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Utilization of Post-Acute Care following Distal Radius Fracture among Medicare Beneficiaries

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Abstract

Purpose—To examine the utilization and cost of post-acute care following isolated distal radius fractures (DRF) among Medicare beneficiaries.

Methods—We examined utilization of post-acute care among Medicare beneficiaries who experienced an isolated DRF (n=38,479) during 2007 using 100% Medicare claims data. We analyzed the effect of patient factors on hospital admission following DRF and the receipt of post-acute care delivered by skilled nursing facilities (SNFs), inpatient rehabilitation facilities (IRFs), home healthcare agencies (HHAs), and outpatient OT/PT for the recovery of DRF.

Results—In this cohort of isolated DRF patients, 1,694 (4.4%) were admitted to hospitals following DRF, and 20% received post-acute care. Women and patients with more comorbid conditions were more likely to require hospital admission. The utilization of post-acute care was higher among women, patients who resided in urban areas, and patients of higher socioeconomic status. The average cost per patient of post-acute care services from IRFs and SNFs (\$15,888/patient) was significantly higher than the average cost other aspects of DRF care and accounted for 69% of the total DRF-related expenditure among patients who received inpatient rehabilitation.

Conclusions—Sociodemographic factors, including sex, socioeconomic status, and age, were significantly correlated with the use of post-acute care following isolated DRFs, and post-acute

care accounted for a substantial proportion of the total expenditures related to these common injuries among the elderly. Identifying patients who will derive the greatest benefit from post-acute care can inform strategies to improve the cost-efficiency of rehabilitation and optimize scarce healthcare resources.

Level of evidence—Therapeutic, III

Keywords

DRF; admission; post-acute care; cost; Medicare

Distal radius fractures (DRFs) are the most common upper extremity fractures among older individuals and are an early indicator of osteoporosis. (1–3) Expenditures related to the treatment of DRFs among Medicare beneficiaries are substantial, and over \$210 million is spent annually on DRF treatment by Medicare in the United States. (4,5) Preservation of upper extremity function is essential for independent self-care, and DRF patients commonly experience pain and difficulty in carrying out activities of daily living following injury. (6,7)

Post-acute care refers to the continued care following hospitalization to support patients' recovery from illness or disability, with the purpose of allowing recovering patients to regain adequate function and return to independent living, ranging from home healthcare to inpatient rehabilitation under the care of medical professionals. (8, 9) In recent years, the utilization of post-acute care has risen for many conditions, such as pneumonia, stroke, and fractures. (10, 11, 27) Among older individuals, the use of post-acute care following inpatient hospital stays has grown considerably. (9, 10) For example, Medicare beneficiaries who experience hip, femur, or pelvic fractures often require up to 5 weeks of inpatient post-acute care, and those who sustain tibia or fibula fractures may require up to 3 weeks of post-acute care, with costs ranging from \$19,182 (tibia/fibula) to \$31,310 (hip). (11, 12) Similar to other major orthopedic injuries, DRFs often require surgical procedures or prolonged limb immobilization. (13–14) However, much less is known regarding the natural history of recovery among older patients who experience a DRF and their utilization of post-acute care.

The incidence of DRFs continues to rise, and it is important to understand the long-term burden of these injuries on our healthcare system. (15, 16) Although prior studies have indicated that procedural costs account for a substantial proportion of expenditures, the effect of post-acute care on the cost of care of DRFs remains unclear. (5) To study this, we examined healthcare claims among Medicare beneficiaries who experienced isolated DRFs to identify the need for hospital admission following DRF and to examine the utilization and cost of post-acute care services among DRF patients. We hypothesized that the use of post-acute care would be higher among older patients with more comorbid conditions and that post-acute care would comprise a larger proportion of the overall expenditures compared with the immediate costs of treatment among patients who received such services.

Method

Data sources

We examined Medicare claims from all beneficiaries who experienced an isolated DRF without any other concomitant injuries (100% sample). We used the beneficiary summary file to determine the demographic characteristics and enrollment status, the provider analysis and review file (Part A claims) for acute inpatient care and SNF claims, the outpatient files and carrier file (Part B claims) for physician and outpatient services, and the home health agency data for home-based rehabilitation.

Study sample

The study cohort included patients who experienced DRFs between January 1 and August 31, 2007 among Medicare continuous enrollees, ages 65 years and older. This study period enabled us to follow each patient for 4 months after the fracture for the utilization of post-acute rehabilitation services. To ensure the indication of rehabilitation was the DRF fracture, we only analyzed isolated DRF cases without any other injuries, including other fractures, neurologic injuries, thoracic injuries, and solid organ injuries (Appendix 1). Additionally, we excluded all enrollees of Medicare Advantage plans or with bone-malignancy related claims. (4, 5,17) To capture incidence DRF cases, we only included patients who were treated operatively (open reduction and internal fixation (ORIF), external fixation, or percutaneous pinning) or non-operatively (closed reduction, casting or splinting) within 14 days following the earliest diagnosis of DRF. (Appendix 2)

Outcome Variables

Hospital admission—Patients who were admitted to an inpatient hospital facility under the diagnosis of DRF and received fracture treatment during the hospital stay were defined as DRF inpatients. Patients with DRF diagnosis and treatment recorded only in outpatient claims (without any DRF inpatient record) were identified as DRF outpatients.

Post-acute care—We followed the study cohort for 4 months after the initial diagnosis of DRF for post-acute care delivered by inpatient rehabilitation facilities (IRFs), skilled nursing facilities (SNFs), and home health agencies (HHAs) (18–22). We also examined utilization of outpatient occupational and physical therapy (OT/PT) following the fracture. We required all rehabilitation service claims (SNF claims, IRF claims, HHA claims and outpatient OT/PT claims) captured to be with the diagnosis of DRF to exclude those post-acute services provided for other conditions.

Expenditures for fracture treatment and post-acute care—We examined the cost of hospitalization, post-acute care, imaging, professional services, and readmission for DRFs. (Appendix 3) Readmission for DRFs was defined as any hospitalization under the diagnosis of DRF within 4 months of the initial discharge or any admission to the inpatient hospitals among those who were treated for DRFs on the outpatient basis at first. Total cost of each type of service was then calculated as the sum of payments made by Medicare, the beneficiary, and primary payers.

Independent variables

Sociodemographic characteristics of the study cohort included patient age, sex, race, socioeconomic status (SES), and rural/urban residence status. Using published methodology we assigned SES and rural/urban status to each beneficiary by residence zip codes. (23, 24) We also obtained the state of residence for each patient according to their residence zip codes. Clinical variables included fracture treatment and comorbid conditions. For each patient, we used the most invasive procedure received for DRF as the type of fracture treatment (open reduction with internal fixation (ORIF), external fixation, and percutaneous pinning). The non-operative treatment included closed reduction, casting and splinting. Lastly, we identified comorbid conditions using the Elixhauser index, a comprehensive set of comorbidity measures for risk adjustment in large administrative data. It includes 30 conditions associated with increased length of hospital stay, charges, and overall mortality, such as congestive heart failure, chronic pulmonary disease, hypertension, and diabetes. (25) Using the International Classification of Diseases, 9th Revision, Clinical Modification, we identified the presence of these conditions for each patient in our cohort and then summarized the comorbidities into one score reflecting disease burden. (26)

Statistical analysis

We performed descriptive statistics to describe the characteristics of the study population. We then examined the patient factors correlated with hospital admission and receipt of post-acute care using multivariate logistic regression model, controlling for all patient demographic and clinic factors. We reported the adjusted odds ratio of hospitalization/the receipt of post-acute care among different patient groups for the variation in the admission for isolated DRFs by patient sociodemographic and clinical characteristics. To examine patient characteristics that influenced the use of post-acute rehabilitation and geographic variation, we performed hierarchical logistic model with a random intercept for each state of residence. We reported adjusted odds ratios among different patient groups in the use of post-acute care and the internal correlation coefficient (ICC) to reflect the percentage of the variation in the use on state level. (27) As previous studies indicated patient age and SES could influence type of fracture treatment DRF patients underwent, we stratified the patient cohort by the fracture treatment (ORIF, external fixation, pinning, and non-operative treatment) and examined the influence of age and SES in each fracture group. Furthermore, we compared the use of outpatient OT/PT services between patients who received post-acute care from IRFs, SNFs, and HHAs and patients who did not received such services using multivariable logistic regression model, controlling for all other patient characteristics. To compare the count of outpatient OT/PT services among the 2 group of patients, we used multivariable linear regression models, using number of rehabilitation therapy received as the numeric outcome and whether receipt of post-acute care from IRFs, SNFs, and HHAs as the primary predictor, controlling for all other patient characteristics. Lastly, we used the Wilcoxon rank sum test for the comparison of average cost among different types of DRF-related services.

Results

Hospitalization following DRF

Our study cohort included 38,479 Medicare beneficiaries who were diagnosed with DRF between January 1 and August 31st 2007. Following the injury, 1,694 patients were hospitalized (4%, Figure 1) for an average stay of 3 days. Patients who had comorbid conditions were more likely to require a hospital stay for DRF (OR=2.8, 95% CI: 2.4–3.2). (Appendix 5) Additionally, women were more likely to be hospitalized than men (OR=1.5, 95% CI: 1.3–1.8). Lastly, age and SES were associated with hospital admission following isolated DRF. Older patients were less likely to be admitted (OR=0.8, 95% CI: 0.7–1.0), and patients with higher SES were less likely to be admitted to hospitals after the fracture (OR=0.8, 95% CI: 0.8–1.0) after controlling for all other demographic and clinical factors. All of the hospitalized patients received operative treatment for DRF and 62% received ORIF.

Post-acute care following DRF

In this cohort, 1,694 patients were admitted following injury, 78 (5%) were discharged to SNFs or IRFs, and 1,616 (95%) to home. (Figure 1) The average length of stay in inpatient post-acute care facilities (SNFs and IRFs) was 41 days. Among patients who were discharged home, 49 (2.9%) received home-based rehabilitation therapy (average number of visits=66) and 339 (20%) received outpatient occupational or physical therapy (average number of visits=8 visits) within 4 months following the fracture treatment. For patients managed as an outpatient, 1 % received home-based rehabilitation (average number of visits=62) and 19.0% received outpatient OT/PT therapy (average number of visits=7). (Figure 1)

The use of outpatient OT/PT was significantly lower among patients who received post-acute care from IRFs, SNFs, and HHAs after controlling for all other patient characteristics ($P=0.001$). For example, 14% of patients who received post-acute care from IRFs, SNFs, and HHAs also received outpatient OT/PT, compared with 24% of patients who did not receive services from IRFs, SNFs, and HHAs.

On line appendix 6 displays the proportion of each type of post-acute care stratified by patient factors and adjusted odds ratios of receiving post-acute care among patients who were hospitalized for fracture treatment (N=1,694). Among these patients, the receipt of post-acute care, including IRF, SNF, HHA services, and outpatient PT/OT, and it was not influenced by patient sex, race, and comorbidity conditions. (Table 1) Compared to younger patients, older patients were significantly less likely to receive post-acute care. For example, 22% of patients 85 years or older received post-acute care compared with 34% of patients ages 65 to 69 years (OR=0.5, 95% CI: 0.4–0.8). Patients with higher SES (OR=1.5, 95% CI: 1.0–2.0) and patients who resided in metropolitan areas (OR=1.4, 95% CI: 1.0–1.9) were more likely to receive post-acute care compared to patients with low SES and patients who lived in rural areas. Lastly, patients who underwent ORIF were more likely to receive post-acute care compared with patients who underwent percutaneous pinning (OR=1.5, 95% CI:

1.0–2.2). Overall, 4% of the variation in the use of post-acute care among DRF was explained by state of residence.

On line Appendix 7 displays the influence of patient characteristics on the use of inpatient rehabilitation delivered by IRFs and SNFs (N=1,694). In our study cohort, older age was the only significant predictor of inpatient rehabilitation. Compared to younger patients, older patients were significantly more likely to receive inpatient post-acute care delivered by IRFs and SNFs (OR=2.2, 95% CI: 1.3–3.8).

On line Appendix 8 displays the distribution of patient characteristics by the receipt of HHA services or outpatient OT/PT among DRF outpatients (N=36,785). Table 2 displays the correlation between patient factors and the use of home-based and outpatient-based therapy among patients who did not require admission following isolated DRFs. Older patients (OR=0.6, 95% CI: 0.6–0.7) with more comorbidities (OR=0.7, 95% CI: 0.6–0.8) were less likely to receive post-acute services, including HHAs and outpatient OT/PT. Women (OR=1.4, 95% CI: 1.3–1.4) and patients from metropolitan counties (OR=1.5, 95% CI: 1.4–1.6) were more likely to receive post-acute care. Patients with high SES were significantly more likely to receive post-acute care compared with patients with low SES (OR=1.4, 95% CI: 1.3–1.5). After the stratifying by DRF treatment, the correlation between age and SES and the use of post-acute care remained. (Appendix 8) Patients treated operatively were more likely to receive post-acute care compared to patients treated non-operatively (OR=2.5; 95% CI: 2.3–2.6).

Cost burden of acute hospitalization and post-acute care following DRF

The total DRF-related costs were \$58 million, with an average cost of \$1,505 per patient. Hospitalizations resulted in expenditures of \$11.4 million (20% of all DRF-related expenditures), with an average cost of \$6,775 per patient. (Figure 2 and 3) Among the hospitalized patients, the cost of hospital stay accounted for 78% of their total DRF-related medical expenditure. (Figure 4) For isolated DRFs, inpatient rehabilitation including post-acute care delivered by IRFs and SNFs accounted for 2% of all DRF-related costs. (Figure 2) However, among patients who were discharged to IRFs/SNFs (N=78), the average cost per patient for inpatient post-acute care was \$15,888, accounting for 69% of their total DRF-related cost. (Figure 3 and 4) Home-based therapy (N=321) and outpatient OT/PT (N=7,313) resulted in 5% (\$ 2.6 million) and 11% (\$ 6.1 million) of the total DRF-related expenditures, respectively. (Figure 2) The average cost per patient for home-based post-acute care and outpatient OT/PT was \$8,216 and \$827, respectively. (Figure 3) The incidence of readmission for isolated DRF was 0.4% and the average cost of readmission was \$ 6,095. (Figure 3)

Discussion

DRFs are common fractures among older patients, and the incidence and associated expenditures is expected to increase over time. (5) The primary aim of this study was to describe the utilization of post-acute care and identify factors associated with the use of post-acute rehabilitation. Overall, 4% of isolated DRF cases were hospitalized and among these patients, 5% received inpatient post-acute care from IRFs and SNFs. The acute

admission and following post-acute care was strongly correlated with higher comorbidity score and older age, indicating that patients might be highly impacted by the injury due to older age, concurrent comorbid conditions, and frailty and thus required hospitalization and intensive post-acute care. Although few patients require admission following treatment, up to 20% of patients received ongoing rehabilitation following the isolated injury. A substantial proportion of the variation in incidences is explained by patient factors, including sex, sociodemographic status, and DRF treatment. Finally, post-acute care, particularly outpatient therapy, accounted for approximately 20% of DRF-expenditures. These findings underscore the morbidity associated with DRFs among patients who required hospitalization and post-acute care following discharge and the challenge of recovery for patients who rely on upper extremity function for self-care and independence.

We identified that patient factors were important predictors of the receipt of post-acute care. For example, our results are consistent with previous studies that demonstrate that patients of lower SES are less likely to use post-acute care and may not have access to extensive rehabilitation services. (28, 29) Advancing age and comorbid conditions may further preclude the use of therapy, particularly outpatient care. Although the reasons for this cannot be discerned from this cohort, it is possible that older patients may have poorer pre-injury functioning and fewer demands with respect to rehabilitation needs. For these reasons, they may be less likely to be referred or qualify for these services. (28, 30) We also observed that women, despite having fewer comorbid conditions, were more likely to be admitted following DRFs and more likely to require postoperative therapy. Finally, patients who underwent operative intervention were more likely to receive post-acute rehabilitation, suggesting that treatment type and fracture severity is correlated with the time needed to return to independent functioning. (4)

Our findings also highlight the potential salutatory effects of intensive post-injury therapy. For example, we observed that the utilization of outpatient therapy was lower among patients who had received inpatient rehabilitation. This finding is encouraging in that aggressive inpatient rehabilitation may prevent the need for prolonged outpatient therapy for some patients. However, other potential explanations for this phenomenon might be the exhaustion of plan coverage due to the high expense of inpatient rehabilitation or lower demand activities after discharge, particularly given that older patients were more likely to use inpatient rehabilitation services. (31–34) Ultimately, prospective studies with greater detail regarding patient pre-injury functioning may be able to identify those patients who may gain benefit from facility-based rehabilitation strategies over home-based programs.

Our study has several limitations. We analyzed administrative claims data, which cannot account for specific clinical variables, such as fracture severity and functional status. Additionally, we cannot discern the clinical indications and decision-making that directed patients to receive specific types of post-acute care. Our study cohort only included patients ages 65 and older who enrolled in fee-for-services programs and excluded beneficiaries enrolled in Medicare Advantage plans due to the lack of Part B Medicare claims and cost comparability with fee-for-service beneficiaries. Thus, our results may not generalize to these patient populations. (35) Moreover, as we only had one year of data, we were not able to capture the pre-injury conditions such as the use of assist devices or previous upper and

lower extremity surgery or trauma that could influence the use of post-acute care. Finally, our data are drawn from 2007 as part of a larger study examining variation in care among patients with DRFs. (3–5, 17, 36) Although our results reflect trends from that year, there is little evidence or change in healthcare policy to suggest that referral patterns for post-acute care have changed substantially since then.

Despite these limitations, our study highlights several important issues. Many DRF patients experience noteworthy pain and disability during recovery, particularly those patients with multiple comorbidities, and post-acute care could ease recovery. (37) For many conditions, post-acute care is one of the largest contributors of variation in Medicare payments to hospitals around episodes of surgery care and one of the fastest growing categories of healthcare expenditures. (38) Furthermore, bundled payment and shared savings programs are directed to provide stronger incentives to improve recovery from common, acute conditions in a cost-efficient manner. (19, 38–42) Our findings are encouraging in that the majority of patients who experience DRFs are not hospitalized, and 20% of patients require some type of post-acute care. Fortunately, facility-based rehabilitation is infrequent and accounts for a low proportion of total spending among Medicare beneficiaries with isolated DRFs. For these patients, strategies to curb spending could be targeted toward other aspects of care, such as hospitalization, imaging, and treatment procedures. For those patients who are vulnerable following injury due to age, comorbid conditions, or sociodemographic disadvantages, identifying specific post-acute care strategies following DRFs and the factors that influence effective recovery is an important opportunity to allocate scarce healthcare resources effectively for DRFs.

DRFs pose a substantial challenge for older individuals with more comorbid conditions, and may disproportionately diminish their ability to return to independent, community-dwelling function. Older patients with multiple comorbid conditions are more likely to require inpatient admission and post-acute care following DRFs. This care yields higher expenditures and a greater proportion of the expenditures compared with other aspects of care. Future research to examine the incremental benefit associated with post-acute care among the elderly may illuminate opportunities to streamline care and reduce costs for these common injuries.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Figure 1.
Post-acute care among Medicare beneficiaries who experienced DRF in 2007

Figure 2.
Proportion of the total medical expense of each type of service among total DRF-related expenditure

Figure 3.
Average cost per patient (\$) by type of DRF-related services

Figure 4.
Proportion of each type of service among total DRF-related expenditure of patients who received this type of service

Table 1

Determinants of post-acute rehabilitation after discharge from hospitals for isolated DRF injury. (N=1,694)

Patient characteristics	Odds ratio [†] of receiving post-acute care	P values
Age		
<i>65 to 69</i> [‡]	1	-
<i>70 to 74</i>	0.9 (0.6–1.2)	0.38
<i>75 to 79</i>	0.7 (0.5–1.0)	0.04
<i>80 to 84</i>	0.6 (0.4–0.8)	0.001
<i>85 and older</i>	0.5 (0.4–0.8)	<0.001
sex		
<i>Female</i> [‡]	1	-
<i>Male</i>	0.7 (0.5–1.0)	0.06
Race		
<i>Non-White</i> [‡]	1	-
<i>White</i>	1.4 (0.8–2.2)	0.22
SES		
<i>Low</i> [‡]	1	-
<i>Medium</i>	1.7 (1.2–2.4)	0.002
<i>High</i>	1.5 (1.0–2.0)	0.03
Rural status		
<i>Non-metro/ rural area</i> [‡]	1	-
<i>Metropolitan counties</i>	1.4 (1.0–1.9)	0.03
Score of comorbidity		
<i>Quartile1(0– 5)</i> [‡]	1	-
<i>Quartile2 (6– 12)</i>	1.0 (0.7–1.4)	0.98
<i>Quartile3 (13– 21)</i>	1.1 (0.8–1.5)	0.66
<i>Quartile4 (> 21)</i>	1.0 (0.7–1.4)	0.88
Types of DRF treatment		
<i>Pinning</i> [‡]	1	-
<i>External fixation</i>	1.3 (1.0–1.8)	0.05
<i>ORIF</i>	1.5 (1.0–2.2)	0.05

ICC=4%

[†] Adjusted odds ratios of receiving any post-acute care among DRF inpatients were calculated from hierarchical logistic regression model, controlling for all patient factors in this table.

[‡] Reference group

Table 2

Determinants of post-acute care after discharge from outpatient-based DRF treatment (N=36,785)

Patient characteristics	Odds ratio [†] of receiving post-acute care	P values
Age		
65 to 69 [‡]	1	-
70 to 74	1.0 (0.9–1.1)	0.89
75 to 79	0.9 (0.8–1.0)	0.003
80 to 84	0.8 (0.7–0.8)	<0.001
85 and older	0.6 (0.6–0.7)	<0.001
sex		
Female [‡]	1	-
Male	0.7 (0.7–0.8)	<0.001
Race		
Non-White [‡]	1	-
White	1.0 (0.9–1.2)	0.51
SES		
Low [‡]	1	-
Medium	1.1 (1.0–1.2)	0.008
High	1.4 (1.3–1.5)	<0.001
Rural status		
Non-metro/ rural area [‡]	1	-
Metropolitan counties	1.5 (1.4–1.6)	<0.001
Score of comorbidity		
Quartile1(0–5) [‡]	1	-
Quartile2 (6–12)	1.0 (0.9–1.1)	0.84
Quartile3 (13–21)	0.9 (0.8–1.0)	0.002
Quartile4 (> 21)	0.7 (0.7–0.8)	<0.001
Type of DRF treatment		
Non-operative treatment [‡]	1	-
ORIF	2.5 (2.3–2.6)	<0.001
External fixation	2.7 (2.3–3.1)	<0.001
Pinning	1.8 (1.6–2.0)	<0.001

ICC=4%

[†] Adjusted odds ratios of receiving any post-acute care among DRF outpatients were calculated from hierarchical logistic regression model, controlling for all patient factors in this table.

[‡] Reference group