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ORIGINAL ARTICLE

Assessment of health care cost for complex surgical patients: review of cost, re-imbursement and revenue involved in pancreatic surgery at a high-volume academic medical centre

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Abstract

Background: Pancreatic surgery is complex with the potential for costly hospitalization.

Methods: A retrospective review of patients undergoing a pancreatic resection was performed.

Results: The median age of the study population was 64 years. Half of the cohort was female (51%), and the majority were white (62%). Most patients underwent a pancreaticoduodenectomy (PD) (69%). The pre-operative age-adjusted Charlson comorbidity index was zero for 36% ($n = 50$), 1 for 31% ($n = 43$) and ≥2 for 33% ($n = 45$). The Clavien–Dindo grading system for post-operative complication was grade I in 17% ($n = 24$), whereas 45% ($n = 62$) were higher grades. The medians direct fixed, direct variable, fixed indirect and total costs were $2476, $15 397, $13 207 and $31 631, respectively. There was a positive contribution margin of $7108, whereas the net margin was a loss of $6790. On univariate analyses, age, type of operation and complication grade were associated with total cost ($P \leq 0.05$), whereas operation type and complication grade were associated with a net margin ($P = 0.01$). These findings remained significant on multivariate analysis ($P < 0.05$).

Conclusions: Increased cost, reimbursement and revenue were associated with type of operation and post-operative complications.

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Introduction

The United States of America has the most expensive healthcare delivery system in the world.[1] A significant portion of this cost (29%) is spent on the care of surgical patients. Surgery cost is expected to reach $912 billion/year, 7.3% of the US GDP, by 2025.[2] In response to rising health care costs, the *Affordable Care Act* has placed significant emphasis on cost control including the development of bundled payment systems led by the Center for Medicare and Medicaid Innovation.[3,4] In spite of the emphasis on cost control, there is little data on the factors associated with the cost, reimbursement and revenue for complex surgical procedures. In this context, investigating pancreatic surgical procedures, in terms of cost factors, may provide some insights.[5–8]

Limited data exist describing the interaction between costs, charges and reimbursement involved in pancreatic surgery. Most of the earlier reports, investigating the expenses related to pancreatic surgery, report charges. However, this is an inaccurate representation of hospital financials, because charges do not reflect actual costs and can significantly vary between institutions.[9,10] Current literature provides information on total costs associated with pancreatic surgery;[11–13] however, there is sparse data showing the cost breakdown and even fewer data on reimbursement and revenue.

The cost of pancreatic surgery has been found to be associated with complications, surgeon experience, post-operative pathways, volume and type of operation. For example, post-operative complications have been found to be consistently associated with increased hospital costs.[8,14,15] In contrast, factors associated with decreased costs include hospital volume,[15] clinical pathways[16] and surgeon experience.[17]

Although Vollmer reported significant programmatic revenue for a high-volume programme, he did not describe the

Table 1 Cost and revenue for patients undergoing pancreatic surgery, 2008–2012

Cost variable	Range (in $)	Median (in $)	Mean ± SD (in $)
Direct Fixed	543–16 080	2 476	3 205 ± 2 467
Direct Variable	3 944–169 431	15 397	21 198 ± 22 759
Fixed Indirect	3 365–133 591	13 207	18 467 ± 17 376
Total Cost	8 487–319 102	31 631	42 869 ± 42 218
Contribution Margin[a]	45 024–71 592	7 108	7 350 ± 14 380
Net Margin[a]	161 040–32 168	(6 790)	(11 467) ± 25 843

[a]For Medicare patients only.

relationship between clinical factors and revenue.[18] To the best of our knowledge, we report here the first study to examine the association between clinical factors and revenue in patients undergoing a pancreatic resection. Given the limited data in the literature on cost, reimbursement and revenue for patients undergoing a major pancreatic resection, we sought better definitions of these factors. We studied patients in a prospective database from a high-volume tertiary teaching hospital. The objective of the study was to investigate whether there is any association of patients and provider characteristics with cost of *hospital* care.

Methods

Data source and collection

A retrospective chart review was performed identifying all patients who underwent pancreatic surgery between 2008 and 2012 at Vidant Medical Center (VMC), Greenville, North Carolina. Patients who underwent pancreatic surgery for both non-malignant and malignant processes were included. Patient demographics, operative factors and financial data were obtained. Patient demographics included age, gender, ethnicity, body mass index (BMI), history of tobacco use and comorbidities. The age-adjusted Charlson comorbidity index (ACCI) was calculated for each patient. Operative factors included type of surgery [pancreaticoduodenectomy (PD) or distal pancreatectomy splenectomy (DPS)], operating surgeon, length of stay (LOS), post-operative complications and discharge *destination*. The Clavien–Dindo grading system was used to classify surgical complications.[19] The cost variables, including direct fixed cost, direct variable cost, indirect fixed cost and total cost (defined below), were obtained for each patient from Allscripts EPSi software (Allscript, Raleigh, NC, USA). Cost only includes those accrued at index admission (both pre- and post-operatively). Readmission data are not included. Hospital reimbursement data were only available for Medicare patients.

ACCI is a scoring method for comorbid conditions described by Charlson,[20] with additional points added for every decade over 40 years of age.[21] The Clavien–Dindo grading system classifies post-operative complications as degree of complication from I–V and the level of therapy required in managing the complication. A grade I complication is defined as any deviation from the normal post-operative course, not requiring any interventions. Grade II and grade III complications require either pharmacological or procedural interventions, respectively. Grade IV complication are life-threatening complications, while patient death is assigned as grade V.[5]

Direct costs are the expenses directly related to patient care. Direct fixed costs are non-variable expenses inherent to running a functioning hospital (i.e. buildings, salaries and equipment). Variable direct costs are those that vary with patient activity (i.e. medications, medical tests or surgical equipment). Indirect costs are expenses not directly related to patient care, but associated with non-revenue producing areas of the hospital (i.e. financial services department and informational technology).[22,23] Total costs are the sum total of direct fixed costs, direct variable cost and indirect cost. The contribution margin is the reimbursement minus the direct costs. Net margin is the contribution margin minus indirect costs.

Statistical analysis

Patient demographic, operative and financial variables are represented as mean, median and/or percentage as necessary. Student's t-test or χ^2-test were used to perform univariate analyses where appropriate. Variables with a $P \leq 0.20$ on univariate analysis were included in logistic regression models. A value of $P \leq 0.05$ was defined as statistically significant. Analysis was conducted using JMP® Pro version 10.0.0; 2012 (SAS Institute Inc., Cary, NC, USA).

Results

Patient population

In the period between 2008 and 2012, 138 patients met the inclusion criteria. Table 1 summarizes the characteristics of the study population. The mean and median ages of the patient population were 63 ± 12.8 and 64 years (range 17–90), respectively. Patients were divided based on age into the following groups: <50 ($n = 18$, 13%), 50–59 ($n = 32$, 23%), 60–69 ($n = 42$, 30%), 70–79 ($n = 30$, 22%) and ≥80 years ($n = 16$, 12%). The majority of the patients were female (51%), white (62%) and smokers (57%). The mean and median BMI were 28 ± 6.5 and 28 kg/m^2 (range 12–49), respectively. There was a nearly equal representation of patients in each of the ACCI categories: 0 (36%), 1 (31%) and ≥2 (33%).

A PD was performed in 95 patients (69%), whereas a DPS was performed in the remaining 43 patients (31%). One surgeon (attending 'A') performed 38 operations (28%), whereas a second surgeon (attending 'B') performed 83 operations (60%); the remaining 17 operations (12%) were performed by six other surgeons. Although no post-operative complications were observed in 52 patients (38%), the remaining 86 patients (62%) had a Clavien–Dindo grade I or greater post-operative complication. To follow are the numbers of patients found with different grades of complication: 24 patients (17%) with a grade I complication, 49 patients (36%) with a grade II complication, 3 patients (2%) with a grade IV complication and 10 patients (7%) with a grade V complication. The mean and median LOS was 16 and 11 days (range 1–100), respectively. The majority of patients, n = 101 (73%), were discharged home with 19 (19%) patients requiring home health care. Ninety-six patients (70%) were Medicare and Medicaid patients. Reimbursement data were available for 77 (80%) Medicare patients.

Hospital cost for the entire population and margins for medicare patients

Table 1 presents the medians of different *hospital* costs for the entire study population. The median direct fixed cost was $2476 (range $543 – $16 080), whereas the median direct variable cost, median total direct cost and median indirect cost were $15 397 (range $3944–$169 431), $18 268 (range $4548–$185 511) and $13 207 (range $3365–$133 591), respectively. The median total cost was $31 631 (range $8487–$319 102). The median contribution margin and net margin were $7108 (range –$42 024–$71 592) and –$6790 (range –$161 040–$32 168), respectively.

Univariate analysis

Univariate analysis revealed significant associations of provider, type of operation and Clavien–Dindo grade of complication with fixed and variable direct *hospital* costs. However, indirect *hospital* costs are significantly associated with only type of operation and grade of complication ($P < 0.0001$) with (Table 2). None of the factors were significantly associated with contribution margin, whereas type of operation and grade of complication were significantly associated with net *hospital* margin ($P = 0.01$) (Table 3).

Multivariate analysis

On logistic regression analysis, increased direct fixed *hospital* cost was found to be independently associated with age of the patient ≥80 years [odds ratio (OR): 4.87, $P = 0.05$] and post-operative complications greater than grade I (OR: 5.00, $P = 0.0001$). We found increased direct variable *hospital* cost to be associated with operative complications greater than a grade I (OR: 5.19, $P = 0.0001$) and pancreaticoduodenectomy (OR: 3.88, $P = 0.003$). In contrast, grade I (OR: 3.98, $P = 0.02$) or greater (OR: 6.95, $P \leq 0.0001$) post-operative complications and PD (OR: 4.69, $P = 0.0006$) were significantly associated with a higher indirect *hospital* cost. An increased total *hospital* cost of care remained independently associated with increasing age ($P \leq 0.04$), grade I (OR: 3.20, $P = 0.04$) or greater (OR: 6.65, $P < 0.0001$) post-operative complication, and PD (OR: 3.73, $P = 0.004$) (Table 4). Multivariate analysis, *that included all factors with a* $P \leq 0.20$ *on univariate*, showed an increased net margin to be significantly associated with a distal pancreatectomy (OR: 5.06, $P = 0.01$) and patients with no post-operative complications (OR: 3.81, $P = 0.02$) (Table 5).

Discussion

Pressure to curtail healthcare expenditure together with the looming implementation of bundled payments makes it imperative that surgeons understand the cost of care and potential implications on the dynamics of hospital finance.[4] In this study, we found that increased *hospital* cost was associated with advanced age, complications and type of pancreatic surgery; however, only complications and type of operation were found to be associated with *hospital* reimbursement. Although our pancreatic programme had a positive *hospital* contribution margin, the programmatic net *hospital* margin was a negative $6790 per patient. Total *hospital* cost (direct plus indirect cost) was independently associated with patient age, complications and type of operation.

The above findings are consistent with previous reports.[11,12] Wilson and Lightwood also found that older patients had greater total medical care costs for pancreatic surgery.[24] In addition, multiple investigators have demonstrated that total costs increase with complications.[11–13,25] We found that a PD was associated with a significantly increased total cost. Given the complex nature of a PD in comparison with a distal pancreatectomy, this finding is not unexpected. However, there are surprisingly very little data directly comparing the cost between a PD and distal pancreatectomy. Cecka found that a greater number and severity of complications were associated with an increased cost of care, but no difference in costs was found when comparing a PD and distal pancreatectomy.[7] In contrast, Pratt reported an increase in the cost for a PD compared with a distal pancreatectomy.[26]

Direct costs or those costs, directly related in providing medical care to a specific patient,[18] are thought to be a more accurate representation of true cost. Trends are similar to those associated with the total cost of care. We found that direct costs were also associated with increased complications and type of operation. The median direct cost was $18 268, ranging from $4548 to $185 511. Although Enestvedt and colleagues described a greater median direct cost of $30 937, they also identified a range in costs based on complications, for example, patients with major complications had a median cost of $56 224 versus $29 038 for those without a complication ($P < 0.001$).[27]

Direct costs can be further divided into fixed and variable costs. Fixed direct costs are set costs related to a hospital's basic function (i.e. physical plant, salaries, and equipment). Variable direct costs are those that vary with patient activity such as medications, medical tests or surgical equipment.[22,23] In order to better assess how patient care for pancreatic surgery specifically affects the

Table 2 Univariate analysis of factors associated with direct, indirect and total cost for patients undergoing a pancreatic resection, 2008–2012

Total		Direct fixed			Direct variable			Fixed indirect			Total Cost		
		≥2500	<2500	*P*	≥15400	<15400	*P*	>13200	≤13200	*P*	>32000	<32000	*P*
		N (%)	N (%)		N (%)	N (%)		N (%)	N (%)		N (%)	N (%)	
		68	70		69	69		69	69		67	71	
Age	<50	5 (27.8)	13 (72.2)	0.14	6 (33.3)	12 (66.7)	0.12	5 (27.8)	13 (72.2)	0.06	3 (16.7)	15 (83.3)	0.008
	50–59	16 (50)	16 (50)		17 (53.1)	15 (46.9)		18 (56.3)	14 (43.7)		18 (56.3)	14 (43.7)	
	60–69	19 (45.2)	23 (54.8)		17 (40.5)	25 (59.5)		17 (40.5)	25 (59.5)		17 (40.5)	25 (59.5)	
	70–79	17 (56.7)	13 (43.3)		20 (66.7)	10 (33.3)		19 (63.3)	11 (36.7)		19 (63.3)	11 (36.7)	
	>= 80	11 (68.8)	5 (31.2)		9 (56.3)	7 (43.7)		10 (62.5)	6 (37.5)		10 (62.5)	6 (37.5)	
Gender				0.50			0.86			0.39			0.62
	Male	35 (52.2)	32 (47.8)		34 (50.8)	33 (49.2)		36 (53.7)	31 (46.3)		34 (50.8)	33 (49.2)	
Race	White	40 (47.1)	45 (52.9)	0.67	42 (49.4)	43 (50.6)	0.32	43 (50.6)	42 (49.4)	0.86	43 (50.6)	42 (49.4)	0.39
	AA	26 (54.2)	22 (45.8)		26 (54.2)	22 (45.8)		23 (47.9)	25 (52.1)		23 (47.3)	25 (52.1)	
	Other	2 (40)	3 (60)		1 (20)	4 (80)		3 (6)	2 (40)		1 (20)	4 (80)	
BMI				0.95			0.80			0.68			0.67
	Mean	28.0	28.0		28.2	27.9		28.3	27.8		28.4	27.8	
Smoking	Yes	37 (46.8)	42 (53.2)	0.51	38 (48.1)	41 (51.9)	0.61	35 (44.3)	44 (55.7)	0.12	35 (44.3)	44 (55.7)	0.25
	No	31 (52.5)	28 (47.5)		31 (52.5)	28 (47.5)		34 (57.6)	25 (42.4)		32 (54.2)	27 (45.8)	
Provider	A	25 (65.8)	13 (34.2)	0.04	26 (68.4)	12 (31.6)	0.02	23 (60.5)	15 (39.5)	0.31	23 (60.5)	15 (39.5)	0.21
	B	37 (44.6)	46 (55.4)		35 (42.2)	48 (57.8)		38 (45.8)	45 (54.2)		36 (43.4)	47 (56.6)	
	Other	6 (35.3)	11 (64.7)		8 (47.1)	9 (52.9)		8 (47.1)	9 (52.9)		8 (47.1)	9 (52.9)	
Operation	Whipple	54 (56.8)	41 (43.2)	0.008	57 (60)	38 (40)	0.0004	58 (61.1)	37 (39.0)		56 (59.0)	39 (41.0)	
	DP	14 (32.6)	29 (67.4)		12 (27.9)	31 (72.1)		11 (25.6)	32 (74.4)		11 (25.6)	32 (74.4)	
ACCI	0	22 (44)	28 (56)	0.63	25 (50)	25 (50)	0.98	25 (50)	25 (50)	0.98	23 (46)	27 (54)	0.88
	1	23 (53.5)	20 (46.5)		22 (51.2)	21 (48.8)		21 (48.8)	22 (51.2)		21 (48.8)	22 (51.2)	
	≥2	23 (51.1)	22 (48.9)		22 (48.9)	23 (51.1)		23 (51.1)	22 (48.9)		23 (51.1)	22 (48.9)	
C–D	0	14 (26.9)	38 (73.1)	<0.001	16 (30.8)	36 (69.2)	<0.001	13 (25)	39 (75)	<0.001	13 (25)	39 (75)	<0.001
Grade	I	12 (50.0)	12 (50.0)		9 (37.5)	15 (62.5)		12 (50)	12 (50)		11 (45.8)	13 (54.2)	
	>I	42 (67.7)	20 (32.3)		44 (71.0)	18 (29.0)		44 (71.0)	18 (29.0)		43 (69.4)	19 (30.7)	

AA, African American; BMI, body mass index; DP, distal pancreatectomy; ACCI, age-adjusted Charlson Comorbidity Index; C-D, Clavien–Dindo.

direct cost of care, we performed a separate cost analysis for fixed and variable direct costs. As expected, variable direct costs increased with complications and type of operation. Other investigators have also reported a higher variable direct cost for patients with complications after a pancreaticoduodenectomy;[25,27] factors that contributed to this increase were radiological tests, medications, laboratory tests and inpatient bed use.[25] To the best of our knowledge, the present study is the first to report the association of fixed direct costs with pancreatic surgery. We identified that elderly patients and those with complications had the highest direct fixed cost of care. In our patient population, the increase in the fixed cost for elderly patients and those with complications may be secondary to an increase in the LOS resulting in a greater allocation of direct fixed costs.[22]

Indirect costs are those not directly related to individual patient care, but are associated with the non-revenue-producing areas of the hospital such as administration, financial services department and information technology.[23] As mentioned before, most of the previous studies assessing the cost for pancreatic surgery focus either on the total cost or direct cost of care, with no specific analysis related to the indirect costs. We found, interestingly, that both complications and a more complex surgery (PD versus DPS) also increased indirect costs. Therefore, patients who had complications not only had an increased cost of care related specifically to providing care for these complications, but also had to bear indirect hospital costs. Although the exact nature of indirect cost is somewhat ethereal, this additional cost (about 50% of the total cost) profoundly impacts the net margin.

Table 3 Factors associated with various median re-imbursement: univariate analysis

Total		Contribution margin			Net margin		
		≥6175	<6175	*P*-value	≥ (6512)	< (6512)	*P*-value
		N (%)	*N* (%)		*N* (%)	*N* (%)	
		48 (50.0)	48 (50.0)		48 (50.0)	48 (50.0)	
Age by decade	<50	0	0	0.70	0	0	0.69
	50–59	2 (50.0)	2 (50.0)		3 (75.0)	1 (25.0)	
	60–69	12 (42.9)	16 (57.1)		15 (53.6)	13 (46.4)	
	70–79	17 (58.6)	12 (41.4)		14 (48.3)	15 (51.7)	
	≥80	8 (50)	8 (50)		7 (43.8)	9 (56.3)	
Gender	Male	21 (55.3)	17 (44.7)	0.42	21 (55.3)	17 (44.7)	0.42
Race	White	25 (50.0)	25 (50.0)	0.47	24 (48.0)	26 (52.0)	0.45
	AA	14 (53.9)	12 (46.1)		14 (53.9)	12 (46.2)	
	Other	0	1 (100.0)		1 (100.0)	0	
BMI	Mean	26.9 ± 5.97	27.4 ± 5.64	0.70	27.3 ± 5.62	27.0 ± 5.99	0.81
Smoking	Yes	23 (52.3)	21 (47.7)	0.74	21 (47.7)	22 (52.3)	0.55
	No	16 (48.5)	17 (51.5)		18 (54.6)	15 (45.4)	
Provider	A	6 (33.3)	12 (66.7)	0.24	7 (38.9)	11 (61.1)	0.20
	B	28 (56.0)	22 (44.0)		29 (58.0)	21 (42.0)	
	Other	5 (55.6)	4 (44.4)		3 (33.3)	6 (66.7)	
Operation	Whipple	30 (52.6)	27 (47.4)	0.56	24 (42.1)	33 (57.9)	0.01
	DP	9 (45.0)	11 (55.0)		15 (75.0)	5 (25.0)	
ACCI	0	12 (50.0)	12 (50.0)	0.92	10 (41.7)	14 (58.3)	0.23
	1	11 (47.8)	12 (52.2)		15 (65.2)	8 (34.8)	
	≥2	16 (53.3)	14 (46.7)		14 (46.7)	16 (53.3)	
C–D Grade	0	16 (51.6)	15 (48.4)	0.96	22 (71.0)	9 (29.0)	0.01
	I	6 (50.0)	6 (50.0)		5 (41.7)	7 (58.3)	
	>I	17 (50.0)	17 (50.0)		12 (35.3)	22 (64.7)	

AA, African American; BMI, body mass index; DP, distal pancreatectomy; ACCI, Age-adjusted Charlson Comorbidity Index; C–D, Clavien-Dindo.

Table 4 Factors associated with increased cost for each of the various cost variables: logistic regression

Variables		Direct fixed cost		Direct variable cost		Indirect cost		Total cost	
		OR	*P*	OR	*P*	OR	*P*	OR	*P*
Age	<50 (Ref)	1		1		1		1	
	50–59	2.4 (0.6–9.8)	0.20	1.8 (0.5–7.2)	0.40	3.6 (0.9–16.8)	0.08	7.0 (1.6–39.2)	0.009
	60–69	2.0 (0.6–7.8)	0.30	0.9 (0.2–3.5)	0.86	1.5 (0.4–6.5)	0.60	3.3 (0.8–17.7)	0.11
	70–79	3.0 (0.8–12.6)	0.11	2.9 (0.7–12.4)	0.14	4.0 (0.9–19.4)	0.06	8.5 (1.9–49.0)	0.005
	≥80	4.9 (1.0–26.8)	0.05	1.6 (0.3–8.6)	0.57	2.1 (0.4–12.2)	0.41	5.9 (1.1–39.3)	0.04
Provider	Other (Ref)	1		1		–	–	–	–
	Attending B	1.0 (0.3–3.7)	0.96	0.5 (0.1–1.9)	0.33	–	–	–	–
	Attending A	2.8 (0.7–11.4)	0.14	2.1 (0.5–8.5)	0.31	–	–	–	–
C–D Grade	0 (Ref)	1		1		1		1	
	I	2.7 (0.9–8.0)	0.08	1.2 (0.4–3.7)	0.81	4.0 (1.3–13.2)	0.02	3.2 (1.0–10.3)	0.04
	>I	5.0 (2.2–12.1)	<0.001	5.2 (2.2–13.0)	0.0001	7.0 (2.9–17.9)	<0.0001	6.7 (2.8–16.9)	<0.0001
Operation	DP (Ref)	1		1		1		1	
	Whipple	2.1 (0.9–5.0)	0.09	3.3 (1.6–10.4)	0.003	4.7 (1.9–12.4)	0.0006	3.3 (1.5–9.7)	0.004

OR, odds ratio; DP, distal pancreatectomy; C–D, Clavien–Dindo.

Table 5 Factors associated with a greater net margin: logistic regression

		OR	95% CI	*P*-value
Provider	Other (Ref)	1		
	Attending A	1.98	0.32–14.66	0.47
	Attending B	4.55	0.89–29.42	0.07
Operation	Whipple	1		
	DP	5.06	1.45–21.18	0.01
C-D Grade	>I	1		
	I	0.60	0.11–2.74	0.52
	0	3.81	1.28–12.12	0.02

OR, odds ratio; CI, confidence interval; DP, distal pancreatectomy; C–D, Clavien–Dindo.

As mentioned earlier, the net margin is calculated by subtracting the total cost (direct and indirect) from reimbursement. Reimbursement is the actual payment received from the payer; in this study we have data only for the Medicare patients. *Contribution margin (gross profit) can also be calculated by subtracting the direct costs from reimbursement*.[18] We found the median contribution margin per patient to be $7108. However, when indirect costs were included for patients with Medicare, we found a loss of $6790 per patient. *One must be mindful that the indirect costs may be variable across institutions as a result of local management patterns*. Vollmer also described a similar dramatic effect of indirect costs in their pancreatic programme, a decrease in the contribution margin; after factoring in indirect costs, the contribution margin of $6 million was decreased by $4 million dollars to a net margin of $2 million per year.[18]

There are inherent limitations to our data because of its retrospective nature. Reimbursement data were only available for Medicare patients. As a result of the lack of reimbursement data for patients with private insurance (28%), our findings do not reflect the overall programme margins. In addition, the data also lacked readmission costs and costs related to the non-surgical care and work-up of these patients, all of which might have a significant effect on both costs and revenue.

Based on the above findings, we conclude that complex gastrointestinal surgeries such as pancreatic resections are intricate both medically and financially. Components of *hospital* cost and revenue include direct costs (fixed and variable), indirect costs, contribution margin and net margin. Factors associated with increased *hospital* cost included patient age, type of operation and post-operative complications. For Medicare patients, who underwent pancreatic surgery, the hospital had a net negative margin of $6790 per patient. In order to minimize loss or sustain a pancreatic programme at Medicare rates, efforts must be directed in preventing or mitigating post-operative complications.

Conflicts of interest

None declared.

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