Published in final edited form as:

Arch Phys Med Rehabil. 2015 May ; 96(5): 790–798. doi:10.1016/j.apmr.2015.01.003.

Performance-based Outcomes of Inpatient Rehabilitation Facilities Treating Hip Fracture Patients in the United States

Michael P. Cary Jr., PhD, RN,

Duke University, School of Nursing, Assistant Professor, DUMC 3322, 307 Trent Drive, Durham, NC 27710, michael.cary@duke.edu, 919-613-6031

Marianne Baernholdt, PhD, MPH, RN, FAAN,

Virginia Commonwealth University, School of Nursing, Professor of Nursing, P.O. Box 980567, Richmond, VA 23298, mbaernholdt@vcu.edu, 804-828-5175

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

Duke University, School of Nursing, Virginia Stone Professor of Nursing, DUMC 3322, 307 Trent Drive, Durham, NC 27710, ruth.anderson@duke.edu, 919-668-4599

Elizabeth I. Merwin, PhD, RN, FAAN

Duke University, School of Nursing, Ann Henshaw Gardiner Professor of Nursing, DUMC 3322, 307 Trent Drive, Durham, NC 27710, elizabeth.merwin@duke.edu, 919-681-0886

Abstract

Objective—To examine the influence of facility and aggregate patient characteristics of inpatient rehabilitation facilities (IRFs) on performance-based rehabilitation outcomes in a national sample of IRFs treating Medicare beneficiaries with hip fracture.

Design—Secondary data analysis.

Setting—U.S. Medicare-certified IRFs (N=983).

Participants—983 US Medicare-certified IRFs. Data included 34,364 patient records of Medicare beneficiaries admitted in 2009 for rehabilitation after hip fracture.

Main Outcome Measures—Performance-based outcomes included mean motor function on discharge, mean motor change (mean motor score on discharge minus mean motor score on admission) and percentage discharged to the community.

Results—Higher mean motor function on discharge was explained by aggregate characteristics of hip fracture patients (lower age [$p=0.009$], lower percentage of Blacks [$p<0.001$] and Hispanics [$p<0.001$], higher percentage of females [$p<0.030$], higher motor function on admission [$p<0.001$], longer length of stay [$p<0.001$]) and facility characteristics (freestanding [$p<0.001$],

© 2015 by the American Congress of Rehabilitation Medicine. All rights reserved.

Correspondence to: Michael P. Cary, Jr..

Publisher's Disclaimer: This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

rural [$p<0.001$], for-profit [$p=0.048$], and smaller IRFs [$p=0.041$]). The findings were similar for motor change, but motor change was also associated with lower mean cognitive function on admission (0.008). Higher percentage discharged to the community was associated with aggregate patient characteristics (lower age [$p<0.001$], lower percentage of Hispanics [$p=0.009$], higher percentage of patients living with others [$p<0.001$], and higher motor function on admission [$p<0.001$]). No facility characteristics were associated with percentage discharged to the community.

Conclusion—Performance-based measurement offers health policymakers, administrators, clinicians, and consumers a major opportunity for securing health system improvement by benchmarking or comparing their outcomes to other similar facilities. These results might serve as the basis for benchmarking and quality-based reimbursement to IRFs for one impairment group: hip fracture.

Keywords

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

Performance-based outcomes of post-acute care settings are of keen policy interest. Due to the growing older population who are at-risk for injuries and disease, as well as major changes in Medicare payment and regulation, most Medicare spending growth over the past 20 years have occurred in post-acute care settings.^{1,2} In 2012, the Centers for Medicare and Medicaid Services (CMS) Value-based Purchasing program linked reimbursement for services to improvement in health care facilities' outcomes in an effort to improve the quality of health care delivered to Medicare beneficiaries.³ However, payment reforms are often implemented with little consideration for facility characteristics or case mix.⁴⁻⁶

Inpatient Rehabilitation Facilities (IRFs) deliver intensive post-acute rehabilitation services to patients experiencing functional loss from illness and/or injury.⁷ To date, patient-level analyses have dominated the research on IRF outcomes; more comprehensive assessments that include facility effects on patient rehabilitation could highlight additional opportunities for performance improvement.^{6,8} Facility characteristics such as ownership, geographic location, capacity, and clinical severity might influence performance-based outcomes in IRFs, as they do in acute care hospitals.⁹

Hip fracture patients were chosen as exemplars of the rehabilitation population for three reasons. First, hip fracture is the second most common Medicare rehabilitation impairment group (after stroke) in IRFs.¹⁰ Second, previous research examining structure (facility) related outcomes has focused on stroke,¹¹ spinal cord,¹² and traumatic brain injury¹³ patients than those with hip fracture. Finally, hip fracture patients have higher potential for returning to previous levels of function than other studied populations.¹⁴

Facility Characteristics Associated with Rehabilitation Outcomes

Several knowledge gaps limit understanding about how characteristics of IRFs affect rehabilitation outcomes among older adults with hip fracture. First, many studies of common conditions in the IRF outcomes literature did not include hip fracture patients.^{11,13,15-19}

Second, research on hip fracture patients treated in IRFs has focused primarily on patient-level factors. These studies have reported significantly higher functional status on discharge and greater improvement in functional independence during rehabilitation for younger, female, and White patients, individuals living alone, and those with better function on admission, fewer comorbidities, less severe comorbidities, and/or longer IRF lengths of stay; discharge to the community is associated with having social support and similar demographic and clinical characteristics (with one exception: community discharge is more likely for Black, Hispanic, and Asian patients than Whites).^{20–29} However, research on facility-level variables have been limited to PAC provider type (inpatient rehabilitation vs. skilled nursing facilities), facility size, and patient volume; these are associated with function on discharge and functional improvement during rehabilitation but not with community discharge.^{19,30–33} Other facility-level factors have not yet been addressed. Finally, studies conducted before implementation of the IRF prospective payment system (PPS)^{34–38} cannot reflect impact of recent policy and reimbursement changes on outcomes.

Providing a better understanding of specific facility characteristics associated with performance-based outcomes in IRFs will inform rehabilitation administrators and professionals in developing system-level interventions needed to improve IRF performance. Specifically, administrators might use findings from this study to benchmark their facilities' performance against this nationally representative sample of IRFs/Medicare hip fracture patients. Such benchmarking could lead to the development of best practices to improve IRF performance and increasing opportunities for higher reimbursement. Study findings might also be relevant to key stakeholders of pay-for-performance initiatives that reward high-performing IRFs and to policymakers seeking to understand facility factors that drive IRF performance.

Building on previous research, this study combines data from three large national datasets following implementation of the IRF PPS to examine the impact of facility-level variables on performance-based outcomes in US Medicare-certified IRFs. The purpose of this study was to ascertain whether IRF performance-based outcomes for hip fracture patients were related to differences in facility characteristics, after controlling for aggregated patient characteristics. Specifically, our hypotheses was that both aggregate patient and facility characteristics would be significantly associated with mean patient motor function on discharge, mean motor change, and percentage discharged to the community.

Methods

Data Source and Study Sample

The study sample was constructed by combining data from three large US datasets: (1) Inpatient Rehabilitation Facility-Patient Assessment Instrument (IRF-PAI), (2) Provider of Service (POS) File, a CMS administrative dataset, and (3) Area Resources File (ARF).³⁹ The sampling frame included all 1,112 IRFs that were Medicare certified in 2009. Exclusion criteria included inability to match IRF data (n=5) or discrepancies in IRF status (n=16) across the three datasets, and having fewer than three hip fracture patients in 2009 (n=108). The effective sample of IRFs (n=983) represented 88% of US IRFs, with n=34,364 patients. Of these, 79% of IRFs (n=775) were hospital-based; 21% (n=208) were freestanding. Data

for individual Medicare hip fracture patients in the IRF-PAI dataset were aggregated and linked via unique beneficiary and provider identification numbers to the POS and ARF to provide an organizational profile of patients treated by each IRF. Prior to linking datasets, records with missing data on key patient variables (e.g., age, race, discharge setting) were excluded.

Study Variables

Donabedian's structure-process-outcome model, expanded to address quality in rehabilitation settings, was used to guide variable selection and statistical analyses.⁴⁰ Variables used to operationalize structure, performance-based outcomes, and control variables representing aggregated patient characteristics (case mix) are described below.

Performance-based outcomes—Dependent variables aggregated at facility level included mean motor function on discharge, mean change in motor function from admission to discharge, and percentage discharged to the community. Motor function on discharge was operationalized as the Motor FIM subscale score from the Functional Independence Measure [FIM], which includes 13 motor items, each scored on a 1-to-7 scale ranging from total assistance (1) to complete independence (7).^{41,42} Following CMS guidelines,⁴³ FIM admission items coded as 0 (did not occur) were converted to 1 (or 2 for transfer to toilet). Change in motor function was defined as Motor FIM score on discharge minus Motor FIM score on admission. Discharge to the community was coded as a dichotomous variable: *yes* for patients discharged from IRF to home, board and care, transitional living, or assisted living residence; *no* for patients discharged from IRF to any other setting, including skilled nursing facilities, other rehabilitation facilities, and hospitals.

Facility characteristics—Independent variables from the POS included: IRF type (freestanding rehabilitation hospital or rehabilitation unit within a short-stay hospital), ownership (for-profit, not-for-profit, or government), and size (number of beds per facility). The ARF provided data on rurality of each county with a rural urban continuum code.⁴⁴ For this study, county code scores were dichotomized to categorize IRFs as either urban (codes 1–3) or rural (codes 4–9).

Aggregated patient characteristics (case mix)—Control variables from the IRF-PAI provided data from assessments of Medicare hip fracture patients completed during the first three days after admission and the last three days before discharge during their IRF stays. Aggregated at the facility level, these included demographic and clinical characteristics. Demographic variables included age on admission, gender, and race/ethnicity, coded as non-Hispanic White (hereafter White), non-Hispanic Black (hereafter Black), Asian, Hispanic, and Other. Social support was operationalized as living with others vs. alone before admission. Mean motor function on admission and mean cognitive function on admission were operationalized respectively as the Motor FIM subscale score (described earlier) and the Cognitive FIM subscale score, which includes 5 items, each scored on a 1 (poorest function) to 7 (best function) scale. Percentage of patients at each comorbidity level (Tier 1-most severe, Tier 2-moderately severe, Tier 3-mildly severe, or no tier comorbidities) and mean length of stay (LOS) were also determined.

Analytic Approach

The unit of analysis was the facility. The conceptual framework determined selection of aggregated patient and facility variables and regression model-building. Preliminary data analysis included univariate and bivariate statistics (χ^2 tests for categorical and Pearson correlation for continuous variables, with point-biserial correlation coefficients used for relationships between facility characteristics). Hierarchical regression (with $P < .05$ indicating statistical significance) was used to estimate the association of facility characteristics with each of the three outcomes after accounting for aggregated patient characteristics. Block 1 estimated effects of aggregated patient characteristics, with facility characteristics added to the model in Block 2. All analyses were performed using SAS version 9.3.⁴⁵

Results

Sample Characteristics

Table 1 presents characteristics of Medicare hip fracture patients (N=34,364) receiving treatment in Medicare-certified US IRFs (N=983). Mean number of hip fracture patients per IRF was 34; mean motor FIM scores increased from 36 on admission to 59 on discharge. Seventy percent of hip fracture patients were discharged from IRF to the community. Facility characteristics of IRFs in the sample are summarized in Table 2

Performance-based Outcome

Motor Function on Discharge—Patient characteristics explained 51% of the variance in mean motor function on discharge (Table 3). In block 1, the mean age and percentages of black and Hispanic patients were negatively associated with motor function on discharge. Adding facility characteristics in Block 2 explained an additional 2% of the variance; motor function on discharge was higher for freestanding, rural, for-profit, and smaller IRFs.

Performance-based Outcome

Motor Change—Patient characteristics explained 14% of the variance in mean motor change (Table 4). In block 1, percentages of blacks and Hispanics and cognitive function on admission were negatively associated with motor change. Adding facility characteristics in Block 2 explained an additional 4% of the variance; motor change was higher in freestanding, rural, for-profit, and smaller IRFs.

Performance-based Outcome

Percentage Discharged to Community—Patient characteristics explained 15% of the variance in percentage discharged to the community (Table 5). In block 1, the mean age and the percentage of Hispanics were negatively associated with the percentage discharged to the community. Facility characteristics (added in Block 2) had no significant effects on community discharge.

Discussion

This is the first study to examine association of facility and aggregated patient variables on performance-based outcomes of IRFs treating hip fracture patients, using three national

datasets. Hypotheses that both aggregated patient and facility characteristics would be significantly associated with outcomes following inpatient rehabilitation for hip fracture patients were supported for mean motor function on discharge and mean motor change. Percent discharge to community was associated only with aggregated patient characteristics.

Motor Function on Discharge

Aggregated patient characteristics were strongly associated with mean motor function on discharge. Consistent with previous studies, age of IRF hip fracture patient populations was inversely related to motor function on discharge,^{25,27} while mean motor FIM on admission^{25,46} and LOS were positively related to motor function on discharge. As in previous research,^{25,35,28} mean motor function on discharge was poorer in IRFs with higher percentages of Black and Hispanic hip fracture patients. In this study, mean motor function was lower ($p<.0001$) in IRFs treating higher percentages of both Black and Hispanic patients. Policy-makers should consider payment adjustments for facilities that treat disproportionate numbers of minority patients. Otherwise, these facilities might be adversely affected^{47,48} by pay-for-performance policies that do not account for effects on functional outcomes of racial/ethnic disparities in patient health status on admission. Mean motor function scores on discharge were strongly and positively related to mean motor function scores on admission, regardless of IRF type, ownership, size, and location, as consistent with the findings of other Medicare²⁵ and Uniform Data System for Medical Rehabilitation studies.^{28,35}

All facility characteristics (except government IRFs) were significantly associated with mean motor function on discharge. This study, the first to compare hip fracture outcomes of freestanding and hospital-based IRFs using Medicare data, builds on earlier outcome research in inpatient, skilled nursing, and home health settings.^{27,33,46,49} Motor function might be higher in freestanding IRFs if they are more likely than hospital-based units to have staff who focus exclusively on rehabilitation processes.^{34,50} Although not a modifiable variable, IRF type might account for performance differences that could inform policy standards for staff qualifications.

This first study of rurality effects on IRF outcomes for hip fracture patients extends previous studies of outcomes of traumatic brain injury.^{51,52} Better outcomes in rural IRFs might reflect improved access derived from federal initiatives such as the Medicare Rural Hospital Flexibility Program (Flex Program), effects of lower occupancy rates,⁵³ or process variables unavailable in the study data.

Findings regarding ownership effects on motor function extend previous work on outcomes such as productivity, efficiency, profitability, and revenue.^{54–56} Responding to the financial incentives inherent in the Prospective Payment System (PPS)^{57–59} IRFs may have developed *selection behavior* and/or *altering coding practices* as strategies to maximize profitability. Selection behavior involves changing admission policies limiting access to less profitable patients (i.e., hip fracture patients with cognitive impairment) while increasing access to patients with more profitable conditions (i.e., hip fracture patients with higher functional independence).⁵⁸ Upcoding (ie, deliberately coding higher motor function in patients with hip fracture on discharge), might be an attempt to increase revenue; upcoding is more

frequently observed in for-profit facilities and those in more competitive markets.^{60,61} Because organizational philosophies and managerial practices in for-profit IRFs (vs. other ownership types [non-profit or government owned IRFs]), reflect differences in decisions that influence service delivery, staffing, patients, and ultimately IRF performance,^{56,62} the for-profit IRFs in this study might have been more sensitive to such profit-maximizing strategies and could explain, in part, higher motor function on discharge. Without access to Medicare claims data in this study, we could not examine these possible explanations and thus these remain important areas for research. Recent national mandatory reporting of quality data and pay-for-performance reforms will likely create additional pressure for IRFs to improve performance. Longitudinal research is needed to monitor the effects of these policies on IRF performance and patient outcomes.

Our finding of better function on discharge in smaller IRFs is consistent with previous research examining IRF size³⁴ and patient volume^{32,46} and functional outcomes. If, as previously observed,³² patients with hip fracture admitted to high-volume facilities have more severe comorbidities, mean motor function on admission (and therefore motor function on discharge) might be lower in larger than in smaller IRFs.

Motor Change

Like motor function on discharge, motor change was significantly associated with race/ethnicity, gender, and LOS; however, age effects were not significant in the full model. Mean cognitive function on admission was negatively associated with motor change. Cognitive function and motor function on admission were strongly correlated ($r=.61$, $p<.001$), so hip fracture patients with high cognitive function tended to also have high motor function. The motor function scale lacks sensitivity to detect change in higher-functioning individuals, and their improvement is likely to be underestimated due to this ceiling effect.^{63–65} IRFs could begin to supplement motor functioning scores with scales more responsive to change (i.e., Timed Up and Go test), which could provide a more comprehensive evaluation of motor change in higher-functioning hip fracture patients.⁶⁴

Motor change, like motor function on discharge, was significantly higher in freestanding, rural, for-profit, and smaller IRFs; facility effects were very similar for both of these outcome variables.

Discharge to the Community

Several aggregated patient characteristics predicted percentage of patients discharged to the community. IRFs that discharged more patients to the community had patient populations with a lower mean age, a higher mean motor function on admission (consistent with earlier research^{27,65}), and higher percentages of patients living with others (also consistent³⁵). Previous research with patient level data indicated that Black, Hispanic, and Asian hip fracture patients are about twice as likely as Whites to be discharged home.^{25,28} In contrast, the current study, which examined aggregated patient effects, showed no association between percentage of Black patients within a facility – and a negative association of percentage of Hispanic patients within a facility – with discharge to the community. This finding underscores the importance of further exploring the relationships of

sociodemographic and health status variables that might elucidate the observed differences between racial/ethnic groups treated within IRFs.

No facility characteristics were significantly associated with percentage discharged to the community in this study. One possible explanation is that relationships of patient-level and facility-level factors to community discharge might have different confounders. Discharge of hip fracture patients to the community might be determined by complex, multi-level factors at the patient (i.e., personal attitudes and preferences), facility (i.e., discharge practices, care transitions, referral patterns), and community (i.e., PAC availability, percent poverty, and racial/ethnic distribution within a given county) levels.⁶⁷ For example, in economically disadvantaged communities, patients discharged from IRFs might have limited access to other PAC providers^{67,68} with specific vulnerable subgroups (minorities, disabled) being disproportionately and negatively affected. Understanding how these factors interact to influence functional outcomes and discharge destination was not the focus of the current study, however this is an important area for future research which will require synthesis of information from multiple, diverse data sources.

Limitations of the Study

Several limitations were noted in our study. The cross-sectional design did not permit confirmation of causal relationships. We did not account for the clustering of patients within facilities nor did we examine interactions between patient and facility levels, however we suggest that these analyses are important areas for future research. Independent and outcome variables were limited by the content of the source datasets. Potentially robust facility-level variables (e.g., nurse staffing, shown previously to be related to rehabilitation outcomes)⁵⁰ were only available for freestanding IRFs (in the POS file). Specific process (e.g., use of medical technology, coordination of care) and confounding variables (e.g., local or state health policies) were not uniformly available in these datasets but will be important areas for future research.

Conclusions

These results provide a basis for benchmarking of public reporting and quality-based reimbursement in IRFs for hip fracture patients. These findings suggest avenues for future performance-based research on the role of structure and case-mix in shaping IRF outcomes. Although considerable progress has been made in developing and reporting performance indicators for acute hospital care, performance-based outcomes are at a much earlier stage of development for post-acute IRFs. The value-based purchasing program still awaits improvements in data collection, measurement and analysis of clinical processes, as well as refinement of outcome measures (i.e., pressure ulcers, urinary tract infections, and unplanned 30-day hospital readmission following IRF discharge) needed for determining quality.

Acknowledgements

Funding

The work was supported by National Institute of Nursing Research at the National Institutes of Health (grant number 1F31-NR012402-01A1 to E. I. M.) and by the University of Virginia School of Nursing Barbara Brodie Scholars Endowment Award to M. P. C. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

The authors thank M. Norman Oliver, MD, MA, Ishan C. Williams, PhD, Ivora Hinton, PhD, and Virginia Rovnyak, PhD, for assistance in research project development, data analysis, and manuscript preparation, and Judith C. Hays, PhD, and Elizabeth P. Flint, PhD, for editorial and technical assistance with this manuscript.

List of Abbreviations

ARF	Area Resources File
CMS	Centers for Medicare and Medicaid Services
FIM	Functional Independence Measure
IRF	inpatient rehabilitation facility
IRF-PAI	Inpatient Rehabilitation Facility Patient Assessment
LOS	Length of stay
PAC	Post-acute care
POS	Provider of Service
PPS	Prospective Payment System

References

1. Chandra A, Dalton MA, Holmes J. Large increases in spending on postacute care in Medicare point to the potential for cost savings in these settings. *Health Aff (Millwood)*. 2013; 32(5):864–872. [PubMed: 23650319]
2. Medicare Payment Advisory Commission [MedPAC]. A data book: Health care spending and the Medicare program. Washington, DC: MedPAC; 2010. Post-acute care (Section 9); p. 121-146.
3. VanLare JM, Conway PH. Value-based purchasing--national programs to move from volume to value. *N Engl J Med*. 2012; 367(4):292–295. [PubMed: 22830460]
4. Chan L. The state-of-the-science: challenges in designing postacute care payment policy. *Arch Phys Med Rehabil*. 2007; 88(11):1522–1525. [PubMed: 17964899]
5. Kaplan SJ. Growth and payment adequacy of medicare postacute care rehabilitation. *Arch Phys Med Rehabil*. 2007; 88(11):1494–1499. [PubMed: 17964895]
6. Kane RL. Assessing the effectiveness of postacute care rehabilitation. *Arch Phys Med Rehabil*. 2007; 88(11):1500–1504. [PubMed: 17964896]
7. Centers for Medicare & Medicaid Services [CMS]. Final Rule. [Federal Register Doc. E9-18616 of August 7, 2009 (74 FR 39762)]. Washington, DC: Government Printing Office; 2009. Medicare Program: Inpatient Rehabilitation Facility Prospective Payment System for Federal Fiscal Year 2010; p. 39762-39838.
8. Prvu Bettger JA, Stineman MG. Effectiveness of multidisciplinary rehabilitation services in postacute care: state-of-the-science. A review. *Arch Phys Med Rehabil*. 2007; 88(11):1526–1534. [PubMed: 17964900]
9. Brand CA, Barker AL, Morello RT, Vitale MR, Evans SM, Scott IA, et al. A review of hospital characteristics associated with improved performance. *Int J Qual Health Care*. 2012; 24(5):483–494. [PubMed: 22871420]
10. Medicare Payment Advisory Commission [MedPAC]. Report to the Congress: Medicare Payment Policy. Washington, DC: MedPAC; 2011 Mar.

11. Zorowitz RD. Stroke rehabilitation quality indicators: raising the bar in the inpatient rehabilitation facility. *Topics in stroke rehabilitation*. 2010; 17(4):294–304. [PubMed: 20826417]
12. Qu H, Shewchuk RM, Chen YY, Richards JS. Evaluating the quality of acute rehabilitation care for patients with spinal cord injury: an extended Donabedian model. *Qual Manag Health Care*. 2010; 19(1):47–61. [PubMed: 20042933]
13. Zumsteg JM, Ennis SK, Jaffe KM, Mangione-Smith R, MacKenzie EJ, Rivara FP. Quality of care indicators for the structure and organization of inpatient rehabilitation care of children with traumatic brain injury. *Arch Phys Med Rehabil*. 2012; 93(3):386–393. e1. [PubMed: 22280893]
14. Graham JE, Granger CV, Karmarkar AM, Deutsch A, Niewczyk P, Divita MA, et al. The Uniform Data System for Medical Rehabilitation: report of follow-up information on patients discharged from inpatient rehabilitation programs in 2002–2010. *Am J Phys Med Rehabil*. 2014; 93(3):231–244. [PubMed: 24088780]
15. Kurichi JE, Xie D, Bates BE, Ripley DC, Vogel WB, Kwong P, et al. Factors associated with home discharge among veterans with stroke. *Arch Phys Med Rehabil*. 2014; 95(7):1277–1282. e3. [PubMed: 24685385]
16. Qu H, Shewchuk RM, Chen Y, Deutsch A. Impact of Medicare prospective payment system on acute rehabilitation outcomes of patients with spinal cord injury. *Arch Phys Med Rehabil*. 2011; 92(3):346–351. [PubMed: 21353819]
17. Reistetter TA, Karmarkar AM, Graham JE, Eschbach K, Kuo YF, Granger CV, et al. Regional variation in stroke rehabilitation outcomes. *Arch Phys Med Rehabil*. 2014; 95(1):29–38. [PubMed: 23921200]
18. Hoenig H, Sloane R, Horner RD, Zolkewitz M, Reker D. Differences in rehabilitation services and outcomes among stroke patients cared for in veterans hospitals. *Health Serv Res*. 2001; 35(6):1293–1318. [PubMed: 11221820]
19. Reker DM, Hoenig H, Zolkewitz MA, Sloane R, Horner RD, Hamilton BB, et al. The structure and structural effects of VA rehabilitation bedservice care for stroke. *J Rehabil Res Dev*. 2000; 37(4):483–491. [PubMed: 11028704]
20. Lieberman D, Friger M, Lieberman D. Rehabilitation outcome following hip fracture surgery in elderly diabetics: a prospective cohort study of 224 patients. *Disabil Rehabil*. 2007; 29(4):339–345. [PubMed: 17364784]
21. Lieberman D, Friger M, Lieberman D. Inpatient rehabilitation outcome after hip fracture surgery in elderly patients: a prospective cohort study of 946 patients. *Arch Phys Med Rehabil*. 2006; 87(2):167–171. [PubMed: 16442967]
22. Wang CY, Graham JE, Karmarkar AM, Reistetter TA, Protas EJ, Ottenbacher KJ. FIM motor scores for classifying community discharge after inpatient rehabilitation for hip fracture. *PM R*. 2014; 6(6):493–497. [PubMed: 24389348]
23. Semel J, Gray JM, Ahn HJ, Nasr H, Chen JJ. Predictors of outcome following hip fracture rehabilitation. *PM R*. 2010; 2(9):799–805. [PubMed: 20869677]
24. Kortebein P, Granger CV, Sullivan DH. A comparative evaluation of inpatient rehabilitation for older adults with debility, hip fracture, and myopathy. *Arch Phys Med Rehabil*. 2009; 90(6):934–938. [PubMed: 19480868]
25. Cary MP Jr, Merwin EI, Oliver MN, Williams IC. Inpatient rehabilitation outcomes in a national sample of Medicare beneficiaries with hip fracture. *J Appl Gerontol*. 2014
26. Bachmann S, Finger C, Huss A, Egger M, Stuck AE, Clough-Gorr KM. Inpatient rehabilitation specifically designed for geriatric patients: systematic review and meta-analysis of randomised controlled trials. *BMJ*. 2010; 340:c1718. [PubMed: 20406866]
27. Reistetter TA, Graham JE, Deutsch A, Markello SJ, Granger CV, Ottenbacher KJ. Diabetes comorbidity and age influence rehabilitation outcomes after hip fracture. *Diabetes Care*. 2011; 34(6):1375–1377. [PubMed: 21562326]
28. Graham JE, Chang PF, Berges IM, Granger CV, Ottenbacher KJ. Race/ethnicity and outcomes following inpatient rehabilitation for hip fracture. *J Gerontol A Biol Sci Med Sci*. 2008; 63(8):860–866. [PubMed: 18772475]
29. Sterling RS. Gender and race/ethnicity differences in hip fracture incidence, morbidity, mortality, and function. *Clin Orthop Relat Res*. 2011; 469(7):1913–1918. [PubMed: 21161737]

30. DeJong G, Hsieh CH, Gassaway J, Horn SD, Smout RJ, Putman K, et al. Characterizing rehabilitation services for patients with knee and hip replacement in skilled nursing facilities and inpatient rehabilitation facilities. *Arch Phys Med Rehabil.* 2009; 90(8):1269–1283. [PubMed: 19651261]
31. McGilton KS, Mahomed N, Davis AM, Flannery J, Calabrese S. Outcomes for older adults in an inpatient rehabilitation facility following hip fracture (HF) surgery. *Arch Gerontol Geriatr.* 2009; 49(1):e23–e31. [PubMed: 18842307]
32. Graham JE, Deutsch A, O'Connell AA, Karmarkar AM, Granger CV, Ottenbacher KJ. Inpatient rehabilitation volume and functional outcomes in stroke, lower extremity fracture, and lower extremity joint replacement. *Med Care.* 2013; 51(5):404–12. [PubMed: 23579350]
33. Mallinson T, Deutsch A, Bateman J, Tseng HY, Manheim L, Almagor O, et al. Comparison of discharge functional status after rehabilitation in skilled nursing, home health, and medical rehabilitation settings for patients after hip fracture repair. *Arch Phys Med Rehabil.* 2014; 95(2): 209–217. [PubMed: 23850612]
34. Johnston MV, Wood KD, Fiedler R. Characteristics of effective and efficient rehabilitation programs. *Arch Phys Med Rehabil.* 2003; 84(3):410–418. [PubMed: 12638110]
35. Ottenbacher KJ, Smith PM, Illig SB, Linn RT, Gonzales VA, Ostir GV, et al. Disparity in health services and outcomes for persons with hip fracture and lower extremity joint replacement. *Med Care.* 2003; 41(2):232–241. [PubMed: 12555051]
36. Kane RL, Chen Q, Finch M, Blewett L, Burns R, Moskowitz M. Functional outcomes of posthospital care for stroke and hip fracture patients under medicare. *J Am Geriatr Soc.* 1998; 46(12):1525–1233. [PubMed: 9848813]
37. Belooesky Y, Hendel D, Hershkovitz A, Skribnic G, Grinblat J. Outcome of medically unstable elderly patients admitted to a geriatric ward after hip fracture. *Aging (Milano).* 2001; 13(2):78–84. [PubMed: 11405389]
38. Jones GR, Miller TA, Petrella RJ. Evaluation of rehabilitation outcomes in older patients with hip fractures. *Am J Phys Med Rehabil.* 2002; 81(7):489–497. [PubMed: 12131174]
39. Health Resources and Services Administration. [accessed on August 23, 2013] Area Health Resource File (AHRF). National County-level Health Resources Information Database. 2012. Available from: URL: <http://www.arf.hrsa.gov/>
40. Donabedian A. The quality of care How can it be assessed? *JAMA.* 1988; 260(12):1743–1748. [PubMed: 3045356]
41. Ottenbacher KJ, Hsu Y, Granger CV, Fiedler RC. The reliability of the functional independence measure: a quantitative review. *Arch Phys Med Rehabil.* 1996; 77(12):1226–1232. [PubMed: 8976303]
42. Hamilton BB, Laughlin JA, Fiedler RC, Granger CV. Interrater reliability of the 7-level functional independence measure (FIM). *Scand J Rehabil Med.* 1994; 26(3):115–119. [PubMed: 7801060]
43. Centers for Medicare & Medicaid Services (CMS). The Inpatient Rehabilitation Facility-Patient Assessment Instrument (IRF-PAI) Training Manual. Baltimore, MD: Centers for Medicare & Medicaid Services(CMS); 2012.
44. US Department of Agriculture Economic Research Service. [cited 2013 August 23] Rural-Urban Continuum Codes. 2013. Available from: URL: <http://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx>
45. SAS Institute Inc. SAS/STAT 9.3 User's Guide. Cary, NC: SAS Institute Inc.; 2013.
46. DeJong G, Horn SD, Smout RJ, Tian W, Putman K, Gassaway J. Joint replacement rehabilitation outcomes on discharge from skilled nursing facilities and inpatient rehabilitation facilities. *Arch Phys Med Rehabil.* 2009; 90(8):1284–1296. [PubMed: 19651262]
47. Ryan AM. Has pay-for-performance decreased access for minority patients? *Health Serv Res.* 2010; 45(1):6–23. [PubMed: 19840137]
48. Casalino LP, Elster A, Eisenberg A, Lewis E, Montgomery J, Ramos D. Will pay-for-performance and quality reporting affect health care disparities? *Health Aff (Millwood).* 2007; 26(3):w405–w414. [PubMed: 17426053]

49. Deutsch A, Granger CV, Fiedler RC, DeJong G, Kane RL, Ottenbacher KJ, et al. Outcomes and reimbursement of inpatient rehabilitation facilities and subacute rehabilitation programs for Medicare beneficiaries with hip fracture. *Med Care*. 2005; 43(9):892–901. [PubMed: 16116354]
50. Nelson A, Powell-Cope G, Palacios P, Luther SL, Black T, Hillman T, et al. Nurse staffing and patient outcomes in inpatient rehabilitation settings. *Rehabil Nurs*. 2007; 32(5):179–202. [PubMed: 17899990]
51. Schootman M, Fuortes L. Functional status following traumatic brain injuries: population-based rural-urban differences. *Brain Inj*. 1999; 13(12):995–1004. [PubMed: 10628504]
52. Gontkovsky ST, Sherer M, Nick TG, Nakase-Thompson R, Yablon SA. Effect of urbanicity of residence on TBI outcome at one year post-injury. *Brain Inj*. 2006; 20(7):701–709. [PubMed: 16809202]
53. Medicare Payment Advisory Commission [MedPAC]. Report to the Congress: Medicare payment policy. Washington, DC: Medicare Payment Advisory Commission(MedPAC); 2012. Inpatient rehabilitation facility services (Section 9); p. 233–253.
54. McCue MJ, Thompson JM. The ownership difference in relative performance of rehabilitation specialty hospitals. *Arch Phys Med Rehabil*. 1995; 76(5):413–418. [PubMed: 7741610]
55. McCue MJ, Thompson JM. Early effects of the prospective payment system on inpatient rehabilitation hospital performance. *Arch Phys Med Rehabil*. 2006; 87(2):198–202. [PubMed: 16442972]
56. McCue MJ, Thompson JM. HealthSouth's inpatient rehabilitation facilities: how does their performance compare with other for-profit and nonprofit inpatient rehabilitation facilities? *Arch Phys Med Rehabil*. 2010; 91(5):708–713. [PubMed: 20434607]
57. Durkin EM, Deutsch A, Heinemann AW. Inpatient rehabilitation facilities: variation in organizational practice in response to prospective payment. *Med Care Res Rev*. 2010; 67(2):149–172. [PubMed: 19638642]
58. Paddock SM, Escarce JJ, Hayden O, Buntin MB. Did the Medicare inpatient rehabilitation facility prospective payment system result in changes in relative patient severity and relative resource use? *Med Care*. 2007; 45(2):123–130. [PubMed: 17224774]
59. Zorowitz RD. Inpatient rehabilitation facilities under the prospective payment system: lessons learned. *European journal of physical and rehabilitation medicine*. 2009; 45(2):259–263. [PubMed: 19532112]
60. Adler-Milstein J, Jha AK. No evidence found that hospitals are using new electronic health records to increase medicare reimbursements. *Health Aff (Millwood)*. 2014; 33(7):1271–1277. [PubMed: 25006156]
61. Bowblis JR, Brunt CS. Medicare skilled nursing facility reimbursement and upcoding. *Health Econ*. 2014; 23(7):821–840. [PubMed: 23775721]
62. Thompson JM, McCue MJ. Performance of freestanding inpatient rehabilitation hospitals before and after the rehabilitation prospective payment system. *Health Care Manage Rev*. 2010; 35(1):36–45. [PubMed: 20010011]
63. Glenny C, Stolee P, Thompson M, Husted J, Berg K. Underestimating physical function gains: comparing FIM motor subscale and interRAI post acute care activities of daily living scale. *Arch Phys Med Rehabil*. 2012; 93(6):1000–1008. [PubMed: 22497989]
64. HersHKovitz A, Brown R, Burstin A, Brill S. Measuring rehabilitation outcome in post-acute hip fractured patients. *Disabil Rehabil*. 2014
65. Williams G, Hill B, Kahn M. The concurrent validity and responsiveness of the high-level mobility assessment tool for mobility limitations in people with multitrauma orthopedic injuries. *PM R*. 2014; 6(3):235–240. [PubMed: 24056162]
66. HersHKovitz A, Kalandariov Z, Hermush V, Weiss R, Brill S. Factors affecting short-term rehabilitation outcomes of disabled elderly patients with proximal hip fracture. *Arch Phys Med Rehabil*. 2007; 88(7):916–921. [PubMed: 17601474]
67. Ottenbacher KJ, Graham JE. The state-of-the-science: Access to postacute care rehabilitation services. A review. *Arch Phys Med Rehabil*. 2007; 88(11):1513–1521. [PubMed: 17964898]
68. Buntin MB. Access to postacute rehabilitation. *Arch Phys Med Rehabil*. 2007; 88(11):1488–1493. [PubMed: 17964894]

69. van Walraven C, Austin P. Administrative database research has unique characteristics that can risk biased results. *J Clin Epidemiol.* 2012; 65(2):126–131. [PubMed: 22075111]

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 1

Profile of Medicare hip fracture patients in U.S. IRFs (N=983) that treated 3 or more Medicare hip fracture patients in 2009.

Aggregated Demographic and Clinical Variables	Mean (SD)
Race / Ethnicity	
% White	87.8 (20.2)
% Hispanic	4.0 (9.0)
% Black	4.1 (12.6)
% Asian	1.1 (5.6)
% Other	3.1 (11.9)
Sex	
% Female	70.2 (12.1)
Average patient age in IRF	81.2 (2.1)
% Social Support (Living with others prior to admission)	61.4 (14.5)
Average Motor FIM score on admission for a given IRF	35.8 (5.1)
Average Cognitive FIM score on admission for a given IRF	25.4 (3.2)
Comorbidity Tier Level	
% no tier	75.8 (13.9)
% Tier 1	1.8 (3.6)
% Tier 2	5.8 (6.9)
% Tier 3	16.7 (11.2)
Average LOS (days)	13.0 (2.1)
% Discharged to the Community	70.1 (14.6)
Average Motor FIM score on discharge for a given IRF	58.8 (5.8)
Average Cognitive FIM score on discharge for a given IRF	28.8 (2.2)
Average Motor FIM change for a given IRF	23.0 (4.5)

Source: Author's analyses of combined IRF-PAI and POS for 2009 (ARF data is from 2003 rural/urban continuum codes).

Table 2

Facility characteristics of U.S. IRFs (N=983) that treated 3 or more Medicare hip fracture patients during 2009.

Facility Characteristics	Total Sample	By Facility Type	
		Freestanding	Hospital Units
Number of IRFs	983 (100%)	208 (21.2%)	775 (78.8%)
Facility Variables:			
Ownership			
Not-for-profit: N (%)	604 (61.4%)	72 (34.6%)	532 (68.6%)
For-profit: N (%)	246 (25.0%)	127 (61.1%)	119 (15.4%)
Government: N (%)	133 (13.5%)	9 (4.3%)	124 (16.0%)
Location			
Rural: N (%)	187 (19.0%)	22 (10.6%)	165 (21.3%)
Urban: N (%)	796 (81.0%)	186 (89.4%)	610 (78.7%)
Facility Size (number of beds):	34.0 (30.2)	66.9 (41.1)	25.2 (18.5)
Mean (SD)			

Source: Author's analyses of combined IRF-PAI and POS for 2009 (ARF data is from 2003 rural/urban continuum codes).

Table 3

Mean motor function on discharge for IRFs treating Medicare hip fracture patients, regressed over aggregated patient and facility characteristics of U.S. IRFs (N=983) during 2009.

IRF Characteristics	Outcome: Mean Motor Function on Discharge			
	Model 1		Model 2	
	b (SE)	p	b (SE)	p
<i>Aggregate patient characteristics:</i>				
Age	-0.196 (0.067)	0.004	-0.171 (0.066)	0.009
Race/ethnicity *				
% Black	-0.041 (0.011)	<0.001	-0.043 (0.011)	<0.001
% Hispanic	-0.103 (0.015)	<0.001	-0.096 (0.015)	<0.001
Gender †				
% Female	0.032 (0.011)	0.004	0.024 (0.011)	0.030
Social support ‡ (% Living with others)	-0.008 (0.010)	0.387	-0.005 (0.009)	0.582
Mean Motor FIM score on admission	0.802 (0.038)	<0.001	0.813 (0.038)	<0.001
Mean Cognitive FIM score on admission	-0.087 (0.053)	0.104	-0.004 (0.054)	0.939
Comorbidity tier level §				
% Tier 1	-0.068 (0.037)	0.068	-0.044 (0.037)	0.228
% Tier 2	-0.011 (0.019)	0.578	-0.015 (0.019)	0.416
% Tier 3	-0.016 (0.012)	0.171	-0.015 (0.012)	0.184
Mean LOS	0.383 (0.076)	<0.001	0.360 (0.075)	<0.001
<i>Facility characteristics:</i>				
Facility type: Freestanding //			1.908 (0.429)	<0.001
Rural location ¶			1.189 (0.347)	<0.001
Ownership #				
For-profit			0.689 (0.348)	0.048
Government			-0.096 (0.392)	0.806
Facility size (number of beds)			-0.013 (0.005)	0.014
<i>Properties of model:</i>				
F, P	F = 91.59, P < 0.001		F = 68.65, P < 0.001	
R ²	0.509		0.532	
Change in R ² (Model 2-Model 1)	0.023			

NOTES. *Reference group=White;

†Reference group=Male;

‡Reference group=Living alone;

§Reference group=No tier comorbidities;

//Reference group=Rehabilitation unit within a hospital;

¶Reference group=Urban location;

[#]Reference group=Not-for-profit.

Source: Author's analyses of combined IRF-PAI and POS for 2009 (ARF data is from 2003 rural/urban continuum codes).

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 4

Mean motor change for IRFs treating Medicare hip fracture patients, regressed over aggregated patient and facility characteristics of U.S. IRFs (N=983) during 2009.

IRF Characteristics	Outcome: Mean Motor Change			
	Model 1		Model 2	
	b (SE)	p	b (SE)	P
<i>Aggregate patient characteristics:</i>				
Age	-0.153 (0.067)	0.023	-0.129 (0.066)	0.052
Race/ethnicity *				
% Black	-0.031 (0.011)	0.004	-0.034 (0.011)	0.002
% Hispanic	-0.090 (0.015)	<0.001	-0.084 (0.015)	<0.001
Gender †				
% Female	0.033 (0.011)	0.004	0.025 (0.011)	0.024
Social support ‡ (% Living with others)	-0.004 (0.010)	0.662	-0.002 (0.010)	0.874
Mean Cognitive FIM score on admission	-0.228 (0.046)	<0.001	-0.128 (0.048)	0.008
Comorbidity tier level §				
% Tier 1	-0.066 (0.038)	0.079	-0.044 (0.037)	0.242
% Tier 2	-0.004 (0.019)	0.847	-0.010 (0.019)	0.591
% Tier 3	-0.013 (0.012)	0.294	-0.012 (0.012)	0.328
Mean LOS	0.544 (0.070)	<0.001	0.505 (0.070)	<0.001
<i>Facility characteristics:</i>				
Facility type: Freestanding //			2.064 (0.433)	<0.001
Rural location ¶			1.113 (0.351)	0.002
Ownership #				
For-profit			0.713 (0.352)	0.043
Government			-0.179 (0.396)	0.652
Facility size (number of beds)			-0.012 (0.005)	0.026
<i>Properties of model:</i>				
F, P	F=16.28, P<0.001		F=14.66 P<0.001	
R ²	0.143		0.185	
Change in R ² (Model 2-Model 1)	0.042			

NOTES. *Reference group=White;

†Reference group=Male;

‡Reference group=Living alone;

§Reference group=No tier comorbidities;

//Reference group=Rehabilitation unit within a hospital;

¶Reference group=Urban location;

#Reference group=Not-for-profit.

Source: Author's analyses of combined IRF-PAI and POS for 2009 (ARF data is from 2003 rural/urban continuum codes).

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript

Table 5

Percentage of Medicare hip fracture patients discharged to the community, regressed over aggregated patient and facility characteristics of U.S. IRFs (N=983) during 2009.

IRF Characteristics	Outcome: % Discharged to the Community			
	Model 1		Model 2	
	b (SE)	P	b (SE)	p
Aggregate patient characteristics:				
Age	-0.940 (0.220)	<0.001	-0.963 (0.221)	<0.001
Race/ethnicity *				
% Black	0.051 (0.036)	0.160	0.049 (0.037)	0.178
% Hispanic	-0.140 (0.049)	0.005	-0.131 (0.050)	0.009
Gender †				
% Female	-0.024 (0.037)	0.503	-0.032 (0.037)	0.384
Social support ‡ (% living with others)	0.123 (0.032)	<0.001	0.128 (0.032)	<0.001
Mean Motor FIM score on admission	0.886 (0.126)	<0.001	0.851 (0.127)	<0.001
Mean Cognitive FIM score on admission	-0.083 (0.175)	0.635	-0.072 (0.180)	0.689
Comorbidity tier level §				
% Tier 1	-0.201 (0.122)	0.100	-0.182 (0.123)	0.141
% Tier 2	0.033 (0.063)	0.635	0.036 (0.063)	0.566
% Tier 3	-0.036 (0.039)	0.357	-0.043 (0.039)	0.274
Mean LOS	-0.072 (0.251)	0.775	-0.031 (0.252)	0.901
Facility characteristics:				
Facility type: Freestanding //			0.407 (1.439)	0.777
Rural location ¶			-0.028 (0.018)	0.126
Ownership #			2.089 (1.164)	0.073
For-profit			-0.167 (1.167)	0.886
Government			-0.756 (1.314)	0.565
Facility size (number of beds)			-0.028 (0.018)	0.126
Properties of model:				
F, P	F=15.71, P<0.001		F=11.34, P<0.001	
R ²	0.151		0.158	
Change in R ² (Model 2-Model 1)	0.007			

NOTES. *Reference group=White;

†Reference group=Male;

‡Reference group=Living alone;

§Reference group=No tier comorbidities;

//Reference group=Rehabilitation unit within a hospital;

¶Reference group=Urban location;

[#]Reference group=Not-for-profit.

Source: Author's analyses of combined IRF-PAI and POS for 2009 (ARF data is from 2003 rural/urban continuum codes).

Author Manuscript

Author Manuscript

Author Manuscript

Author Manuscript