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Skilled nursing facility quality and hospital readmissions

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Abstract

Importance—Hospital readmissions are common, costly, and potentially preventable. Little is known about the association between available SNF performance measures and the risk of hospital readmission.

Objective—To measure the association between SNF performance measures and hospital readmissions among Medicare beneficiaries receiving post-acute care at U.S. SNFs.

Design—Using national Medicare data, we examined the association between SNF performance on publicly available metrics (SNF staffing intensity, performance on required facility site inspections, and the percentages of SNF patients with delirium, moderate-to-severe pain, and new or worsening pressure ulcers) and the risk of readmission or death 30 days after discharge to a SNF. Adjusted analyses controlled for patient case-mix, SNF facility factors, and the discharging hospital.

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Participants—Fee-for-service Medicare beneficiaries discharged to a SNF following an acute-care hospitalization between September 1, 2009 and August 31, 2010.

Main outcomes and measures—Readmission to an acute-care hospital or death within 30 days of the index hospital discharge.

Results—Out of 1,530,824 discharges, 357,752 (23.4%;99% CI: 23.3%, 23.5%) were readmitted or died within 30 days; 4.7% (72,472 discharges) died within 30 days (99% CI: 4.7%, 4.8%), and 21.0%(N=321,709) were readmitted (99% CI: 20.9%, 21.1%). The unadjusted risk of readmission or death was lower at SNFs with better staffing ratings (lowest (19.2% of SNFs) vs. highest (6.7% of SNFs): 25.5%; 99% CI: 25.3%, 25.8% vs 19.8%; 99% CI: 19.5%, 20.1%, p<0.001) and better facility inspection ratings (lowest (20.1% of SNFs) vs. highest (9.8% of SNFs): 24.9%; 99% CI: 24.7%,25.1%; vs. 21.5%; 99% CI: 21.2%, 21.7%; p<0.001). Adjustment for patient factors, SNF facility factors, and the discharging hospital attenuated these associations; we observed small differences in the adjusted risk of readmission or death according to SNF facility inspection ratings (lowest vs. highest rating: 23.7%; 99% CI: 23.7%, 23.7%; vs 23.0%; 99% CI:23.0%, 23.1%; p<0.001). Other measures did not predict clinically meaningful differences in the adjusted risk of readmission or death.

Conclusions and relevance—Among fee-for-service Medicare beneficiaries discharged to a SNF following an acute care hospitalization, available performance measures were not consistently associated with differences in the adjusted risk of readmission or death.

BACKGROUND

One in five Medicare beneficiaries is readmitted to the hospital within 30 days of discharge.[1] Under traditional fee-for-service reimbursement, hospitals had few incentives to invest in reducing readmission rates. However, with Medicare's Hospital Readmission Reduction Program (HRRP)[2] and the growing prevalence of bundled payments and shared-savings programs since the passage of the Affordable Care Act,[3–6] hospitals have increased incentive to improve post-discharge management. One commonly discussed way to do so is through more effective use of post-acute care.[7, 8]

Skilled nursing facilities (SNFs) represent the most common setting for post-acute care in the U.S. Rates of readmission from SNFs are high. One in four patients discharged to a SNF are readmitted within 30 days,[9] and two-thirds of these readmissions may be preventable.[10] As readmission rates vary across SNFs,[11] preferential discharge of post-acute care patients to high-quality SNFs may be one strategy by which hospitals could lower the likelihood of readmission among these patients. Information on SNF performance on common quality metrics is widely available through Medicare's Nursing Home Compare website. However, little is known about whether performance on these metricsis associated with differences in performance predict the likelihood of readmission. To address this, we examined the association between available indicators of SNF quality and hospital readmission among Medicare beneficiaries receiving post-acute care at U.S. SNFs.

METHODS

Data

This study was approved by the Perelman School of Medicine Institutional Review Board, which waived the requirement for participant informed consent. Data sources included: (1) the 2008–2010 100% Medicare Provider Analysis and Review (MedPAR) files, which include records of inpatient care for all fee-for-service Medicare beneficiaries; (2) the 2009 and 2010 Nursing Home Minimum Data Set (MDS), which includes detailed clinical data on all patients in Medicare-certified SNFs; (3) the 2009 and 2010 Medicare Beneficiary Summary files, which record vital status and health maintenance organization enrollment; (4) the 2009 and 2010 Medicare Online Survey, Certification, and Reporting (OSCAR) files, which compile data on SNF facility characteristics; and (5) SNF performance data published on the Nursing Home Compare website in 2009 and 2010.

Study sample

We based our inclusion criteria on methods used to calculate risk-adjusted hospital-wide readmission rates by the HRRP.[12] Our starting sample included all Medicare discharges from non-federal acute care hospitals between September 1, 2009 and August 31, 2010 to Medicare-certified SNFs for post-acute care, as indicated by an appropriate MDS admission assessment within 7 days of discharge.

Since we obtained patient comorbidity data from claims filed up to 12 months prior to the index discharge, we excluded beneficiaries who were less than 66 years old at hospital discharge or who were in an HMO in the during or 12 months prior to hospitalization, as their claims were unavailable in our data; were enrolled in an HMO in the 30 days after hospital discharge, as we could not identify readmissions among these patients; were discharged against medical advice or discharged to hospice (as recorded in the MedPAR discharge status field); for whom the primary reason for hospitalization was apsychiatric condition, rehabilitation, or medical cancer treatment following HRRP definitions,[12] since readmissions following hospitalizations for these indications are likely to occur for different reasons than readmissions after other acute care hospitalizations; and who received post-acute care at SNFs that were excluded from Nursing Home Compare at the time of the index discharge for one or more of the five performance measures we examined due to low case volumes or an insufficient duration of participation in the Nursing Home Compare program.

For consistency with HRRP methods, if a patient had more than one eligible discharge over the study period, all discharges meeting the above criteria were used in our regression analyses. In other words, our analysis was at the discharge level rather than the patientlevel.[12] However, we also conducted a supplementary patient-level analysis that included only the first eligible discharge for each patient in our sample. The sample definition used International Classification of Disease, 9th Revision (ICD-9) diagnosis and procedure codes for each discharge, grouped by AHRQ Clinical Classification Software (CCS).[12]

Outcomes

Our primary outcome was a composite endpoint of unplanned readmission or death from any cause within 30 days of hospital discharge. To allow for a uniform time window for outcomes assessment for each discharge in our study, we did not distinguish between patients who were directly readmitted from SNF and those who were discharged from to home from a SNF and subsequently readmitted, as long as this readmission occurred within 30 days of the index discharge. Death within 30 days was included in our primary outcome to prevent inappropriate censoring of observations;[13, 14] however, for purposes of comparison, we conducted a secondary analysis using an endpoint of readmission at 30 days, rather than a combined endpoint of readmission or death.

We considered a readmission to be unplanned if it involved an admission to an acute-care hospital that occurred within 30 days of hospital discharge and the reason for admission was not bone marrow or solid organ transplant, maintenance chemotherapy, rehabilitation, or a potentially planned procedure not performed to treat an acute condition or a complication of prior care.[12]

Independent variables

We obtained five indicators of SNF performance from Medicare's Nursing Home Compare website, using data listed on the website as of the date of hospital discharge. Performance indicators included three clinical measures for post-acute care residents (the percentage of SNF residents with delirium, with new or worsening pressure ulcers, and reporting moderate to severe pain[15, 16]), a categorical summary rating of staffing intensity that ranged from one to five stars,[17] and a categorical summary rating of performance on state health inspections that also ranged from one to five stars.[17]

Information on other SNF facility characteristics came from the OSCAR survey closest in time to hospital discharge. Facility characteristics included nursing home size (50 beds or fewer; 51–100 beds; 101–150 beds; 151 beds or more);[18–20] the percent of patients covered by Medicare and Medicaid within each facility;[21–24] occupancy rate;[20, 25] chain membership;[26–28] location in a hospital;[20, 29] and ownership (not-for-profit, for-profit, or government owned).[28,30–32]

We obtained data on patient age, race,[33] gender, and the indication for the index hospitalization from MedPAR files. We categorized indications for hospitalization into five broad groups based on ICD-9-CM diagnosis and procedure codes using HRRP algorithms:[12] (1) surgical and gynecological conditions; (2) respiratory conditions and heart failure; (3) cardiac and non-cardiac vascular conditions; (4) neurological conditions; and (5) other general medical conditions. We also obtained HRRP-defined variables on 31 risk factors and 173 admission diagnosis categories using hospital discharge claims from the index discharge and all hospitalizations occurring in the 12 months prior to the index.[12]

Statistical analyses

We used chi-squared tests and the Wilcoxon rank-sum test to characterize differences in the baseline characteristics of patients according to outcomes at 30 days. We used linear

probability models to test the association between SNF factors and risk of readmission or death within 30 days of discharge. Models evaluated the association between risk of readmission or death and 1) the five above SNF performance measures; 2) SNF facility characteristics; and 3) the combination of available SNF performance measures and facility characteristics. All regression models adjusted for age, sex, and race; the indication for the index hospitalization; and all 204 risk factor and admission diagnosis variables. Since observed differences in rates of readmission or death across SNFs could reflect differences in quality of the discharging hospital, our regression models included hospital fixed effects to account for time-invariant hospital characteristics. In other words, each regression was a "within-hospital" analysis that compared outcomes among patients who were discharged from the same hospital to different SNFs. We handled missing data via list wise deletion (i.e., omitting from each model all observations with missing data on a variable included in that model); out of our sample of 1,530,824 discharges, 4 (<0.001%) were omitted due to missing data on race. Models used robust standard errors that adjusted for clustering of observations within SNFs.

We used these regressions to generate predicted risks for readmission or death within 30 days of hospital discharge for patients treated at SNFs that differed across available performance measures and facility characteristics, holding all other factors (including other quality and facility characteristics) at their means. For categorical variables (e.g. staffing and survey ratings, chain status, location in a hospital, size, and ownership), we compared the adjusted risk of readmission or death across categories; for continuous variables (e.g. percentages of patients with delirium, pain, and pressure ulcers, occupancy, and percent Medicare and Medicaid), we used the regression coefficient to calculate predicted risk values for a discharge to ahypothetical SNF at the 25th percentile to a discharge to a hypothetical SNF at the 75th percentile. We generated 99% confidence intervals based on the distribution of predicted risks across 500 block-bootstrapped samples that used the individual SNF as the sampling unit to account for potential clustering of observations within SNFs. Because of our large sample size, we used a P-value of 0.01 as our threshold for statistical significance; all hypothesis tests were two-sided. Analyses used Stata 13.1 (StataCorp, College Station TX, 2013).

RESULTS

Our sample included 1,530,824 discharges from 3,537 hospitals to 14,251 SNFs. The median hospital in our sample discharged patients to 21 SNFs (interquartile range (IQR), 9, 40); the median SNF received patients from 7 hospitals (IQR 4, 10). Our sample included 1,150,063 unique patients, with 271,892 (23.6%) having more than one hospital discharge to a SNF over the period. Table 1 describes the SNFs included in our sample.

Out of 1,530,824 discharges to SNF, 321,709 were followed by readmission within 30 days (99% CI: 20.9%, 21.1%), and 72,472 were followed by a death within 30 days (4.7%, 99% CI: 4.7%, 4.8%). The overall rate of 30-day readmission or death was 23.3% (N=357,752; 99% CI: 23.3%, 23.5%).

Compared to other discharges to SNF in our sample, discharges that led to a readmission or death more often occurred among patients who were older and more likely to be male or black (Table 2). They were also more likely to occur among patients who were hospitalized for a general medical condition, a pulmonary condition or congestive heart failure, or a cardiac or vascular condition; were less likely to have been hospitalized for a neurological condition or a surgical or gynecological condition; and were more likely to have common comorbidities such as coronary artery disease, diabetes, and chronic obstructive pulmonary disease.

In unadjusted analyses (Table 3), the risk of readmission or death within 30 days was lower for discharges from SNFs with better staffing ratings (lowest rating vs. highest rating: 64,677 of 253,231 discharges (25.5%;99% CI: 25.3%, 25.8%) vs 26,531 of 134,029 discharges (19.8%;99% CI: 19.5%, 20.1%), p<0.001); better facility inspection ratings (lowest rating vs. highest rating: 68,642 of 275,471 discharges (24.9%; 99% CI: 24.7%, 25.1%) vs 35,332 of 164,629 discharges (21.5%; 99% CI: 21.2%, 21.7%), p<0.001); and lower rates of new or worsening pressure ulcers (SNFs above the 75th percentile vs SNFs at or below the 25th percentile: 111,116 of 457,429 discharges (24.3%; 99% CI: 24.1%, 24.5%) vs 63,166 of 288,664 discharges (21.9%; 99% CI: 21.7%, 22.1%; p<0.001). Rates of readmission or death were paradoxically lower at SNFs that had higher percentages of patients with moderate-to-severe pain and acute delirium. 92,309 of 434,008 discharges to SNFs with rates above the 75th percentile on the pain measure were readmitted or died within 30 days (21.3%; 99% CI: 21.1%, 21.4%) vs 81,990 of 328,252 discharges to SNFs at or below the 25th percentile (25.0%; 99% CI: 24.8%, 25.2%; p<0.001). 63,275 of 285,258 discharges to SNFs above the 75th percentile on the delirium measure were readmitted or died within 30 days (22.2%; 99% CI: 22.0%, 22.4%) vs 102,210 of 428,349 discharges to SNFs at or below the 25th percentile (23.9%; 95% CI: 23.7%, 24.0%; p<0.001).

Table 4 presents our regression results for our primary outcome; in addition to the fully adjusted model (Model 3), models with differing degrees of adjustment for SNF performance measures and facility factors are shown for comparison. In our fully adjusted model, which controlled for patient factors, SNF facility factors, and the discharging hospital, SNFs with the best inspection ratings (9.8% of all SNFs) had a slightly lower risk of 30-day readmission or death compared to discharges to the 20.1% of SNFs that were in the lowest category of inspection rating (23.0%;99% CI:23.0%, 23.0%vs 23.7%;99% CI: 23.7%, 23.7%; p<0.001). Discharges to SNFs with lower rates of new or worsened pressure were associated with a marginally lower adjusted risk of 30-day readmission or death compared to SNFs with worse performance on this measure (25th vs. 75th percentile: 23.2%; 99% CI:23.2%, 23.3%vs. 23.4%;99% CI:23.4%, 23.4%; p<0.001). The adjusted risk of readmission or death at 30 days did not differ according to SNF staffing rating or the percentage of patients with delirium.

Several SNF facility characteristics were also associated with 30-day risk of readmission or death in both the unadjusted and adjusted analyses. In our fully adjusted model, we observed independent associations between the predicted risk of readmission or death and SNF ownership status; the predicted risk was lower for discharges to not-for-profit SNFs compared to discharges to for-profit SNFs (22.8%;99% CI:22.8%, 22.8% vs 23.7%;99% CI:

23.6%, 23.7%; p<0.001). Discharge to the smallest facilities were associated with a lower adjusted risk of 30-day readmission or death compared to discharges the largest facilities (151 beds or more vs 50 beds or fewer: 22.7%;99% CI:22.7%, 22.7% vs 23.5%;99% CI: 23.5%, 23.5%; p<0.001).

We obtained similar results when we repeated our regression models to predict an endpoint readmission at 30 days, rather than a combined endpoint of readmission or death (Table 5). When we repeated our analyses in a smaller dataset that included only the first available discharge for each patient in the sample, we observed a lower overall rate of 30-day readmission or death (240,771 of 1,173,072 patients; 20.5%;99% CI:20.4%, 20.6%); however, the adjusted associations between SNF performance measures and facility factors and 30-day outcomes that were qualitatively similar to those obtained in our main regression analyses.

DISCUSSION

Among fee-for-service Medicare beneficiaries who received post-acute care at a U.S. SNF, better performance on available measures of post-acute care quality was not consistently associated with a lower adjusted risk of readmission or death at 30 days. While better performance on several available SNF performance measures was associated with improved outcomes in unadjusted analyses, these associations were attenuated substantially after adjustment for patient factors, the discharging hospital, and SNF facility characteristics. In our fully adjusted regression models, SNFs with better facility inspection ratings demonstrated a slightly lower adjusted risk of readmission or death; however, adjusted outcomes did not vary meaningfully across SNFs that differed in terms of staffing ratings or their performance on clinical measures related to pain or delirium.

Past research has suggested that SNF quality may be associated with the risk of hospital readmission;[10, 11, 34–36] however, prior studies have focused on small groups of hospitals[10, 34] and selected subsets of patients.[35] Our study, which takes a comprehensive approach that includes all fee-for-service Medicare beneficiaries admitted to SNFs for post-acute care, accords with these past findings insofar as it demonstrates variations in rates of readmission or death according to selected SNF facility characteristics and SNF facility inspection rating performance.[18–24, 28, 30–32] However, as past analyses have not accounted hospital effects, their comparisons of performance across SNFs could be confounded by differences in the quality of care at discharging hospitals.[11, 35] By using fixed effects to control for all time-invariant hospital factors, our analysis provides insight into the association between measured SNF performance and clinical outcomes while holding hospital factors constant.

As hospitals seek ways to prevent readmissions, our finding of lower readmission rates at certain types of SNFs may inform hospitals' approaches to discharge planning. At the same time, our results also suggest that preferential discharge to SNFs with better performance on available quality metrics may yield only modest effects on readmission rates after accounting for other factors. In the setting of an average readmission or death rate of 23%, we find that by choosing a SNF in the highest versus the lowest category of facility

inspection ratings, hospitals might expect at most an absolute reduction in their readmission rate of 0.7 percentage points, or a relative reduction of just over 3%. Such a reduction in a hospital's readmission rate may be meaningful both to the hospital in terms of their finances and to the patients whose readmission is potentially prevented; however, our findings suggest that there is significant remaining variation in rates of readmission across SNFs that is not explained by currently available performance measures.

We chose to study performance measures that are publicly reported by Medicare and available on virtually all U.S. SNFs, as they could be easily incorporated by hospitals into current discharge planning processes. Since these performance measures were developed prior to recent policy efforts to reduce hospital readmissions, it is unlikely that they were designed to capture aspects of quality directly related to readmission. In particular, the three clinical measures of performance that we examined in and of themselves represent important aspects of SNF quality. However, they do not predict clinically meaningful differences in the risk of readmission or death. As such, our work suggests a need for further efforts to develop metrics that influence readmission rates among SNF patients, potentially including care transitions and efforts to avoid unnecessary hospitalizations for changes in clinical status that can be safely managed at a SNF.

Alternately, publication of risk-adjusted readmission rates among patients receiving post-acute care at a given SNF could represent a further policy strategy to aid discharge planning by hospitals and potentially reduce readmissions. At present, hospitals do not have access to information on SNF readmission rates. While making this information publicly available could potentially improve transparency and motivate SNFs to improve their quality, such a strategy could also lead to unintended negative consequences if it motivated SNFs to differentially accept the healthiest patients, limit post-acute care access for sicker patients, or fail to transfer patients to hospitals when medically necessary.

Our work has limitations. Since MedPAR files do not contain information on patients in Medicare HMOs, our sample included only fee-for-service Medicare patients. As such, our findings may not be generalizable to patients in Medicare HMOs or patients not enrolled in Medicare, groups that tend to be healthier than patients enrolled in fee-for-service Medicare. While our models adjusted for an array of potential confounders, our results may still be biased if patients' severity of illness varied across SNFs in ways that we could not observe in the study database, or if the claims-based algorithms we used for risk adjustment incompletely captured important aspects of patients' health. However, we followed approaches currently used by CMS in the HRRP to adjust for a wide range of observed patient factors. As a retrospective analysis, our study cannot address whether a causal relationship exists between measured SNF performance and clinical outcomes.

Despite these limitations, our results provide new information to inform the efforts of hospitals, health systems, and insurers to reduce rates of hospital readmission through more effective use of post-acute care. Ultimately, while SNF performance measurement plays an important role in promoting transparency and accountability in the U.S. health care system, our findings suggest that in their current form they are unlikely to serve as a sole basis for large-scale reductions in readmissions unless accompanied by other strategies.

CONCLUSIONS

Among fee-for-service Medicare beneficiaries discharged to a SNF following an acute care hospitalization, available performance measures were not consistently associated with differences in the risk of readmission or death.

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Table 1

Skilled nursing facilities included in the study sample (N=14,251)[a].

Skilled nursing facility performance measures	
Clinical measures of post-acute care quality	
Percentage of post-acute care residents with delirium, median (IQR)	0.7 (0, 2.1)
Percentage of post-acute care residents with moderate to severe pain, median (IQR)	17.3 (9.3, 27.2)
Percentage of post-acute care residents with new or worsening pressure ulcers, median (IQR)	12.1 (8.2, 16.7)
Staffing rating[b]	
One star, n (%)	2,742 (19.2)
Two stars, n (%)	2,722 (19.1)
Three stars, n (%)	3,018 (21.8)
Four stars, n (%)	4,810 (33.8)
Five stars, n (%)	959 (6.7)
Facility inspection rating[b]	
One star, n (%)	2,867 (20.1)
Two stars, n (%)	3,331 (23.4)
Three stars, n (%)	3,326 (23.3)
Four stars, n (%)	3,331 (23.4)
Five stars, n (%)	1,396 (9.8)
Skilled nursing facility characteristics	
Total beds	
50 or fewer, n (%)	1,533 (10.8)
51–100, n (%)	5,323 (37.4)
101–150, n (%)	4,817 (33.8)
151 or more, n (%)	2,578 (18.0)
Percentage of all residents covered by Medicare, median (IQR)	12.8 (8.0, 19.4)
Percentage of all residents covered by Medicaid, median (IQR)	64.3 (50.3, 74.7)
Percent occupied, median (IQR)	87.4 (75.8, 93.5)
Part of a chain, n (%)	8,142 (57.1)
Hospital based, n (%)	742 (5.2)
Ownership	
Not-for-profit, n (%)	3,569 (25.3)
For-profit, n (%)	9,919 (70.4)
Government, n (%)	597 (4.2)

Notes:

[a]For staffing and inspection ratings, five stars represent the highest category of performance. IQR: Interquartile range.

Table 2

Characteristics of study patients according to outcome at 30 days after acute care hospital discharge.

	Status at 30 days after hospital discharge: alive without readmission (N=1,173,072)	Status at 30 days after hospital discharge: readmitted or died (N=357,572)
Demographics		
Age, median (IQR)	83 (76, 88)	82 (75, 88)
Sex: Male, n (%)	384,190 (32.8)	142,615 (39.9)
Sex: Female, n (%)	788,882 (67.3)	215,137 (60.1)
Race: White, n (%)	1,029,823 (87.8)	302,480 (84.6)
Race: Black, n (%)	102,043 (8.7)	41,246 (11.5)
Race: Other, n (%)	41,203 (3.5)	14,025 (3.9)
Admission diagnosis group		
General medical conditions, n (%)	504,933 (43.0)	167,954 (47.0)
Surgical and gynecologic conditions, n (%)	360,751 (30.8)	77,778 (21.7)
Neurological conditions, n (%)	84,793 (7.2)	23,778 (6.7)
Cardiac and non-cardiac vascular conditions, n (%)	66,983 (5.7)	23,607 (6.6)
Pulmonary diseases and congestive heart failure, n (%)	155,612 (13.3)	64,625 (18.1)
Risk factors[a]		
Coronary atherosclerosis	605,688 (51.6)	224,365 (62.7)
Iron deficiency anemia	499,284 (42.6)	170,090 (47.5)
Pneumonia and other infectious diseases	346,084 (29.5)	149,941 (41.9)
Diabetes mellitus	363,088 (31.0)	132,908 (37.2)
Fluid disorders	328,134 (28.0)	142,293 (39.8)
Chronic obstructive pulmonary disease	287,975 (24.6)	117,954 (33.0)
Congestive heart failure	254,091 (21.7)	123,728 (34.6)
Cardiac arrhythmias	258,803 (22.1)	112,000 (31.3)
Renal failure	237,202 (20.2)	118,827 (33.2)
Psychiatric comorbidities	288,907 (24.6)	90,063 (25.2)

Notes:

[a]Data is presented on 10 most frequent out of 31 risk factors identified during all hospitalizations in the 12 months prior to discharge. P<0.001 for all comparisons. IQR: Interquartile range.

Table 3

Unadjusted study outcomes death within 30 days according to skilled nursing facility performance measures and facility characteristics.

	Discharges	Death within 30 days (%)	Readmission within 30 days (%)	Readmission or death within 30 days (%)
Percentage of post-acute care residents with delirium				
At or below the 25th percentile	428,349	20,500 (4.8)[a]	92,262 (21.5)	102,210 (23.9)
Between the 25th and 75th percentiles	817,217	38,355 (4.7)	173,444 (21.2)	192,267 (23.5)
Above the 75th percentiles	285,258	13,617 (4.8)	56,003 (19.6)	63,275 (22.2)
Percentage of post-acute care residents with moderate-to- severe pain				
At or below the 25th percentile	328,252	16,542 (5.0)	74,021 (22.6)	81,990 (25.0)
Between the 25th and 75th percentiles	768,564	37,843 (4.9)	164,592 (21.4)	183,453 (23.9)
Above the 75th percentiles	434,008	18,087 (4.2)	83,096 (19.2)	92,309 (21.3)
Percentage of post-acute care residents with new or worsening pressure ulcers				
At or below the 25th percentile	288,664	13,331 (4.6)[b]	56,143 (19.5)	63,166 (21.9)
Between the 25th and 75th percentiles	784,731	37,455 (4.8)	164,775 (21.0)	183,470 (23.4)
Above the 75th percentiles	457,429	21,686 (4.7)	100,791 (22.0)	111,116 (24.3)
Staffing rating				
One star	253,231	13,687 (5.4)	58,004 (22.9)	64,677 (25.5)
Two stars	278,207	13,906 (5.0)	61,938 (22.3)	68,713 (24.7)
Three stars	329,884	16,283 (4.9)	70,938 (21.5)	78,920 (23.9)
Four stars	535,473	23,919 (4.5)	106,722 (19.9)	118,911 (22.2)
Five stars	134,029	4,677 (3.5)	24,107 (18.0)	26,531 (19.8)
Inspection rating				
One star	275,471	14,045 (5.1)	61,838 (22.5)	68,642 (24.9)
Two stars	353,400	17,666 (5.0)	76,415 (21.6)	85,175 (24.1)
Three stars	367,110	17,296 (4.7)	76,496 (20.8)	85,103 (23.2)
Four stars	370,214	16,643 (4.5)	75,130 (20.3)	83,500 (22.6)
Five stars	164,629	6,822 (4.1)	31,830 (19.3)	35,332 (21.5)
Total beds				
50 or fewer	125,749	4,379 (3.5)	22,110 (17.6)	24,451 (19.4)
51–100	360,133	16,982 (4.7)	71,472 (19.9)	80,370 (22.3)
101–150	577,442	28,364 (4.9)	122,754 (21.3)	136,736 (23.7)
151 or more	467,500	22,747 (4.9)	105,373 (22.5)	116,195 (24.9)
Percentage of all residents covered by Medicare				
At or below the 25th percentile	150,276	8,040 (5.4)	30,609 (20.4)	35,035 (23.3)
Between the 25th and 75th percentiles	672,206	34,472 (5.1)	144,244 (21.5)	161,937 (24.1)

	Discharges	Death within 30 days (%)	Readmission within 30 days (%)	Readmission or death within 30 days (%)
Above the 75th percentiles	708,342	29,960 (4.2)	146,856 (20.7)	160,780 (22.7)
Percentage of all residents covered by Medicaid				
At or below the 25th percentile	575,956	22,870 (4.0)	112,610 (19.6)	123,694 (21.5)
Between the 25th and 75th percentiles	736,854	37,672 (5.1)	157,349 (21.4)	176,432 (23.9)
Above the 75th percentiles	218,014	11,930 (5.5)	51,750 (23.7)	57,626 (26.4)
Percent occupancy				
At or below the 25th percentile	291,504	13,505 (4.6)	60,419 (20.7)	67,159 (23.0)
Between the 25th and 75th percentiles	808,962	38,971 (4.8)	172,042 (21.3)	191,248 (23.6)
Above the 75th percentiles	430,358	19,996 (4.7)	89,248 (20.7)	99,345 (23.1)
Part of a chain				
Yes	853,722	41,614 (4.9)	180,089 (21.1)[c]	200,935 (23.5)
No	677,102	30,858 (4.6)	141,620 (20.9)	156,817 (23.2)
Hospital based				
Yes	114,781	4,062 (3.5)	20,526 (17.9)	22,708 (19.8)
No	1,416,043	68,410 (4.8)	301,183 (21.3)	335,044 (23.7)
Ownership				
Not-for-profit	414,348	17,493 (4.2)	79,136 (19.1)	88,325 (21.3)
For profit	1,049,227	51,515 (4.9)	229,424 (21.9)	254,449 (24.3)
Government	49,532	2,472 (5.0)	9,345 (18.9)	10,705 (21.6)

Notes: Percentile cutoffs determined based on the distribution of values across 14,251 SNFs in the study sample. Chi-square P<0.001 for difference across categories except where noted as follows:

[a] P= 0.038;

[b] P= 0.004,

[c] P=0.007.

For staffing and inspection ratings, five stars indicate the highest category of performance.

Table 4

Adjusted risks of hospital readmission or death within 30 days of hospital discharge according to skilled nursing facility performance measures and facility characteristics.

	Model 1: Performance measures		Model 2: Facility characteristics		Model 3: Performance measures plus facility characteristics	
	Estimated risk of readmission or death (99% CI)	**P**	**Estimated risk of readmission or death (99% CI)**	**P**	**Estimated risk of readmission or death (99% CI)**	**P**
Percentage of post-acute care residents with delirium						
25th percentile	23.4% (23.4%, 23.4%)	0.718			23.4% (23.4%, 23.4%)	0.643
75th percentile	23.4% (23.3%, 23.4%)				23.4% (23.4%, 23.4%)	
Percentage of post-acute care residents with moderate-to-severe pain						
25th percentile	23.5% (23.5%, 23.5%)	<0.001			23.5% (23.5%, 23.5%)	0.010
75th percentile	23.3% (23.3%, 23.3%)				23.3% (23.3%, 23.3%)	
Percentage of post-acute care residents with new or worsening pressure ulcers						
25th percentile	23.2% (23.2%, 23.2%)	<0.001			23.2% (23.2%, 23.3%)	0.001
75th percentile	23.4% (23.4%, 23.4%)				23.4% (23.4%, 23.4%)	
Staffing rating						
One star[a]	23.9% (23.9%, 23.9%)	<0.001			23.6% (23.6%, 23.7%)	0.084
Two stars	23.5% (23.5%, 23.5%)				23.3% (23.3%, 23.4%)	
Three stars	23.5% (23.5%, 23.5%)				23.4% (23.4%, 23.5%)	
Four stars	23.2% (23.2%, 23.2%)				23.3% (23.3%, 23.3%)	
Five stars	22.5% (22.5%, 22.5%)				23.1% (23.1%, 23.1%)	
Inspection rating						
One star[a]	23.8% (23.8%, 23.9%)	<0.001			23.7% (23.7%, 23.7%)	<0.001
Two stars	23.6% (23.6%, 23.6%)				23.5% (23.5%, 23.5%)	
Three stars	23.2% (23.2%, 23.3%)				23.2% (23.2%, 23.3%)	
Four stars	23.1% (23.1%, 23.1%)				23.2% (23.2%, 23.2%)	
Five stars	22.9% (22.9%, 22.9%)				23.0% (23.0%, 23.1%)	
Total beds						
50 or fewer[a]			22.5% (22.5%, 22.5%)	<0.001	22.7% (22.7%, 22.7%)	<0.001

	Model 1: Performance measures		Model 2: Facility characteristics		Model 3: Performance measures plus facility characteristics	
	Estimated risk of readmission or death (99% CI)	**P**	**Estimated risk of readmission or death (99% CI)**	**P**	**Estimated risk of readmission or death (99% CI)**	**P**
51–100			23.2% (23.1%, 23.1%)		23.2% (23.2%, 23.2%)	
101–150			23.6% (23.6%, 23.6%)		23.5% (23.5%, 23.6%)	
151 or more			23.5% (23.5%, 23.6%)		23.5% (23.5%, 23.5%)	
Percentage of all residents covered by Medicare						
25th percentile			23.1% (23.0%, 23.1%)	<0.001	23.1% (23.0%, 23.1%)	<0.001
75th percentile			23.3% (23.3%, 23.3%)		23.3% (23.3%, 23.3%)	
Percentage of all residents covered by Medicaid						
25th percentile			23.4% (23.3%, 23.4%)	<0.001	23.4% (23.3%, 23.4%)	<0.001
75th percentile			23.8% (23.8%, 23.9%)		23.8% (23.8%, 23.8%)	
Percent occupancy						
25th percentile			23.5% (23.4%, 23.5%)	0.001	23.5% (23.4%, 23.5%)	0.009
75th percentile			23.3% (23.3%, 23.3%)		23.3% (23.3%, 23.3%)	
Part of a chain						
Yes			23.4% (23.4%, 23.4%)	0.938	23.4% (23.3%, 23.4%)	0.680
No[a]			23.4% (23.4%, 23.4%)		23.4% (23.4%, 23.4%)	
Hospital based						
Yes			23.0% (22.9%, 23.0%)	0.087	23.1% (23.0%, 23.1%)	0.219
No[a]			23.4% (23.4%, 23.4%)		23.4% (23.4%, 23.4%)	
Ownership						
Not-for-profit[a]			22.7% (22.7%, 22.7%)	<0.001	22.8% (22.8%, 22.8%)	<0.001
For profit			23.7% (23.7%, 23.7%)		23.7% (23.6%, 23.7%)	
Government			22.4% (22.4%, 22.4%)		22.5% (22.4%, 22.5%)	

Notes: For staffing and inspection ratings, five stars indicate best performance. Models adjust for age, sex, race, admission indication, 31 risk factors, 173 discharge diagnoses, and hospital fixed effects. Model 1:1,530,820 observations; r^2=0.067. Model 2: 1,530,820 observations; r^2=0.067. Model 3:1,530,820 observations; r^2=0.067.

[a]Reference category

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Table 5

Adjusted risks of hospital readmission within 30 days of hospital discharge according to skilled nursing facility performance measures and facility characteristics.

	Model 1: Performance measures		Model 2: Facility characteristics		Model 3: Performance measures plus facility characteristics	
	Estimated risk of readmission (99% CI)	**P**	**Estimated risk of readmission (99% CI)**	**P**	**Estimated risk of readmission (99% CI)**	**P**
Percentage of post-acute care residents with delirium						
25th percentile	21.0% (21.0%, 21.1%)	0.321			21.0% (21.0%, 21.0%)	0.908
75th percentile	21.0% (21.0%, 21.0%)				21.0% (21.0%, 21.0%)	
Percentage of post-acute care residents with moderate-to- severe pain						
25th percentile	21.1% (21.1%, 21.1%)	0.004			21.1% (21.1%, 21.1%)	0.010
75th percentile	21.0% (20.9%, 21.0%)				21.0% (21.0%, 21.0%)	
Percentage of post-acute care residents with new or worsening pressure ulcers						
25th percentile	20.9% (20.9%, 20.9%)	0.001			20.9% (20.9%, 20.9%)	0.030
75th percentile	21.1% (21.0%, 21.1%)				21.0% (21.0%, 21.1%)	
Staffing rating						
One star[a]	21.4% (21.4%, 21.5%)	<0.001			21.2% (21.2%, 21.3%)	0.305
Two stars	21.1% (21.1%, 21.1%)				21.0% (21.0%, 21.0%)	
Three stars	21.1% (21.1%, 21.1%)				21.1% (21.1%, 21.1%)	
Four stars	20.8% (20.8%, 20.8%)				20.9% (20.9%, 20.9%)	
Five stars	20.4% (20.3%, 20.4%)				20.9% (20.8%, 20.9%)	
Inspection rating						
One star[a]	21.5% (21.5%, 21.5%)	<0.001			21.4% (21.4%, 21.4%)	<0.001
Two stars	21.2% (21.2%, 21.2%)				21.2% (21.2%, 21.2%)	
Three stars	20.9% (20.9%, 20.9%)				20.9% (20.9%, 20.9%)	
Four stars	20.8% (20.8%, 20.8%)				20.9% (20.9%, 20.9%)	
Five stars	20.5% (20.5%, 20.5%)				20.6% (20.6%, 20.6%)	
Total beds						
50 or fewer[a]			20.1% (20.1%, 20.1%)	<0.001	20.3% (20.3%, 20.3%)	<0.001
51–100			20.8% (20.8%, 20.8%)		20.8% (20.8%, 20.8%)	

	Model 1: Performance measures		Model 2: Facility characteristics		Model 3: Performance measures plus facility characteristics	
	Estimated risk of readmission (99% CI)	**P**	**Estimated risk of readmission (99% CI)**	**P**	**Estimated risk of readmission (99% CI)**	**P**
101–150			21.2% (21.2%, 21.2%)		21.2% (21.2%, 21.2%)	
151 or more			21.2% (21.2%, 21.2%)		21.1% (21.1%, 21.2%)	
Percentage of all residents covered by Medicare						
25th percentile			20.5% (20.5% 20.5%)	<0.001	20.5% (20.5%, 20.5%)	<0.001
75th percentile			20.9% (20.9%, 20.9%)		20.9% (20.8%, 20.9%)	
Percentage of all residents covered by Medicaid						
25th percentile			21.0% (21.0%, 21.0%)	<0.001	21.0% (21.0%, 21.0%)	<0.001
75th percentile			21.5% (21.5%, 21.5%)		21.4% (21.4%, 21.4%)	
Percent occupancy						
25th percentile			21.1% (21.1%, 21.1%)	0.023	21.1% (21.1%, 21.1%)	0.029
75th percentile			20.9% (20.9%, 21.0%)		20.9% (20.9%, 20.9%)	
Part of a chain						
Yes			21.0% (21.0%, 21.0%)	0.857	21.0% (21.0%, 21.0%)	0.502
No[a]			21.0% (21.0%, 21.0%)		21.1% (21.1%, 21.1%)	
Hospital based						
Yes			20.4% (20.4%, 20.4%)	0.011	20.6% (20.5%, 20.6%)	0.045
No[a]			21.1% (21.1%, 21.1%)		21.1% (21.0%, 21.1%)	
Ownership						
Not-for-profit[a]			20.4% (20.4%, 20.4%)	<0.001	20.4% (20.4%, 20.4%)	<0.001
For profit			21.3% (21.3%, 21.3%)		21.3% (21.3%, 21.3%)	
Government			20.0% (19.9%, 20.0%)		20.0% (20.0%, 20.0%)	

Notes: For staffing and inspection ratings, five stars indicate best performance. Models adjust for age, sex, race, admission indication, 31 risk factors, 173 discharge diagnoses, and hospital fixed effects. Model 1:1,530,820 observations; r^2=0.059. Model 2:1,530,820 observations; r^2=0.059. Model 3:1,530,820 observations; r^2=0.059.

[a]Reference category.