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Self-care and Mobility following Post-Acute Rehabilitation for Older Adults with Hip Fracture: A Multilevel Analysis

Michael P. Cary Jr., PhD, RN,

Duke University, School of Nursing, Assistant Professor, DUMC 3322, 307 Trent Drive, Durham, NC 27710, Business Tel.: 1-919-613-6031; Home Tel.: 1-919-471-7730

Wei Pan, PhD,

Duke University, School of Nursing, Associate Professor, DUMC 3322, 307 Trent Drive, Durham, NC 27710, 919- 684-9324

Richard Sloane, MPH,

Duke University, Biostatistician, Center for the Study of Aging, DUMC 3322, 307 Trent Drive, Durham, NC 27710, 919-668-4599

Janet Prvu Bettger, ScD, FAHA,

Duke University, School of Nursing, Associate Professor of Nursing, DUMC 3322, 307 Trent Drive, Durham, NC 27710, 919-668-4599

Helen Hoenig, MD, MPH,

Physical Medicine & Rehabilitation Durham VA Medical Center, 508 Fulton Street, Durham, North Carolina, U.S.A., 919-286-6874

Elizabeth I. Merwin, PhD, RN, FAAN, and

Duke University, School of Nursing, Ann Henshaw Gardiner Professor of Nursing, DUMC 3322, 307 Trent Drive, Durham, NC 27710, 919-681-0886

Ruth A. Anderson, PhD, MA, RN, FAAN

Duke University, School of Nursing, Virginia Stone Professor of Nursing, DUMC 3322, 307 Trent Drive, Durham, NC 27710, 919-668-4599

Abstract

Objective—To examine contextual (facility and community) and individual factors associated with self-care and mobility outcomes among Medicare hip fracture patients receiving inpatient rehabilitation.

Design—Retrospective cohort study of 3 linked data files: Inpatient Rehabilitation Facility-Patient Assessment Instrument, Provider of Services, and Area Health Resources. Multilevel

Correspondence to: Michael P. Cary, Jr..

Conflict of Interest Disclosure

We certify that no party having a direct interest in the results of the research supporting this article has or will confer a benefit on us or on any organization with which we are associated AND, if applicable, we certify that all financial and material support for this research (eg, NIH or NHS grants) and work are clearly identified in the title page of the manuscript (Cary, Pan, Sloane, Bettger, Hoenig, Merwin, Anderson).

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modeling was used to examine the effects of contextual and individual factors on self-care and mobility outcomes.

Setting—Inpatient Rehabilitation Facilities (IRFs).

Participants—Medicare hip fracture patients (N=35,264) treated in IRFs (N = 1072) in 2012.

Interventions—Not applicable.

Main Outcome Measure(s)—Self-care (eating, grooming, bathing, upper and lower body dressing, and toileting) and mobility (walk/wheelchair and stairs) at discharge.

Results—Mean age was 81 years. Mean self-care and mobility scores at admission were 3.17 (SD=0.87) and 1.24, (SD=0.51), respectively; mean self-care and mobility scores at discharge were 5.03 (SD=1.09) and 3.31 (SD=1.54), respectively. Individual and contextual levels explained 44.4% and 21.6% of the variance in self-care at discharge and 19.5% and 1.9% of the variance in mobility at discharge, respectively. Individual level, age, race/ethnicity, cognitive and motor FIM scores at admission, and Tier comorbidities explained variance in self-care and mobility; gender and length of stay explained variance only in self-care. At the contextual level, facilities' case mix (mean patient age, percent Non-Hispanic White, mean self-care score at admission) and structural characteristics (rural location, freestanding, and for-profit ownership) explained variance only in self-care; facilities' case mix (mean patient age, percent Non-Hispanic White, percent living with social support, and mean mobility score at admission) explained variance in mobility. Community variables were non-significant.

Conclusion—Individual and facility factors were significant predictors of discharge self-care and mobility among Medicare hip fracture patients in IRFs. Findings may improve quality of IRF services to hip fracture patients and inform risk adjustment methods.

Keywords

Hip Fractures; Rehabilitation Centers; Health Services Research; Medicare; Outcome Assessment (Health Care)

After an acute hospitalization for hip fracture, over 90% of Medicare beneficiaries use postacute care services including inpatient rehabilitation facilities (IRFs), skilled nursing facilities (SNFs), and home health care for ongoing medical management and rehabilitation.¹ In general, evidence suggests hip fracture patients who receive intensive rehabilitation demonstrate positive functional gains;²⁻⁴ these studies focused largely on patient factors. Little evidence exists on the influence of facility characteristics (e.g., case mix, structural characteristics) associated functional outcomes among hip fracture patients.^{2, 5-7} Moreover, rehabilitation researchers have increasingly recognized the importance of environmental contexts of care (e.g., demographic and socioeconomic characteristics of the community) that may result in health disparities^{2,5-7} and impact the use of rehabilitation services and outcomes.⁸ To our knowledge, no studies have been conducted that account for both contextual (facility and community) and patient factors that might contribute to the variation in functional outcomes among hip fracture patients following inpatient rehabilitation.

Past studies examining the effectiveness of inpatient rehabilitation among large samples of hip fracture patients used measures such as the Functional Independence Measure™ (FIM) and its motor domain.^{9–12} Given the intent of IRFs to return patients to community-based settings and the Centers for Medicare and Medicaid Services' (CMS) focus on measures of IRF quality, research examining self-care and mobility (measures which closely represent patients' abilities to perform basic tasks and participate in life activities) would inform healthcare practice and policy efforts.

This study builds on previous research by examining (1) clinically meaningful functional outcomes, self-care and mobility, in a national sample of Medicare beneficiaries; and (2) important contextual (facility and community) and individual factors that might explain variation in functional outcomes among hip fracture patients following inpatient rehabilitation.

Methods

Design

We conducted a retrospective cohort study of Medicare beneficiaries with hip fracture who received inpatient rehabilitation.

Conceptual Framework

Andersen's model for health services use (Figure 1)^{13,14} and evidence from previous research^{6,10} was used to identify variables for inclusion in this study. Andersen's model posits that outcomes of care are influenced by factors in three domains: (1) contextual factors, including the external environment (the economic, political, and social context in which health systems operate) and facility characteristics (how the health system is structured to deliver care); (2) individual factors including predisposing (age, race, gender), enabling (social support), and need-factors (health status); and (3) healthcare access (use of IRF services).

Data Source and Sample

We used two CMS datasets from calendar year 2012 (Inpatient Rehabilitation Facility-Patient Assessment Instrument [IRF-PAI]¹⁵ and the Provider of Services file which included individual and facility variables, respectively, to conduct this study. We also used the typology codes from the 2004 Area Health Resources File¹⁶, which included community variables. The sample was limited to Medicare beneficiaries, age 65 years and older, who lived in the community prior to their hip fracture and subsequent hospital admission. Records of these patients, who were later admitted to inpatient rehabilitation between January 2012 and December 2012, were identified based on International Classification of Diseases, Ninth Revision, Clinical Modification codes (ICD-9CM codes 820.0–820.9). Exclusion criteria developed by CMS reflecting patients with an atypical course of rehabilitation^{17,18} were used to create the final sample and outlined accordingly in a flow diagram (Figure 2). The final sample contained 35,264 patient records from 1,072 US IRFs in 638 counties in 2012. The University institutional review board deemed the study exempt from full review.

Variables

Table 1 presents operational definitions/coding schemes and data sources for all contextual (facility and community) and individual factors as well as the outcomes of interest. Facility factors including facilities' case mix and structural characteristics were drawn from the IRF-PAI and Provider of Services file, respectively. To measure a facilities' case mix, patient characteristics of the study sample of hip fracture patients were aggregated to the level of the facility. Structural characteristics included: location (rural vs. urban), facility type (hospital-based unit vs. freestanding facility), and ownership (for-profit vs. nonprofit vs. government-owned). Community characteristics (low education, low employment, persistent poverty, and retirement community status) were operationalized using county typology codes extracted from the Area Health Resources file. Individual factors including predisposing (age, race, and gender), enabling (social support), and need characteristics (motor function [self-care and mobility] at admission, cognitive function at admission, and tier comorbidities) were drawn from the IRF-PAI. Healthcare access (use of IRF services as measured by the number of days spent in the IRF) was also drawn from the IRF-PAI.

Self-care and mobility at discharge, the outcomes of interest in this study, are two subscales of the FIM. FIM items are rated on a scale from 1 (total dependence) to 7 (total independence). Self-care was measured by averaging 6 FIM items (eating, grooming, bathing, upper body dressing, lower body dressing, and toileting). Mobility, operationally defined as locomotion, was measured by averaging 2 items (walk/wheelchair and stairs); transfers were not included in our mobility measure as we were primarily interested in lower extremity impairment. Also, qualitative research shows mobility (described as walking and stair climbing) is most valued by patients recovering from hip fracture.¹⁹

Analysis

Multilevel modeling (MLM) was used to examine the effects of individual and contextual (facility and community) factors on self-care and mobility. MLM allows researchers to account for the clustering or nested structure of the data.²⁰ Because these hip fracture patients were nested within facilities and facilities were nested within communities, we initially envisioned a 3-level model, but 60% of the communities (counties) in the dataset had only one IRF, and thus level-specific variance was non-estimable without dropping these IRFs from the analysis. To retain over 98% of the subjects in the analysis, facility and community variables were collapsed into one level (level 2). Thus, in this study, level-1 variables represent individual factors, and level-2 variables represent contextual (facility and community) factors. Specifically, individual level variables included age, gender, race/ethnicity; social support, Tier comorbidities, self-care and mobility scores at admission, and length of stay (LOS). Contextual variables included facilities' case mix (aggregated patient characteristics) and structural characteristics (location, type, ownership), as well as community characteristics (low education, low employment, poverty, retirement community). Effect size (ES) were measured as the relative regression coefficient to the standard deviation of the residuals, which is analogous to Cohen's d : small ($ES = 0.20$ and < 0.50), medium ($ES = 0.50$ and < 0.80), large ($ES = 0.80$).²¹ The HLM version 7²² was used for MLM analyses and SAS Version 9.3²³ was used for all other statistical analyses.

Results

Sample Characteristics

Table 2 summarizes individual characteristics: mean patient age was 81 years; most patients were female (71%) and Non-Hispanic White (88%); and 63% of patients lived with others pre-hospitalization. Overall, 2%, 7%, and 19% were categorized as having a tier 1 (most severe), tier 2 (moderately severe), and tier 3 (mild) comorbidity, respectively. Mean LOS was 13 days. Mean self-care scores increased from 3.17 at admission to 5.03 at discharge; mean mobility scores increased from 1.24 at admission to 3.31 at discharge.

Table 3 summarizes facility and community characteristics. Most IRFs were located in urban areas (82%), hospital-based units (79%), and nonprofit ownership (60%). Fewer than 10% of counties were classed as low-education, low-employment, or persistent poverty; 11% were considered retirement communities. Facilities' mean self-care scores increased from 3.29 at admission to 5.05 at discharge; facilities' mean mobility scores increased from 1.27 at admission to 3.30 at discharge.

Self-Care at Discharge

In the unconditional self-care model, the ICCs indicated 9.6% of the variance in self-care at discharge was attributed to the heterogeneity between contextual-level units and the rest (90.4%) of the variance was attributed to the heterogeneity between individuals within each contextual-level unit. In the fully adjusted self-care model (Table 4), individual and contextual factors explained 44.4% and 21.6% of the variance, respectively.

Individual factors (level-1) associated with better self-care at discharge ($p < .001$) were: younger age (ES = -2.95), female (ES = 1.38), Non-Hispanic White (ES = 0.66), not living with others pre-hospitalization (ES = -1.29), and better cognitive function scores at admission (ES = 3.21), better self-care scores at admission (ES = 0.33), having less severe comorbidities (Tier 1: [ES= -0.95]; Tier 2: [ES= -1.02]; Tier 3 [ES= -1.72]), and longer LOS (ES= 1.36).

Several contextual factors (level-2) were associated with better self-care at discharge. Specifically, facility case mix associated with better self-care at discharge included: lower mean patient age ($p < .001$, ES = -0.07), lower percentage of female patients ($p < .05$, ES = -0.54), higher percentage of Non-Hispanic White patients ($p < .01$, ES = 0.62), and higher facility mean self-care scores at admission ($p < .001$, ES = 0.28). Facility structural characteristics associated with better self-care at discharge were: rural location ($p < .01$, ES = 0.24), freestanding (vs. hospital-based) type ($p < .001$, ES = 0.63), and for-profit (vs. nonprofit) ownership ($p < .05$, ES = 0.19). No community characteristics were significantly associated with self-care at discharge.

Mobility at Discharge

In the unconditional mobility model, the ICCs indicated 8.4% of the variance in mobility at discharge was attributed to the heterogeneity between contextual-level units, and the rest (91.6%) of the variance was attributed to the heterogeneity between individuals within each

contextual-level unit. In the fully adjusted mobility model, individual and contextual factors explained 19.5% and 1.9% of the variance, respectively.

Individual factors (level-1) associated with better mobility at discharge ($p < .001$) were: younger age (ES = -2.28), Non-Hispanic White (ES = 1.17), not living with others pre-hospitalization (ES = -1.02), better cognitive function at admission (ES = 3.83), better mobility scores at admission (ES = 0.78), and having less severe comorbidities (Tier 1[ES = -2.16]; Tier 2: [ES = -1.63]; Tier 3[ES = -1.15]).

Several contextual factors (level-2) were associated with better mobility at discharge. Specifically, facilities' case mix characteristics associated with better mobility at discharge were: lower mean patient age ($p < .001$, ES = -0.06), higher percentage of Non-Hispanic White patients ($p < .05$, ES = 0.48), lower percentage of patients living with others pre-hospitalization ($p < .05$, ES = -0.59), and better aggregated mean mobility scores at admission ($p < .001$, ES = 1.15). No structural or community characteristics were associated with mobility outcomes.

Discussion

Our study was the first to investigate contextual (facility and community) and individual factors associated with self-care and mobility among a national sample of Medicare hip fracture patients treated in IRFs. Contextual factors (most notably facilities' case mix [percent female, percent Non-Hispanic White] and facility type) explained a large proportion of the variance in self-care at discharge, but very little of the variance in mobility. However, individual factors explained a larger proportion of the variance in both outcomes than contextual factors. All individual factors were associated with self-care at discharge, and similar factors were associated with mobility at discharge (except gender and LOS) indicating gender and LOS had little to do with recovery of mobility; most individual factors had large effects on self-care (except Non-Hispanic White and self-care at admission) and mobility (except female and LOS).

Individual Factors

Predisposing characteristics—In the current study, older hip fracture patients treated within IRFs were discharged with lower self-care and mobility scores than younger patients. Possible explanations include 1) increased prevalence of multiple coexisting conditions (i.e., arthritis²⁴, diabetes²⁵) in older patients which increases their risk for physical disability²⁶ and 2) frail older hip fracture patients (whose decreased physiologic reserves increase vulnerability to stressors) are less likely to experience successful functional outcomes.²⁷ Orthogeriatric models of care involving therapeutic targets developed for the “oldest and frailest” hip fracture subgroups²⁸ might inform care practices for IRF patients.

At discharge, women had higher self-care scores than men but did not differ from men on mobility. Most studies of hip fracture patients in IRFs have not reported gender differences in functional scores at discharge,²⁹ with one exception; this small (N=99) prospective study³⁰ reported higher motor gains in men than in women. These researchers assumed women suffered more from pain which resulted in substantial gender differences in motor

outcomes. Pain and function are correlated³¹ thus inadequate pain therapy may preclude regaining mobility. To date, effective approaches to pain management for hip fracture are largely unexplored in rehabilitation settings.³² Large prospective studies assessing pain management practices in IRFs among specific hip fracture patient groups (e.g., women vs. men) are needed.

Our results are consistent with previous findings that hip fracture patients of minority race/ethnicity, compared to non-Hispanic Whites, were associated with lower functional outcomes among adults receiving inpatient rehabilitation.^{10,33}

Enabling characteristics—Hip fracture patients who lived with others pre-hospitalization had poorer scores on self-care and mobility at discharge than those who lived alone. Some patients living with others may have been unable to live alone due to pre-existing functional limitations and could live in the community only with assistance from others. This is consistent with previous studies indicating hip fracture patients who lived with others prior to admission had poorer self-care and mobility scores at admission.^{2,10}

Need characteristics—Not surprisingly, better self-care and mobility scores at admission were associated with better self-care and mobility scores at discharge. The presence of Tier comorbidities 1, 2, and 3 (vs. no Tier comorbidities) at admission was associated with poorer self-care and mobility scores at discharge. Yet, it remains unclear if specific comorbidities or combinations of comorbidities are related to self-care and mobility. Research determining the effects of specific comorbidities and combinations thereof on rehabilitation outcomes is a priority for our future work.

Contextual Factors

Rural location—Better self-care outcomes were found among patients receiving inpatient rehabilitation in rural areas, but not in mobility outcomes. In a previous study, researchers also reported a positive rural effect on functional outcomes of hip fracture patients receiving inpatient rehabilitation in rural areas; however, the unit of analysis was the IRF (not the patient), and functional outcomes (motor function at discharge and motor change) were aggregated to the facility level.⁶ Hip fracture patients treated in rural IRFs may have benefited from better access (longer lengths of stay) to services funded by federal initiatives such as the Medicare Rural Hospital Flexibility Program³⁴, which was designed to strengthen the rural healthcare infrastructure.

IRF type and ownership

In this study, self-care scores at discharge were higher for patients in freestanding (vs. hospital-based) IRFs and for-profit (vs. nonprofit) IRFs; IRF type and ownership had no effect on mobility outcomes. We note that two-thirds of freestanding IRFs were also for-profit facilities. Freestanding facilities had longer LOS, which were associated at the individual patient level with better self-care outcomes. Greater medical complexity in patients admitted to freestanding facilities than those admitted to hospital-based units might explain longer LOS among freestanding IRFs.^{35,36}

Case mix (facility aggregated patient characteristics)

Both self-care and mobility at discharge were higher in IRFs treating hip fracture patients with lower mean age and higher percentages of Non-Hispanic White patients. These findings are consistent with previous research on effects of patient age and race/ethnicity on functional status outcomes.⁶

Health Access

Use of IRF services—Longer IRF LOS was associated with higher self-care scores at discharge; however, LOS was not associated with mobility at discharge. Our findings might be explained by the chronology of hip fracture recovery reported by Magaziner and colleagues³⁷ – upper extremity function (which relates to self-care) is recovered much more quickly than lower extremity function (which relates to mobility), so significant lower extremity improvement may not be realized within the intense but short inpatient rehabilitation period. Additional measures of mobility (i.e. gait speed) that are safe for patients to perform and capable of detecting meaningful change might be more useful than current FIM motor items for assessing short-term mobility improvement in rehabilitation settings.³⁸ Furthermore, reduced muscle strength, weight loss, and inflammation impacting primarily lower extremity functioning represent factors that also likely contribute to the explanation of why greater variance was explained by self-care outcomes (and not mobility outcomes).^{39,40}

Implications for Policy, Management, Clinical Practice

Self-care and mobility represent concepts in the World Health Organization International Classification of Functioning, Disability, and Health.⁴¹ Use of these concepts when evaluating rehabilitation outcomes has the potential to promote a common language among clinicians, researchers and policy-makers interested in improving rehabilitation care across the United States and in comparison with other nations.^{42–44}

Adjusting for case-mix is necessary when comparing outcomes among IRFs. MLM, the statistical approach used in this study, allowed for us to model the data structure and partition the variance attributed to contextual and individual levels. This approach should be used in determining its usefulness in detecting case-mix adjusters among other IRF populations.

Successful implementation and knowledge translation of quality initiatives is affected by context.⁴⁵ Therefore, identifying facility factors associated with rehabilitation outcomes might encourage administrators to benchmark their facilities' performance against the nationally representative sample of IRFs/Medicare hip fracture patients examined in this study; benchmarking may create opportunities for sharing best practices.

Our findings reveal differences in the predictors of self-care and mobility but not the activities that influence such outcomes. Future research that identifies specific self-care and mobility activities may inform the development of clinical strategies that enable patients to meet self-care and mobility requisites during the IRF stay and impede subsequent disability likely exacerbated in the absence of effective rehabilitation.^{46,47}

Study Limitations

Using administrative datasets maximizes sample size, but limitations include potential coding errors and missing data. Community factors related to service access (e.g., distance between home and post-acute provider), facility factors (e.g., staff mix), and process variables (e.g., treatment guidelines, team processes), were not available in the datasets used and might explain additional variance in self-care and mobility.

Conclusion

In a national sample of Medicare hip fracture patients treated in IRFs, we identified specific individual and facility factors that impact self-care and mobility outcomes, a critical first step in helping to ensure the delivery of quality rehabilitation services. Furthermore, this study highlights the importance of evaluating self-care distinct from mobility which is useful in supporting intervention activities and quality improvement programs targeting vulnerable subgroups of hip fracture patients. Also, these data are useful to IRFs as CMS begins to assess facility performance based on risk-adjusted quality metrics.

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List of Abbreviations

CMS	Centers for Medicare and Medicaid Services
FIM	Functional Independence Measure
IRF	Inpatient Rehabilitation Facility
SNF	Skilled Nursing Facility
HH	Home Health
IRF-PAI	Inpatient Rehabilitation Facility-Patient Assessment Instrument
LOS	Length of Stay
MLM	Multilevel modeling

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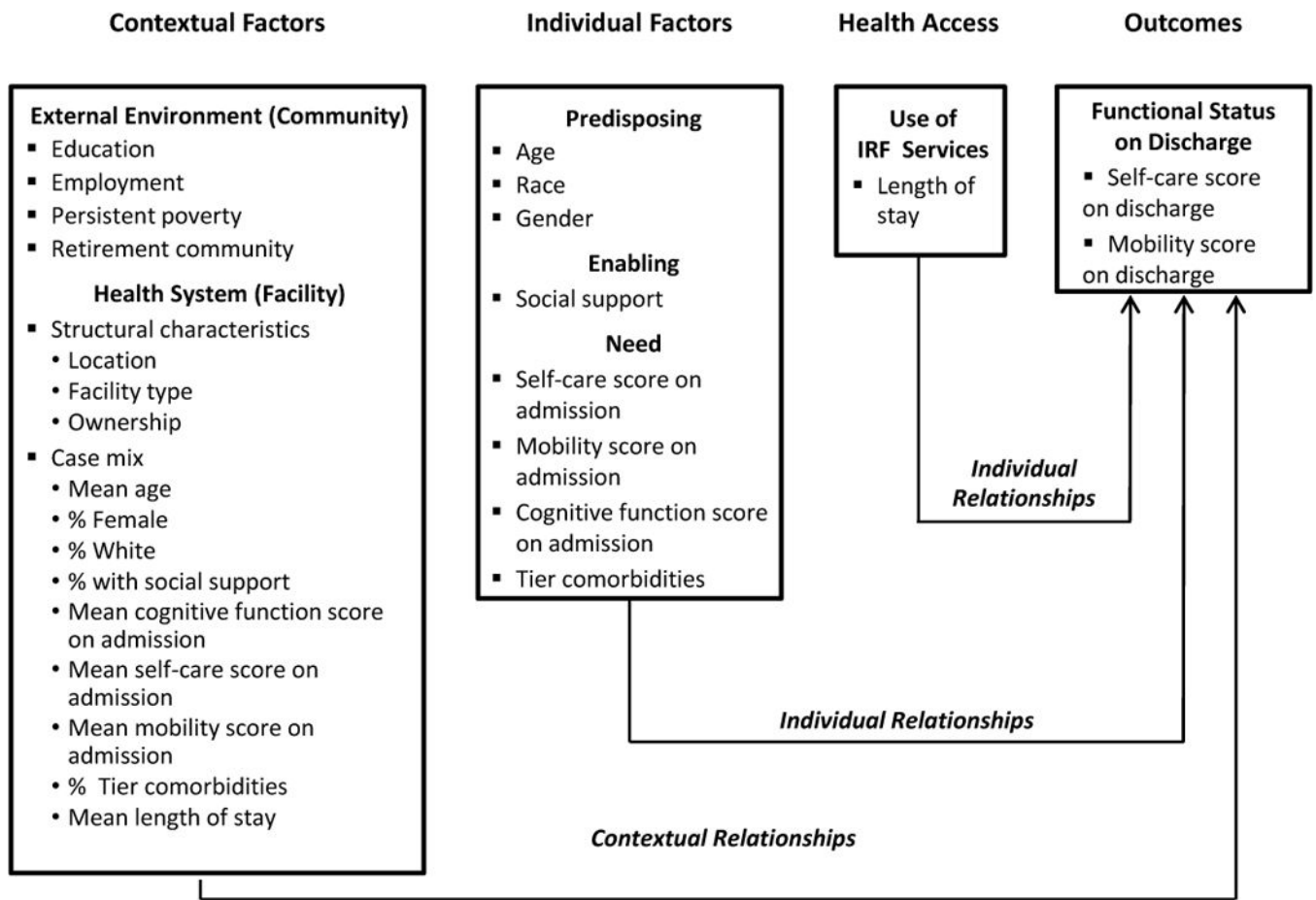


Figure 1.
We used Andersen’s model for health services use as a guiding framework for this study.

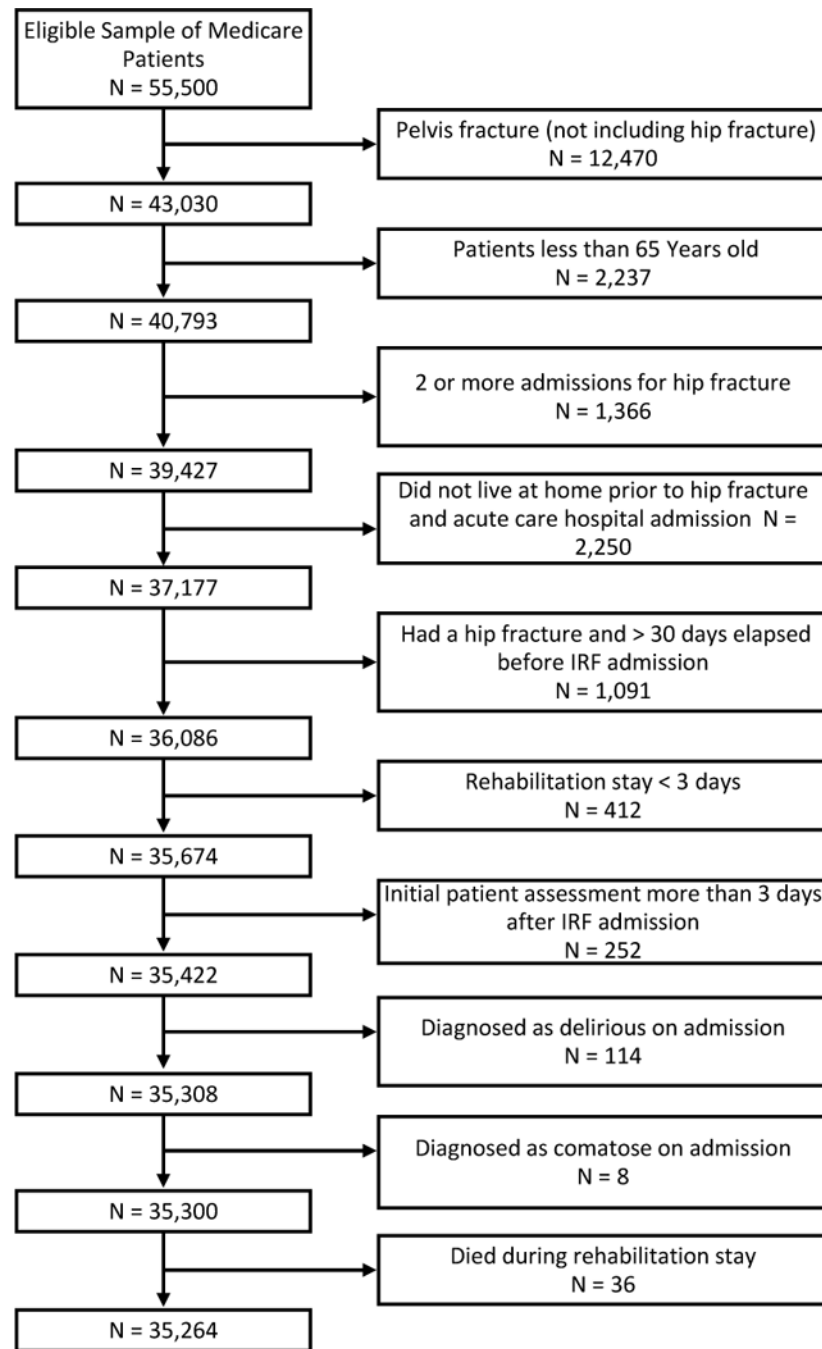


Figure 2. Flow diagram. Adults aged 65 years or older with Medicare fee-for-service insurance treated in an Inpatient Rehabilitation Facility with a primary diagnosis of hip fracture (ICD-9CM codes 820-820.9) in 2012.

Table 1

Operational Definitions/Coding Schemes and Data Sources for Variables Used in the Multilevel Models.

Variable	Operational Definition/Coding Schemes	Data Source
Level-1: Individual Factors		
<i>Predisposing characteristics</i>		
Age	Patient's age in years at the date of IRF admission	IRF-PAI
Gender	Patient's gender: 0 = male; 1 = female	IRF-PAI
Race/ethnicity	Patient's race/ethnicity: (1) Non-Hispanic White; (2) Minority	IRF-PAI
<i>Enabling characteristic</i>		
Social support	Patient living with others pre-hospitalization: 0 = no/1 = yes	IRF-PAI
<i>Need characteristics</i>		
Cognitive function at admission ^a	Measured by averaging 5 cognitive items of the Functional Independence Measure (FIM): comprehension, expression, social interaction, problem solving, and memory.	IRF-PAI
Motor FIM: Self-care at admission ^a	Measured by averaging the 6 self-care items from the Functional Independence Measure (FIM): eating, grooming, bathing, upper body dressing, lower body dressing, and toileting.	IRF-PAI
Motor FIM: Mobility at admission ^a	Measured by averaging 2 locomotion items from the Functional Independence Measure (FIM): walk/wheelchair and stairs.	IRF-PAI
Tier comorbidities	Presence or absence of comorbidities categorized at four levels (Tier 1: most severe, Tier 2: moderately severe, Tier 3: mild; No Tier: none of the listed tier comorbidities).	IRF-PAI
<i>Health access</i>		
Length of stay in IRF	Number of days spent in inpatient rehabilitation facility	IRF-PAI
Level-2: Contextual (Facility and Community) Factors		
<i>Facility: Case mix (aggregated patient characteristics)</i>		
Facility-wide age ^b	Age in years (mean)	IRF-PAI
Facility-wide gender ^b	% Female	IRF-PAI
Facility-wide race/ethnicity ^b	% White	IRF-PAI
Facility-wide social support ^b	% of patients living with others pre-hospitalization	IRF-PAI
Cognitive function at admission ^{a,b}	Mean cognitive function on admission (measured by averaging 5 cognitive items of the FIM: comprehension, expression, social interaction, problem solving, and memory).	IRF-PAI
Motor FIM: Self-care at admission ^{a,b}	Mean of self-care scores on admission (measured by averaging the 6 self-care items from the FIM: eating, grooming, bathing, upper body dressing, lower body dressing, and toileting)	IRF-PAI
Motor FIM: Mobility at admission ^{a,b}	Mean of mobility scores on admission (measured by averaging the 2 locomotion items from the FIM: walk/wheelchair, and stairs)	IRF-PAI
Comorbid conditions ^b	% of patients at each comorbidity level (Tier 1: most severe; Tier 2: moderately severe; Tier 3: mildly severe; no Tier comorbidities)	IRF-PAI
Aggregated Length of stay in IRF	Average number of days spent in an inpatient rehabilitation facility	IRF-PAI
<i>Facility: Structural characteristics</i>		
Facility location	Located in Rural/Non-metro area. 0 = no/1 = yes	POS
Facility type	Hospital-based unit = 0; freestanding facility = 1	POS
Facility ownership	Ownership: (1) For-profit; (2) Nonprofit; (3) Government	POS

Variable	Operational Definition/Coding Schemes	Data Source
<i>Community characteristics^c</i>		
Low education	Low-education county indicator. 0 = no/1 = yes	AHRF
Low employment	Low-employment county indicator. 0 = no/1 = yes	AHRF
Persistent poverty	Persistent poverty county indicator. 0 = no/1 = yes	AHRF
Retirement community	Retirement destination county indicator. 0 = no/1 = yes	AHRF
Outcomes		
Self-care at discharge ^a	Average of scores for the 6 self-care items from the FIM (eating, grooming, bathing, upper dressing, lower dressing, and toileting) on discharge from IRF.	IRF-PAI
Mobility at discharge ^a	Average of scores for the 2 locomotion items from the FIM (walk/wheelchair and stairs) on discharge from IRF.	IRF-PAI

Notes.

Data Sources: 2012 IRF-PAI: Inpatient Rehabilitation Facility Patient Assessment Instrument; 2012 POS: Provider of Services file; 2004 AHRF: Area Health Resources File.

^aEach FIM item is rated on a scale of 1 (total dependence) to 7 (complete independence). Per CMS guidelines, any FIM item scored as 0 (activity did not occur) was converted to 1 (total dependence) for analysis. Range for cognitive FIM score (5 items) = 5 – 35; range for self-care FIM score = 1 – 7; range for mobility FIM score = 1 – 7.

^bAggregated variable for all Medicare hip fracture patients treated in each facility during 2012.

^cCommunity characteristics were taken from the AHRF county typology codes which classifies all U.S. counties according to six non-overlapping categories of economic dependence and seven overlapping categories of policy-relevant themes. The economic types include the following: farming, mining, manufacturing, services, Federal/State government, and unspecialized counties. The policy types (several of which were used in our study) include the following: low education, low employment, persistent poverty, and retirement destination; counties were indicated as persistent poverty if 20 percent or more of its residents were poor; counties were considered low-education, if 25 percent or more of residents had neither a high school diploma nor GED; counties were considered low employment if less than 65% of residents age 25-64 were employed.

Table 2

Individual Factors of Medicare Hip Fracture Patients ($N = 35,264$) Treated in Inpatient Rehabilitation Facilities in 2012.

Level-1: Individual Factors	Mean (SD)	%
Predisposing Characteristics		
Age (years)	81.23 (7.65)	
Female		71%
White		88%
Enabling Characteristic		
Social support (living with others pre-hospitalization)		63%
Need Characteristics		
Cognitive FIM score at admission	23.68 (6.73)	
Self-care FIM score at admission	3.17 (0.87)	
Mobility FIM score at admission	1.24 (0.51)	
Comorbidity tier level:		
Tier 1- most severe		2%
Tier 2- moderately severe		7%
Tier 3- mildly severe		19%
No tier comorbidities		72%
Health access		
Length of stay in IRF (days)	13.43 (4.62)	
Outcomes		
Self-care FIM score at discharge	5.03 (1.09)	
Mobility FIM score at discharge	3.31 (1.54)	

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Table 3

Contextual (Facility and Community) Factors for Inpatient Rehabilitation Facilities (N = 1072) and Counties (N = 638) in the Sample.

Level-2: Contextual (Facility and Community) Factors	Mean (SD)	%
Facility Factors		
<i>Case Mix (Aggregated Patient Variables) Characteristics^a</i>		
Mean patient age (years)	80.96 (2.92)	
% Female		70%
% White		73%
% Living with others pre-hospitalization		64%
Mean cognitive FIM score at admission	24.54 (3.54)	
Mean self-care FIM score at admission	3.29 (0.49)	
Mean mobility FIM score at admission	1.27 (0.26)	
Comorbidity tier level:		
% Tier 1 – most severe		2%
% Tier 2 – moderately severe		7%
% Tier 3 – mildly severe		20%
No tier comorbidities		71%
Mean length of stay in IRF (days)	13.22 (2.47)	
Mean self-care FIM score at discharge	5.05 (0.49)	
Mean mobility FIM score at discharge	3.30 (0.66)	
<i>Structural Characteristics</i>		
Facility Location:		
Rural		18%
Urban		82%
Facility Type:		
Freestanding		21%
Hospital-based		79%
Facility Ownership:		
For-profit		29%
Nonprofit		60%
Government		11%
Community Factors		
Low education		9%
Low employment		7%
Persistent poverty		5%
Retirement community		11%

^aAggregated variables for all Medicare hip fracture patients treated within each IRF in 2012.

Table 4

Multilevel Linear Model Results for Two Outcomes (FIM Self-Care Score on Discharge and FIM Mobility Score on Discharge) in Hip Fracture Patients Treated in Inpatient Rehabilitation Facilities during 2012.

Variable	Outcomes: Fixed Effects					
	Self-Care Score at Discharge			Mobility Score at Discharge		
	<i>b</i> (<i>SE</i>)	<i>ES</i>	<i>p</i>	<i>b</i> (<i>SE</i>)	<i>ES</i>	<i>p</i>
Level 1: Individual Factors						
<i>Predisposing Characteristics</i>						
Age	-0.094 (0.003)	-2.95	<.001	-0.039 (0.002)	-2.28	<.001
Female ^a	0.469 (0.057)	1.38	<.001	-0.027 (0.034)	-0.12	.413
Non-Hispanic White ^b	0.511 (0.099)	0.66	<.001	0.226 (0.052)	1.17	<.001
<i>Enabling Characteristics</i>						
Living with others pre-hospitalization ^c	-0.418 (0.055)	-1.29	<.001	-0.205 (0.031)	-1.02	<.001
<i>Need Characteristics</i>						
Cognitive FIM score at admission	0.268 (0.005)	3.21	<.001	0.125 (0.002)	3.83	<.001
Self-care FIM score at admission	0.624 (0.009)	0.33	<.001	N/A		
Mobility FIM score at admission	N/A			0.717 (0.017)	0.78	<.001
Comorbidities: Tier 1 – most severe ^d	-1.939 (0.217)	-0.95	<.001	-1.242 (0.104)	-2.16	<.001
Comorbidities: Tier 2 – moderately severe ^d	-1.722 (0.129)	-1.02	<.001	-0.690 (0.062)	-1.63	<.001
Comorbidities: Tier 3 – mildly severe ^d	-0.827 (0.066)	-1.72	<.001	-0.496 (0.042)	-1.15	<.001
<i>Health access</i>						
Length of stay in IRF	0.199 (0.009)	1.36	<.001	-0.006 (0.004)	-0.09	.160
Level 2: Contextual Factors (Facility and Community Characteristics)						
<i>Facility: Case mix (aggregated Patient Characteristics)^e</i>						
Mean patient age	-0.135 (0.030)	-0.07	<.001	-0.057 (0.015)	-0.06	<.001
% Female ^a	-1.021 (0.500)	-0.54	.042	-0.241 (0.263)	-0.26	.359
% Non-Hispanic White ^b	1.175 (0.403)	0.62	.004	0.438 (0.191)	0.48	.022
% Living with others pre-hospitalization ^c	-0.824 (0.484)	-0.44	.089	-0.543 (0.241)	-0.59	.025

Variable	Outcomes: Fixed Effects					
	Self-Care Score at Discharge			Mobility Score at Discharge		
	<i>b</i> (<i>SE</i>)	<i>ES</i>	<i>p</i>	<i>b</i> (<i>SE</i>)	<i>ES</i>	<i>p</i>
Mean Cognitive FIM score at admission	0.005 (0.023)	0.00	.819	0.004 (0.010)	0.00	.663
Mean Self-care FIM score at admission	0.530 (0.036)	0.28	<.001	N/A	N/A	
Mean Mobility FIM score at admission		N/A		1.056 (0.098)	1.15	<.001
% Tier 1 – most severe ^d	-0.171 (1.388)	-0.09	.902	-0.581 (0.704)	-0.63	.409
% Tier 2 – moderately severe ^d	0.328 (0.960)	0.17	.732	0.059 (0.477)	0.06	.900
% Tier 3 – mildly severe ^d	0.694 (0.499)	0.37	.164	-0.228 (0.258)	-0.25	.377
Mean length of stay in IRF	0.039 (0.035)	0.02	.269	0.006 (0.016)	0.01	.682
Facility: Structural Characteristics						
Rural location	0.453 (0.170)	0.24	.008	0.137 (0.090)	0.15	.130
Type: Freestanding (vs. hospital-based)	1.186 (0.194)	0.63	<.001	0.101 (0.083)	0.11	.225
Ownership: For-profit (vs. nonprofit)	0.351 (0.176)	0.19	.047	-0.019 (0.079)	-0.02	.809
Ownership: Government (vs. nonprofit)	0.047 (0.182)	0.02	.797	-0.178 (0.091)	-0.19	.052
Community Characteristics						
Low education	-0.511 (0.261)	-0.27	.051	-0.049 (0.136)	-0.05	.717
Low employment	-0.244 (0.308)	-0.13	.429	-0.161 (0.158)	-0.18	.307
Persistent poverty	-0.280 (0.348)	-0.15	.421	0.142 (0.176)	0.15	.421
Retirement community	0.112 (0.187)	0.06	.549	-0.111 (0.096)	-0.12	.246
Variable	Outcomes: Random Effects					
	Self-Care Score at Discharge			Mobility Score at Discharge		
	Variance	$\chi^2(df)$	<i>p</i>	Variance	$\chi^2(df)$	<i>p</i>
Level 2 Residual						
For Patient-level intercept	3.54	289.64 (209)	<.001	0.84	294.74 (209)	<.001
For Age	<0.01	226.69 (227)	>.500	<0.01	215.71 (227)	>.500
For Female ^a	0.12	205.98 (227)	>.500	0.05	244.59 (227)	.202
For Non-Hispanic White ^b	0.59	280.82 (227)	.009	0.04	259.53 (227)	.068
For Living with others pre-hospitalization ^c	0.10	204.81 (227)	>.500	0.04	192.70 (227)	>.500

Variable	Outcomes: Random Effects				
	Self-Care Score at Discharge		Mobility Score at Discharge		
	Variance	$\chi^2(df)$	<i>p</i>	<i>p</i>	
For Cognitive FIM score at admission	0.01	318.68 (227)	>.500	<0.01	282.11 (227) .008
For Tier 1 – most severe ^d	4.15	305.15 (227)	.001	0.33	217.22 (227) >.500
For Tier 2 – moderately severe ^d	2.85	272.86 (227)	.020	0.18	216.42 (227) >.500
For Tier 3 – mildly severe ^d	0.23	221.82 (227)	>.500	0.18	291.22 (227) .003
For Length of stay	0.02	365.93 (227)	<.001	<0.01	302.13 (227) .001
Level 1 Residual					6.79

% of Variance Explained by Multilevel Model	Outcomes	
	Self-Care Score at Discharge: % of Variance	Mobility Score at Discharge: % of Variance
Level 1: Individual Factors	44.4%	19.5%
Level 2: Contextual (Facility and Community) Factors	21.6%	1.9%

Notes: *b* = unstandardized beta coefficient

^aReference group = Male;

^bReference group = Non -Hispanic white;

^cReference group = Living alone;

^dReference group = No tier comorbidities.

^eVariables in this section are aggregated characteristics for all Medicare hip fracture patients treated within each IRF in 2012.