Research Article

Variation in Functional Status After Hip Fracture: Facility and Regional Influence on Mobility and Self-Care

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Abstract

Background: Recent reports show substantial geographic variation in postacute health care spending. Little is known about variation in functional outcomes after postacute rehabilitation for patients with hip fracture. We examined variation in mobility and self-care after hip fracture rehabilitation across inpatient rehabilitation facilities (IRFs), hospital referral regions (HRRs) and states.

Methods: Retrospective cohort study using data from the Centers for Medicare and Medicaid Services (CMS) from 2006 to 2009. Study sample included 149,258 records from patients 66 years and older at 1,166 IRFs located within 292 HRRs and across 50 states. Hip fracture cases were defined by CMS impairment group codes (08.11, 08.12). Hierarchical generalized linear models were used to assess discharge mobility and self-care functional status, adjusting for individual patient characteristics and the random effect of IRFs, HRRs, and states.

Results: Variation in discharge mobility status as assessed by the intraclass correlation percentage (ICC%) was 8.8% across IRFs, 4.0% across HRRs, and 1.8% across states. For self-care, the ICCs were 10.2% across IRFs, 4.8% across HRRs, and 2.4% across states. The range of discharge mobility scores (maximum functional status rating to minimum functional status rating) showed a 9.6-point difference for IRFs, 6.5 for regions, and 2.6 for states. Range of discharge self-care scores were 13.1 for IRFs, 6.8 for HRRs, and 3.4 for states.

Conclusion: Variation in functional status following postacute hip fracture rehabilitation appears to occur primarily at the level of facilities rather than geographic location.

Keywords: Variation—Quality of care—Functional status—Hip fracture—Postacute—Rehabilitation

Hip fracture is associated with increased mortality, debility, and institutionalization in older adults (1). Postacute rehabilitation after hip fracture surgery has been shown to improve functional independence (2,3) and lower mortality (3). An Institute of Medicine (IOM) report indicates that around 73% of the variation in health care costs across hospital referral regions (HRRs) is comprised of spending on postacute care (4,5). Geographic variation in rates of hip fracture (6–8) and other orthopedic procedures commonly associated with rehabilitation such as knee and shoulder replacement have been reported (9,10). It is not clear from these studies if regional differences in hip fracture prevalence rates, translate to quality of care parameters such as functional status. Few studies have focused on geographic variation in functional status in postacute care settings (11–13).

Patient level demographic and clinical characteristics do not fully explain observed rates of variation (14,15) in health care (16,17). While understanding that higher spending does not necessarily translate to better quality of care and outcomes (18), the Centers for Medicare and Medicaid Services (CMS) recently targeted high spending regions in an attempt to limit Medicare coverage and lower payments (14–16). These measures do not appear to have been successful to-date in reducing variation (19). The Federal Register’s proposed rules for the Medicare Inpatient Rehabilitation Facility Prospective Payment System for 2015, include the use of metrics such as mobility and self-care function at discharge as indicators of the quality of patient care (20). The purpose of our study was to examine variation in hip fracture mobility and self-care function at discharge across inpatient rehabilitation facilities (IRFs), HRRs,
and states after adjusting for patient level demographic and clinical factors.

Methods

Study Participants

We used the CMS claims files and examined a national sample of Medicare fee-for-service beneficiaries receiving inpatient rehabilitation from 2006 through 2009. We included records from the following files: (a) Medicare Provider Analysis and Review (MedPAR), (b) Inpatient Rehabilitation Facility-Patient Assessment Instrument (IRF-PAI), (c) Beneficiary Summary file, and the (d) Provider of Service file (POS). A data use agreement was completed in accordance with CMS requirements. Approval was obtained from the University’s Institutional Review Board.

Our eligible sample included 185,644 records from patients, 66 years and older, with hip fracture (IRF-PAI impairment codes 08.11, 08.12) who were discharged from acute care to IRFs. These codes correspond to ICD-9 codes 820.00–820.9. The analysis was restricted to those patients with unilateral and bilateral hip fracture, and excluded individuals with pelvis fracture, multiple fractures, and femur shaft fractures (n = 31,792). We further excluded records from 125 rehabilitation facilities that treated less than 10 patients (n = 335) over the 3-year period. Patients with atypical length of stay (ie, ≤3 days, n = 3,256) and patients with missing information on covariates used in our multivariable models were also excluded (n = 803). The final sample included 149,258 patient records from 1,166 rehabilitation facilities located across 292 HRRs in 50 states.

Outcome of Interest: Variation in Discharge Mobility and Self-Care

Functional status at discharge was assessed using items from the Functional Independence Measure (FIM) instrument (21). The 18-items from the FIM instrument are included in the IRF-PAI (22). The items from the IRF-PAI are administered by clinicians within 3 days of admission and discharge, and evaluate the patient’s motor and cognitive abilities across six subscales including self-care, sphincter control, locomotion, transfers, communication, and social recognition. Scores for each functional item range from 1 (total assistance) to 7 (complete independence). We examined variation in self-care and mobility subscales at discharge as they were likely to be influenced in patients with hip fracture (23,24). The mobility subscale includes five items: (a) transfers from bed, chair, and wheelchair, (b) toilet transfers, (c) tub/shower transfers, (d) walking/wheelchair locomotion, and (e) stairs resulting in a range of scores from 5 to 35 with higher scores indicating better performance. The self-care scale is comprised of six items: (a) eating, (b) grooming, (c) bathing, (d) upper body dressing, (e) lower body dressing, and (f) toileting with scores ranging from 6 to 42. The IRF-PAI functional items have been used extensively in the literature and their reliability and validity is well established (21,25).

Variation in discharge scores was assessed instead of change from admission, as the later does not completely capture patient level of function (26). Change scores among patients may differ in the direction of change. Furthermore, comparisons in the magnitude of change for someone starting at the lower end of the scale to others starting higher on the scale are not appropriate and are difficult to interpret from a clinical point of view. Finally, discharge function ratings represent a metric understandable to clinicians as well as discharge planners.

Covariates

Patient level demographic covariates included age, gender and race/ethnicity, marital status, and pre-hospital living status (27–31). Age was examined as a continuous variable. Race/ethnicity was categorized as non-Hispanic white, non-Hispanic black, Hispanic, and others. We used responses for marital status (married vs unmarried [never married, separated, divorced, widowed]) and pre-hospital living status (not alone [family/relatives, friends, attendant, other] vs alone) to construct a support variable. Patients were considered to have support if they were married or were living with others prior to hospitalization. Clinical covariates included mobility or self-care ratings at admission, length of stay, and 30 comorbid conditions from the Elixhauser Comorbidity index (27,32). Additionally, we included clinical comorbidities of osteoarthritis, osteoporosis, avascular necrosis, deep vein thrombosis, and pulmonary embolism. In-patient rehabilitation facilities included freestanding hospitals/centers and units within a hospital, identified from ID codes in the MedPAR file. The region variable in our analysis was based on the Dartmouth HRRs (17). We used the Dartmouth Atlas crosswalk linked to facility ZIP codes in the Provider of Service file to identify the HRRs and states.

Table 1. Characteristics of the Study Sample*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Study Sample (N = 149,256)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years</td>
<td>81.9 ± 7.2</td>
</tr>
<tr>
<td>Female (%)</td>
<td>108,898 (73.0)</td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
</tr>
<tr>
<td>Non-Hispanic White</td>
<td>135,446 (90.8)</td>
</tr>
<tr>
<td>Non-Hispanic Black</td>
<td>5,142 (3.5)</td>
</tr>
<tr>
<td>Hispanic/Latino</td>
<td>6,041 (4.1)</td>
</tr>
<tr>
<td>Others</td>
<td>2,627 (1.8)</td>
</tr>
<tr>
<td>Married (%)</td>
<td>57,164 (38.3)</td>
</tr>
<tr>
<td>Living with someone (%)</td>
<td>86,694 (58.1)</td>
</tr>
<tr>
<td>Support (%)</td>
<td></td>
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<tr>
<td>Married/living with someone</td>
<td>90,948 (60.9)</td>
</tr>
<tr>
<td>Not-married/living alone</td>
<td>58,308 (39.1)</td>
</tr>
<tr>
<td>Elixhauser comorbidities (%)</td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>91,337 (61.2)</td>
</tr>
<tr>
<td>Deficiency anemia</td>
<td>40,673 (27.3)</td>
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<tr>
<td>Chronic pulmonary disease</td>
<td>27,828 (18.6)</td>
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<tr>
<td>Arrhythmias</td>
<td>26,396 (17.7)</td>
</tr>
<tr>
<td>Diabetes without chronic complications</td>
<td>23,926 (16.0)</td>
</tr>
<tr>
<td>Clinical comorbidities (%)</td>
<td></td>
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<tr>
<td>Osteoarthritis</td>
<td>32,255 (21.6)</td>
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<tr>
<td>Osteoporosis</td>
<td>31,508 (21.1)</td>
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<tr>
<td>Avascular necrosis</td>
<td>246 (0.2)</td>
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<tr>
<td>Deep vein thrombosis</td>
<td>2,093 (1.4)</td>
</tr>
<tr>
<td>Pulmonary embolus</td>
<td>731 (0.5)</td>
</tr>
<tr>
<td>Length of stay, days</td>
<td>13.6 ± 4.7</td>
</tr>
<tr>
<td>Admission mobility score, mean ± SD (range)</td>
<td>9.2 ± 3.2 (5–29)</td>
</tr>
<tr>
<td>Discharge mobility score, mean ± SD (range)</td>
<td>19.0 ± 6.2 (5–35)</td>
</tr>
<tr>
<td>Admission self care score, mean ± SD (range)</td>
<td>19.5 ± 5.3 (6–42)</td>
</tr>
<tr>
<td>Discharge self care score, mean ± SD (range)</td>
<td>29.5 ± 6.8 (6–42)</td>
</tr>
</tbody>
</table>

*Data presented are unadjusted number (percentages) or mean values ± SD, as appropriate for each variable. †Frequencies for the top five Elixhauser comorbidity measures.
Statistical Analysis

Summary statistics (percentages [%], mean and standard deviation (SD)) were calculated for the sample. Multilevel mixed models with a restricted maximum likelihood estimation approach were used to assess discharge mobility and self-care function following hip fracture rehabilitation. The percentage of variance (ICC; intraclass correlation) in mobility and self-care ratings was calculated independently at the level of the rehabilitation facilities, HRRs, and states, after adjusting for their clustering (random) effect. Patient level (fixed effects) adjustments included age, gender, race/ethnicity, support, length of stay, admission self-care and mobility ratings, clinical comorbidities, and Elixhauser comorbidity index to examine discharge mobility and self-care FIM scores. Variation profiles for discharge function along with 95% Empirical Bayes confidence intervals (33,34) were constructed using adjusted two and three level models (patients–IRFs, patients–IRFs–HRR, patients–IRFs–states). Likewise, maps for multivariable adjusted predicted mean discharge mobility and self-care by state were created at two and three levels (patients–states, patients–IRFs–states). All analyses were performed with SAS version 9.4 (SAS, Inc., Cary, NC).

Results

Table 1 presents the unadjusted demographic and clinical characteristics of the study sample. Approximately 73% of the sample were women and the mean age was 81.9 (SD = 7.2) years. The sample was predominantly white (90.8%) and had support (60.9%). The most common comorbidities were hypertension (61.2%), deficiency anemia (27.3%), osteoarthritis (21.6%), osteoporosis (21.1%), chronic pulmonary disease (18.6%), arrhythmias (17.7%), and diabetes without chronic complications (16.0%). The average functional status rating at admission was 9.2 (SD = 3.2) for mobility and 19.5 (SD = 5.3) for self-care. Mean discharge functional status ratings were 19.0 (SD = 6.2) for mobility and 29.5 (SD = 6.8) for self-care. The average length of stay (LOS) was 13.6 days (SD = 4.7).

Table 2 shows the results for the variation (ICC%) in discharge mobility and self-care function at the level of IRFs, HRRs, and states. Without adjustments for random effects (ie, Model I) variation in discharge mobility was 8.8% across facilities, 4.0% across HRRs, and 1.8% across states. Likewise, discharge self-care ICCs for IRFs, HRRs, and states were 10.2%, 4.8%, and 2.4%, respectively.

Furthermore, we examined the change in explained variation due to adjustments for random effects (Model II: patients–IRFs–HRRs and Model III: patients–IRFs–states). At IRFs discharge mobility scores decreased 10.2% after accounting for HRRs and 6.8% when adjusting for states. In contrast among HRRs, discharge mobility scores decreased by 75.0% when adjusting for facility effects. Adjusting for facility effects among states resulted in a 61.1% decrease in discharge mobility. Estimates for variables included in the models are reported in Supplementary Tables 3 and 4.

Additionally, we computed variation plots for discharge mobility and self-care functional status (Figures 1 and 2) across facilities. The first 1,166 IRFs were ranked based on their multivariable adjusted mean mobility or discharge self-care ratings, and accounting for random state level effects. Each vertical line in the figure represents the adjusted mean discharge mobility or self-care scores along with the Empirical Bayes confidence interval for each facility. For discharge self-care (Figure 1) the shaded vertical lines on the left show the 250 facilities significantly below the mean while shaded vertical lines on the right indicate the 252 facilities above the national average. Similarly, Figure 2 illustrates the variation in discharge self-care scores across facilities.

Figures 3 and 4 show the predicted mean discharge mobility and self-care scores across states with and without adjusting for random effects of facilities. California, Texas, Florida, and Alabama had below average discharge mobility as well as self-care scores. In contrast, Arkansas had discharge mobility scores above the national mean. Iowa, Ohio, and Wisconsin were in the upper tertile for discharge self-care.

Overall, the range of discharge functional status scores (maximum functional status rating to minimum functional status rating) was higher for IRFs when compared to regions and states. For
discharge mobility, there was a 9.6-point difference for IRFs, 6.5 for HRRs, and 2.6 for states. Likewise, the range for discharge self-care scores was 13.1 for IRFs, 6.8 for HRRs, and 3.4 for states.

Discussion

In the current study, we examined variation in mobility and self-care status at the level of IRFs, HRRs, and across states in patients receiving postacute rehabilitation following hip fracture. We found greater variation in functional status at discharge among IRFs when compared to HRRs or states. The results were consistent when comparing unadjusted and adjusted multi-level models for both mobility and self-care at discharge.

Our findings of greater variation in discharge functional status at the facility level are consistent with the Donabedian model for health service evaluation and quality of care (35). Structural factors within a facility such as space, equipment, payment methods, availability of staff, and their level of expertise may influence functional outcomes (36–38). In addition, process factors such as physician practice styles, discharge planning, and continuity of care models also influence functional status outcomes (39–43). Gozalo et al. (44) found that among hip fracture patients a successful return to the community depends on the volume and staffing characteristics of the facility. Another study by Leland et al. (45) concluded that existing metrics such as 30-day readmission do not completely capture the needs of the PAC market and there is a need for additional quality measures. A previous study on variation in functional status among stroke patients in inpatient rehabilitation revealed that facility-level practice patterns and procedures influence outcomes (13).

The need for national information related to variation in functional outcomes is particularly important in the context of the programs and services associated with the Affordable Care Act (48) including the development of Accountable Care Organizations, Medical Homes, site neutral payments and the CMS Bundled Payments for Care Improvement (BPCI) Initiative (49). Our findings are particularly relevant to the recent implementation of the Comprehensive Care for
Joint Replacement Program (50) and the Improving Medicare Post-Acute Care Transformation (IMPACT) Act (51).

Information on how patient-centered outcomes such as self-care vary across different postacute facilities and geographic regions is becoming increasingly important as the programs of the Affordable Care Act are implemented. For example, in the bundled payment initiative the focus is on the services needed and outcomes attained by patients across an episode of care (47). Knowing what factors are related to variation in patient-centered outcomes across facilities and regions will be helpful in the successful implementation of these programs (52). Our results suggest substantial differences in variation in mobility and self-care across postacute rehabilitation facilities, HRRs, and states for Medicare beneficiaries receiving treatment following a hip fracture. Factors such as volume, provider supply, workforce differences, as well as other state programs and policies may be responsible for the observed findings (53,54). These differences are a part of our ongoing research examining rehabilitation service areas and require further exploration.

Our results must be interpreted in the context of the study’s limitations. First, we examined only records for Medicare fee-for-service beneficiaries, and our findings are not generalizable to the overall Medicare population. Second, our observations were restricted to IRFs and did not include data from other postacute care settings such as home health, long-term acute care hospitals or skilled nursing facilities. Third, we did not explore facility specific factors such as urban versus rural designations, teaching versus nonteaching, or number of beds. Finally, we used the Dartmouth based HRRs, originally developed for acute care settings as our region level geographic variable for rehabilitation facilities. This unit of analysis may not be ideal for variation across postacute settings. Quality of care among PAC settings is currently a topic of active research. Compared to patients treated at SNFs, hip fracture patients receiving postacute care at IRFs have demonstrated better functional outcomes despite shorter length of stay (55,56). In previous research, people treated at IRFs showed lower readmission rates when compared to other PAC settings (57). In contrast, Deutsch et al. (58) found similar or better outcomes in hip fracture patients receiving care at SNFs. Further research is needed to better understand the redistribution of patients across PAC settings and the potential changes in outcomes due to healthcare reform.

In conclusion, we observed greater variation in postacute hip fracture mobility and self-care at discharge within IRFs compared to geographical regions as defined by HRRs and states. Additional research is required to better understand the factors responsible for differences in functional status outcomes across both facilities and geographic regions. This is particularly true for outcomes in postacute care where substantial changes are planned in service delivery models over the next decade.

Supplementary Material
Supplementary data are available at The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences online.

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Conflict of Interest
The authors report no conflicts of interest related to this manuscript.

References


