the availability of services in a particular post-discharge placement does not inform us about the actual extent of resource utilization.

Nevertheless, we identified a higher likelihood of being discharged to a post-acute care facility or home with services among patients at higher activity limitation stages (except stage III), even after adjusting for the covariates. This supports the notion that ADL performance prior to hospital admission is independently associated with discharge dispositions, and may be useful in estimating population-level post-discharge resource utilization.⁹

Activity limitation stages integrate severity estimates and disability profiles that depict the extent and type of difficulty experienced by individuals and populations in the performance of everyday self-care and domestic activities. The distributions of beneficiaries according to ADL stages can help to project the magnitude of population-level healthcare and supportive needs.¹⁷ Our study shows that older adults at higher activity limitation stages, once hospitalized, will end up consuming more in-home services and post-acute care. However, ADL and IADL stages tell slightly different stories. In the ADL domain, although higher stages all show an increased chance of discharge to a post-acute care facility or home with services compared to stage 0, the likelihood of discharge to a facility that can provide rehabilitation is higher than the likelihood of discharge home with services at stages I-III compared to stage 0; whereas the likelihood of discharge home with services is higher than discharge to a post-acute care facility at stage IV ($RRR=3.6$ versus 2.5 in the adjusted model). These findings may signify different potential for recovery of function or different service needs at different limitation stages. The rehabilitation potential to restore physical functioning may be quite limited for severely disabled patients at stage IV, although rehabilitation services may be warranted to maintain function or limit further decline. In the IADL domain, discharge to post-acute care facilities and home with services both increase across stages (except non-fitting stage III). We stipulate that this slight discrepancy between ADL and IADL stages may be due to the relative sparing of physical abilities in some individuals with impairment in cognitive capacity that is required to perform IADLs. Thus, individuals at IADL-IV who are unable to perform domestic management tasks yet have preserved ability to perform self-care tasks may still benefit from rehabilitation.

We identified differences in the likelihood of discharge to post-acute care facilities in relation to age, race, and education. Many hospitalized older adults, especially the oldest old, have poorer ADL function at hospital discharge compared to their baseline function due to the deterioration of function during their hospital stay.²⁵ We also observed disparities in rehabilitation use among racial and ethnic minorities and individuals with less than a high school education. Other investigators have found black patients with hip fracture were more likely than whites to be discharged home than to a post-acute care facility.²⁶ Compared to older adults who live with a spouse, those who live alone or with others are more likely to be discharged home with services or to acute care facilities versus to home with self-care. This is expected since living with a spouse may indicate care-giver availability at home. In addition, dual eligibility for Medicare and Medicaid also increases the chance of being discharged home with services and to acute care facilities, because of available insurance coverage for post-hospital care. Further studies are needed to investigate the hospital discharge placement processes that are associated with these disparities.

In terms of comorbidities, Alzheimer's disease, osteoporosis, and heart conditions independently contributed to the likelihood of discharge to a post-acute care facility in the fully adjusted model, albeit in opposite directions. Previous research sheds some light on our findings. Stroke patients with cognitive impairment had a greater likelihood of being discharged to rehabilitation and nursing home settings than those without.²⁷ Older patients with progressive cardiac disease received less hospital care and rehabilitation due to poor prognosis.²⁸

Our study suggests a slightly increased likelihood of discharge to post-acute care facilities and home with services over time as opposed to home with self-care, consistent with the rising trend (1996–2010) of hospital discharge to post-acute care facilities revealed previously.²⁹ A challenge for health care planners and policy makers is to identify those post-hospital discharge dispositions and services that are most appropriate for promoting the rehabilitation and recovery of subpopulations of patients with specific patterns of disability. CMS's Jimmo Settlement Agreement established care coverage for a beneficiary, when skilled nursing services are necessary to maintain the patient's current condition or prevent or slow further deterioration.³⁰ Although severe premorbid disability may limit recovery potential, post-acute care should ensure access to rehabilitation services when required to maintain functional status or limit functional decline, and to assist with changes in functional status that require additional supports. Our findings suggest that, in addition to predicting post-hospital discharge disposition, activity limitation stages may have utility for matching disability profiles and appropriate rehabilitation resources. Conversely, activity limitation stages may also be useful for identifying individuals and subpopulations that are less likely to benefit from discharge to post-acute care settings that provide rehabilitation services. The ADL/IADL assessment instruments can be used regularly during annual well-visits. Such routine assessments of premorbid activity limitation stages may be used to inform treatment goals and predict post-hospital discharge setting and needed resources.

Limitations

The purpose of this study was to assess the potential utility of activity limitation stages in forecasting post-hospital discharge disposition following all-cause hospitalizations. Although we were able to show that activity limitation stages were independently associated with post-discharge dispositions, it was not possible, within the scope of this study based on MCBS data, to determine actual post-discharge resource utilization, particularly with respect to rehabilitation services. The second limitation, pertaining to insufficient sample size, is that we were not able to show inpatient rehabilitation separately from other sub-acute rehabilitation services by activity limitation stages and covariates. Inpatient-level rehabilitation services are more intensive, require physician supervision, and are delivered by a coordinated interdisciplinary team.³¹ Due to fixed survey data collection intervals in the MCBS, we were not able to account for activity limitation stages measured upon hospital admission and discharge, both of which may potentially alter the effect of pre-hospitalization stages on discharge placement. Self- and proxy-reported ADL and IADL assessments in the community setting may be more efficient and resource-sparing than performance-based assessment, yet recall and non-response biases in self-reported data could cause misclassification of the primary exposure. Due to data limitation, we were not

able to adjust for all confounders, such as socioeconomic status and objective measures of cognitive function. Our study only applies to community-dwelling elderly Medicare beneficiaries in the traditional fee-for-service program, as beneficiaries in managed care programs were not required to submit claims of service utilization. Elderly Medicare beneficiaries residing in facilities were also excluded, as activity limitation stages developed specifically for community-dwelling elders may not be applicable to those residing in facilities due to their different care needs.

Conclusion

Our work represents a population-level analysis of post-hospitalization discharge dispositions as independently associated with routinely assessed ADL and IADL limitations. Disparities in likelihood of discharge to post-acute care facilities with available rehabilitation services among the racial and ethnic minorities and individuals with low educational achievement may deserve further investigation and policy attention. We also observed a temporal trend of increasing reliance on post-acute care facilities and home care services. This finding suggests that further research may be warranted to determine if activity limitation stages also have utility for matching population-level patterns of disability to appropriate post-discharge resources.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1
Distribution of Hospital Discharge Dispositions among Elderly Medicare Beneficiaries by Patient Characteristics (2001–2009)

Patient characteristics	Total weighted column % N=9909	Discharge Destinations (weighted row %)			P value
		Home Self-care N=5717 (59%)	Home with services N=1524 (15%)	Post-acute care facilities N=1922 (19%)	
ADL stages					
Stage 0	5261 (54.5)	3482 (67.1)	685 (12.8)	751 (13.9)	343 (6.2)
Stage I	2182 (21.8)	1175 (54.9)	345 (15.8)	495 (21.8)	167 (7.5)
Stage II	1322 (12.8)	569 (44.3)	262 (20.0)	371 (27.0)	120 (8.8)
Stage III	917 (8.8)	415 (46.2)	164 (18.1)	252 (26.6)	86 (9.1)
Stage IV	227 (2.2)	76 (33.1)	68 (29.7)	53 (23.9)	30 (13.4)
IADL stages					
Stage 0	4422 (46.3)	2993 (68.4)	533 (12.0)	611 (13.4)	285 (6.2)
Stage I	2183 (22.1)	1233 (57.5)	352 (16.1)	468 (20.6)	130 (5.8)
Stage II	1282 (12.5)	596 (47.6)	263 (20.5)	311 (23.5)	112 (8.4)
Stage III	1536 (14.5)	724 (48.5)	268 (17.3)	380 (23.8)	164 (10.4)
Stage IV	486 (4.5)	171 (34.1)	108 (22.7)	152 (31.9)	55 (11.2)
Age					
65–74	3076 (37.1)	2148 (69.6)	389 (12.9)	350 (11.5)	189 (6.0)
75–84	4457 (43.1)	2554 (57.5)	689 (15.5)	884 (19.8)	330 (7.3)
85	2376 (19.9)	1015 (42.2)	446 (19.0)	688 (29.3)	227 (9.5)
Sex					
Male	4294 (43.2)	2672 (63.2)	594 (13.8)	687 (15.4)	341 (7.7)
Female	5615 (56.8)	3045 (55.7)	930 (16.3)	1235 (21.0)	405 (6.9)
Race/ethnicity					
< 0.0001					
Non-Hispanic White	8438 (85.1)	4844 (58.7)	1260 (14.8)	1705 (19.3)	629 (7.1)
Non-Hispanic Black	791 (8.0)	471 (60.2)	135 (16.9)	128 (16.1)	57 (6.7)
Hispanic	474 (4.7)	281 (59.6)	92 (18.9)	54 (10.7)	47 (10.8)

Patient characteristics	Total weighted column % N=9909	Discharge Destinations (weighted row %)				P value
		Home Self-care N=5717 (59%)	Home with services N=1524 (15%)	Post-acute care facilities N=1922 (19%)	Other N=746 (7%)	
Non-Hispanic Other	206 (2.2)	121 (61.4)	37 (17.3)	35 (15.7)	13 (5.5)	<.0001
Living Arrangement						
Alone	3574 (34.9)	1836 (52.3)	557 (15.5)	901 (24.5)	280 (7.7)	
With spouse	4514 (47.3)	2906 (65.5)	639 (14.1)	658 (13.9)	311 (6.6)	
With children	1286 (12.3)	687 (54.6)	227 (17.7)	259 (19.3)	113 (8.5)	0.0134
With others	535 (5.5)	288 (54.2)	101 (17.9)	104 (20.5)	42 (7.4)	
Education						
High school above	6498 (67.3)	3787 (59.5)	969 (14.8)	1288 (18.9)	454 (6.8)	<.0001
Below high school	3411 (32.7)	1930 (57.7)	555 (16.0)	634 (18.0)	292 (8.2)	
Dual Eligibility in Medicare and Medicaid						
Dual eligible	2022 (19.5)	999 (50.4)	349 (16.9)	479 (23.0)	195 (9.7)	0.0249
Medicare only	7887 (80.5)	4718 (61.0)	1175 (14.8)	1443 (17.5)	551 (6.6)	
Residence location						
Non-Metropolitan	3234 (30.2)	1949 (61.1)	446 (13.3)	571 (17.6)	268 (8.1)	0.5753
Metropolitan	6675 (69.8)	3768 (58.0)	1078 (16.1)	1351 (19.0)	478 (6.9)	
Self-reported comorbidities						
Alzheimer's disease	No	5508 (60.0)	1425 (15.0)	1755 (18.0)	686 (7.0)	<.0001
	Yes	535 (4.9)	209 (38.6)	99 (19.4)	167 (30.7)	
Amputation	No	9740 (98.3)	5621 (59.0)	1495 (15.2)	1897 (18.6)	0.5753
	Yes	169 (1.7)	96 (58.0)	29 (15.7)	25 (16.1)	
Broken hip	No	9278 (94.1)	5451 (59.9)	1405 (15.0)	1729 (17.9)	<.0001
	Yes	631 (5.9)	266 (43.3)	119 (19.1)	193 (29.4)	
Cancer (no skin cancer)	No	7687 (77.7)	4425 (58.9)	1151 (14.8)	1530 (19.0)	0.1608
	Yes	2222 (22.3)	1292 (59.2)	373 (16.6)	392 (17.1)	
Chronic heart disease	No	8200 (82.8)	4618 (57.6)	1278 (15.5)	1683 (19.6)	<.0001
	Yes	1709 (17.2)	1099 (65.4)	246 (14.1)	239 (13.7)	

Patient characteristics		Total weighted column % N=9909	Discharge Destinations (weighted row %)				P value
			Home Self-care N=5717 (59%)	Home with services N=1524 (15%)	Post-acute care facilities N=1922 (19%)	Other N=746 (7%)	
Chronic obstructive pulmonary disease	No	7777 (78.1)	4421 (58.1)	1170 (14.9)	1597 (19.7)	589 (7.3)	0.0003
	Yes	2132 (21.9)	1296 (61.9)	354 (16.4)	325 (14.7)	157 (7.0)	
Diabetes	No	8001 (79.9)	4593 (58.5)	1188 (14.8)	1604 (19.3)	616 (7.5)	0.0006
	Type1	251 (2.5)	125 (51.7)	63 (23.9)	47 (17.9)	16 (6.6)	
	Type2	1360 (14.5)	819 (61.8)	219 (15.8)	227 (15.9)	95 (6.4)	
	Other	297 (3.2)	180 (61.8)	54 (17.7)	44 (14.0)	19 (6.5)	
Heart failure	No	8690 (88.1)	5037 (59.2)	1306 (15.0)	1713 (18.8)	634 (7.0)	0.0110
	Yes	1219 (11.9)	680 (57.0)	218 (17.1)	209 (16.9)	112 (9.0)	
Hardening of the arteries	No	8566 (86.7)	4863 (58.0)	1328 (15.3)	1727 (19.3)	648 (7.3)	<.0001
	Yes	1343 (13.3)	854 (64.9)	196 (14.6)	195 (13.8)	98 (6.8)	
Heart rhythm disorder	No	7509 (76.1)	4323 (58.9)	1114 (14.8)	1495 (19.0)	577 (7.3)	0.1207
	Yes	2400 (23.9)	1394 (59.0)	410 (16.6)	427 (17.4)	169 (6.9)	
Heart valve disease	No	8767 (88.5)	5039 (58.8)	1329 (14.9)	1728 (18.8)	671 (7.4)	0.0709
	Yes	1142 (11.5)	678 (59.7)	195 (17.4)	194 (16.6)	75 (6.2)	
Hypertension	No	2954 (29.8)	1673 (58.2)	439 (14.6)	618 (20.1)	224 (7.1)	0.0837
	Yes	6955 (70.2)	4044 (59.3)	1085 (15.5)	1304 (17.9)	522 (7.3)	
Incontinence	No	6174 (63.0)	3805 (62.6)	881 (14.2)	1043 (16.3)	445 (7.0)	<.0001
	yes	3587 (35.6)	1842 (52.8)	610 (16.9)	848 (22.7)	287 (7.6)	
Mental Disorder	Dialysis/catheterized	148 (1.5)	70 (51.4)	33 (20.6)	31 (19.0)	14 (9.0)	0.0032
	No	9105 (92.0)	5296 (59.5)	1386 (15.0)	1755 (18.4)	668 (7.1)	
Mental Retardation	Yes	804 (8.0)	421 (52.4)	138 (17.9)	167 (20.5)	78 (9.2)	0.0475
	No	9869 (99.6)	5699 (59.0)	1521 (15.3)	1907 (18.5)	742 (7.2)	
Myocardial Infarction	Yes	40 (0.4)	18 (47.8)	3 (6.3)	15 (32.0)	4 (13.9)	<.0001
	No	7779 (79.0)	4408 (57.9)	1220 (15.5)	1587 (19.6)	564 (7.0)	
Osteoporosis	Yes	2130 (21.0)	1309 (62.9)	304 (14.2)	335 (14.9)	182 (8.0)	<.0001
	No	7711 (78.1)	4583 (60.7)	1167 (15.0)	1381 (17.1)	580 (7.2)	

Patient characteristics		Total weighted column % N=9909	Discharge Destinations (weighted row %)				P value
			Home Self-care N=5717 (59%)	Home with services N=1524 (15%)	Post-acute care facilities N=1922 (19%)	Other N=746 (7%)	
Paralysis	Yes	2198 (21.9)	1134 (52.7)	357 (16.0)	541 (23.8)	166 (7.4)	0.0757
	No	9491 (95.8)	5499 (59.2)	1458 (15.2)	1821 (18.4)	713 (7.2)	
	Yes	418 (4.2)	218 (52.8)	66 (16.3)	101 (23.1)	33 (7.8)	
Parkinson's disease	No	9674 (97.7)	5605 (59.2)	1482 (15.2)	1857 (18.4)	730 (7.3)	0.0035
	Yes	235 (2.3)	112 (48.1)	42 (18.5)	65 (26.7)	16 (6.7)	
	No	8495 (85.7)	4946 (59.5)	1280 (14.9)	1630 (18.4)	639 (7.2)	
Rheumatoid arthritis	Yes	1414 (14.3)	771 (55.5)	244 (17.1)	292 (20.0)	107 (7.4)	0.0385
	No	3827 (39.2)	2294 (61.6)	551 (14.2)	667 (16.5)	315 (7.7)	
	Yes	6082 (60.8)	3423 (57.2)	973 (15.9)	1255 (19.9)	431 (6.9)	
Non-rheumatoid Arthritis	No	8125 (82.6)	4765 (59.9)	1219 (14.8)	1532 (18.1)	609 (7.2)	0.0005
	Yes	1784 (17.4)	952 (54.4)	305 (17.0)	390 (20.9)	137 (7.6)	
	No	3941 (38.8)	2134 (55.5)	641 (16.1)	907 (22.3)	259 (6.1)	
Smoker	Ever	4948 (50.4)	2946 (60.5)	749 (15.1)	853 (16.5)	400 (7.9)	<.0001
	Recent	1009 (10.8)	631 (63.9)	132 (12.8)	160 (15.0)	86 (8.3)	
Major Diagnostic Categories							
<.0001							
Circulatory system		1657 (16.9)	941 (59.1)	270 (15.8)	320 (17.7)	126 (7.4)	
Digestive system		575 (6.1)	430 (74.5)	77 (13.3)	45 (7.6)	23 (4.6)	
Eye		384 (3.7)	217 (59.4)	40 (9.3)	43 (10.5)	84 (20.8)	
Ear, nose, mouth, and throat		876 (8.3)	621 (72.2)	100 (11.1)	94 (10.2)	61 (6.6)	
Hepatobiliary system and pancreas		276 (2.8)	166 (60.9)	33 (12.1)	43 (15.2)	34 (11.9)	
Infectious and parasitic diseases		104 (1.1)	40 (40.2)	24 (20.1)	23 (21.5)	17 (18.2)	
Kidney and urinary tract		169 (1.8)	97 (58.2)	32 (18.9)	29 (16.3)	11 (6.6)	
Musculoskeletal system and connective tissue		1522 (16.0)	776 (51.2)	247 (16.9)	425 (27.5)	74 (4.4)	
Nervous System		1314 (13.0)	776 (60.1)	229 (17.3)	221 (16.2)	88 (6.4)	
Respiratory system		1153 (11.7)	778 (69.0)	150 (12.6)	143 (11.6)	82 (6.8)	
Other*		1879 (18.6)	875 (48.1)	322 (16.9)	536 (27.3)	146 (7.6)	

Note. ADL = Activity of Daily Living; IADL = Instrumental Activity of Daily Living. The other category includes ungrouped DRGs, as well as MDCs that have very small cell size (<11) skin, subcutaneous tissue and breast; endocrine, nutritional and metabolic system; reproductive systems; blood and blood forming organs and immunological disorders; myeloproliferative diseases; mental diseases and disorders; alcohol/drug use or induced mental disorders; injuries, poison and toxic effect of drugs; burns; factors influencing health status; multiple significant trauma; HIV Infection.

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Table 2

Association of Activity of Daily Living (ADL) Stages with Hospital Discharge Dispositions in the Multinomial Model (Relative Risk Ratio with 95% Confidence Intervals) $N=9,909$

	Discharge Destinations (ref = Home with self-care)		
	Home with services	Post-acute care facilities	Other destinations
ADL Stages (ref=stage 0)			
Stage I	1.3 (1.1–1.6)	1.7 (1.5–2.0)	1.4 (1.1–1.7)
Stage II	1.9 (1.6–2.3)	2.4 (2.0–2.9)	1.8 (1.4–2.3)
Stage III	1.7 (1.3–2.2)	2.4 (1.9–3.0)	1.8 (1.3–2.5)
Stage IV	3.6 (2.4–5.5)	2.5 (1.6–4.1)	3.1 (1.9–5.1)
Age (ref= 65–74)			
75–84	1.4 (1.2–1.7)	2.0 (1.7–2.4)	1.4 (1.1–1.7)
85	2.2 (1.8–2.6)	3.5 (2.9–4.2)	2.1 (1.7–2.7)
Gender (ref = male)			
Female	1.1 (1.0–1.3)	1.0 (0.9–1.2)	0.8 (0.6–0.9)
Race ethnicity (ref= non-Hispanic white)			
Non-Hispanic Black	1.0 (0.8–1.2)	0.7 (0.5–0.9)	0.7 (0.5–1.0)
Hispanic	1.1 (0.8–1.5)	0.5 (0.3–0.7)	1.2 (0.8–1.8)
Non-Hispanic Other	0.9 (0.6–1.4)	0.6 (0.4–0.9)	0.6 (0.3–1.0)
Education (ref= high school and above)			
Below High school	1.0 (0.9–1.1)	0.8 (0.7–0.9)	0.9 (0.8–1.1)
Dual eligibility (ref=no)			
Dually eligible	1.2 (1.0–1.4)	1.7 (1.4–2.0)	1.6 (1.3–2.1)
Living arrangement (ref= live with spouse)			
Alone	1.2 (1.0–1.4)	1.8 (1.5–2.1)	1.3 (1.1–1.7)
With children	1.0 (0.8–1.3)	1.1 (0.9–1.3)	1.1 (0.9–1.5)
With others	1.4 (1.0–1.8)	1.6 (1.2–2.2)	1.2 (0.8–1.7)
Residence location (ref= Non-metropolitan)			
Metropolitan	1.2 (1.1–1.4)	1.1 (0.9–1.2)	0.9 (0.7–1.0)
Cohort effect	1.05 (1.02–1.09)	1.05 (1.02–1.08)	1.01 (0.96–1.05)
Alzheimer's disease (ref=no)	1.4 (1.1–1.9)	1.9 (1.5–2.5)	1.8 (1.3–2.5)
Chronic heart diseases(ref=no)	0.8 (0.7–1.0)	0.7 (0.6–0.9)	0.8 (0.6–1.0)
Chronic obstructive pulmonary disease (ref=no)	1.0 (0.9–1.2)	0.8 (0.6–0.9)	0.9 (0.7–1.1)
Diabetes (ref=no)			
Type 1	1.6 (1.1–2.2)	1.1 (0.8–1.6)	0.8 (0.4–1.4)
Type 2	1.0 (0.8–1.2)	0.8 (0.7–1.0)	0.8 (0.6–1.0)
Other	1.0 (0.7–1.4)	0.6 (0.4–0.9)	0.7 (0.4–1.2)
Hardening of the arteries (ref=no)	0.8 (0.7–1.0)	0.7 (0.6–0.8)	0.8 (0.6–1.0)
Myocardial infarction (ref=no)	0.9 (0.7–1.0)	0.8 (0.7–0.9)	1.0 (0.8–1.3)

Discharge Destinations (ref = Home with self-care)			
	Home with services	Post-acute care facilities	Other destinations
Osteoporosis (ref=no)	1.0 (0.8–1.2)	1.2 (1.1–1.4)	1.1 (0.9–1.4)
Major Diagnostic Categories (ref = circulatory system)			
Digestive system	0.7 (0.5–0.9)	0.4 (0.3–0.5)	0.5 (0.3–0.9)
Ear, nose, mouth, throat, dental and oral	0.6 (0.5–0.9)	0.5 (0.4–0.7)	0.7 (0.5–1.0)
Eye	0.7 (0.5–1.0)	0.7 (0.5–1.1)	3.0 (2.1–4.2)
Hepatobiliary system & pancreas	0.7 (0.5–1.1)	0.8 (0.5–1.2)	1.5 (0.9–2.2)
Infectious & parasitic diseases	1.5 (0.8–2.7)	1.6 (0.9–2.8)	3.3 (1.7–6.3)
Kidney and urinary tract	1.1 (0.7–1.6)	0.8 (0.5–1.4)	0.9 (0.4–1.7)
Musculoskeletal system & connective tissue	1.5 (1.2–1.9)	2.4 (2.0–2.9)	0.8 (0.6–1.1)
Nervous system	1.2 (0.9–1.4)	1.0 (0.8–1.2)	0.8 (0.6–1.1)
Respiratory system	0.7 (0.5–0.9)	0.6 (0.5–0.8)	0.8 (0.6–1.1)
Other	1.5 (1.2–1.8)	2.2 (1.8–2.7)	1.3 (1.0–1.7)

Note. The model is adjusted for all covariates listed in table 2, but only covariates with significant overall effects are shown. Ref=reference.

Table 3

Association of Instrumental Activity of Daily Living (IADL) Stages with Hospital Discharge Dispositions in the Multinomial Model (Relative Risk Ratio with 95% Confidence Intervals), $N=9,909$

	Discharge Destinations (ref = Home with self-care)		
	Home with services	Post-acute care facilities	Other destinations
IADL Stages (ref=stage 0)			
Stage I	1.4 (1.2–1.7)	1.7 (1.4–2.0)	1.1 (0.8–1.4)
Stage II	2.1 (1.8–2.6)	2.3 (1.9–2.8)	1.8 (1.3–2.3)
Stage III	1.7 (1.4–2.1)	2.0 (1.7–2.4)	1.9 (1.5–2.4)
Stage IV	2.7 (2.0–3.8)	3.4 (2.5–4.8)	2.6 (1.7–3.9)
Age (ref= 65–74)			
75–84	1.4 (1.2–1.6)	2.0 (1.7–2.4)	1.4 (1.1–1.7)
85	2.1 (1.8–2.5)	3.4 (2.8–4.1)	2.1 (1.6–2.6)
Gender (ref=male)			
Female	1.1 (0.9–1.3)	1.0 (0.8–1.1)	0.8 (0.6–1.0)
Race ethnicity (ref= non-Hispanic white)			
Non-Hispanic Black	1.0 (0.8–1.2)	0.7 (0.5–0.9)	0.7 (0.5–1.0)
Hispanic	1.1 (0.9–1.5)	0.5 (0.3–0.7)	1.2 (0.8–1.9)
Non-Hispanic Other	0.8 (0.5–1.3)	0.6 (0.4–0.8)	0.5 (0.3–1.0)
Education (ref= high school and above)			
Below High school	1.0 (0.8–1.1)	0.8 (0.7–0.9)	0.9 (0.8–1.1)
Dual eligibility (ref=no)			
Dual eligible	1.2 (1.0–1.4)	1.7 (1.4–2.0)	1.6 (1.3–2.0)
Living arrangement (ref= live with spouse)			
Alone	1.2 (1.0–1.4)	1.8 (1.6–2.1)	1.4 (1.1–1.7)
With children	1.0 (0.8–1.3)	1.1 (0.9–1.3)	1.1 (0.9–1.5)
With others	1.4 (1.0–1.8)	1.6 (1.2–2.2)	1.2 (0.8–1.7)
Residence location (ref=Non-metropolitan)			
Metropolitan	1.3 (1.1–1.5)	1.1 (1.0–1.3)	0.9 (0.7–1.1)
Cohort effect	1.05 (1.02–1.09)	1.05 (1.02–1.08)	1.01 (0.96–1.05)
Alzheimer's disease (ref=no)	1.4 (1.0–1.8)	1.7 (1.3–2.2)	1.6 (1.1–2.2)
Chronic heart Disease (ref=no)	0.8 (0.7–1.0)	0.7 (0.6–0.9)	0.8 (0.6–1.0)
Chronic obstructive pulmonary disease (ref=no)	1.0 (0.9–1.2)	0.8 (0.6–0.9)	0.9 (0.7–1.1)
Diabetes (ref=no)			
Type 1	1.6 (1.1–2.2)	1.1 (0.8–1.7)	0.8 (0.5–1.5)
Type2	1.0 (0.8–1.2)	0.8 (0.7–1.0)	0.8 (0.6–1.0)
Other	1.0 (0.7–1.4)	0.6 (0.4–0.9)	0.7 (0.4–1.2)
Hardening of the arteries (ref=no)	0.8 (0.7–1.0)	0.7 (0.6–0.8)	0.8 (0.6–1.0)
Myocardial infarction (ref=no)	0.9 (0.7–1.0)	0.8 (0.7–0.9)	1.0 (0.8–1.3)

Discharge Destinations (ref = Home with self-care)			
	Home with services	Post-acute care facilities	Other destinations
Osteoporosis (ref=no)	1.0 (0.8–1.1)	1.2 (1.0–1.4)	1.1 (0.9–1.4)
Major Diagnostic Categories (ref= circulatory system)			
Digestive system	0.7 (0.5–0.9)	0.4 (0.2–0.5)	0.5 (0.3–0.9)
Ear, nose, mouth, throat, dental and oral	0.7 (0.5–0.9)	0.5 (0.4–0.7)	0.7 (0.5–1.0)
Eye	0.7 (0.5–1.0)	0.7 (0.5–1.0)	2.9 (2.1–4.1)
Hepatobiliary system & pancreas	0.7 (0.5–1.1)	0.8 (0.5–1.1)	1.4 (0.9–2.2)
Infectious & parasitic diseases	1.5 (0.8–2.7)	1.6 (0.9–2.7)	3.3 (1.7–6.3)
Kidney and urinary tract	1.0 (0.7–1.6)	0.8 (0.5–1.4)	0.9 (0.4–1.7)
Musculoskeletal system & connective tissue	1.6 (1.3–1.9)	2.4 (2.0–3.0)	0.8 (0.6–1.2)
Nervous system	1.1 (0.9–1.4)	0.9 (0.8–1.2)	0.8 (0.6–1.1)
Respiratory system	0.7 (0.5–0.9)	0.6 (0.4–0.7)	0.8 (0.6–1.0)
Other	1.5 (1.2–1.8)	2.1 (1.8–2.6)	1.3 (1.0–1.7)

Note. The model is adjusted for all covariates listed in table 2, but only covariates with significant overall effects are shown. Ref=reference.