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The Association of Discharge Destination with 30-Day Rehospitalization Rates Among Older Adults Receiving Lumbar Spinal Fusion Surgery

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Abstract

Background: As defined by Medicare (United States), post-acute rehabilitation services include care provided in inpatient rehabilitation units and facilities, skilled nursing facilities, long-term acute hospitals, and by home health services.

Methods: We retrospectively evaluated the use of rehabilitation-based post-acute services among Medicare beneficiaries who were hospitalized for lumbar spinal fusion (ICD-9-CM procedure codes 81.04–81.08) in 2012–2014, examined the case-mix for those discharged to rehabilitation- and non-rehabilitation based services, and determined the association between these categories of discharge disposition and 30-day rehospitalization. The independent effect of rehabilitation-based

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DECLARATIONS

Ethics Approval and Consent to Participate

This study was approved by the Institutional Review Board at the University of Texas Medical Branch (IRB number: 13–0549).

Availability of Data and Material

The data used in this study are research identifiable files, which the authors cannot make publicly available. However, the exact files can be obtained from the Centers for Medicare and Medicaid Services. Information on costs and data use agreements are available through the Research Data Assistance Center (ResDAC) at the University of Minnesota: <https://www.resdac.org>.

Competing Interests

CC receives royalties from Pearson Education (textbook), consulting fees from the Hawkins Foundation, speaking fees for keynote at conferences, and has a grant from the Department of Defense. RAC and JPB declare that they have no competing interests. JEG has grants from the NIDILRR Program and the Agency for Healthcare Research and Quality.

Authors' Contributions

CC provided overall supervision of the study as well as participated in the study concept and design and data analysis and interpretation. RAC analyzed and interpreted the data. JPB assisted with supervision of the study and participated in the study concept and design. JEG provided administrative and technical support for the study, participated in the study concept and design, acquired the data, and performed statistical analysis and interpretation of the data. All authors drafted, reviewed, and approved the final manuscript.

discharge destination on 30-day readmissions was examined with a generalized linear mixed model, first adjusting for patient characteristics and then stratified by clusters that delineated more homogenous clinical profiles.

Results: Among 261,558 Medicare beneficiaries with lumbar spinal fusion surgery, 50.8% were discharged to a rehabilitation-based post-acute services. Patients discharged to rehabilitation-based services were older and had more comorbidities, and had longer hospital lengths of stays. After adjusting for patient and hospital characteristics, patients discharged to rehabilitation-based post-acute care had increased odds of 30-day rehospitalization than those without discharge to other destinations (OR 1.36; 95%CI=1.31, 1.40). Analysis of patients by clinical profile clusters found similar results.

Conclusions: Clinical profiles of Medicare beneficiaries who had lumbar spinal fusion surgery and were discharged to rehabilitation-based post-acute services included more comorbidities than those discharged to non-rehabilitation based settings. Controlling for these differences did not mediate the negative association between use of rehabilitation-based post-acute services and 30-day readmission.

Keywords

Discharge destination; Spinal Fusion; Lumbar; Rehabilitation; Rehospitalization; Hospital Readmission

BACKGROUND

Spinal fusion surgery is a common elective intervention in the United States, with over 460,000 procedures performed annually (Agency for Healthcare Research and Quality, 2017). Fusion rates are increasing, especially for older adults with degenerative lumbar conditions or deformity (Missios and Bekelis, 2016). Although a number of procedural advances have occurred, it is surmised that 10% to 20% of spine surgery recipients suffer complications of various degrees of severity during the immediate post-discharge period (Nasser et al., 2010). These complications are the most frequent reason for hospital readmission (Savage and Anderson, 2013). The *Agency for Healthcare Research and Quality* has reported readmission rates of 6.4% for all individuals receiving fusions (Agency for Healthcare Research and Quality, 2017), whereas others have reported 13% of older adults who receive complex fusions (>2 levels) are readmitted to the hospital (Deyo et al., 2010). A meta-analysis of 13 studies identified complications of systemic (28.2%) and surgical site infections (20.3%), as well as medical complications (26.6%), as the most common reason for all-cause hospital readmissions after spine surgery (Bernatz and Anderson, 2015).

Most hospital re-admissions associated with spine surgery occur within 10 days of hospital discharge (Verla et al., 2016). The decision at discharge on what services a patient should be referred for could have a pivotal role in care management and outcomes. Medicare beneficiaries with spinal surgery may be discharged from the hospital to inpatient rehabilitation, skilled nursing facilities or home health. These post-acute care services provide skilled care including rehabilitation with the goal of independent living in the community. In general, the patient case mix referred to post-acute rehabilitative care for all

conditions is more debilitated than non-rehabilitation comparators. With respect to spine surgery, the patient case mix for post-acute rehabilitative care is unclear and there are no established clinical practice guidelines for the post-discharge management of patients receiving lumbar spinal fusion surgery. The research to-date examining hospital readmissions among patients who received post-acute rehabilitative care is inconclusive (Akamnonu et al., 2015; Abt et al., 2017).

Understanding the association between rehabilitation-based discharge destinations and hospital readmissions may call attention to discharge planning for patients with spinal surgery and the need to evaluate post-acute care options. The objectives of this study were two-fold: 1) Determine patient case mix across rehabilitation-based and non-rehabilitation based discharge destinations, and 2) examine the independent effect of rehabilitation-based discharge destinations on all-cause 30-day rehospitalization with and without controlling for heterogeneity of the population. We hypothesized higher rehospitalization rates for patients with non-rehabilitation based discharge destinations.

METHODS

Study Design and RECORD

This was a retrospective observational cohort study approved by the University of Texas Medical Branch's Institutional Review Board. We conducted a secondary analysis of the 100% Medicare Part A files from 2012–2014. In the United States, Medicare is a socially funded federal health insurance program for individuals 65 or older, selected individuals with disabilities, and people with End-Stage Renal Disease.

Prior to the study, we obtained a data use agreement with the Centers for Medicare and Medicaid Services. We followed the *REporting of studies Conducted using Observational Routinely-collected Data* (RECORD) initiative (Benchimol et al., 2015). Key elements of the RECORD initiative include an explanation of merging of databases, appropriate description of codes used in the study, information on data cleaning methods of data removal, and eligibility of data; including how data were retained and analyzed for applicability (Langan et al., 2016).

Data source and study population

The Medicare Provider Analysis and Review (MedPAR) file contains complete claims data for inpatient stays (University of Minnesota, 2016). Cases selected from the MedPAR were linked to the Beneficiary Summary file to obtain basic demographic and Medicare enrollment information. Hospital-level variables were obtained from the Impact file. We selected patients who received lumbar spinal fusion (International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) procedure codes 81.04–81.08) and ICD-9-CM diagnostic codes related to disc herniation, disc degeneration, spinal stenosis, instability, and miscellaneous thoracolumbar spine disorders discharged from the hospital between July 1, 2012 and October 31, 2014. These dates were chosen to enable a 6-month look-back period for prior hospitalizations and a post-discharge observation window to capture readmissions.

The initial sample included 269,613 cases. We applied four exclusion criteria: 1) surgical procedure not performed in an acute short-stay hospital (n=936); 2) primary diagnosis of infection, neoplasia, spina bifida, traumatic spinal cord injury, or fracture (ICD-9-CM codes: 170.2, 170.6, 198.5, 213.2, 238.0, 239.2, 324.1, 324.9, 730.0, 730.1, 741.02, 741.92, 756.11, 805.2, 805.3, 806.2, 806.3, 846.0) (n=4,470); 3) death in hospital or within 30 days of discharge (n=1,998); and 4) discharge against medical advice, to a federal hospital, another type of institution for inpatient care, court, or hospice (n=651). The final sample included 261,558 cases.

Outcome measure

All-cause 30-day readmissions (yes / no) were coded based on any claim for an acute hospital admission over the 30-day period following discharge from the index stay.

Independent variable

We created a dichotomous discharge destination variable to categorize post-acute care services that provide skilled rehabilitation care and those that do not. “Rehabilitation-based discharge destinations” included Medicare-designated post-acute care services provided in skilled nursing facilities (including swing bed units, SNF), inpatient rehabilitation facilities (IRF), and by home health agencies (Morley et al., 2014). Long-term acute hospitals were not classified as a rehabilitation-based service because care is more akin to an acute hospital than acute rehabilitation provided in IRFs. The non-rehabilitation based discharge destinations included home for self-care, intermediate care facilities, long-term acute and other acute hospitals, and nursing homes.

Covariates

Demographic variables included age, sex, and race/ethnicity (White, Black, Hispanic, or other). Comorbidity burden was recorded by summing conditions listed in the Elixhauser comorbidity index (Elixhauser et al., 1998), and creating a 3-level categorical variable: 0–1, 2–3, or 4+ conditions. Length of stay (days) was included as a continuous variable. We created dichotomous (yes / no) indicator variables for a prior lumbar spinal fusion anytime over the 3-year study period and for a prior hospitalization for any reason during the 6-months prior to the index hospital admission. Lastly, we created dichotomous (yes / no) hospital-level variables for rural designation and for teaching status. In the United States, teaching hospitals focus on integrating medical education as part of patient care.

Handling of missing data

Small percentages of missing values were observed in three variables: race/ethnicity (n=1,808 [0.7%]) and rural status and teaching hospital status (n=1,060 [0.4%] each). Missing was coded as an additional category so the cases would be included in the multivariable models, but the parameter estimates were not compared to or reported with the estimates from the definitive categories.

Statistical analysis

Descriptive summaries of demographic, clinical, and facility variables were tabulated and stratified by discharge setting (rehabilitation-based versus non-rehabilitation based). Bivariate comparisons were performed via independent t-tests and chi-square tests as appropriate. We examined the independent effect of rehabilitation-based discharge setting on 30-day readmission rate with a generalized linear mixed model. Step one included discharge setting (rehabilitation-based or non-rehabilitation based) as the only independent variable. All covariates were added in step two.

Objective two examined the independent effect of rehabilitation-based discharge destinations on all-cause 30-day rehospitalization with and without controlling for heterogeneity of the population. Given the potential for systematic differences in the two clinical populations (referred to rehabilitation versus not), we ran a k-means, two-step cluster analysis to create distinct groups with more homogenous clinical profiles (Hirsch et al., 2014). Cluster analysis—also called segmentation (or taxonomy analysis) is an explorative approach that identifies grouping structures within data. Cluster analysis identifies homogenous subgroups in situations where the grouping is not previously known. The k-means procedure identifies relatively homogeneous sub-groups while maximizing the variability between the final, defined clusters (Hirsch et al., 2014). K-means clustering is particularly useful when analyzing differences in sub-groups within a large dataset, and when corroborating a main finding of the parent sample (Hirsch et al., 2014). We then repeated the basic method described above: 1) unadjusted comparisons within each homogeneous cluster and 2) generalized linear mixed modeling, but this time stratified by cluster. All analyses were performed with IBM SPSS Statistics for Windows Version 23.0 (IBM Corp, Armonk, NY).

RESULTS

Our sample included 261,558 Medicare beneficiaries who received lumbar spinal fusion surgery. Some patients received more than one spinal procedure during a given hospital stay. Thus, the sum of total procedure counts is greater than the sample size: dorsal and dorsolumbar fusion of the anterior column, anterior technique (n=2,161), dorsal and dorsolumbar fusion of the posterior column, posterior technique (n=21,502), lumbar and lumbosacral fusion of the anterior column, anterior technique (n=38,580), lumbar and lumbosacral fusion of the posterior column, posterior technique (n=167,776), lumbar and lumbosacral fusion of the anterior column, posterior technique (n=84,4469). Table 1 shows patient characteristics stratified by discharge destination (rehab-based versus non-rehab). Overall participants averaged 69.1 (SD=9.6) years of age, 60.1% were female, and 88.9% were White. Half (50.8%) had a rehabilitation-based discharge destination: 12.3% IRF, 19.1% SNF, and 19.5% home health. Overall, 8.6% of patients were rehospitalized within 30 days. Rates for patients discharged to rehabilitation-based services and non-rehabilitation services were 10.7% and 6.4%, respectively.

Baseline differences were notable among those discharged to rehabilitation- versus non-rehabilitation based services. Higher proportions of Blacks (8.2% versus 5.5%), those with four or more comorbidities on the Elixhauser scale (30.0% versus 15.8%), and those from teaching hospitals (58.5% versus 52.9%) were discharged to rehabilitation-based versus non-

rehabilitation destinations. Patients who were discharged to rehabilitation- versus non-rehabilitation based destinations were also older (70.9 years, SD=9.1 versus 67.3, SD=9.7) and had a longer lengths of stay (5.1 days, SD=4.3 versus 3.1 days, SD=2.6). In contrast, those discharged to non-rehabilitation versus rehabilitation-based services had higher proportions of prior hospitalizations (12.9% versus 9.9%), patients who were White (90.6% versus 87.3%), and exhibited one or fewer comorbidities (40.4% versus 25.7%), respectively.

Table 2 displays unadjusted and adjusted associations of rehabilitation-based discharge destination on all cause 30-day readmission rate. Individuals discharged to a rehabilitation-based service had 1.75 (95% CI = 1.70, 1.80) higher odds of being readmitted to the hospital in 30 days than those discharged to a non-rehabilitation service. Results attenuated some after adjusting for age, sex, race/ethnicity, Elixhauser categorization, length of stay, subsequent fusion, prior hospitalization, rural/urban hospital, and teaching hospital status, but the likelihood of rehospitalization for patients discharged to a rehabilitation-based post-acute service remained significant (OR 1.36; 95% CI = 1.31, 1.40).

Because of the notable baseline differences between those discharged to a rehabilitation-based and non-rehabilitation based destination, we applied a two-step cluster analysis using length of stay and the Elixhauser categories. Three distinct and more homogeneous groups were identified (Table 3). Comorbidity burden, length of stay, and discharge to rehabilitation-based setting all increased progressively from cluster 1–3. Unadjusted readmission rates also increased with each subsequent cluster: 5.9%, 8.1%, and 13.5%.

Reanalysis of the multivariable models stratified by cluster found similar findings for the association between discharge destination and rehospitalization (Table 4). The odds of 30-day rehospitalization for patients discharged to a rehabilitation-based service were on average 30% higher than those discharged to a non-rehabilitation based service (Cluster one OR=1.28, 95% CI=1.20, 1.36; Cluster two OR=1.27, 95% CI = 1.21, 1.33; Cluster three OR=1.33, 95% CI = 1.26, 1.41).

DISCUSSION

The objectives of this study were to examine differences in case mix and 30-day readmission risk among patients with lumbar spinal fusion discharged to rehabilitation-based and non-rehabilitation based services. We found notable case mix differences between discharge destinations and increased odds of hospital readmission when discharged to a rehabilitation-based post-acute service. Our findings suggest that those discharged to a rehabilitation-based post-acute service are inherently different and these differences likely account for increased risk of downstream readmission and potentially morbidity.

Other studies (Abt et al., 2017; Aldebeyan et al., 2016; Kanaan et al., 2014) have explored predictors of a rehabilitation-based discharge destination after spinal fusion surgery. Each prior study used a different definition for discharge destination. Discharge definitions were based on discharge to home versus ‘other’ (Aldebeyan et al., 2016) and discharge to home versus skilled nursing facility or inpatient rehabilitation facility (Abt et al., 2017; Kanaan et

al., 2014). We combined the three rehabilitation-intensive post-acute settings into a single, inclusive rehabilitation category for comparison with all other discharge destinations. Comparison of findings across studies must consider the differences in how discharge destinations are categorized. Our findings confirm earlier reports that older age (Abt et al., 2017; Aldebeyan et al., 2016; Kanaan et al., 2014), a higher number of comorbidities (Aldebeyan et al., 2016; Kanaan et al., 2014), and longer lengths of stay (Abt et al., 2017; Aldebeyan et al., 2016; Kanaan et al., 2014) are more common among those discharged to rehabilitation-based post-acute services. Within the literature, findings regarding gender are mixed as Aldebeyan and colleagues stated more females received rehabilitation-based post-acute care (Aldebeyan et al., 2016) whereas Abt et al. identified more males with rehabilitation-based discharge destinations (Abt et al., 2017). We found a higher percentage of females in rehabilitation-based discharge destinations. Further, we found higher proportions of individuals who were Black and who were seen in teaching hospitals discharged to rehabilitation-based settings; measures that were previously unexplored.

Unadjusted and adjusted odds of 30-day rehospitalization were higher for those discharged to rehabilitation-based destinations. Further analyses using clustered homogenous groups identified similar findings that patients discharged to rehabilitation-based post-acute services increase patients' odds of rehospitalization. Our findings contradict those by Abt and colleagues (Abt et al., 2017) who investigated the role of discharge destination and 30-day hospital readmission among 34,000 patients within the ACS-NSQIP database who received elective spinal surgery. In their study that compared rehospitalization for patients discharged to IRF and SNF compared with those discharged home, only IRF influenced unplanned hospital admissions, resulting in a decreased risk of readmission at 30 days (OR = 0.41; 95%CI 0.21, 0.79) when compared to a home discharge.

Along with how the discharge destination was defined, there were other notable differences in the patient populations and covariates used in the models. Abt et al. included patient behavior variables such as smoking, alcohol use, and body mass index (Abt et al., 2017). They also used a non-descript morbidity score that appeared to represent perioperative surgical complications and included individual comorbidities such as cardiovascular problems and neurological morbidity, but did not categorize these into a scale. We did not use a morbidity scale but opted to use the Elixhauser scale to categorize comorbidities. The Elixhauser scale is designed to identify hospital-based patients who are likely to have higher hospital resource use and are at risk for higher in-hospital mortality (Elixhauser et al., 1998). The patient population studied by Abt et al. included those with surgeries (Abt et al., 2017) that are likely to have very different care needs and health trajectories from fusion. These included lumbar disc replacement, complete and hemi-laminectomy, and cervical surgeries. We feel that the surgical population in our study was more homogeneous and thus direct comparison of the two studies was only to describe the current state of the science.

Does discharge to a rehabilitation-based post-acute service increase the risk for 30-day hospital readmission? Based on our study and others to-date, more research is needed to examine the clinical differences among those referred to rehabilitation-based services and the factors considered during discharge planning and referral. In general, patients who continue with post-acute care are more seriously ill, have more chronic or co-occurring

conditions, and have higher risks of functional decline and mortality; thus requiring discharge to skilled care (Strosberg et al., 2017). Despite controlling statistically for selected comorbidities and demographics, we were unable to compensate for this, a limitation of both the study design and regression modeling of observational data (Livingston et al., 2011). We were also unable to account for factors such as functional status, which is the primary determinant of need for post-acute rehabilitation services and is also strongly associated with readmission risk.

It is also plausible that a *monitoring effect* may have played a role in higher observed readmission rates among patients discharged to intensive rehabilitation-based settings. As Strosberg and colleagues debate, it is logical to assume that the function of rehabilitation-based discharge destinations is to provide superior, carefully monitored care (Strosberg et al., 2017). The increase in hospital readmissions may be attributed to exposure to a greater number of trained healthcare workers and more time under the supervision of these workers who are integral in recognizing a new or worsening medical condition that requires rehospitalization. Routine discharge home without skilled health monitoring of new health issues may be less likely to prompt readmission. Strosberg et al.'s opinions (Strosberg et al., 2017) are further supported by our study's use of the clustered approach, which homogenized patients into like-type groups and still found that discharge to a rehabilitation-based service increases in hospital readmission despite analyses in low, medium, and high risk groups. Although imperfect, the clustering approach we used improves the likelihood that characteristics are similar in identified groups across key identifiers that are targeted. In clinical practice, a different method of clustered would be a necessity, such as the use of the STarT Back tool (Hill et al., 2010) since the application of our clustering model lacks transferability. Additional research examining longer-term outcomes (e.g., 1-year institutionalization and mortality rates) may lend support to the ultimate benefits of the monitoring effect.

In addition to the previous limitations stated, others should be considered in interpreting our findings. First, this was a retrospective observational analysis, so there is risk for confounding. In addition to the lack of clinical measures including functional status, studies using administrative data do not include measures of surgical severity (e.g., simple versus complex fusion). Second, this study of Medicare fee-for-service beneficiaries may not be generalizable to other patient populations. Finally, our coding of discharge disposition includes post-acute services that can provide rehabilitation but we did not verify receipt, intensity or quality of the rehabilitation provided after hospital discharge. The provision of rehabilitation provided is likely highly variable and may have further influenced our findings.

CONCLUSION

As reimbursement models shift from fee-for-service to episode-based payments (bundling acute, post-acute, and other related care over 90 days), our findings suggest that patients for whom post-acute rehabilitation is clinically indicated may face a double jeopardy in access issues. To date, the bundled payment models do not risk adjust beyond the initial diagnosis related group code and thus, do not account for individual differences in functional status or

post-acute needs. Thus, patients requiring post-acute rehabilitation will be viewed as both more costly to manage and higher risk for poor quality outcomes. Prospective research including measures of health and functional status, care continuity, the provision of rehabilitation and patient-reported outcomes will further inform the field on opportunities to promote successful recovery following lumbar spinal fusion surgery.

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ABBREVIATIONS

RECORD	Reporting of studies Conducted using Observational Routinely-collected Data
MedPAR	Medicare Provider Analysis and Review
ICD-9-CM	International Classification of Diseases, Ninth Revision, Clinical Modification
SNF	skilled nursing facility
IRF	inpatient rehabilitation facility

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Table 1.

Descriptive comparison by discharge setting within the sample

	Discharge Setting			p-value
	Total	Rehabilitation Based	Non-Rehabilitation Based	
N	261,558	132,991	128,567	
Age	69.1 (9.6)	70.9 (9.1)	67.3 (9.7)	< .001
Female	60.1%	64.8%	55.1%	< .001
Race/ethnicity *				< .001
White	88.9%	87.3%	90.6%	
Black	6.9%	8.2%	5.5%	
Hispanic	1.2%	1.5%	1.0%	
Other	2.3%	2.5%	2.2%	
Elixhauser sum				< .001
0–1 comorbidities	32.9%	25.7%	40.4%	
2–3 comorbidities	44.1%	44.3%	43.8%	
4+ comorbidities	23.0%	30.0%	15.8%	
Subsequent fusion	4.0%	4.0%	3.9%	.036
Prior hospitalization	12.9%	15.8%	9.9%	< .001
Length of stay	4.1 (3.7)	5.1 (4.3)	3.1 (2.6)	< .001
Rural †	6.0%	5.2%	6.8%	< .001
Teaching †	55.7%	58.5%	52.9%	< .001
Rehospitalized	8.6%	10.7%	6.4%	< .001

Values are percent or mean (SD)

* Missing 1,808

† Missing 1,060

Table 2.

Unadjusted and adjusted analyses involving rehabilitation setting and all cause 30-day hospital readmission rates

30-day readmission	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Rehabilitation setting	1.75 (1.70, 1.80)	1.36 (1.31, 1.40)
Age, 5 years		1.04 (1.03, 1.05)
Male		1.04 (1.01, 1.07)
Race/ethnicity (white)		ref
Black		1.15 (1.09, 1.21)
Hispanic		0.92 (0.81, 1.05)
Other		0.84 (0.76, 0.93)
Elixhauser sum (0–1)		ref
2–3 comorbidities		1.29 (1.24, 1.33)
4+ comorbidities		1.88 (1.80, 1.95)
Length of stay		1.05 (1.04, 1.05)
Subsequent fusion		0.88 (0.82, 0.95)
Prior hospitalization		1.55 (1.50, 1.61)
Rural		0.97 (0.89, 1.06)
Teaching		1.00 (0.96, 1.05)

Table 3.

Descriptive characteristics of clustered groups

	Total	Cluster		
		1	2	3
N	261,558	85,974	114,684	60,900
Rehabilitation setting	50.8%	39.6%	51.1%	66.3%
Age	69.1 (9.6)	68.4 (10.1)	69.4 (9.4)	69.6 (9.3)
Female	60.1%	55.6%	60.8%	64.9%
Race/ethnicity [*]				
White	88.9%	90.2%	88.7%	87.3%
Black	6.9%	5.3%	7.1%	8.6%
Hispanic	1.2%	1.3%	1.2%	1.3%
Other	2.3%	2.3%	2.3%	2.3%
Elixhauser sum				
0–1 comorbidities	32.9%	100.0%		0.2%
2–3 comorbidities	44.1%		100.0%	0.9%
4+ comorbidities	23.0%			98.9%
Subsequent fusion	4.0%	3.4%	3.9%	4.8%
Prior hospitalization	12.9%	8.9%	12.0%	20.2%
Length of stay	4.1 (3.7)	3.2 (1.9)	3.8 (2.3)	6.0 (6.2)
Rural [†]	6.0%	6.2%	6.0%	5.7%
Teaching [†]	55.7%	52.9%	55.5%	60.1%
Rehospitalized	8.6%	5.9%	8.1%	13.5%

^{*} Missing 1,808[†] Missing 1,060

Table 4.

Adjusted analyses involving rehabilitation setting and all cause 30-day hospital readmission rates by cluster

30-day readmission	Cluster 1 OR (95% CI)	Cluster 2 OR (95% CI)	Cluster 3 OR (95% CI)
Rehabilitation setting	1.28 (1.20, 1.36)	1.27 (1.21, 1.33)	1.33 (1.26, 1.41)
Age, 5 years	1.04 (1.03, 1.06)	1.03 (1.02, 1.05)	1.03 (1.02, 1.05)
Male	1.08 (1.02, 1.14)	1.04 (0.99, 1.09)	1.01 (0.97, 1.07)
Race/ethnicity (white)	ref	ref	ref
Black	1.11 (0.98, 1.25)	1.12 (1.04, 1.22)	1.20 (1.11, 1.30)
Hispanic	0.86 (0.66, 1.14)	0.95 (0.78, 1.16)	0.90 (0.73, 1.12)
Other	0.78 (0.63, 0.96)	0.83 (0.72, 0.97)	0.89 (0.76, 1.05)
Elixhauser sum (0–1)			ref
2–3 comorbidities			1.11 (0.66, 1.88)
4+ comorbidities			1.69 (1.04, 2.74)
Length of stay	1.11 (1.10, 1.13)	1.10 (1.09, 1.11)	1.04 (1.03, 1.04)
Subsequent fusion	0.93 (0.80, 1.08)	0.90 (0.80, 1.00)	0.86 (0.77, 0.96)
Prior hospitalization	1.44 (1.32, 1.58)	1.62 (1.53, 1.72)	1.53 (1.44, 1.61)
Rural	0.97 (0.84, 1.12)	0.95 (0.85, 1.07)	1.04 (0.92, 1.18)
Teaching	0.94 (0.87, 1.01)	0.95 (0.90, 1.01)	1.06 (0.99, 1.13)