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Functional Decline and Recovery of Activities of Daily Living among Hospitalized, Disabled Older Women: The Women's Health and Aging Study I

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Abstract

Objectives—Among community-dwelling, disabled older women who were hospitalized, to determine: 1) the rates and predictors of functional decline, 2) the probability and time course of subsequent functional recovery, and 3) predictors of functional recovery.

Design—Population-based observational cohort study.

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Author Contributions:

Dr. Boyd conceptualized this paper, obtained funding, collaborated in design of the analysis with Drs. Bandeen-Roche, Xue, and Fried, and wrote this manuscript. Dr. Xue collaborated in the design and supervision of the statistical analysis and interpretation of data, critical revision of this manuscript for important intellectual content. Dr. Fried was the principal investigator of the Women's Health and Aging Study I and was responsible for collaborating in the following activities for this paper: study design and implementation, obtainment of funding, analysis and interpretation of data and critical revision of the manuscript for important intellectual content. Dr. Guralnik was a co-investigator responsible for collaborating in the following activities for this paper: design and implementation, interpretation of data, and critical revision of the manuscript for important intellectual content. Ms. Ricks was a co-investigator responsible for collaborating in the following activities for this paper: the analysis and interpretation of data and critical revision of the manuscript for important intellectual content. Dr. Bandeen-Roche was a co-investigator responsible for collaborating in the following activities for this paper: design and implementation, obtaining funding, design and supervision of the statistical analysis and interpretation of data, supervision of the entire paper and critical revision of the manuscript for important intellectual content.

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Sponsor's Role:

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Setting—Woman's Health and Aging Study

Participants—A subset of the 1002 moderately to severely disabled community-dwelling older women who were hospitalized over 3 years (n=457).

Measurements—Functional decline and complete and partial recovery were defined using a 0-6 scale of dependencies in Activities of Daily Living (ADL), evaluated every six months over 3 years. Complete recovery was defined as returning to baseline function after functional decline; partial recovery was defined as any improvement in the ADL scale after functional decline. Multiple logistic regression analysis was used to determine predictors of functional decline. Kaplan-Meier curves were produced to estimate the proportions recovering as a function of time since hospitalization. Discrete-time proportional hazards models were used to regress the time-to-recovery hazards on the predictor variables.

Results—33% of hospitalized women experienced functional decline. Older age, frailty, length of stay and higher education were associated with functional decline. 50% fully recover over the subsequent 30 months, with 33% recovering within 6 months, and an additional 14% over the next 6 months. Younger women were more likely to recover (80 to 70 year old women, Hazard Ratio=0.39, 95% CI 0.24, 0.64).

Conclusions—While most recovery of function occurs by 6 months after the first visit after a hospitalization, a significant proportion of women recover over the next 2 years.

Keywords

Hospitalization; Activities of Daily Living; Disability; Recovery

INTRODUCTION

Functional decline is an outcome of hospitalization for acute events among population-based cohorts of older people.¹⁻³ Resulting disability in activities of daily living (ADL) has serious short-term consequences for patients and families as patients dependent in activities of daily living cannot live at home without assistance from caregivers. Predictors of functional decline in prior studies include older age, sociodemographic characteristics, preexisting disability, cognitive impairment, delirium, polypharmacy, history of falls, and comorbidity.⁴⁻⁸ Studies of predictors of functional decline among older hospitalized patients often are limited in their ability to assess premorbid health status as many of these studies begin at the time of hospitalization.^{6, 9, 10} The long-term prognosis of new or additional disabilities in ADL after hospitalization is not well understood.

Recovery from disability among community-dwelling older persons is common, with rates of recovery from disability as high as 80%, and frequent transitions observed.¹¹⁻¹⁴ However, limited evidence suggests that rates of recovery after hospitalization are worse. The timing and predictors of recovery among disabled persons after acute events is not well understood. Cognitive impairment, severity of underlying disability, less physical activity, comorbidity, older age, depression, and lack of positive affect have been associated with less recovery among community-dwelling or hospitalized patients.¹⁴⁻¹⁸

Disabled older women have high rates of hospitalization for acute illness, and older patients are frequently discharged to long-term care facilities.¹⁹ Given the importance of disability in ADL for quality of life and maintaining independence, understanding the long-term functional course, including both functional decline and recovery in ADL among older patients hospitalized for acute illness, is of great clinical and public health importance.

To address these questions, we assessed among a cohort of community-dwelling, disabled older women, those women with incident hospitalization over three years of follow-up. We sought to determine: 1) the rates and predictors of functional decline, 2) the probability and time course of subsequent functional recovery, and 3) predictors of functional recovery.

METHODS

Study Sample

The Women's Health and Aging Study I (WHAS-I) is a population-based, prospective, observational study of moderately to severely disabled community-dwelling older women, described in detail elsewhere.²⁰⁻²² The WHAS-I cohort was derived from an age-stratified random sample using 1992 Medicare data of 32,538 women aged 65 and older living in Eastern Baltimore City and County. Of 5,316 randomly-selected women, 4,137 (78%) agreed to an in-home screening interview. Inclusion criteria were both of the following: 1) self-report of difficulty or dependence with tasks in two or more of the following four functional domains: a) mobility, b) upper extremity function, c) higher functioning tasks, and d) self-care tasks, and 2) Mini-Mental State Exam score ≥ 18 .²³

One-thousand-two women (78% of those eligible) provided written informed consent and enrolled in WHAS-I. Participation rates did not vary based on severity of disability. Medicare claims data for the participants was used to determine presence and number of hospitalizations, length of stay for each hospitalization, and discharge date. The sample for the study presented here was restricted to women who were hospitalized over three years of follow-up (n=457). The Johns Hopkins Medicine Institutional Review Board approved the study.

Defining Observation Periods

We aimed to assess functional status proximal and subsequent to first hospitalizations. Functional status was only measured at WHAS visits. We defined intervals for observing functional status and change beginning with the visit just preceding each woman's first hospitalization. The first hospitalization between round 1 (first study interview) and round 7 (end of study interview) was identified. The visit immediately prior to hospitalization was identified as the pre-hospitalization baseline. The first visit after hospitalization was identified as the post-hospitalization visit, and this time point was used to determine if functional decline had occurred as compared with the pre-hospitalization baseline (see Figure 1a). However, in some cases, participants missed their six monthly study visits. As a compromise between allowing some flexibility in visit scheduling and maintaining reasonable standardization in timing, we imposed a 365-day limit on the gap between visits, and considered subsequent information to be right-censored. That is, we only considered post-hospitalization decline to be determinable if the total time from the pre-hospitalization baseline to the post-hospitalization visit was ≤ 365 days. All available subsequent visits satisfying the 365-day gap criterion were considered for assessment of recovery. Variations in interval length and hospitalization timing within intervals were then handled analytically.

Data Collection

Participants were interviewed in their homes every 6 months for 3 years. At baseline, data were collected on demographic factors, health status, and medical diagnoses of chronic conditions. Validation of the presence of seventeen chronic conditions was performed at baseline using state-of-the-art disease algorithms.²² Depressive symptoms were assessed by the Geriatric Depression Scale²⁴, and emotional vitality was defined using published methodology.^{25,26} Emotional support was assessed by the questions: "Could you have used more emotional support than you received in the last year?" (yes, no) and, if yes, "would you say you needed

a lot more, some more or a little more?”. Cognitive function was measured by the Mini-Mental State Exam.²³

At baseline, each participant identified a proxy who would be contacted if, for any reason, the participant was unable to be interviewed or contacted. The percentage of proxy interviews increased from 0 for pre-hospitalization visits to 2.3% of first post-hospitalization visits and 3.2% of all subsequent visits. In cases where rounds involving proxy assessment occurred between participant interviews, proxy interviews were evaluated to ensure their consecutive timing between the participant interviews. In all cases, they were evaluated for satisfaction of the 365-day gap criterion. Data from proxy interviews that met both of these criteria were included in our analysis.

Physical performance measures included a standardized 4-meter measured walk at usual pace timed to 0.1 second, and grip strength measured in kilograms by a hand-held Jamar dynamometer.²² Frailty was defined according to the construct previously validated in the Cardiovascular Health Study (CHS)²⁷ and cross-validated in WHAS²⁸, which includes the following five components: “shrinking” (weight loss), self report of “exhaustion”, low physical activity, slowness, and weakness. An ordinal measure was created, as in CHS, with those with 0 criteria defined as “non-frail”, those with 1-2 criteria considered “intermediate”, and those with ≥ 3 criteria defined as “frail”. The metrics used to define individual frailty criteria were slightly different in WHAS-I than in CHS, due to data differences, as detailed previously.^{2, 28} “Shrinking” was defined here as present if the participant’s baseline measured weight was 10% less than their self-report of weight at age 60 or BMI <18.5 at baseline. “Exhaustion” was defined by any of three self-reported criteria. Low physical activity was defined using the Modified Minnesota Leisure Time Activities Questionnaire²⁹ to determine the weekly kilocalories expended, using an equilibrated threshold for low physical activity to that used in CHS. Slowness was ascertained by walking speed in the first of two trials of a measured walk at usual pace. Weakness was assessed, as in CHS, by grip strength measured by dynamometer in the dominant hand, using the strongest of three trials. Cut points for both slow walking speed and weak grip strength were equivalent to those used to define frailty in women in CHS.

Hospitalization characteristics were assessed using claims data. Length of stay was calculated using the admission and discharge date. Aggregate length of stay was the total number of hospital days between a pre- and the first post-hospitalization visit. Average length of stay was calculated by dividing aggregate length of stay by the number of hospitalizations. The length of time between discharge and the first post-hospitalization visit was calculated using the date of the study visit and the discharge date.

Outcome

ADL dependence was defined as being unable to do an ADL (toileting, bathing, transferring, eating, dressing, and walking across a small room) or requiring the help of another person for any ADL at baseline and follow-up. The outcome was a 0-6 scale of number of dependencies in ADL with a score of 6 representing dependencies in all ADLs. Functional decline was defined as worsening of this scale, comparing the visit prior to hospitalization (pre-hospitalization baseline) to the first visit post-hospitalization. Among those defined as having functional decline, full functional recovery was defined as returning to pre-hospitalization baseline function after decline observed at the first visit post-hospitalization at any time point subsequently. Partial recovery was defined as any improvement in number of ADL dependencies after observed decline at the first visit post-hospitalization, but failure to return to pre-hospitalization number of ADL dependencies. (See Figure 1a.)

Data Analysis

We aimed to identify primary predictors of functional decline, and of recovery rate following a decline, across a number of risk factor domains. Analyses were performed using SAS 9.1, Cary, North Carolina. Statistical significance was assessed at the two-sided $\alpha = 0.05$ level. ADL dependence was ascertained at each WHAS visit (maximum of seven visits over three years of follow-up).

We first evaluated bivariate relationships between risk factors and outcomes using contingency tables and chi-square tests in the case of categorical risk factors, and box-plots and t-tests for continuously scaled risk factors. Kaplan-Meier curves were produced to estimate the proportions recovering as a function of time since hospitalization. We then used multiple logistic regression analysis to determine predictors of functional decline and discrete-time proportional hazards models to determine factors associated with the time-to-recovery hazards.³⁰ The latter are appropriate when outcomes are determined within intervals of time rather than at points of time. Covariates assessed for prediction of both functional decline and recovery were classified into four domains: (1) socio-demographic, including age and race; (2) psychosocial including cognitive impairment, depressive symptoms, living alone, education, emotional vitality, emotional support; (3) physiologic, including number of validated chronic medical conditions, self-reported health status, frailty; and (4) hospitalization characteristics, including average length of stay, aggregate length of stay, number of hospitalizations, and time between discharge and first post-hospitalization visit. We first fit separate models per each of these domains. Covariates were included in the final models if they were statistically significantly associated with ADL decline; at least one characteristic from each domain was brought forward to the final models. In cases where multiple variables defined a single risk factor (e.g., multiple dummy variables defining several education categories), likelihood ratio tests were used to evaluate global significance of the entire set of the defining variables.

RESULTS

Baseline Characteristics of Hospitalized Women Compared With Non-Hospitalized Women

Baseline characteristics of the WHAS population were examined, stratified by hospitalization status (any, none), over next 3 years. Forty-six percent of women (n=457) had at least one hospitalization over the 3 years of the study. Thirty-three percent of hospitalized women were African-American, as compared to 25% of women who were not hospitalized. (Chi-square=7.51, p=0.006). Worse self-reported health and greater number of chronic diseases (mean 4.3, SD 1.91 vs. 3.8, SD 1.75; p<0.001) predicted hospitalization. No other significant differences were found among educational status, GDS score, living alone, frailty status, emotional vitality, emotional support, age, or MMSE score.

Functional Decline

Among those who were hospitalized (n=457), we were able to ascertain for 88% (n=400) whether there was a decline in functional status at the visit directly following hospitalization compared to the visit immediately preceding hospitalization. Six of these participants had the worst ADL scores possible at baseline and were, thus, unable to decline further on this scale. Additionally, two women died prior to being seen for a post-hospitalization visit. Fifty-five participants had missing information on ADL status either at baseline or the visit following hospitalization (Figure 1b). Among those with any available data on whether or not they recovered (n=102), fifty-one fully recovered at some point over follow up. Among those for whom we did not observe full recovery (n=51), 27% (n=14/51) had one study visit after the visit following hospitalization, 25% (n=13/51) had two study visits after the visit following hospitalization, 12% (n=6/51) had three, 18% (n=9/51) had 4, and 18% (n=9/51) had five.

Among the 394 women thus eligible for analysis, 33% (n=130) experienced functional decline measured at the first visit post hospitalization. We compared the distributions of baseline characteristics for hospitalized women stratified by whether or not there was a functional decline at the visit following hospitalization. Participants with functional decline were older (mean age $\pm$ standard deviation=79.1 years $\pm$ 8.2 vs. mean age= 77.3 $\pm$ 7.6, $p=0.028$). Higher educational status also predicted functional decline, with 51% of women without decline having less than ninth grade education, compared to 36% of women with functional decline. Mean MMSE score was lower among women with functional decline (26.1 $\pm$ 3.1 vs. 26.7 $\pm$ 2.8, $p=0.04$). Participants with decline were more likely to be frail (49% of those with decline vs. 29% of those without decline were frail, 45% of those with decline had intermediate frailty vs. 56% of those without decline, and 5% of those with decline were not frail vs. 14% of those without decline; $p=0.0002$). Participants with functional decline reported lower percentages of receiving enough emotional support as compared to those without decline (63 % vs 69%; $p=0.03$). Average length of stay for each hospitalization was significantly longer among those with functional decline (mean = 7.1 days $\pm$ 6.7 vs. 4.8 days $\pm$ 3.6; $p=0.0004$), as was the total number of days spent in the hospital for all hospitalizations in this interval (mean = 11.3 days $\pm$ 13.8 vs. 7.0 days $\pm$ 7.4; $p=0.0012$). No other significant differences were found among race, GDS score, living alone, number of hospitalizations, self-reported health, emotional vitality, or number of diseases.

We described change in the probability of decline as a function of increasing age, applying a lowess smoother to a scatter plot showing decline data (1=yes, 0=no) versus age (Figure 2). The risk of functional decline increases with age, in a way that is most pronounced in the oldest ages. To reflect this, all subsequent models described age using a linear spline with knot at eighty-five years.³¹

In Table 1, results of multivariate models of predictors of functional decline are shown. Models were chosen based on our *a priori* hypotheses of domains which may contribute to functional decline as indicated through our literature review and conceptual framework. Model 1 suggests that white race may be associated with decreased odds of decline. A model of psychosocial predictors (Model 2) suggests that higher education and worse cognition are associated with increased risk of functional decline, adjusting each for the other. Characteristics of each participant's hospitalization were considered (Model 3), including the average length of stay of each hospitalization within the interval, the number of hospitalizations within that interval and the amount of time in days between the hospitalization and first post-hospitalization study visit. Average length of stay was highly correlated with total number of hospital days, and was chosen for inclusion in this model over aggregate length of stay to standardize interpretation by the number of hospitalizations in the interval. Average length of stay was significantly predictive of functional decline; number of hospitalizations was not. Model 4 examined physiologic factors, including baseline frailty and number of adjudicated baseline medical diagnoses. Baseline frailty status was strongly predictive of functional decline as compared with not-frail status (OR 3.6; 95% CI 1.5-8.9).

Our final model was chosen by including the most strongly predictive factor from each of the individual models, as well as others significant at the 0.10 level. As seen in Table 1, white race was not significantly protective adjusting for education, cognition, frailty status, and average length of stay. Average length of stay, frailty, and higher education were the strongest independent predictors of functional decline. While the age effect is attenuated by physiologic factors, age predicts functional decline in our final model at higher ages –comparing 90 to 80 year olds [Odds Ratio 1.85 (95% CI 1.11-3.07)], and for 80 to 70 year olds [OR 1.16 (0.79-1.70)]. We conducted analyses including baseline number of ADL disabilities in our final model; this did not change the association between any other variables and decline.

Functional Recovery (Full and Partial)

Figure 3 is a Kaplan Meier Curve probability of failing to recover over time. Forty-eight percent of participants at least partially recovered by 6 months. Another 18 % at least partially recovered over the subsequent 6 months (12 months after the visit following hospitalization); in fact, the incidence of recovery during this interval is not significantly different than in the first six-month interval (adjusting for age). Following this, the probability of recovery falls off greatly. At the third interval after the first post-hospitalization visit (18 months) the age-adjusted instantaneous incidence of partial recovery is less than 15% of that in the first interval (6 months) following the post-hospitalization visit (Hazard Ratio (HR)=0.14, 95% confidence interval (CI) = 0.02-1.01). Full recovery occurs less often, with a similar pattern. Thirty-three percent experienced full recovery in the first six months, with another 14 % recovering over the subsequent 6 months. At the third interval after the first post-hospitalization visit (18 months), the age-adjusted instantaneous incidence of full recovery is less than 30% of that in the first interval (6 months) following the post-hospitalization visit (HR=0.29, 95% CI = 0.09-0.95)

In Figure 4, a plot of the proportion experiencing full recovery versus age demonstrates that the youngest women were most likely to recover. In modeling, we used a quadratic function of age to capture this phenomenon; associated estimates of recovery hazard ratios (HR) are, for instance, for 80 to 70 yr old women = 0.39; 95% CI (0.24, 0.64), HR for 90 to 80 yr old women = 1.15; 95% CI (0.65, 2.01).

Our multivariate models of hypothesized domains of contributors to full recovery showed that no sociodemographic, psychosocial, hospitalization, or physiologic variables other than age were predictive of either full or partial recovery. Bivariate comparisons of women who experienced full recovery by the first interval (6 months) post hospitalization, compared to those (n=68) who did not experience recovery at this first interval, did not identify significant differences in terms of race, education, GDS, living alone, number of hospitalizations, frailty, self-reported health, emotional vitality, receiving enough emotional support, average or aggregate length of stay, number of diseases, and MMSE. Women who recovered by this first interval were significantly younger (mean age = 76.6 years $\pm$ 9.1 vs. 80.0 years $\pm$ 7.8, $p=0.03$). Of the 68 women who had not experienced full recovery by the first interval post-hospitalization, 17 recovered subsequently. These women were younger than women who never recovered or died (mean age = 76.4 years $\pm$ 8.4 vs. 81.2 $\pm$ 7.3 vs. 82.8 $\pm$ 8.0, $p=0.03$).

DISCUSSION

Among hospitalized, disabled older women, frailty predicts disability progression among a cohort of disabled older community-dwelling women, suggesting that frailty confers a vulnerability to the acute stressor illness at a severity necessitating hospitalization. In this study, three quarters of disabled, community-dwelling women recover function partially after a post-hospitalization decline over the next two years. While most recovery occurs by 6 months, a significant proportion of women recover over the next 2 years. These results have implications for the timing and duration of rehabilitation services. Most rehabilitative services are offered and covered in the first month after hospitalization. Given the clinical and societal implications of optimizing physical function in our aging society, these results suggest that evaluating whether some patients respond best to rehabilitative interventions of longer duration would be worthwhile.

Predictors of functional decline in disabled older women who are hospitalized include older age, frailty, higher education, and length of hospital stay. Length of stay likely represents severity of the illness and hospitalization.³² The association between older age and functional decline diminished, but remains, after association for physiologic factors and other established

predictors of disability among hospitalized people.⁵ The finding that higher education predicted functional decline was surprising; we performed sensitivity analyses to determine if this was a result of women who were more highly educated having a greater number of ADL dependencies at baseline. There was no change in the observed association, and this may merit investigation in other populations. Previously, both frailty and hospitalization have been shown to independently predict functional decline among disabled older, community-dwelling women, suggesting that both vulnerability and the acute stress of hospitalization are associated with functional decline among community-dwelling, disabled older women.² Our results build on this prior work by showing that among disabled older women who are hospitalized, frailty is a strong predictor of functional decline in activities of daily living. Frailty may be a useful tool for clinical evaluation for older persons who are admitted to the hospital urgently or for elective surgery in order to help identify those at risk for functional decline.³³

Prior work on the natural history of functional recovery suggests that by one month, less than one quarter of hospitalized older adults with functional decline have improved physical function.³⁴ The natural history of long-term functional outcomes following hospitalization has not been previously well-described, but suggest that functional improvement may occur after the acute period.^{15-17, 35, 36} Our results suggest that many disabled, community-dwelling older women eventually experience both full and partial recovery, but that duration of time to recovery may be as much as 18 months.

These results have implications for health-care delivery. These results support testing of alternate models of rehabilitation, with patients not making progress in the short-term, offered aggressive rehabilitation at later time points or interventions of longer duration. Patients who are not able to participate in 3 hours a day of therapy may benefit from less intense, but longer duration rehabilitation services. It is possible that a certain degree of physical recovery from the sentinel illness is necessary to see functional improvement. In skilled nursing facilities, outpatient settings and at home, most therapy is offered within one month of discharge.^{37, 38} In part, this is due to the changes in financing including shortening the length of home care and roll-out of prospective payment systems. Providing prehabilitation to older community-dwelling persons at risk of functional decline may prevent episodes of disability.

These results apply to the one third most disabled of community-dwelling women. Hospitalized women who are not disabled and hospitalized men may have different predictors of functional decline and different trajectories and likelihood of recovery. However, older disabled women are frequently hospitalized and are among the most likely to experience functional decline associated with hospitalization for acute illness¹⁹.

There are several limitations to this work but also relevant strengths. We cannot identify function immediately prior to the acute illness leading to the hospitalization. We have variable follow-up due to variable timing of hospitalization as well as study dropout. Skipped visits and loss to follow up are likely not at random as women who are sicker are more likely to be missing and there is competing risk of death. However, reported hazard ratios have valid “cause-specific” interpretations to recovery as opposed to dropout or death.³⁹ Moreover, retention in WHAS was high and we have more than 1.5 years of follow-up after hospitalization on 59.9% of women. We also cannot identify the exact time that functional recovery occurred and, thus, describe our results as to whether recovery has occurred by a specific time point. Given our assessment of six-month intervals, it is likely that some women had recovery and subsequent decline in between our assessments. Prior work has shown that there is a significant amount of variability in functional status among community-dwelling older adults with multiple episodes of disability and recovery.¹¹ Six-month assessments of functional status are believed to be appropriate and valid.⁴⁰ We also do not account for the cause of hospitalization or utilization of rehabilitative services here. The reason for hospitalization is often complex and

due, in part, to multiple diagnoses. During the period of the study, there was little utilization of rehabilitative services, although changes in the structure of hospital financing have led to greater use of post-acute services. In 1995, less than one percent of elders hospitalized with heart failure, chronic obstructive pulmonary disease (COPD), pneumonia, other respiratory infections, or genitourinary infections received inpatient acute rehabilitation, with more patients utilizing home health care and SNFs.⁴¹ The rates of patients with stroke, COPD, pneumonia, congestive heart failure, and hip fracture receiving inpatient post acute rehabilitation services upon discharge ranged from 0.2% - 13% based on Medicare Standard Analytic Files from 1996-1998, with the highest rates observed for stroke and hip fracture.⁴² These issues will be explored in future work. We view as particular strengths of this study our analysis of a population-based cohort and the measurement of function and predictors at regular intervals before and after hospitalization, with timing and method independent of the hospitalization per se.

CONCLUSION

Through this study, we describe predictors of functional decline and the natural history of functional recovery among disabled older women who are hospitalized. Approximately half of the participants recovered during the subsequent two years following hospitalization. Identification of how to maximize functional recovery and how to target services towards those most likely to benefit is critical. For those patients who do not recover, needs for caregiver support and palliative care may also be appropriate if consistent with the overall goals of care. While most of this recovery does occur by the six-month follow-up, there is a significant amount of recovery that occurs subsequently. Understanding the timing, duration, location, and intensity of rehabilitative services that would maximize functional outcomes for these patients is critically important.

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Conflict of Interest:

Elements of Financial/Personal Conflicts	Cynthia Boyd		Qian-Li Xue		Jack Guralnik		Michelle Ricks		Linda Fried		Karen Bandeen Roche	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Employment or Affiliation		X		X	X			X		X		X
Grants/Funds	X		X			X		X	X		X	
Honoraria		X		X		X		X		X		X
Speaker Forum		X		X		X		X		X		X
Consultant		X		X		X		X		X		X
Stocks		X		X		X		X		X		X
Royalties		X		X		X		X		X		X
Expert Testimony		X		X		X		X		X		X
Board Member		X		X		X		X		X		X
Patents		X		X		X		X		X		X
Personal Relationship		X		X		X		X		X		X

For “yes” x mark(s): give brief explanation below:

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Figure 1.
a and b: Defining Study Time: WHAS I

Figure 2.
Probability of Functional Decline in Conjunction with Hospitalization, by age

Figure 3.
Full and Partial Recovery after Hospitalization: WHAS I
Kaplan Meier (n=102)

Figure 4.
Kaplan Meier Plot for full recovery by age categories

Table 1

Odds Ratios and Confidence Intervals for the Predictors of Functional Decline^a

	Model 1	Model 2	Model 3	Model 4	Final Model
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	
<u>Age and Age Spline</u>					
Age	1.02 (0.98, 1.06)				
Age spline	1.10 (0.95, 1.26)				
<u>Socio-Demographics</u>					
Age	1.02 (0.98, 1.06)				
Age spline	1.09 (0.94, 1.25)				
Race	0.68 (0.43, 1.06) *				
<u>Psycho-social</u>					
Age		1.01 (0.97, 1.06)			
Age spline		1.09 (0.94, 1.26)			
Live Alone		1.11 (0.70, 1.76)			
Education (0 - 8 years) ^d		0.51 (0.29, 0.88) **			
Reference ≥12 years					
Education (9 - 11 years) ^d		1.55 (0.86, 2.8)			
Reference ≥12 years					
MMSE		0.92 (0.84, 1.00) **			
Enough Emotional Support		0.76 (0.47, 1.24)			
Emotionally Vital		0.78 (0.45, 1.35)			

	Model 1	Model 2	Model 3	Model 4	Final Model
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	
GDS >= 10		1.03 (0.60,1.79)			
<u>Hospitalization Factors</u>					
Age			1.02 (0.98, 1.06)		
Age spline			1.07 (0.93, 1.24)		
LN(Average Length of Stay)			1.76 (1.30, 2.38) **		
# of hospitalizations (= 2) ^b (Reference = 1)			0.80 (0.43, 1.47)		
# of hospitalizations (≥3) ^b (Reference = 1)			1.20 (0.56, 2.56)		
Log (centered # of days between discharge and first post-hospitalization visit)			1.02 (0.78, 1.33)		
<u>Physiologic Factors</u>					
Age				1.00 (0.97, 1.05)	
Age spline				1.09 (0.94, 1.26)	
Frail ^c				3.60 (1.46, 8.87) **	
Pre-Frail ^c				1.89 (0.79, 4.51)	
Disease (3 - 5) ^d				0.58 (0.32, 1.04) *	
Disease (≥ 6) ^d				0.76 (0.39, 1.49)	
<u>Final Model w/o disease</u>					
Age					1.01 (0.97, 1.05)

	Model 1	Model 2	Model 3	Model 4	Final Model
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	
Age spline					1.05 (0.90, 1.23)
Race					0.68 (0.41, 1.13)
Education (0 - 8 years) ^e					0.46 (0.26, 0.81) ^{**}
Education (9 - 11 years) ^e					1.53 (0.83, 2.82)
MMSE					0.93 (0.85, 1.02)
LN(Average Length of Stay)					1.69 (1.24, 2.29) ^{**}
Frail ^f					3.36 (1.33, 8.47) ^{**}
Pre-Frail ^f					1.71 (0.70, 4.21)

^I All models adjusted for age and age spline (at age 85).

^{**} Significant at the 5% level.

^{*} Significant at the 10% level.

^a LR Test: p-value = 0.0008, df = 2

^b LR Test: p-value = 0.63, df = 2

^c LR Test: p-value = 0.0026, df = 2

^d LR Test: p-value = 0.16, df = 2

^e LR Test: p-value = 0.0003, df = 2

^f LR Test: p-value = 0.0045, df = 2