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Featured Article

The association of Hospital Medicare beneficiary payer-mix, national quality rankings and outcomes following hepatopancreatic surgery☆

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ABSTRACT

Introduction: We sought to determine the impact of payer-mix on post-operative outcomes among Medicare beneficiaries following hepatopancreatic surgery.

Methods: Medicare beneficiaries who underwent hepatopancreatic surgery were identified. Hospital quality markers were obtained from the Hospital General Information dataset. Hospitals were dichotomized (low/average vs. high) based on Medicare patient days versus all patient days irrespective of payer type.

Results: High Medicare patient-mix hospitals were more likely to be ranked higher than the national average relative to safety of care (29.4% vs. 38.1%) and timeliness of care (15.4% vs. 26.3%) versus low burden Medicare hospitals (both $p < 0.001$). However, Medicare beneficiaries who had hepatopancreatic surgery at a high Medicare patient-mix hospital were at higher risk of a complication (OR = 1.13, 95%CI 1.04–1.22), and death within 30-days (OR = 1.37, 95%CI 1.23–1.53) following surgery.

Conclusion: While hospitals caring for higher numbers of Medicare beneficiaries generally performed better on CMS quality indicators, these rankings did not equate to improved post-operative outcomes.

Introduction

Over the past 60 years, the life expectancy of the U.S. population has increased by 9.8 years.[1] In fact, the proportion of Americans aged 65 and older is projected to nearly double from 52 million in 2018 to 98 million by 2060. Older adults account for more than 40% of all inpatient operations annually in the U.S and this number is anticipated to grow as the population ages.[2] The peri-operative management of the geriatric surgical patient poses unique challenges, in part due to the physiologic changes associated with aging, the heightened risk of morbidity, as well as possible functional decline and loss of independence. The aged patient may be at particular higher risk for complications following complex surgical procedures, which are often associated with high morbidity.

Some policymakers and physicians have suggested centralizing care of older patients to centers that have a high volume of geriatric patients as a means to improve outcomes for this patient population. To this point, the American College of Surgeons initiated a Coalition for Quality in Geriatric Surgery Project composed of more than 50 stakeholder organizations representing the needs of older patients and families, advocacy and regulatory groups, health care professionals, and multiple medical and surgical specialties.[3] The Coalition has suggested a verification process to designate certain centers as "Geriatric Surgery Verified." While outcomes of aged patients have been examined at the procedure level, the association of hospital-level aged versus non-aged patient proportion relative to post-operative outcomes has not been well examined. Despite advances in patient selection and surgical technique, hepatopancreatic (HP) surgery has been particularly associated with high morbidity as one in four patients experience some type of postoperative complication.[4] As such, the objective of the current study was to define the impact of hospital payer-mix, specifically the proportion of Medicare patients treated at a given hospital, on

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outcomes among Medicare beneficiaries. In particular, we sought to assess the association of high hospital level Medicare patient-mix on short-term postoperative outcomes among Medicare beneficiaries undergoing HP surgery.

Methods

Data source, study population, and medicare burden

Medicare beneficiaries 65 years old or older who underwent elective HP surgery were identified in the 2013–2017 Medicare Standard Analytic Files (SAFs) using previously reported methods.[5] Hospital characteristics including overall hospital quality rating, and relative nationally benchmarked hospital performance (above average, average or below average) related to mortality, safety of care, readmission, patient experience, and timeliness of care were obtained from the Hospital General Information Dataset. For the purposes of this study, the proportion of Medicare patient days versus all patient days, regardless of payer type, was obtained from the Final Rule Dataset for each hospital. Hospitals were dichotomized (low/average vs. high) to identify hospitals serving a disproportionately high number of Medicare beneficiaries (high Medicare patient-mix). The optimal cutoff point was identified by testing each whole percentage between the 10th and 90th percentiles. Chi-square test statistics were calculated for each possible cutoff point and each outcome. An average chi-square test statistic was calculated across outcomes for each cutoff point. The optimal percentage Medicare patient days cutoff was determined from the average chi-square test statistic.[6,7] Subsequently, hospitals with a Medicare patient-mix >43.0% were considered high Medicare hospitals. In order to determine whether a hospital was considered a high-volume center, Leapfrog criteria were adjusted; specifically, given that roughly 40% of HP surgeries are performed on Medicare beneficiaries, 40 surgeries over the 5-year period (8 surgeries/year) rather than 20 surgeries/year was used as a cutoff to define a high volume center.[8]

Statistical analysis

Demographics, clinical characteristics and outcomes were presented as median (interquartile range [IQR]) and frequency (%) for continuous and categorical data, respectively. To compare characteristics across hospital Medicare patient-mix groups (low/average vs. high) Wilcoxon rank sum tests and chi-squared tests were used to compare continuous and categorical data, respectively. Multivariable logistic regression analysis adjusting for age, sex, race, Charlson comorbidity burden, and procedure type was used to examine the association of Hospital Medicare patient-mix and patient outcomes including in-hospital mortality, complication, extended length-of-stay (LOS), 30-day mortality, 30-day readmission and expenditure. All analyses were performed using SAS v9.4 (Cary, NC).

Results

Patient and hospital characteristics

A total of 33,829 Medicare beneficiaries who met inclusion criteria were identified across 1631 hospitals. Overall, 19,795 (58.5%) patients underwent a pancreatectomy (n = 19,795, 58.5%), while a smaller subset (n = 14,034, 41.5%) underwent a hepatectomy (Table 1); median age was 72 years (IQR: 68–77) with the majority of individuals being male (n = 17,470, 51.6%). The median comorbidity burden score was 3 (IQR: 2–8). Median Medicare patient-mix for a given hospital was 37.9% (IQR: 29.5–46.1%), with one-half of all hospitals having at least this proportion of total number patient hospital days being occupied by Medicare patients. Roughly one-in-five (n = 6,382, 18.9%) individuals underwent an HP operation at a high Medicare patient-mix hospital. Of note, patients treated at high Medicare patient-mix hospitals were generally the same age (low/average: 72, IQR: 68–77 vs. high: 73, IQR: 69–78) and ethnicity/race (white, low/average: n = 24,249, 88.3% vs. high: 5,663, 88.7%), and had a comparable comorbidity burden (low/average: 3, IQR: 2–8 vs. high: 3, IQR: 2–8) versus low/average Medicare patient-mix hospitals.

Interestingly, high Medicare patient-mix hospitals generally had better quality indicators versus low/average Medicare patient-mix hospitals (Table 2). Specifically, high Medicare patient-mix hospitals were overall more likely to be ranked higher than the national average relative to safety of care (n = 304, 29.4% vs. n = 228, 38.1%; $p < 0.001$) and timeliness of care (n = 159, 15.4% vs. n = 157, 26.3%; $p < 0.001$) compared with low/average patient-mix Medicare hospitals. However, high Medicare patient-mix hospitals were less likely to be teaching hospitals (low/average: n = 574, 55.6% vs. high: n = 193, 32.3%; $p < 0.001$), as well as be high volume HP centers (low/average: n = 240, 23.2% vs. high: n = 62, 10.4%; $p < 0.001$).

Following surgery, patients who underwent an HP operation at a high Medicare patient-mix hospital more often experienced a postoperative complication compared with individuals treated at low/average Medicare patient-mix hospitals (low/average: n = 6,700, 24.4% vs. high: n = 1,878, 29.4%; $p < 0.001$); patients who had HP surgery at a high Medicare patient-mix hospital also more frequently died within 30-days of surgery (low/average: n = 1,303, 4.7% vs. high: n = 510, 8.0%; $p < 0.001$) (Table 3). While LOS was not dissimilar among patients relative to hospital Medicare patient-mix (low/average: 7, IQR:5–10 vs. high: 7, IQR: 5–11; $p = 0.65$), median Medicare expenditures were $3000 less for patients who underwent surgery at a high Medicare patient-mix hospital (low/average: $19,981, IQR: $15,219-$32,422 vs. high: $16,975, IQR: $12,804-$29,422; $p = 0.65$).

After adjusting for relevant clinical and hospital covariates including hospital HP-specific volume, Medicare patient-mix remained associated with post-operative outcomes (Table 4). Specifically, patients who underwent an HP operation at a high Medicare patient-mix hospital had greater odds of a complication following surgery (OR 1.13, 95%CI 1.04–1.22), as well as dying within 30-days of surgery (OR 1.37, 95%CI 1.23–1.53). In contrast, odds of extended length-of-stay le and readmission were similar among low/average versus high Medicare patient-mix hospitals (both $p > 0.05$). Of note, hospital volume was also an independent risk factor for adverse outcomes. Specifically, patients who underwent an HP operation at a low volume center, also had greater odds of in-hospital mortality (OR 1.69, 95%CI 1.42–2.02), complication (OR 1.22, 95%CI 1.13–1.33), as well as dying within 30-days of surgery (OR 2.14, 95%CI 1.92–2.38) versus high volume centers. In contrast with the unadjusted, bivariate analyses, Medicare expenditure was not associated with Medicare patient-mix.

Conclusions

Centralization of care for aged patients at centers with a high geriatric volume has been postulated as a means to improve outcomes for this vulnerable and growing population. The current study was important because we specifically sought to examine the association of hospital level Medicare patient-mix on postoperative outcomes among patients undergoing HP surgery. Hospitals with a high Medicare patient-mix had improved quality indicators versus low/average patient-mix hospitals including higher national rankings relative to safety of care and timeliness of care. Despite better quality ratings, treatment at high Medicare patient-

Table 1
Patient demographics and clinical characteristics of patients undergoing hepatopancreatic surgery stratified by Medicare patient-mix.

Variable	Total N = 33,829	Low/Average Medicare Patient-mix N = 27,447	High Medicare Patient-mix N = 6382	p-value
Age (median, IQR)	72 (68, 77)	72 (68, 77)	73 (69, 78)	<0.001
Male	17,470 (51.6%)	14,217 (51.8%)	3253 (51%)	0.23
Race				
White	29,912 (88.4%)	24,249 (88.3%)	5663 (88.7%)	<0.001
Minority	3917 (11.6%)	3198 (11.7%)	719 (11.3%)	
CCS (median, IQR)	3 (2, 8)	3 (2, 8)	3 (2, 8)	<0.001
Surgery				<0.001
Pancreatectomy	19,795 (58.5%)	16,296 (59.4%)	3499 (54.8%)	
Hepatectomy	14,034 (41.5%)	11,151 (40.6%)	2883 (45.2%)	

IQR, interquartile range; SVI, social vulnerability index; CCS, Charlson comorbidity score.

mix hospitals did not equate to improved post-operative outcomes following HP surgery among Medicare beneficiaries. Specifically, while patients who underwent an HP operation at low/average versus high Medicare patient-mix hospitals were largely similar relative to age and comorbidity burden, Medicare beneficiaries who had an HP operation at high Medicare patient-mix hospitals had greater odds of a complication and death following surgery. Collectively, the data demonstrated that while high Medicare patient-mix hospitals may attain higher scores on certain quality indicators, outcomes for Medicare beneficiaries did not track with these hospital-level indicators.

Olufajo and colleagues previously examined adult trauma admissions in the California State Inpatient Database and noted that patients aged 65 years and older has 28% reduced odds of complications and failure-to-rescue if cared for at a hospital with a high proportion of geriatric trauma.[9] In a separate study, Mehta and colleagues examined outcomes among aged adults undergoing emergency general surgery and noted that surgeon specific geriatric experience predicted adverse surgical outcomes for older patients.[10] In the current study, we noted that individuals 65 years or older who underwent an operation at hospitals with a large proportion of Medicare admissions had higher odds of complications and death. Even after adjusting for hospital specific HP procedural volume, Medicare hospital patient-mix was an independent predictor of adverse outcomes among Medicare beneficiaries. These data highlight that tying verification or certification of geriatric centers of excellence to a simple number or proportion of aged patients cared for at a given institution may not be sufficient to ensure adequate outcomes for Medicare beneficiaries. Collectively the data underscore the need for centralization of care for complex patients, including older patients, to centers not only with high population-specific volume, but also to hospitals that meet the surgery volume specific standards.

While high Medicare patient-mix hospitals outperformed low/average Medicare patient-mix hospitals with regard to certain quality indicators, high Medicare patient-mix hospitals were less often high-volume HP centers or teaching facilities. To this point, Mehta and colleagues noted that the odds of achieving an optimal

Table 2
Hospital characteristics stratified by Medicare burden.

	Total N = 1631	Low/Average Medicare Patient-mix N = 1033	High Medicare Patient-mix N = 598	P
High Volume Hospital (yes)	302 (18.5%)	240 (23.2%)	62 (10.4%)	<0.001
Teaching Hospital (yes)	767 (47%)	574 (55.6%)	193 (32.3%)	<0.001
Hospital Overall rating				0.03
Below Average	444 (27.2%)	299 (28.9%)	145 (24.2%)	
Average	687 (42.1%)	429 (41.5%)	145 (24.2%)	
Above Average	459 (28.1%)	281 (27.2%)	178 (29.8%)	
Unknown	41 (2.5%)	24 (2.3%)	17 (2.8%)	
Mortality National Comparison				0.11
Below Average	256 (15.7%)	149 (14.4%)	107 (17.9%)	
Average	1014 (62.2%)	657 (63.6%)	357 (59.7%)	
Above Average	296 (18.1%)	181 (17.5%)	115 (19.2%)	
Unknown	65 (4%)	46 (4.5%)	19 (3.2%)	
Safety of Care National Comparison				<0.001
Below Average	499 (30.6%)	348 (33.7%)	151 (25.3%)	
Average	538 (33%)	351 (34%)	187 (31.3%)	
Above Average	532 (32.6%)	304 (29.4%)	228 (38.1%)	
Unknown	62 (3.8%)	30 (2.9%)	32 (5.4%)	
Readmission National Comparison				0.82
Below Average	548 (33.6%)	344 (33.3%)	204 (34.1%)	
Average	481 (29.5%)	303 (29.3%)	178 (29.8%)	
Above Average	547 (33.5%)	348 (33.7%)	199 (33.3%)	
Unknown	55 (3.4%)	38 (3.7%)	17 (2.8%)	
Patient Experience National Comparison				0.002
Below Average	611 (37.5%)	405 (39.2%)	206 (34.4%)	
Average	505 (31%)	300 (29%)	205 (34.3%)	
Above Average	476 (29.2%)	312 (30.2%)	164 (27.4%)	
Unknown	39 (2.4%)	16 (1.5%)	23 (3.8%)	
Timeliness of Care National Comparison				<0.001
Below Average	627 (38.4%)	439 (42.5%)	188 (31.4%)	
Average	626 (38.4%)	390 (37.8%)	236 (39.5%)	
Above Average	316 (19.4%)	159 (15.4%)	157 (26.3%)	
Unknown	62 (3.8%)	45 (4.4%)	17 (2.8%)	

Table 3
Unadjusted rates of postoperative outcomes stratified by Medicare patient-mix.

Variable	Total	Low/Average Medicare Patient-mix	High Medicare Patient-mix	p-value
Complication at Index	8578 (25.4%)	6700 (24.4%)	1878 (29.4%)	<0.001
In-hospital mortality	676 (2.5%)	219 (3.4%)	895 (2.7%)	<0.001
Length of Stay	7 (5, 10)	7 (5, 10)	7 (5, 11)	0.65
Discharge Destination				<0.001
Home	17,170 (50.8%)	14,109 (51.4%)	3061 (48%)	
Home with Home health care	9310 (27.5%)	7798 (28.4%)	1512 (23.7%)	
SNF	5438 (16.1%)	4140 (15.1%)	1298 (20.3%)	
Other	1911 (5.6%)	1400 (5.1%)	511 (8%)	
30-day Readmission	5073 (15%)	4110 (15%)	963 (15.1%)	0.82
30-day Mortality	1813 (5.4%)	1303 (4.7%)	510 (8%)	<0.001
Medicare expenditure (USD)	19,468 (14,770, 31,829)	19,981 (15,219, 32,422)	16,975 (12,804, 29,422)	<0.001

90d, 90-day; LOS, length-of-stay; USD, United States dollar.

textbook outcome, a composite measurement of quality, after HP surgery was greater at major versus minor teaching hospitals.[11] In addition, this effect was largely mediated by HP specific procedural volume rather than teaching status alone.[11] Other work from our group has similarly demonstrated that national quality rankings or designations did not necessarily track with better outcomes.[12,13] Specifically, Safety Grade A and Magnet designation alone were not associated with higher odds of an optimal composite outcome following HP surgery.[12] Rather, compliance with Leapfrog volume criteria was associated with lower odds of serious complications and mortality. In a different study, Dimick and colleagues also reported that among Medicare patients undergoing bariatric surgery, there was no difference in the rates of complications and reoperation before versus after the Centers for Medicare & Medicaid Services policy of restricting coverage to centers of excellence.[14] Data from the current study were consistent with these previous reports and highlight how verification programs or designations of "centers of excellence" can sometimes provide patients and payers misplaced assurances about quality and actual clinical outcomes. Given that data in the current study, as well as previous reports, have failed to associate national quality rankings or center designation with outcomes, caution needs to be exercised in adopting such a policy. To this point, while attempts to provide certain centers with "geriatric verification" is laudable, efforts should be directed at development of evidence-based practice guidelines, age-specific interventions, as well as ensuring adequate procedure volume to optimize surgical care.

Several limitations should be considered when interpreting results from the current study. Given that the data on all admissions were derived from Medicare, the findings may not be generalizable to a non-Medicare cohort. As such, these results should be compared with non-Medicare patients to understand the generalizability of the results. The SAFs were derived from administrative billing database and, as such, lacked patient-reported outcomes that may be important. Additionally, information on the structures and processes at hospitals including the availability of support services such as gerontological social workers, or geriatricians was not able to be ascertained in the current dataset. Due to limitations of ICD-10 procedure codes we were not able to adjust for extent of surgery/resection. We also dichotomized the primary independent variable for ease of conceptualization of the results, as well as to eliminate possible modeling issues if the effect of Medicare payer-mix was not linear; however, it was possible that more granular categorizations may find more pronounced effects of Medicare payer-mix.

Table 4
Multivariable Regression assessing the association of hospital's Medicare patient-mix and outcomes of interest following HP surgery.

Outcome	High Medicare Patient-mix	
	OR	95%CI
In-hospital mortality	1.16	0.96–1.39
Complication	1.13	1.04–1.22
Extended LOS	1.04	0.97–1.10
30-day Mortality	1.37	1.23–1.53
30-day Readmission	1.00	0.92–1.09
Expenditure	0.98	0.95–1.01

HP, hepatopancreatic; LOS, length-of-stay; OR, odds ratio.

In conclusion, while hospitals caring for a higher number of Medicare beneficiaries generally performed better on national quality benchmark indicators, these findings did not equate to improved post-operative outcomes following HP surgery for aged patients. Rather, Medicare beneficiaries undergoing HP surgery at hospitals serving a high number of Medicare beneficiaries had worse post-operative outcomes. The reason for this was undoubtedly multifactorial and was likely mediated through lower HP procedure volumes at those institutions. Future efforts should aim to ensure adequate and equitable care for aged patients at hospitals that have the appropriate surgery-specific volume, as well as age-specific resources (e.g. geriatric surgery nurse champions, geriatric-friendly rooms, etc.) so as to optimize outcomes for this growing population.

Declaration of competing interest

WE HAVE NO CONFLICTS OF INTEREST.

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