

Healthcare

Impact of skilled nursing facility quality on postoperative outcomes after pancreatic surgery



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ARTICLE INFO

Article history:

Accepted 10 December 2018

Available online 28 January 2019

ABSTRACT

Background: Data on skilled nursing facility utilization among patients undergoing pancreatic surgery remain scarce. We sought to define the incidence of utilization of skilled nursing facilities and determine the impact of skilled nursing facility quality markers on postoperative outcomes among patients who underwent pancreatic surgery.

Methods: Medicare Standard Analytic Files were used to identify patients who underwent pancreatic resection during 2013–2015. Nursing Home Compare datasets were used to examine the influence of skilled nursing facility quality as estimated by quality markers (Medicare star ratings) on postoperative outcomes.

Results: Among 13,018 patients who underwent pancreatectomy, 2,247 (17.3%) were discharged to a skilled nursing facility. Compared with patients discharged home, patients discharged to a skilled nursing facility were older (median age: 72 [interquartile range 68–76] vs 76 [interquartile range 71–80]), more likely female (44.4% vs 56.8%), and had greater Charlson comorbidity index scores (median score: 3 [interquartile range 2–8] vs 4 [interquartile range 2–8]) (all $P < .001$). Most patients were discharged to an above-average skilled nursing facility ($N=1,463$, 65.1%), and a lesser subset was discharged to a skilled nursing facility with a below-average ($N=490$, 21.8%) or average ($N=294$, 13.1%) star rating. The 30-day hospital readmission was greatest among patients discharged to a below-average skilled nursing facility (below average $N=217$, 44.3%; average $N=110$, 37.4%; above average $N=517$, 35.3%; $P=.002$). On multivariate analysis, patients discharged to below-average skilled nursing facilities remained 64% more likely to be readmitted within 30 days (OR 1.64, 1.29–2.02, $P < .001$). In contrast, 30-day mortality was comparable across the skilled nursing facility star rating categories ($P=.08$).

Conclusion: Roughly 1 in 6 patients undergoing pancreatic surgery were discharged to a skilled nursing facility. Patients discharged to a below-average skilled nursing facility were more likely to be readmitted compared with patients discharged to an above-average skilled nursing facility.

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Introduction

Operative resection is the treatment of choice for a variety of benign and malignant diseases of the pancreas. Since 1993, there has been more than a two-fold increase in the number of pancreatic operations performed in the United States.¹ Despite advances in patient selection and surgical technique, the incidence of perioperative complications after pancreatic resection remains high

at about 30%–40%.^{2–4} In turn, patients who experience a perioperative complication often require postdischarge care.^{5,6} As the population ages, patients with a greater preoperative comorbidity burden are undergoing complex surgery, and it is these patients who may require postdischarge planning more frequently.^{6,7} Concomitant with these changes has been a relative decrease in the proportion of patients who are discharged directly home, and more patients are requiring greater levels of postoperative care, including discharge to a skilled nursing facility (SNF).^{8,9}

The impact of discharge to a SNF on perioperative outcomes has not been well studied. Although placement in an SNF may benefit a subset of patients, discharge to a SNF has been associated with increased risk of readmission and greater medical costs.^{10,11}

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Table 1
Demographics and characteristics of patients who underwent pancreatectomy, by discharge destination

Variable	Total N = 13,018	Home N = 10,771	SNF N = 2,247	P
Age (median, IQR)	72 (68, 77)	72 (68, 76)	76 (71, 80)	< .001
Male	6,741 (51.8%)	5,771 (53.6%)	970 (43.2%)	< .001
Race				.060
White	11,642 (89.4%)	9,633 (89.4%)	2,009 (89.4%)	
AA	808 (6.2%)	655 (6.1%)	153 (6.8%)	
Hispanic	64 (0.5%)	49 (0.5%)	15 (0.7%)	
Other/unknown	504 (3.9%)	434 (4%)	70 (3.1%)	
Charlson comorbidity Index score (median, IQR)	3 (2, 8)	3 (2, 8)	4 (2, 8)	< .001

AA, African American.

In fact, Medicare expenditures for SNF care totaled USD\$26.4 billion in 2016—roughly a 25% increase during the past decade.^{12,13} The quality of SNF may also vary considerably. To this point, in 2008, the Centers for Medicare & Medicaid Services (CMS) developed ratings—the SNF star ratings—to improve quality reporting among SNF.¹⁴ The star ratings are derived from the CMS health inspection data set, Minimum Data Set (MDS), and Medicare claims data.¹⁴ Other studies have explored the relationship between the SNF star rating and clinical outcomes. Although Ogunneye et al¹⁵ noted that SNF quality ratings did not correlate with hospital readmission among patients with acute decompensated heart failure, Kimball et al¹⁶ reported that the overall SNF star rating correlated strongly with the risk of readmission among patients undergoing total joint arthroplasty.

Data on relative SNF utilization among patients undergoing pancreatic surgery remain vague. In addition, factors associated with SNF placement, and SNF-related outcomes after pancreatic resection, have not been characterized. The impact of SNF star quality ratings in the postdischarge setting after pancreatic surgery has also not been investigated. As such, the objective of the current study was to define SNF utilization among patients undergoing pancreatic resection. In addition, we sought to determine the impact of SNF quality markers, such as star ratings, nursing ratio, and physical therapy ratio, on short-term outcomes, including readmission, morbidity, and mortality, among patients who underwent pancreatic surgery.

Methods

Study population and data collection

Patients 65 years of age or older who underwent a pancreatic resection (Supplementary Table 1) between 2013 and 2015 were identified using the CMS 100% Limited Data Set (LDS) Standard Analytic Files (SAFs), Hospital Compare Dataset, and Nursing Home Compare Datasets. The SAFs contained deidentified data on claims for services rendered per calendar year for Medicare beneficiaries.¹⁷ For the purposes of this study, the Inpatient, Denominator, and Skilled Nursing Facility SAFs were combined with the CMS Hospital Compare dataset and the CMS Nursing Home Compare dataset. The Hospital Compare Dataset and Nursing Home Compare dataset did not contain patient-level information. The Nursing Home Compare dataset has been used to examine the effect of SNF quality on health outcomes.^{15,16,18,19}

Patients who were enrolled in Medicare Part A and Part B, had no additional payments from a health maintenance organization (HMO), and had no record of payment made by a primary payer were selected. Patients who were admitted from an outside hospital, an SNF, or another health care facility at the time of index admission were excluded in order to obtain a homogenous group and to limit confounding. Only patients discharged to home or a SNF were included in the final cohort. In addition, patients

discharged to an SNF who were not included in the Nursing Home Compare dataset were excluded.

Primary outcomes included 30- and 90-day readmissions. Secondary outcomes included the incidence of 30- and 90-day complications and 30- and 90-day mortality. Readmissions were defined as the admission to any hospital within 30 and 90 days of discharge. If a patient had more than 1 readmission, only the first readmission was evaluated. Medicare data abstracted included age at the time of operation, biologic sex, and perioperative data. The Charlson comorbidity index score was computed using a validated algorithm.²⁰ Postoperative complications were determined using the International Classification of Diseases, 9th ed, Clinical Modification (ICD-9 CM) diagnosis codes identified previously as having the greatest sensitivity and specificity for the identification of postsurgical complications, including pulmonary failure, pneumonia, myocardial infarction, deep venous thrombosis (DVT)/pulmonary embolism (PE), acute renal failure, postoperative hemorrhage, surgical-site infection, and gastrointestinal bleeding (Supplementary Table 2).^{21–23} Hospital length of stay (LOS) was determined for all patients and SNF LOS was calculated for patients discharged to a SNF. Overall SNF star rating, and nurse and physical therapy staff-to-patient day ratios, were collected per resident from the Nursing Home Compare dataset. To examine the influence of these parameters of SNF quality on outcomes of interest, SNFs were grouped into one of three quality categories based on star ratings (Star Rating 1–2 = below average; Star Rating 3 = average, Star Rating 4–5 = above average).¹⁴ To examine the influence of overall hospital rating, hospital star ratings were similarly grouped into one of three quality categories based on star ratings (Star Rating 1–2 = below average; Star Rating 3 = average, Star Rating 4–5 = above average).¹⁹

Data analysis

Categorical variables were presented as frequencies and percentages, and continuous variables were presented as medians and interquartile ranges (IQR). Demographics, patient characteristics, and 30- and 90-day perioperative and postoperative outcomes, including complications, LOS, and incidence of readmission or mortality, were compared among patients who were and were not discharged to a SNF in addition to the various SNF groups, stratified by quality ratings. Categorical variables were compared using χ^2 tests and Fisher exact tests where appropriate. Continuous variables were compared using the Wilcoxon rank-sum tests and the Kruskal-Wallis one-way analysis of variance.

Logistic regression was utilized to identify factors associated with 30- and 90-day readmission after discharge to a SNF after pancreatic surgery. All factors associated with 30- and 90-day readmission on bivariate analysis were considered in the full multivariable model. A backward stepwise approach was used to identify a final model. Statistical significance was assessed at $\alpha = 0.05$. All analyses were performed using SAS v 9.4 (SAS Institute, Cary, NC).

Table 2
Perioperative and postoperative outcomes of patients undergoing pancreatotomy by discharge destination

Outcomes	Total N = 13,018	Home N = 10,771	SNF N = 2,247	P
Outcomes at index visit				
Complications				
Pulmonary failure	1,110 (8.5%)	845 (7.9%)	265 (11.8%)	< .001
Pneumonia	347 (2.7%)	260 (2.4%)	87 (3.9%)	< .001
Myocardial infarction	182 (1.4%)	136 (1.3%)	46 (2%)	.004
DVT/PE	434 (3.3%)	330 (3.1%)	104 (4.6%)	< .001
Acute renal failure	1,529 (11.7%)	1,168 (10.8%)	361 (16.1%)	< .001
Hemorrhage	172 (1.3%)	129 (1.2%)	43 (1.9%)	.007
Surgical site infection	1,355 (10.4%)	991 (9.2%)	364 (16.2%)	<.001
GI hemorrhage	95 (0.7%)	72 (0.7%)	23 (1%)	.070
Index LOS	8 (6, 13)	8 (6, 12)	12 (8, 18)	< .001
30-d outcomes				
Complications				
Pulmonary failure	217 (1.7%)	147 (1.4%)	70 (3.1%)	< .001
Pneumonia	93 (0.7%)	56 (0.5%)	37 (1.6%)	< .001
Myocardial infarction	33 (0.3%)	21 (0.2%)	12 (0.5%)	.004
DVT/PE	208 (1.6%)	138 (1.3%)	70 (3.1%)	< .001
Acute renal failure	370 (2.8%)	255 (2.4%)	115 (5.1%)	< .001
Hemorrhage	162 (1.2%)	118 (1.1%)	44 (2%)	< .001
Surgical site infection	910 (7%)	687 (6.4%)	223 (9.9%)	< .001
GI hemorrhage	61 (0.5%)	42 (0.4%)	19 (0.8%)	.004
Readmission	2,935 (22.5%)	2,091 (19.4%)	844 (37.6%)	< .001
Mortality	724 (5.6%)	644 (6.0%)	80 (3.6%)	< .001
90-day outcomes				
Complications				
Pulmonary failure	345 (2.7%)	246 (2.3%)	99 (4.4%)	< .001
Pneumonia	156 (1.2%)	95 (0.9%)	61 (2.7%)	< .001
Myocardial infarction	80 (0.6%)	61 (0.6%)	19 (0.8%)	.12
DVT/PE	374 (2.9%)	253 (2.3%)	121 (5.4%)	< .001
Acute renal failure	596 (4.6%)	422 (3.9%)	174 (7.7%)	< .001
Hemorrhage	246 (1.9%)	183 (1.7%)	63 (2.8%)	< .001
Surgical site infection	1,152 (8.8%)	868 (8.1%)	284 (12.6%)	< .001
GI hemorrhage	94 (0.7%)	67 (0.6%)	27 (1.2%)	.003
Readmission	4,250 (32.6%)	3,124 (29%)	1,126 (50.1%)	< .001
Mortality	1171 (9.0%)	921 (8.6%)	250 (11.1%)	< .001

GI, gastrointestinal.

Results

Patients characteristics

A total of 13,018 patients who underwent a pancreatotomy between 2013 and 2015 who met inclusion criteria are described (Table 1). Median patient age was 72 years (IQR 68–77). Approximately half the patients were male ($N=6,741$, 51.8%). The majority of patients were white ($N=11,642$, 89.4%) and had a preoperative Charlson comorbidity score ≥ 3 ($N=7,206$, 55.4%). Pancreatic resection consisted of pancreatoduodenectomy ($N=7,697$, 59.1%), distal pancreatotomy ($N=4,006$, 30.8%), total pancreatotomy ($N=536$, 4.1%), and other pancreatotomy procedures ($N=779$, 6.0%). Overall, 983 hospitals were used. Most patients underwent resection at a below-average hospital ($N=374$, 38.0%), whereas 36.0% ($N=354$) and 25.9% ($N=255$) underwent resection at an above-average and average hospital, respectively. The most common postoperative complications included pulmonary failure ($N=1,110$, 8.5%), acute renal failure ($N=1,529$, 11.7%), and surgical-site infection ($N=1,355$, 10.4%) (Table 2). The median LOS on the index admission was 8 days (IQR 6–13). Roughly one-fourth of patients experienced a readmission within 30 days ($N=2,935$, 22.5%), and one-third of patients were readmitted within 90 days ($N=4,250$, 32.6%). The 30- and 90-day incidence of mortality was 5.6% and 9.0%, respectively. Among the 2,247 patients discharged to a SNF, 1,641 SNFs were utilized. Most patients were discharged to an above-average SNF ($N=1,463$, 65.1%), and a lesser subset was discharged to a SNF with a below-average ($N=490$, 21.8%) or average ($N=294$, 13.1%) star rating.

Patient outcomes

After index hospitalization, 2,247 (17.3%) patients were discharged to an SNF. Compared with patients who were discharged to home, patients who were discharged to an SNF were somewhat older (median age: 72 years [IQR 68–76] vs 76 years [IQR 71–80]), more likely to be female (44.4% vs 56.8%), and had a greater preoperative Charlson comorbidity score (median score: 3 [IQR 2–8] vs 4 [IQR 2–8]) (all $P < .001$). Patients discharged to a SNF generally had a greater LOS (median days 8 [IQR 6–12]) vs 12 [IQR 8–18]) and were more likely to have experienced a complication during the index hospital stay. Specifically, patients discharged to a SNF had a greater incidence of pulmonary failure, pneumonia, myocardial infarction, DVT/PE, acute renal failure, hemorrhage, and surgical-site infection during their index admission (all $P < .001$) (Table 2). In addition, among patients discharged to an SNF from an above-average hospital, 71.1% ($N=674$) of patients were discharged to an above-average SNF; whereas only 59.3% ($N=412$) of patients discharged from a below-average hospital were discharged to an above-average SNF ($P < .001$). Furthermore, 27% ($N=188$) of patients discharged to an SNF from a below-average hospital were admitted to a below-average SNF. A total of 16.6% ($N=157$) of patients discharged from an above-average hospital were admitted to a below-average SNF ($P < .001$).

Within 90 days, patients discharged to a SNF were more likely to experience certain complications, such as pneumonia, DVT/PE, and surgical-site infection (all $P < .001$). Moreover, compared with patients who were discharged to home, patients discharged to an SNF were more likely to be readmitted within

Table 3
Demographics and characteristics of patients who underwent pancreatectomy by Medicare SNF quality rating

Variable	Total N = 2,247	Below average N = 490	Average N = 294	Above average N = 1,463	P
Age (median, IQR)	76 (71, 80)	75.5 (71, 80)	76 (71, 80)	76 (71, 81)	.270
Male	970 (43.2%)	225 (45.9%)	126 (42.9%)	619 (42.3%)	.380
Race					.002
White	2009 (89.4%)	418 (85.3%)	264 (89.8%)	1327 (90.7%)	
AA	153 (6.8%)	49 (10%)	22 (7.5%)	82 (5.6%)	
Hispanic	15 (0.7%)	8 (1.6%)	1 (0.3%)	6 (0.4%)	
Other/unknown	70 (3.1%)	15 (3.1%)	7 (2.4%)	48 (3.3%)	
Charlson comorbidity index score (median, IQR)	4 (2, 8)	3 (2, 8)	4 (2, 8)	4 (2, 8)	.110

AA, African American.

30 days (19.4% vs 37.6%) and 90 days (29.0% vs 50.1%) (both $P < .001$). In addition, patients who were discharged to home had a greater incidence of 30-day mortality (home: 6.0% vs SNF: 3.6%); whereas patients discharged to a SNF had a greater incidence of 90-day mortality (home: 8.6% vs SNF: 11.1%) (both $P < .001$).

The impact of SNF quality on postoperative outcomes

Among the 2,247 patients discharged to an SNF, 1,641 SNFs were used. Most patients were discharged to an above-average SNF ($N = 1,463$, 65.1%), and a lesser subset was discharged to a SNF with a below-average ($N = 490$, 21.8%) or average ($N = 294$, 13.1%) star rating. Of note, patients discharged to an above-average SNF were disproportionately more likely to be white ($N = 1,327$, 90.7%), whereas African Americans more frequently were discharged to a below-average SNF ($N = 49$, 10.0%, $P = .002$) (Table 3). In contrast, other factors, such as age, sex, and preoperative Charlson comorbidity index score, were not associated with discharge to a specific quality star rating SNF ($P > .05$).

The median number of nurse and physical therapy hours per resident day were 0.78 (IQR 0.55–1.13) and 0.15 (IQR 0.09–0.23), respectively (Table 4). Above-average SNFs had the greatest median nurse hours per resident day (below average 0.56 [IQR 0.37–0.80] vs average 0.67 [IQR 0.5–0.87] vs above average 0.89 [IQR 0.63–1.44]; $P < .001$). Similarly, physical therapy hours per resident day incrementally increased somewhat with quality star rating categories (below average 0.11 [IQR 0.07–0.16] vs average 0.14 [IQR 0.08–0.22] vs above average 0.17 [IQR 0.1–0.27]; $P < .001$).

No difference was observed in the overall incidence of 30- and 90-day pulmonary failure, pneumonia, myocardial infarction, acute renal failure, hemorrhage, surgical site infection, and GI hemorrhage among patients stratified by SNF quality star rate categories ($P > .05$) (Table 4). Among the 2,247 patients discharged to a SNF, the median LOS was 14 days (IQR 8–23) (below average 15 [IQR 8–24] vs average 14 [IQR 8–24] vs above average 14 [IQR 8–22]; $P = .380$). Although LOS was comparable among the SNFs of different quality star ratings, the incidence of 30-day hospital readmission was greatest among patients who were discharged to a below-average SNF (Fig 1, below average, $N = 217$, 44.3%, average $N = 110$, 37.4%, above average $N = 517$, 35.3%; $P = .002$). On multivariate analysis, after controlling for other relevant covariates, patients discharged to below-average SNFs were 64% more likely to be readmitted within 30 days versus patients discharged to an above-average SNF (OR 1.64, 1.29–2.02, $P < .001$) (Table 5). Similarly, readmission within 90 days of discharge from the index hospital was also greater among patients discharged to a below-average SNF (Fig 1, below average $N = 270$, 55.1%, average $N = 143$, 48.6%, above average $N = 713$, 48.7%; $P = .044$). In contrast, both 30- and 90-day mortality were comparable across all 3 categories of SNF quality star ratings ($P = .08$) (Fig 2).

Discussion

Pancreatic resection is a complex operative procedure that can be associated with a risk of complications, prolonged LOS, and readmission.^{6,24–26} As the population ages, a greater number of elderly patients with multiple comorbidities are being offered hepatopancreatic procedures. In turn, because of this increasing factor of age, more patients may require additional services and postdischarge care after pancreatic operations. In the current study, the CMS Standard Analytic Files and Nursing Home Compare Dataset were used to assess the utilization of SNFs among patient undergoing pancreatic surgery. Of note, almost 1 in 6 Medicare beneficiaries were discharged to a SNF after pancreatic surgery. Perhaps not surprising, patients with more preoperative medical comorbidities, and patients who experienced a complication and had a greater LOS, were more likely to be discharged to a SNF. The current study was the first study to use a large, national database to analyze the relationship between SNF quality as estimated by Medicare star ratings and postsurgical outcomes among patients undergoing pancreatic surgery. In addition, high-quality hospitals as estimated by Medicare star ratings were more likely to discharge patients to above-average SNFs. Despite factors such as age, sex, and preoperative Charlson comorbidity index score being unrelated to discharge to a specific SNF, SNF quality star rating impacted patient-related outcomes. Specifically, the incidence of 30- and 90-day readmission was greatest among patients who were discharged to a below-average SNF. In contrast, both 30- and 90-day mortality were comparable across all 3 categories of SNF quality star ratings. Collectively, these data demonstrated a high SNF utilization among elderly pancreatic surgery patients and identified the impact of SNF quality as measured by Medicare star ratings and nurse and physical therapy hours-per-patient day on specific outcomes such as readmission.

As the US elderly population continues to age, an increasing number of patients are not returning directly home after major surgery.⁵ For older patients, acute health care crises such as a major operation can have a substantial impact on functional capacity, often involving a prolonged recovery extending beyond the acute care hospitalization.²⁷ Given the high costs associated with SNFs, there has been increased interest in defining the overall utilization of SNFs after discharge. Chen et al²⁸ reported that SNF utilization among Medicare beneficiaries after coronary artery bypass grafting ranged 16%–19%, and SNF use was as great as 40%–46% among patients being discharged after total hip replacement. The reported overall utilization among patients undergoing cancer-related surgery has varied. Examining data obtained from the Surveillance, Epidemiology, and End Results–Medicare linked database, Stitzenberg et al²⁹ reported that roughly 13%–15% of patients who had a range of cancer operations were discharged to a SNF. In a separate study that focused only on patients who underwent hepatopancreatobiliary surgery, Merath et al³⁰ noted that approximately 5%–6% of patients had a postdischarge admission to a SNF. In the current study, the utilization of a SNF was much greater

Table 4
Perioperative and postoperative outcomes by SNF Medicare quality rating

Outcome	Below average N = 490	Average N = 294	Above average N = 1,463	P
Outcomes at index visit				
Complications				
Pulmonary failure	52 (10.6%)	29 (10.9%)	184 (12.6%)	.280
Pneumonia	20 (4.1%)	5 (1.7%)	62 (4.2%)	.120
Myocardial infarction	11 (2.2%)	4 (1.4%)	31 (2.1%)	.660
DVT/PE	20 (4.1%)	8 (2.7%)	76 (5.2%)	.150
Acute renal failure	78 (15.9%)	51 (17.3%)	232 (15.9%)	.810
Hemorrhage	5 (1.0%)	4 (1.4%)	34 (2.3%)	.140
Surgical site infection	84 (17.1%)	43 (14.6%)	237 (16.2%)	.650
GI hemorrhage	3 (0.6%)	1 (0.3%)	19 (1.3%)	.200
Index LOS	12 (8, 18)	13 (9, 18)	11 (8, 18)	.043
30-d outcomes				
Complications				
Pulmonary failure	20 (4.1%)	7 (2.4%)	43 (2.9%)	.330
Pneumonia	9 (1.8%)	5 (1.7%)	23 (1.6%)	.920
Myocardial infarction	5 (1.0%)	0 (0.0%)	7 (0.5%)	.150
DVT/PE	14 (2.9%)	16 (5.4%)	40 (2.7%)	.048
Acute renal failure	30 (6.1%)	8 (2.7%)	77 (5.3%)	.100
Hemorrhage	10 (2.0%)	8 (2.7%)	26 (1.8%)	.560
Surgical site infection	59 (12.0%)	30 (10.2%)	134 (9.2%)	.180
GI hemorrhage	2 (0.4%)	3 (1.0%)	14 (1%)	.490
SNF LOS	15 (8, 24)	14 (8, 24)	14 (8, 22)	.380
Readmission	217 (44.3%)	110 (37.4%)	517 (35.3%)	.002
Mortality	19 (3.9%)	15 (5.1%)	46 (3.1%)	.230
90-day outcomes				
Complications:				
Pulmonary failure	32 (6.5%)	11 (3.7%)	56 (3.8%)	.035
Pneumonia	14 (2.9%)	8 (2.7%)	39 (2.7%)	.970
Myocardial infarction	5 (1.0%)	1 (0.3%)	13 (0.9%)	.580
DVT/PE	29 (5.9%)	19 (6.5%)	73 (5.0%)	.500
Acute renal failure	43 (8.8%)	16 (5.4%)	115 (7.9%)	.230
Hemorrhage	19 (3.9%)	9 (3.1%)	35 (2.4%)	.220
Surgical site infection	70 (14.3%)	41 (13.9%)	173 (11.8%)	.280
GI hemorrhage	4 (0.8%)	3 (1.0%)	20 (1.4%)	.600
Readmission	270 (55.1%)	143 (48.6%)	713 (48.7%)	.044
Mortality	63 (12.9%)	40 (13.6%)	147 (10%)	.080

GI, gastrointestinal.

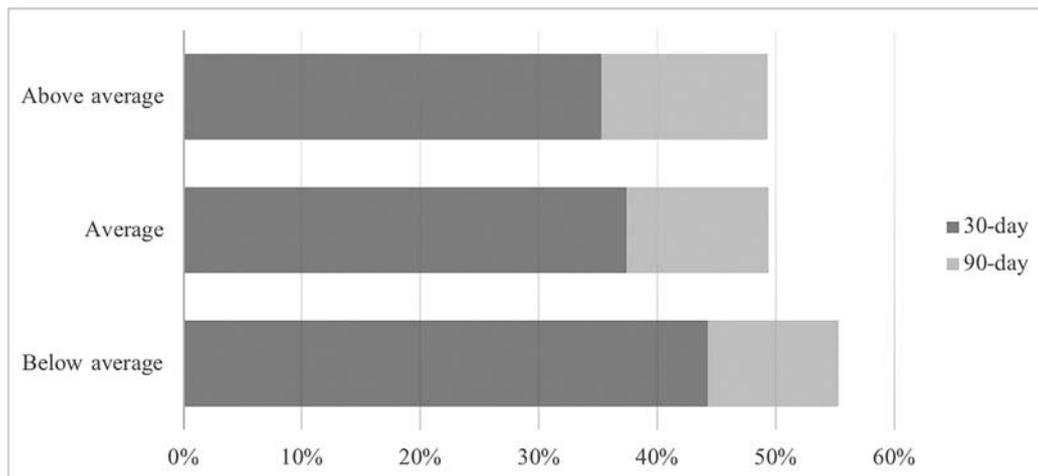


Fig 1. The 30- and 90-day readmission rates among patients discharged to SNF after pancreatic surgery, stratified by Medicare SNF quality ratings.

at 17%. The reason for the greater incidence of SNF utilization in the current study was undoubtedly multifactorial and likely related to differences in the underlying patient cohort. For example, unlike the study by Merath et al³⁰ that included patients of all ages who underwent either liver or pancreatic procedures, the current study included only patients who were 65 years of age or older and had undergone pancreatic resection. The older patient cohort, as well as the focus on pancreatic procedures that can be associated with complications, such as fistula and delayed gastric emptying, likely explain the greater SNF utilization in this patient population.

The impact of SNF on patient outcomes remains debated. Schoenfeld et al³¹ examined the impact of the increased hospital–SNF linkage as measured by the proportion of surgical patients referred from a hospital to a particular SNF on readmission reduction after surgery. Among patients who underwent 1 of 5 operative procedures (ie, coronary artery bypass grafting, repair of hip fractures, total hip arthroplasty, colectomy, or lumbar spine surgery), the authors noted a strong negative correlation between the proportion of selected surgical discharges received by an SNF and the rate of hospital readmission. The benefits of increased hospital–SNF

Table 5
Multivariable analysis for factors associated with 30-day readmission

Variable	OR	95% CI	P	
Medicare SNF rating	Above average	Ref		
	Average	1.13	0.85–1.51	.410
	Below average	1.64	1.29–2.02	< .001
Charlson comorbidity index score	0	Ref		
	1	2.06	1.17–3.63	.012
	2	1.39	0.91–2.13	.130
	≥ 3	2.51	1.70–3.70	< .001
Nurse hours per resident day	0.99 (mean)	Ref		
	1.99	0.85	0.75–0.96	.011
LOS	18.3 days (mean)	Ref		
	19.3 days	0.93	0.92–0.94	< .001

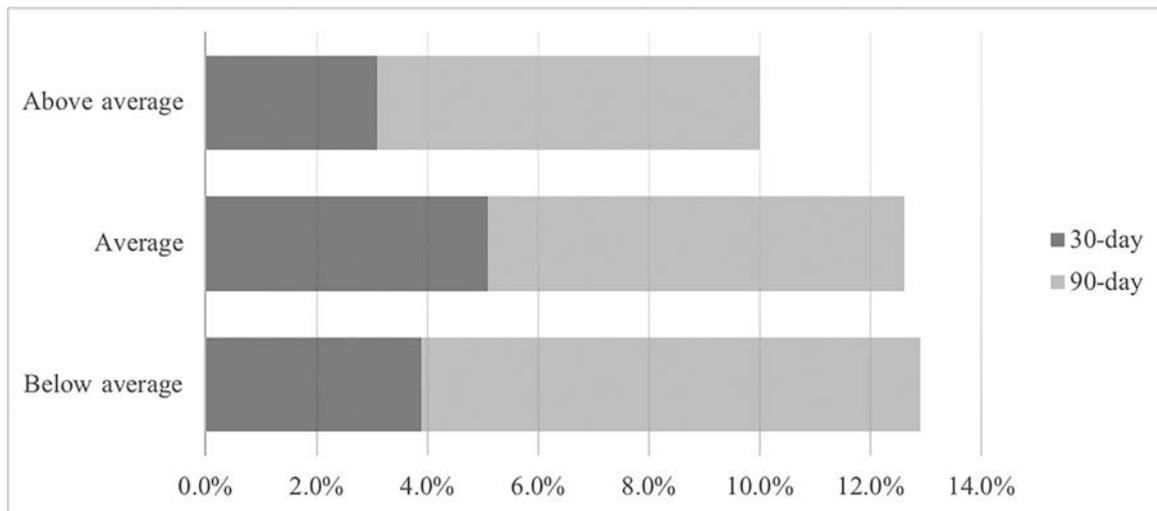


Fig 2. The 30- and 90-day mortality rates among patients discharged to SNF after pancreatic surgery, stratified by Medicare SNF quality ratings.

linkage seemed to result in meaningful increases in hospital readmission after surgery. Specifically, with each 10% increase in the proportion of surgical referrals to a particular SNF, there was an estimated decrease in readmissions by 4%.³¹ In contrast, in a different study by Chen et al,²⁸ which examined patients who underwent coronary artery bypass grafting or total hip replacement, changes in SNF utilization were not associated with changes in readmission rates. In the current study, the overall 30- and 90-day readmissions after discharge were 22.5% and 32.6%, respectively. Moreover, compared with patients who were discharged to home, patients who underwent a pancreatectomy and were discharged to a SNF had almost a two-fold greater incidence of readmission. Together, these data strongly suggest that discharge to a SNF, although likely appropriate for certain patients, was not an effective readmission mitigation strategy for patients undergoing pancreatic surgery.

Given the high incidence of readmission after discharge to a SNF, and the high Medicare expenditures associated with SNF utilization, there has been an increasing focus on SNF quality relative to patient outcomes.^{15,32,33} Beginning in 2008, CMS publicly displays a 5-star quality rating system for all Medicare- and Medicaid-certified SNFs on their Nursing Home Compare website.^{14,15} Using this 5-star quality rating, Neuman et al³⁴ reported that readmission among Medicare beneficiaries after an acute care hospitalization was less at SNFs that had better star ratings. In a separate study, Kimball et al¹⁶ noted that SNFs with greater staffing ratios per patient day had better patient outcomes after total joint arthroplasty. In the current study, we noted that above-average SNFs had the greatest median nurse and physical therapy hours per resident day. In addition, although there were no differences

in the incidence of most perioperative complications, patients discharged to a below-average SNF were more likely to be readmitted. In fact, almost half of patients discharged to a below-average SNF were readmitted within 30 days. Undoubtedly, the reasons for greater readmissions of patients discharged to below-average SNFs are multifactorial, but may represent, in part, an education gap of the health care providers caring for patients at SNFs after pancreatic resection. Greater readmission rates may be secondary to a lesser threshold at average and below-average SNFs for greater acuity of care for problems that could have been addressed safely without the need for acute hospitalization. Although limiting patient discharge to above-average SNFs may not be a feasible option because of issues such as location, family references, and others, postdischarge care coordination and communication may be a way to mitigate these greater observed rates of readmission. At our institution, discussions around discharge to SNF now include information around quality ratings relative to other patient-center factors (eg, location, convenience, etc). Data in the current study also underscore the fact that CMS should focus efforts to improve SNF readmissions rates as a prime opportunity to impact the utilization of health care resources while simultaneously improving quality of care delivered. The relation of SNF quality measures and quality-based metrics, such as readmission, warrant further investigation.

Several limitations should be considered when interpreting the current study. Despite the Standard Analytic Files providing a large national data set on claims for all Medicare beneficiaries, no physiologic or biochemical, patient-specific information was available. Thus, the ability to assess fully an individual's baseline patient health status was limited. To minimize this limitation, the Charlson comorbidity index score was calculated for each patient

and included in the regression analysis.³⁵ In addition, information regarding socioeconomic status or social determinants of health are inadequately captured from this national data set. To ensure accuracy to identify complications, we used complication codes known to have a high sensitivity and specificity for identifying postoperative complications among surgical patients.^{23,36} Although the methodology of the Medicare SNF star quality ratings was extensive, validated, and had been widely adopted, any rating system cannot fully capture the quality of care received by patients. We maintain that the star ratings were, however, the best source of information on SNF quality and had been utilized by CMS in the past.

In conclusion, roughly 1 in 6 patients undergoing pancreatic surgery were discharged to an SNF. Although there was a similar incidence in perioperative complications across SNF quality ratings, patients discharged to a below-average SNF were more likely to be readmitted within 30 and 90 days compared with patients discharged to an above-average SNF. As the population continues to age and an increasing number of patients require care at an SNF, a better understanding of SNF quality and SNF-specific outcomes will be necessary. Data from the current study highlight the importance of continued management of patients postdischarge and increasing efforts to determine how to achieve the best outcomes among patients discharged to a SNF after pancreatic surgery.

Conflicts of interest

The authors have indicated that they have no conflicts of interest regarding the content of this article.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.surg.2018.12.008](https://doi.org/10.1016/j.surg.2018.12.008).

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