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Functional Status is Associated with 30-day Potentially Preventable Readmissions following Skilled Nursing Facility Discharge among Medicare Beneficiaries

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Abstract

Objectives—Determine the association between patients' functional status at discharge from skilled nursing facility (SNF) care and 30-day potentially preventable hospital readmissions. Examine common reasons for potentially preventable readmissions.

Design—Retrospective cohort study.

Setting—SNFs and acute care hospitals submitting claims to Medicare.

Participants—National cohort of Medicare fee-for-service beneficiaries discharged from SNF care between 7/15/2013 and 7/15/2014 (N=693,808). Average age was 81.4 (SD, 8.1) years, 67.1% were female, and 86.3% non-Hispanic white.

Measurements—Functional items from the Minimum Data Set 3.0 were categorized into self-care, mobility, and cognition domains. We used specifications for the SNF potentially preventable 30-day post-discharge readmission quality metric to identify potentially preventable readmissions.

Results—The overall observed rate of 30-day potentially preventable readmissions following SNF discharge was 5.7% (N=39,318). All three functional domains were independently associated with potentially preventable readmissions in the multivariable models. Odds ratios (OR) for the most dependent category versus the least dependent category from multilevel models adjusted for

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patients' sociodemographic and clinical characteristics were as follows: mobility, 1.54 (95% confidence interval (CI): 1.49–1.59); self-care, 1.50 (95% CI: 1.44–1.55); and cognition, 1.12 (95% CI: 1.04–1.20). The five most common conditions were congestive heart failure (N=7654, 19.5%), septicemia (N=7412, 18.9%), urinary tract infection/kidney infection (N=4297, 10.9%), bacterial pneumonia (N=3,663, 9.3%), and renal failure (N=3587, 9.1%). Across all three functional domains, septicemia was the most common condition among the most dependent patients and congestive heart failure among the least dependent.

Conclusions—Patients with functional limitations at SNF discharge are at increased risk of hospital readmissions considered potentially preventable. Future research is needed to determine whether improving functional status reduces risk of potentially preventable readmissions among this vulnerable population.

Keywords

mobility; self-care; cognition; infection; chronic conditions

Introduction

The focus of readmission-related healthcare reform is shifting from 30-day all-cause readmissions to potentially preventable readmissions.^{1–3} Older adults discharged from post-acute care in skilled nursing facilities (SNF) are a high-risk population for hospital readmission, with reported all-cause readmission rates as high as 23%.^{4–6} Potentially preventable readmissions over this time frame have only been examined by Medicare contractors during measure development. In their analyses of 2013 Medicare data, the average facility-level rate of post-SNF potentially preventable readmissions was 6.2%.²

Post-SNF potentially preventable readmissions are defined as readmissions “that should be avoidable with adequately planned, explained, and implemented post discharge instructions, including the establishment of appropriate follow-up ambulatory care.”^{2, p.25} The conditions considered potentially preventable represent 1) inadequate management of chronic conditions, 2) inadequate management of infections, or 3) inadequate management of other unplanned events.² Understanding the risk factors associated with potentially preventable readmissions is an important first step in preventing this undesirable outcome. This area of research is important because beginning in 2018 SNF provider rates of potentially preventable readmissions occurring over the 30 days following discharge will be publicly reported as part of the SNF Quality Reporting Program.⁷

Functional status is a patient characteristic likely associated with potentially preventable readmissions following SNF discharge;⁸ however, this relationship has not been studied. Improving patients' functional independence is a primary goal of SNF care, and functional outcomes are indicative of quality of care in this setting.^{3,9} Subsequently, function is a component of the Minimum Data Set (MDS), the comprehensive patient assessments conducted at 5, 14, 30, 60, and 90 days during SNF stays and at discharge from the facility.¹⁰ The standardized collection of data provides an opportunity for examining the association between patients' functional status at discharge and their risk for a potentially preventable readmission.

Investigating the relationship between discharge functional status and risk for potentially preventable readmissions following SNF care is logical for several reasons. First, functional status is associated with hospital readmissions in other settings.^{8,11–13} Second, functional status is routinely assessed during SNF care. If a relationship is established between discharge functional status and 30-day potentially preventable readmissions, at-risk individuals can be identified without additional resource utilization. Finally, the goal of SNF care is to stabilize and improve patients' health following a hospitalization so they can successfully return home. Functional status may be a modifiable risk factor for potentially preventable readmissions following SNF discharge. Determining modifiable risk factors will inform targeted prevention efforts.

The primary objective of our study was to determine the association between patients' functional status at discharge from SNF care and 30-day potentially preventable hospital readmissions. We hypothesized that lower functional status would be associated with greater readmission risk. To more accurately inform prevention efforts, we examined three distinct functional domains: self-care, mobility, and cognition. A secondary objective was to identify the most common conditions resulting in potentially preventable readmissions.

Methods

Data sources

We used the following 100% national Center for Medicare and Medicaid Services (CMS) data files for 2013–2014: Minimum Data Set (MDS) version 3.0, Medicare Provider Analysis and Review (MedPAR), and Beneficiary Summary. MDS files were used to identify our cohort of interest and obtain information on patients' functional status at SNF discharge. MedPAR Part A files were used to verify SNF stays, identify potentially preventable readmissions, and extract information on patients' clinical characteristics. The Beneficiary Summary files were used to obtain information on patients' sociodemographic characteristics and to identify those with continuous Part A enrollment. The study was approved by the University Institutional Review Board. A Data Use Agreement was completed following CMS requirements.

Patient population

The cohort selection is presented in Figure 1. The final sample included 693,808 Medicare fee-for-service beneficiaries aged 66 years and older newly discharged from a SNF between 7/15/2013 and 7/15/2014. We did not include long-stay (>100 days) SNF residents.^{14,15} Additional exclusion criteria were based on the specifications included in the SNF Quality Reporting Program measure.² Furthermore, because patients' functional status at discharge was our predictor of interest, we excluded patients who were comatose at discharge and those with incomplete functional data at the MDS assessment closest to SNF discharge.

Outcome

We used the specifications for the new potentially preventable 30-day post-discharge readmission quality metric for SNFs to identify the outcome of interest.² The ICD-9 codes for readmissions that occurred over the specified observation window (i.e., days 2 to 32 after

SNF discharge) were compared to the list developed for the quality metric to determine whether the hospitalization was potentially preventable.²

Primary predictors

The predictors of interest were patients' self-care, mobility, and cognitive status at SNF discharge. We used the MDS assessment occurring closest to discharge to extract information on patients' functional status. Self-care included eating, personal hygiene, bathing, dressing, and toilet use. Mobility included transfers, bed mobility, walking in the room, walking in the corridor, and locomotion on and off the unit. Patient performance on the items in the self-care and mobility domains are scored 0 (Independent) to 4 (Total dependence) if the activity occurred 3 or more times over the previous 7 days, otherwise items are scored as 7 (activity occurred only once or twice) or 8 (activity did not occur).¹⁰ We recoded scores of 7 or 8 as 'Total dependence' (4 points).¹⁵ The range of scores for the self-care domain was 0 to 20 and the range of scores for mobility was 0 to 24, with higher scores reflecting greater dependence. We created four-level categorical variables for mobility and self-care scores based on quartiles of domain score distributions.

Cognitive status was operationally defined using the Cognitive Function Scale,¹⁶ which can be calculated from MDS items. Depending on patients' cognitive abilities, either the Brief Interview for Mental Status (BIMS)¹⁷ or the Cognitive Performance Scale (CPS)¹⁸ is used to evaluate patients' cognitive status during MDS assessments. The BIMS is a cognitive screening tool that measures patients' attention, orientation, and recall.¹⁰ Scores on the BIMS can range from 0 to 15 points, with lower scores indicating greater cognitive impairment. If a patient cannot attempt or is unable to complete the BIMS, a CPS score is calculated using five MDS items. The Cognitive Function Scale is a validated scale that integrates data from the BIMS and CPS and classifies patients as cognitively intact (BIMS 13–15), mildly impaired (BIMS 8–12 or CPS 0–2), moderately impaired (BIMS 0–7 or CPS 3–4), or severely impaired (CPS 5–6).¹⁶ Patients who complete the BIMS do not receive the cognitive MDS items that are used to calculate a CPS score. It should also be noted that the BIMS classifies patients who score between 0–7 points as severely impaired¹⁷ whereas the Cognitive Function Scale considers these patients to be moderately impaired. The Cognitive Function Scale validation study reported that nearly 80% of patients with a CPS score of 5–6 (severe impairment) were unable to complete the BIMS and 43% of patients with a CPS score of 3–4 (moderate impairment) scored between 0–7 points on the BIMS.¹⁶ This indicates that being unable to complete the BIMS is consistent with severe impairment whereas the lowest scores on the BIMS are more closely associated with moderate impairment.¹⁶

Covariates

Sociodemographic variables included age, sex, race/ethnicity, Medicare entitlement, and dual (Medicare/Medicaid) eligibility. Patients' clinical characteristics included the number of hospitalizations over the one-year prior to the index hospitalization, comorbidities, and the following information regarding the index hospitalization- primary diagnosis (ICD-9 code), primary procedure (if applicable), length of stay (days), receipt of dialysis (yes/no), and intensive care or coronary care unit (ICU/CCU) utilization (days). We reviewed all

diagnoses associated with hospitalizations over the one-year prior to the SNF stay to identify comorbidities using the CMS hierarchical condition categories (HCC) approach.^{19,20}

Data Analysis

We calculated 30-day potentially preventable readmission rates and corresponding 95% confidence intervals (95% CI) for the overall cohort and by patient characteristics. We used multilevel logistic regression models to examine the association between patients' discharge functional status and potentially preventable readmissions. All models were adjusted for patients' sociodemographic and clinical characteristics. We estimated separate models for each of the functional domains. We also estimated the independent effects for each of the functional domains while adjusting for the others, with the exception of models including both self-care and mobility due to multicollinearity between those variables (Spearman correlation coefficient=0.76, $p<0.0001$). For patients who experienced a 30-day potentially preventable readmission, we extracted the primary condition (ICD-9 code) for the readmission and calculated frequencies of the potentially preventable conditions for the overall cohort and stratified by level of independence (e.g., score quartile) on self-care, mobility, and cognition at SNF discharge.

Results

Cohort Characteristics

We present cohort characteristics in Table 1. The average age of the cohort was 81.4 (SD, 8.1) years. A majority were female (67.1%) and non-Hispanic white (86.3%). The overall observed rate of 30-day potentially preventable readmissions following SNF discharge was 5.7% (N=39,318) (Table 1).

Potentially Preventable Readmissions

Across all three functional domains, greater dependence at discharge was associated with higher adjusted odds of a 30-day potentially preventable readmission (Table 2). Odds ratios for the most dependent mobility category versus the least dependent category were 1.57 (95% CI: 1.52–1.62) prior to adjusting for cognition and 1.54 (95% CI: 1.49–1.59) after adjustment. Odds ratios for the most dependent self-care category versus the least dependent category were 1.52 (95% CI: 1.47–1.58) prior to adjusting for cognition and 1.50 (95% CI: 1.44–1.55) after adjustment. Adjusting for self-care reduced the strength of the association between cognition and potentially preventable readmissions. Odds ratios for those with severe cognitive impairment versus those with intact cognition were 1.33 (95% CI: 1.24–1.42) prior to adjusting for self-care and 1.12 (95% CI: 1.04–1.20) after adjustment. A similar effect was observed after adjustment for mobility, with odds ratios decreasing to 1.13 (95% CI: 1.06–1.21) for severely impaired versus intact cognitive function. A complete listing of the odds ratios from the multilevel models are available in Appendix 1.

The five most common conditions (ICD-9 codes) resulting in 30-day potentially preventable readmissions following SNF discharge were congestive heart failure (N=7654, 19.5%), septicemia (N=7412, 18.9%), urinary tract infection/kidney infection (N=4297, 10.9%), bacterial pneumonia (N=3,663, 9.3%), and renal failure (N=3587, 9.1%). A complete listing

of the condition categories, ICD-9 codes, and frequencies is available in Appendix 2. In Table 3, we present the five most frequent conditions stratified by levels of independence on mobility, self-care, and cognition at SNF discharge. Across all three domains, septicemia was the most common condition among patients in the category representing the greatest dependence, and congestive heart failure in the category representing the greatest independence.

Discussion

Providers are incentivized to reduce rates of potentially preventable readmissions over the 30 days following SNF discharge, as these rates are a new measure included in the SNF Quality Reporting Program.⁷ In our national cohort of Medicare beneficiaries, the 30-day potentially preventable readmission rate following SNF discharge was 5.7%, which is similar to the 6.2% rate reported by measure developers.² Understanding who is at-risk (i.e., patient characteristics) and what they are at-risk for (i.e., conditions) are important first steps in reducing readmission rates.

Greater impairment in self-care, mobility, and cognitive domains at discharge were each associated with significantly higher odds for readmission. Dependence with mobility or self-care at SNF discharge was more strongly associated with potentially preventable 30-day readmissions than severe cognitive impairment. Adjusting for patients' cognitive status did not have an appreciable impact on the association between mobility and potentially preventable readmissions or on the association between self-care and potentially preventable readmissions. However, the association between cognition and potentially preventable readmissions weakened after adjustment for mobility or self-care. This implies that the increased odds for 30-day potentially preventable readmissions for patients with severe cognitive impairment may be due in part to greater limitations in self-care and mobility. Patients with cognitive impairments may be less consistent with their mobility and self-care activities, which increases their risk of a readmission for an avoidable condition. These findings also suggest that clinical interventions that improve self-care and mobility may be effective for reducing the risk of potentially preventable readmissions for SNF patients with severe cognitive impairment.

A key component of reducing readmissions is understanding the potentially preventable conditions patients are experiencing. In our cohort, congestive heart failure and septicemia were the most common conditions. To better understand the association between patient's functional status and potentially preventable readmissions, we examined common conditions across levels of independence on the functional domains. Interestingly, across all three domains the most common condition among patients in the category representing the greatest dependence was septicemia. Per measure developers, septicemia represents "inadequate management of infection" and is considered potentially preventable.² Perhaps patients with more severe functional limitations at SNF discharge would benefit from patient and caregiver training on infection prevention and recognizing early signs of infection.

We also observed consistency across all three functional domains in the most common condition among individuals with the greatest independence at discharge. These higher

functioning individuals most frequently experienced potentially preventable readmissions for congestive heart failure. Congestive heart failure was included on the list of conditions by measure developers and classified as “inadequate management of chronic conditions”.² Our findings suggest that even individuals who are higher functioning at SNF discharge may benefit from education and follow-up care focused on managing chronic conditions.

Limitations

We used Medicare data to address our study objectives. Although this provided a national cohort, there are limitations associated with the use of administrative and claims data for research purposes. We do not have information on coding accuracy, and analyses are limited to data available in these datasets. Important factors, such as social support at home, are not available. We studied potentially preventable readmissions among Medicare fee-for-service beneficiaries over the age of 65 years discharged from SNFs. Findings may not be generalizable to individuals covered by other payers or Medicare programs (e.g., Medicare Advantage), younger individuals, or those discharged from other post-acute settings. Our outcome was 30-day potentially preventable readmissions, which we identified using the list of diagnoses developed for the SNF Quality Reporting Program measure. We followed the list specified for the measure because these are the diagnoses that will be used for quality reporting. However, we acknowledge that potentially preventable readmissions are controversial. The diagnoses on the list may have varying degrees of preventability, and some readmissions for these conditions may be unavoidable. Further research is needed to better understand the conditions that are preventable post-discharge and which providers/settings should be held accountable for these readmissions. Finally, the findings for cognitive status should be interpreted with the operational definitions of the Cognitive Function Scale categories in mind. The “Moderately Impaired” category for the Cognitive Function Scale includes patients with BIMS scores ranging from 0 to 7 points. Individuals on the lower end of that range may have more severe cognitive deficits than what is traditionally considered “moderate”; however, they are higher functioning than those categorized as “Severely Impaired” on the Cognitive Function Scale¹⁶.

Conclusions

Patients with functional limitations at SNF discharge are at increased risk of hospital readmissions considered potentially preventable. These findings can be informative for identifying individuals who are at high-risk for experiencing a potentially preventable readmission following discharge from a SNF. Prevention efforts may seek to target these vulnerable individuals and focus on management of chronic conditions and infection prevention. Future research is also needed to determine whether improving functional status reduces patients’ risk of potentially preventable hospital readmissions following discharge from SNFs.

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Appendix 1

Table A1

Effects of mobility on potentially preventable 30-day readmissions following skilled nursing facility discharge, estimated from a multilevel model adjusted for sociodemographic and clinical characteristics.

Patient Characteristic	Odds Ratio* (95% CI)
Mobility Score (points)[†]	
0–11	Reference
12–15	1.16 (1.12 – 1.20)
16–18	1.35 (1.31 – 1.40)
19–24	1.57 (1.52 – 1.62)
Age (years)	
66–70	Reference
71–75	1.08 (1.03 – 1.13)
76–80	1.14 (1.09 – 1.19)
81+	1.23 (1.18 – 1.28)
Sex	
Male	Reference
Female	0.94 (0.92 – 0.96)
Race/Ethnicity	
White	Reference
Black	1.01 (0.97 – 1.05)
Hispanic	1.03 (0.97 – 1.09)
Other	0.90 (0.84 – 0.97)
Medicare Original Entitlement[‡]	
Age	Reference
Disability	1.12 (1.08 – 1.15)
ESRD	1.59 (1.27 – 1.98)
ESRD and Disability	1.22 (0.97 – 1.54)
Dual Eligibility[§]	
No	Reference
Yes	1.00 (0.98 – 1.03)
Dialysis during Index Hospitalization	
No	Reference

Patient Characteristic	Odds Ratio* (95% CI)
Yes	1.08 (0.70 – 1.66)
Index Hospitalization Length of Stay (days)	
1–2	Reference
3	0.89 (0.82 – 0.96)
4	0.98 (0.90 – 1.06)
5	1.07 (0.98 – 1.16)
6–7	1.12 (1.03 – 1.22)
8+	1.24 (1.14 – 1.34)
Index Hospitalization ICU/CCU Utilization (days)	
0	Reference
1–2	0.97 (0.94 – 1.01)
3–4	1.04 (1.00 – 1.07)
5+	1.01 (0.98 – 1.04)
Acute Stays over Prior Year (count)	
0	Reference
1	1.25 (1.22 – 1.29)
2	1.47 (1.42 – 1.53)
3	1.81 (1.73 – 1.91)
4+	2.25 (2.13 – 2.38)

Abbreviations: CI, confidence interval; ESRD, end-stage renal disease; ICU/CCU, intensive care unit or critical care unit

*Odds ratios are from multilevel models adjusted for all patient characteristics listed in the Table, as well as comorbidities (hierarchical condition categories) and index hospitalization diagnostic category and primary procedure (if applicable).

[†]Mobility and self-care domains created using items from the Resident Assessment Instrument Minimum Data Set 3.0. The range of scores for the mobility domain was 0 to 24 and the range of scores for self-care domain was 0 to 20, with higher scores reflecting greater dependence.

[‡]Original reason for Medicare enrollment

[§]Eligible for Medicare and Medicaid

Table A2

Effects of self-care on potentially preventable 30-day readmissions following skilled nursing facility discharge, estimated from a multilevel model adjusted for sociodemographic and clinical characteristics.

Patient Characteristic	Odds Ratio* (95% CI)
Self-Care Score (points)[†]	
1–8	Reference
9–11	1.14 (1.10 – 1.18)
12–13	1.32 (1.28 – 1.36)
14–20	1.52 (1.47 – 1.58)
Age (years)	
66–70	Reference
71–75	1.08 (1.04 – 1.13)
76–80	1.15 (1.10 – 1.20)
81+	1.23 (1.18 – 1.29)

Patient Characteristic	Odds Ratio* (95% CI)
Sex	
Male	Reference
Female	0.95 (0.93 – 0.97)
Race/Ethnicity	
White	Reference
Black	1.01 (0.97 – 1.05)
Hispanic	1.03 (0.97 – 1.08)
Other	0.90 (0.83 – 0.96)
Medicare Original Entitlement[‡]	
Age	Reference
Disability	1.12 (1.08 – 1.16)
ESRD	1.60 (1.28 – 1.99)
ESRD and Disability	1.23 (0.97 – 1.55)
Dual Eligibility[§]	
No	Reference
Yes	1.00 (0.97 – 1.02)
Dialysis during Index Hospitalization	
No	Reference
Yes	1.08 (0.70 – 1.67)
Index Hospitalization Length of Stay (days)	
1–2	Reference
3	0.89 (0.82 – 0.96)
4	0.98 (0.90 – 1.06)
5	1.07 (0.98 – 1.16)
6–7	1.13 (1.04 – 1.22)
8+	1.25 (1.15 – 1.35)
Index Hospitalization ICU/CCU Utilization (days)	
0	Reference
1–2	0.97 (0.93 – 1.01)
3–4	1.04 (1.00 – 1.07)
5+	1.01 (0.97 – 1.04)
Acute Stays over Prior Year (count)	
0	Reference
1	1.25 (1.22 – 1.29)
2	1.47 (1.42 – 1.53)
3	1.81 (1.72 – 1.91)
4+	2.24 (2.12 – 2.37)

Abbreviations: CI, confidence interval; ESRD, end-stage renal disease; ICU/CCU, intensive care unit or critical care unit

* Odds ratios are from multilevel models adjusted for all patient characteristics listed in the Table, as well as comorbidities (hierarchical condition categories) and index hospitalization diagnostic category and primary procedure (if applicable).

[‡] Mobility and self-care domains created using items from the Resident Assessment Instrument Minimum Data Set 3.0. The range of scores for the mobility domain was 0 to 24 and the range of scores for self-care domain was 0 to 20, with higher scores reflecting greater dependence.

[‡]Original reason for Medicare enrollment

[§]Eligible for Medicare and Medicaid

Table A3

Effects of cognitive function on potentially preventable 30-day readmissions following skilled nursing facility discharge, estimated from a multilevel model adjusted for sociodemographic and clinical characteristics.

Patient Characteristic	Odds Ratio* (95% CI)
Cognitive Function Scale^{//}	
Intact	Reference
Mildly Impaired	1.11 (1.08 – 1.14)
Moderately Impaired	1.15 (1.12 – 1.19)
Severely Impaired	1.33 (1.24 – 1.42)
Age (years)	
66–70	Reference
71–75	1.09 (1.05 – 1.14)
76–80	1.17 (1.12 – 1.22)
81+	1.28 (1.23 – 1.33)
Sex	
Male	Reference
Female	0.95 (0.93 – 0.98)
Race/Ethnicity	
White	Reference
Black	1.03 (0.99 – 1.07)
Hispanic	1.04 (0.99 – 1.10)
Other	0.90 (0.84 – 0.97)
Medicare Original Entitlement[‡]	
Age	Reference
Disability	1.12 (1.09 – 1.16)
ESRD	1.61 (1.29 – 2.01)
ESRD and Disability	1.25 (0.99 – 1.57)
Dual Eligibility[§]	
No	Reference
Yes	1.01 (0.99 – 1.04)
Dialysis during Index Hospitalization	
No	Reference
Yes	1.05 (0.68 – 1.61)
Index Hospitalization Length of Stay (days)	
1–2	Reference
3	0.89 (0.82 – 0.96)
4	0.98 (0.90 – 1.07)
5	1.07 (0.99 – 1.17)
6–7	1.14 (1.05 – 1.23)
8+	1.26 (1.16 – 1.37)
Index Hospitalization ICU/CCU Utilization (days)	

Patient Characteristic	Odds Ratio* (95% CI)
0	Reference
1–2	0.97 (0.93 – 1.01)
3–4	1.04 (1.01 – 1.08)
5+	1.01 (0.98 – 1.04)
Acute Stays over Prior Year (count)	
0	Reference
1	1.25 (1.22 – 1.28)
2	1.46 (1.41 – 1.52)
3	1.79 (1.71 – 1.89)
4+	2.21 (2.09 – 2.34)

Abbreviations: CI, confidence interval; ESRD, end-stage renal disease; ICU/CCU, intensive care unit or critical care unit

* Odds ratios are from multilevel models adjusted for all patient characteristics listed in the Table, as well as comorbidities (hierarchical condition categories) and index hospitalization diagnostic category and primary procedure (if applicable).

// Cognitive Function Scale¹: Intact (Brief Interview for Mental Status (BIMS): 13–15), Mildly Impaired (BIMS: 8–12 or Cognitive Performance Scale (CPS): 0–2), Moderately Impaired (BIMS: 0–7 or CPS: 3–4), Severely Impaired (CPS: 5–6).

1. Thomas KS, Dosa D, Wysocki A, Mor V. The Minimum Data Set 3.0 Cognitive Function Scale. *Med Care*. 2017;55(9):e68–e72.

[†]Original reason for Medicare enrollment

[§]Eligible for Medicare and Medicaid

Table A4

Effects of mobility and cognitive function on potentially preventable 30-day readmissions following skilled nursing facility discharge, estimated from a multilevel model adjusted for sociodemographic and clinical characteristics.

Patient Characteristic	Odds Ratio* (95% CI)
Mobility Score (points)[†]	
0–11	Reference
12–15	1.16 (1.12 – 1.20)
16–18	1.35 (1.31 – 1.40)
19–24	1.54 (1.49 – 1.59)
Cognitive Function Scale^{//}	
Intact	Reference
Mildly Impaired	1.07 (1.04 – 1.10)
Moderately Impaired	1.05 (1.02 – 1.09)
Severely Impaired	1.13 (1.06 – 1.21)
Age (years)	
66–70	Reference
71–75	1.08 (1.03 – 1.13)
76–80	1.14 (1.09 – 1.19)
81+	1.22 (1.17 – 1.28)
Sex	
Male	Reference
Female	0.95 (0.93 – 0.98)

Patient Characteristic	Odds Ratio* (95% CI)
Race/Ethnicity	
White	Reference
Black	1.01 (0.97 – 1.05)
Hispanic	1.02 (0.97 – 1.08)
Other	0.89 (0.83 – 0.96)
Medicare Original Entitlement[‡]	
Age	Reference
Disability	1.12 (1.08 – 1.16)
ESRD	1.60 (1.28 – 1.99)
ESRD and Disability	1.24 (0.97 – 1.55)
Dual Eligibility[§]	
No	Reference
Yes	0.99 (0.96 – 1.01)
Dialysis during Index Hospitalization	
No	Reference
Yes	1.08 (0.70 – 1.67)
Index Hospitalization Length of Stay (days)	
1–2	Reference
3	0.89 (0.82 – 0.96)
4	0.98 (0.90 – 1.06)
5	1.07 (0.98 – 1.16)
6–7	1.13 (1.04 – 1.22)
8+	1.25 (1.15 – 1.35)
Index Hospitalization ICU/CCU Utilization (days)	
0	Reference
1–2	0.97 (0.94 – 1.01)
3–4	1.04 (1.01 – 1.07)
5+	1.01 (0.98 – 1.04)
Acute Stays over Prior Year (count)	
0	Reference
1	1.25 (1.22 – 1.29)
2	1.47 (1.42 – 1.53)
3	1.82 (1.73 – 1.91)
4+	2.25 (2.13 – 2.38)

Abbreviations: CI, confidence interval; ESRD, end-stage renal disease; ICU/CCU, intensive care unit or critical care unit

* Odds ratios are from multilevel models adjusted for all patient characteristics listed in the Table, as well as comorbidities (hierarchical condition categories) and index hospitalization diagnostic category and primary procedure (if applicable).

[‡] Mobility and self-care domains created using items from the Resident Assessment Instrument Minimum Data Set 3.0. The range of scores for the mobility domain was 0 to 24 and the range of scores for self-care domain was 0 to 20, with higher scores reflecting greater dependence.

[§] Cognitive Function Scale¹: Intact (Brief Interview for Mental Status (BIMS): 13–15), Mildly Impaired (BIMS: 8–12 or Cognitive Performance Scale (CPS): 0–2), Moderately Impaired (BIMS: 0–7 or CPS: 3–4), Severely Impaired (CPS: 5–6).

1. Thomas KS, Dosa D, Wysocki A, Mor V. The Minimum Data Set 3.0 Cognitive Function Scale. *Med Care*. 2017;55(9):e68–e72.

[†]Original reason for Medicare enrollment

[§]Eligible for Medicare and Medicaid

Table A5

Effects of self-care and cognitive function on potentially preventable 30-day readmissions following skilled nursing facility discharge, estimated from a multilevel model adjusted for sociodemographic and clinical characteristics.

Patient Characteristic	Odds Ratio* (95% CI)
Self-care Score (points)[†]	
1–8	Reference
9–11	1.14 (1.10 – 1.18)
12–13	1.31 (1.27 – 1.35)
14–20	1.50 (1.44 – 1.55)
Cognitive Function Scale^{//}	
Intact	Reference
Mildly Impaired	1.04 (1.00 – 1.07)
Moderately Impaired	1.07 (1.03 – 1.09)
Severely Impaired	1.12 (1.04 – 1.20)
Age (years)	
66–70	Reference
71–75	1.08 (1.04 – 1.13)
76–80	1.15 (1.10 – 1.20)
81+	1.23 (1.18 – 1.29)
Sex	
Male	Reference
Female	0.95 (0.93 – 0.97)
Race/Ethnicity	
White	Reference
Black	1.01 (0.97 – 1.05)
Hispanic	1.03 (0.97 – 1.08)
Other	0.90 (0.83 – 0.96)
Medicare Original Entitlement[‡]	
Age	Reference
Disability	1.12 (1.08 – 1.16)
ESRD	1.60 (1.28 – 1.99)
ESRD and Disability	1.23 (0.97 – 1.55)
Dual Eligibility[§]	
No	Reference
Yes	1.00 (0.97 – 1.02)
Dialysis during Index Hospitalization	
No	Reference
Yes	1.08 (0.70 – 1.67)
Index Hospitalization Length of Stay (days)	
1–2	Reference
3	0.89 (0.82 – 0.96)

Patient Characteristic	Odds Ratio* (95% CI)
4	0.98 (0.90 – 1.06)
5	1.07 (0.98 – 1.16)
6–7	1.13 (1.04 – 1.22)
8+	1.25 (1.15 – 1.35)
Index Hospitalization ICU/CCU Utilization (days)	
0	Reference
1–2	0.97 (0.93 – 1.01)
3–4	1.04 (1.00 – 1.07)
5+	1.01 (0.98 – 1.04)
Acute Stays over Prior Year (count)	
0	Reference
1	1.25 (1.22 – 1.29)
2	1.47 (1.42 – 1.53)
3	1.81 (1.72 – 1.91)
4+	2.25 (2.12 – 2.37)

Abbreviations: CI, confidence interval; ESRD, end-stage renal disease; ICU/CCU, intensive care unit or critical care unit

* Odds ratios are from multilevel models adjusted for all patient characteristics listed in the Table, as well as comorbidities (hierarchical condition categories) and index hospitalization diagnostic category and primary procedure (if applicable).

[†] Mobility and self-care domains created using items from the Resident Assessment Instrument Minimum Data Set 3.0. The range of scores for the mobility domain was 0 to 24 and the range of scores for self-care domain was 0 to 20, with higher scores reflecting greater dependence.

^{//} Cognitive Function Scale¹: Intact (Brief Interview for Mental Status (BIMS): 13–15), Mildly Impaired (BIMS: 8–12 or Cognitive Performance Scale (CPS): 0–2), Moderately Impaired (BIMS: 0–7 or CPS: 3–4), Severely Impaired (CPS: 5–6).

1. Thomas KS, Dosa D, Wysocki A, Mor V. The Minimum Data Set 3.0 Cognitive Function Scale. *Med Care*. 2017;55(9):e68–e72.

[‡] Original reason for Medicare enrollment

[§] Eligible for Medicare and Medicaid

Appendix 2

Table A1

Frequencies of 30-day potentially preventable readmissions following skilled nursing facility discharge by condition category. The total number of potentially preventable readmissions was 39,318.

Condition Category	N (%)
Overall	39,318 (100%)
Congestive Heart Failure (CHF)	7654 (19.5%)
Septicemia	7412 (18.9%)
Urinary Tract Infection/Kidney Infection	4297 (10.9%)
Bacterial Pneumonia	3663 (9.3%)
Renal Failure	3587 (9.1%)
COPD	2317 (5.9%)
Dehydration/Electrolyte Imbalance	1798 (4.6%)

Condition Category	N (%)
C. Difficile Infection	1699 (4.3%)
Arrhythmia	1644 (4.2%)
Skin and Subcutaneous Tissue Infections	1613 (4.1%)
Aspiration Pneumonitis; Food/vomitus	1321 (3.4%)
Hypertension/Hypotension	980 (2.5%)
Diabetes short-term complication	634 (1.6%)
Adult Asthma	347 (0.9%)
Pressure Ulcers	136 (0.4%)
Intestinal Impaction	106 (0.3%)
Influenza	93 (0.2%)

Table A2

ICD-9 codes for diagnoses included in the condition categories. Table is adapted from the Measure Specifications for Measures Adopted in the FY 2017 SNF QRP Final Rule, Table 2–1. List of Conditions for Defining Potentially Preventable Hospital Readmissions for 30-Days Post-PAC [post-acute care] Discharge with ICD-9 Codes¹

Condition Category	ICD-9 Codes
Congestive Heart Failure (CHF)	398.91, 402.01, 402.11, 402.91, 404.01, 404.03, 404.11, 404.13, 404.91, 404.93, 428.0, 428.1, 428.20, 428.21, 428.22, 428.23, 428.30, 428.31, 428.32, 428.33, 428.40, 428.41, 428.42, 428.43, 428.9, 518.4
Septicemia	003.1, 020.2, 022.3, 036.2, 038.0, 038.1, 038.10, 038.11, 038.12, 038.19, 038.2, 038.3, 038.40, 038.41, 038.42, 038.43, 038.44, 038.49, 038.8, 038.9, 054.5, 449, 995.91, 995.92, 785.52
Urinary Tract Infection/Kidney Infection	590.10, 590.11, 590.2, 590.3, 590.80, 590.81, 590.9, 595.0, 597.0, 599.0
Bacterial Pneumonia	481, 482.2, 482.30, 482.31, 482.32, 482.39, 482.41, 482.42, 482.9, 483.0, 483.1, 483.8, 485, 486
Renal Failure	584.5, 584.6, 584.7, 584.8, 584.9, 586, 997.5
COPD	491.0, 491.1, 491.20, 491.21, 491.22, 491.8, 491.9, 492.0, 492.8, 494, 494.0, 494.1, 496, 466.0, 490
Dehydration/Electrolyte Imbalance	276.0 *, 276.1, 276.2, 276.3, 276.4, 276.50, 276.51, 276.52, 276.6, 276.69, 276.7, 276.8, 276.9, 008.61 *, 008.62 *, 008.63 *, 008.64 *, 008.65 *, 008.66 *, 008.67 *, 008.69 *, 008.8 *, 009.0 *, 009.1 *, 009.2 *, 009.3 *, 558.9 *
C. Difficile Infection	008.45
Arrhythmia	427.31, 427.32
Skin and Subcutaneous Tissue Infections	681.00, 681.10, 681.9, 682.0, 682.1, 682.2, 682.3, 682.4, 682.5, 682.6, 682.7, 682.8, 682.9, 686.8, 686.9
Aspiration Pneumonitis; Food/vomitus	507.0
Hypertension/Hypotension	401.0, 401.9, 402.00, 402.10, 402.90, 403.00, 403.10, 403.90, 404.00, 404.10, 404.90, 458.0, 458.1, 458.29, 458.8, 458.9
Diabetes short-term complication	249.1X, 249.2X, 249.3X, 249.8X, 250.8X, 250.10, 250.11, 250.12, 250.13, 250.20, 250.21, 250.22, 250.23, 250.30, 250.31, 250.32, 250.33
Adult Asthma	493.00, 493.01, 493.02, 493.10, 493.11, 493.12, 493.20, 493.21, 493.22, 493.81, 493.82, 493.90, 493.91, 493.92
Pressure Ulcers	707.0X, 707.2X
Intestinal Impaction	560.30, 560.32, 560.39

Condition Category	ICD-9 Codes
Influenza	487.X, 488.X

* ICD-9 code represents primary diagnosis and dehydration (276.50, 276.51, 276.52) is secondary diagnosis as specified in the Potentially Preventable Hospital Readmissions for 30-Days Post-PAC Measure¹

'X' Refers to all numbers 0 to 9.

¹ RTI International. Measure Specifications for Measures Adopted in the FY 2017 SNF QRP Final Rule; <https://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/NursingHomeQualityInits/Downloads/Measure-Specifications-for-FY17-SNF-QRP-Final-Rule.pdf>. Accessed 8/23/2016.

Figure 1.

Flow chart presenting number of eligible cases remaining at each step as exclusion criteria applied. Percentages are percent remaining from the previous step. Abbreviations: SNF, skilled nursing facility; PPS, prospective payment system; MDS, Resident Assessment Instrument Minimum Data Set 3.0; IRF, inpatient rehabilitation facility.

* 1st discharge was selected if patient had more than one over the study period.

† Based on assessment windows for the scheduled PPS MDS assessments.

‡ 'Index hospitalization' is an acute care stay over the 30 days prior to SNF admission.

§ ‘Study period’ refers to the 6 months prior to the index hospitalization through the 32 days post-discharge for each SNF stay.

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Table 1

Cohort characteristics and observed rates of potentially preventable 30-day readmissions following skilled nursing facility discharge

	Overall Sample	Observed Rate (95% CI)
Overall	693,808	5.7% (5.6, 5.7)
Age (years)		
66–70	79,043	4.7% (4.5, 4.8)
71–75	101,656	5.1% (4.9, 5.2)
76–80	126,348	5.4% (5.3, 5.6)
81+	386,761	6.1% (6.0, 6.2)
Sex		
Male	228,410	6.5% (6.4, 6.6)
Female	465,398	5.3% (5.2, 5.3)
Race/Ethnicity		
White	598,730	5.6% (5.5, 5.6)
Black	51,861	6.6% (6.4, 6.8)
Hispanic	26,228	6.3% (6.0, 6.6)
Other	16,989	5.0% (4.7, 5.3)
Medicare Original Entitlement[*]		
Age	607,651	5.5% (5.4, 5.5)
Disability	84,361	6.9% (6.7, 7.1)
ESRD	856	11.4% (9.3, 13.6)
ESRD and Disability	940	9.0% (7.2, 10.9)
Dual Eligibility[†]		
No	518,961	5.3% (5.3, 5.4)
Yes	174,847	6.7% (6.6, 6.8)
Dialysis during Index Hospitalization		
No	693,572	5.7% (5.6, 5.7)
Yes	236	10.2% (6.3, 14.0)
Index Hospitalization Length of Stay (days)		
1–2	11,555	6.1% (5.7, 6.5)
3	216,875	3.6% (3.5, 3.7)
4	123,426	5.0% (4.9, 5.1)
5	87,485	6.0% (5.8, 6.1)
6–7	112,118	6.8% (6.6, 6.9)
8+	142,349	8.3% (8.2, 8.5)
Index Hospitalization ICU/CCU Utilization (days)		
0	458,021	4.9% (4.8, 4.9)
1–2	55,996	6.0% (5.8, 6.2)
3–4	76,485	6.6% (6.4, 6.8)
5+	103,306	8.4% (8.2, 8.6)

	Overall Sample	Observed Rate (95% CI)
Acute Stays over Prior Year (count)		
0	468,736	4.3% (4.2, 4.3)
1	144,691	6.9% (6.8, 7.1)
2	48,915	9.5% (9.3, 9.8)
3	18,432	12.8% (12.3, 13.3)
4+	13,034	16.9% (16.2, 17.5)
Mobility Score (points)[‡]		
0–11	162,809	4.4% (4.3, 4.5)
12–15	186,946	5.0% (4.9, 5.1)
16–18	182,086	6.0% (5.9, 6.1)
19–24	161,967	7.3% (7.2, 7.4)
Self-Care Score (points)[‡]		
1–8	149,468	4.3% (4.2, 4.4)
12–15	202,756	5.1% (5.0, 5.2)
16–18	210,152	6.1% (6.0, 6.2)
19–24	131,432	7.3% (7.2, 7.5)
Cognitive Function Scale[§]		
Intact	450,206	5.2% (5.1, 5.3)
Mildly Impaired	135,754	6.5% (6.4, 6.7)
Moderately Impaired	93,635	6.4% (6.3, 6.6)
Severely Impaired	14,213	7.0% (6.6, 7.4)

Abbreviations: CI, confidence interval; ESRD, end-stage renal disease; ICU/CCU, intensive care unit or critical care unit

* Original reason for Medicare enrollment

[†] Eligible for Medicare and Medicaid

[‡] Mobility and self-care domains created using items from the Resident Assessment Instrument Minimum Data Set 3.0. The range of scores for the mobility domain was 0 to 24 and the range of scores for self-care domain was 0 to 20, with higher scores reflecting greater dependence.

[§] Cognitive Function Scale¹⁶: Intact (Brief Interview for Mental Status (BIMS): 13–15), Mildly Impaired (BIMS: 8–12 or Cognitive Performance Scale (CPS): 0–2), Moderately Impaired (BIMS: 0–7 or CPS: 3–4), Severely Impaired (CPS: 5–6).

Table 2

Odds ratios from adjusted multilevel logistic regression models estimating the association between discharge functional scores and potentially preventable 30-day readmissions following skilled nursing facility care.

Functional Domain	Odds Ratio [*] (95% CI)		
Mobility [†]	Not Adjusted for Cognition	Adjusted for Cognition	
0–11	Reference	Reference	
12–15	1.16 (1.12 – 1.20)	1.16 (1.12 – 1.20)	
16–18	1.35 (1.31 – 1.40)	1.35 (1.31 – 1.40)	
19–24	1.57 (1.52 – 1.62)	1.54 (1.49 – 1.59)	
Self-Care [†]	Not Adjusted for Cognition	Adjusted for Cognition	
1–8	Reference	Reference	
9–11	1.14 (1.10 – 1.18)	1.14 (1.10 – 1.18)	
12–13	1.32 (1.28 – 1.36)	1.31 (1.27 – 1.35)	
14–20	1.52 (1.47 – 1.58)	1.50 (1.44 – 1.55)	
Cognitive status [‡]	Not Adjusted for Self-Care or Mobility	Adjusted for Self-Care	Adjusted for Mobility
Intact	Reference	Reference	Reference
Mildly impaired	1.11 (1.08 – 1.14)	1.04 (1.00 – 1.07)	1.07 (1.04 – 1.10)
Moderately impaired	1.15 (1.12 – 1.19)	1.07 (1.03 – 1.09)	1.05 (1.02 – 1.09)
Severely impaired	1.33 (1.24 – 1.42)	1.12 (1.04 – 1.20)	1.13 (1.06 – 1.21)

^{*} Odds ratios are from multilevel models adjusted for patients' age; sex; race/ethnicity; dual eligibility; Medicare original reason for entitlement; number of hospitalizations over the prior year; comorbidities (hierarchical condition categories); and index hospitalization diagnostic category, primary procedure (if applicable), length of stay, receipt of dialysis, and intensive or coronary care unit utilization. Complete listings of the odds ratios from the multilevel models presented are available in Appendix 1.

[†] Mobility and self-care domains created using items from the Resident Assessment Instrument Minimum Data Set 3.0. The range of scores for the mobility domain was 0 to 24 and the range of scores for self-care domain was 0 to 20, with higher scores reflecting greater dependence.

[‡] Cognitive Function Scale¹⁶. Intact (Brief Interview for Mental Status (BIMS): 13–15), Mildly Impaired (BIMS: 8–12 or Cognitive Performance Scale (CPS): 0–2), Moderately Impaired (BIMS: 0–7 or CPS: 3–4), Severely Impaired (CPS: 5–6).

Table 3

Five most frequent conditions resulting in potentially preventable 30-day readmissions stratified by levels of independence on mobility, self-care, and cognition at skilled nursing facility discharge.

Mobility Score at Discharge*						
0 – 11		12 – 15		16 – 18		19 – 24
Rank	Condition	N (%)	Condition	N (%)	Condition	N (%)
1	CHF	1598 (22.3%)	CHF	2075 (22.0%)	CHF	2220 (20.4%)
2	Septicemia	1033 (14.4%)	Septicemia	1498 (15.9%)	Septicemia	1933 (17.8%)
3	Bacterial Pneumonia	682 (9.5%)	Bacterial Pneumonia	943 (10.0%)	UTI/ Kidney Infection	1237 (11.4%)
4	Renal Failure	671 (9.4%)	Renal Failure	872 (9.3%)	Bacterial Pneumonia	1032 (9.5%)
5	COPD	621 (8.7%)	UTI/ Kidney Infection	835 (8.9%)	Renal Failure	970 (8.9%)
Self-care Score at Discharge*						
1–8		9–11		12–13		14–20
Rank	Condition	N (%)	Condition	N (%)	Condition	N (%)
1	CHF	1509 (23.3%)	CHF	2369 (23.1%)	CHF	2572 (19.9%)
2	Septicemia	895 (13.8%)	Septicemia	1570 (15.3%)	Septicemia	2403 (18.6%)
3	Bacterial Pneumonia	614 (9.5%)	Bacterial Pneumonia	1020 (9.9%)	UTI/ Kidney Infection	1529 (11.8%)
4	COPD	596 (9.2%)	Renal Failure	940 (9.2%)	Bacterial Pneumonia	1191 (9.2%)
5	Renal Failure	588 (9.1%)	UTI/ Kidney Infection	894 (8.7%)	Renal Failure	1179 (9.1%)
Cognitive Status at Discharge [†]						
Intact		Mildly Impaired		Moderately Impaired		Severely Impaired
Rank	Condition	N (%)	Condition	N (%)	Condition	N (%)
1	CHF	5144 (22.0%)	CHF	1746 (19.7%)	Septicemia	1463 (24.3%)
2	Septicemia	3887 (16.6%)	Septicemia	1697 (19.1%)	UTI/ Kidney Infection	1000 (16.6%)
3	Bacterial Pneumonia	2186 (9.3%)	UTI/ Kidney Infection	1073 (12.1%)	CHF	716 (11.9%)
4	Renal Failure	2065 (8.8%)	Renal Failure	845 (9.5%)	Renal Failure	592 (9.8%)
5	UTI/ Kidney Infection	2064 (8.8%)	Bacterial Pneumonia	826 (9.3%)	Bacterial Pneumonia	580 (9.6%)
						71 (7.1%)

Abbreviations: CHF, congestive heart failure; UTI, urinary tract infection; COPD, chronic obstructive pulmonary disease

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* Mobility and self-care domains created using items from the Resident Assessment Instrument Minimum Data Set 3.0. The range of scores for the mobility domain was 0 to 24 and the range of scores for self-care domain was 0 to 20, with higher scores reflecting greater dependence.

⁷ Cognitive Function Scale¹⁶: Intact (Brief Interview for Mental Status (BIMS): 13–15), Mildly Impaired (BIMS: 8–12 or Cognitive Performance Scale (CPS): 0–2), Moderately Impaired (BIMS: 0–7 or CPS: 3–4), Severely Impaired (CPS: 5–6).