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Relative value units poorly correlate with measures of surgical effort and complexity

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ABSTRACT

Background: The relationship between procedural relative value units (RVUs) for surgical procedures and other measures of surgeon effort are poorly characterized. We hypothesized that RVUs would poorly correlate with quantifiable metrics of surgeon effort.

Methods: Using the 2010 American College of Surgeons - National Surgical Quality Improvement Program (NSQIP) database, we selected 11 primary current procedural terminology codes associated with high volume surgical procedures. We then identified all patients with a single reported procedural RVU who underwent nonemergent, inpatient general surgical operations. We used linear regression to correlate length of stay (LOS), operative time, overall morbidity, frequency of serious adverse events (SAEs), and mortality with RVUs. We used multivariable logistic regression using all preoperative NSQIP variables to determine other significant predictors of our outcome measures.

Results: Among 14,481 patients, RVUs poorly correlated with individual LOS ($R^2 = 0.05$), operative time ($R^2 = 0.10$), and mortality ($R^2 = 0.35$). There was a moderate correlation between RVUs and SAEs ($R^2 = 0.79$) and RVUs and overall morbidity ($R^2 = 0.75$). However, among low- to mid-level RVU procedures (11–35) there was a poor correlation between SAEs ($R^2 = 0.15$), overall morbidity ($R^2 = 0.05$), and RVUs. On multivariable analysis, RVUs were significant predictors of operative time, LOS, and SAEs (odds ratio 1.06, 95% confidence interval: 1.05–1.07), but RVUs were not a significant predictor of mortality (odds ratio 1.02, 95% confidence interval: 0.99–1.05).

Conclusions: For common, index general surgery procedures, the current RVU assignments poorly correlate with certain metrics of surgeon work, while moderately correlating with others. Given the increasing emphasis on measuring and tracking surgeon productivity, more objective measures of surgeon work and productivity should be developed.

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1. Introduction

As a result of the development of a fee-for-service model for determining medicare reimbursement [1], relative value units (RVUs) have become a metric of physician work and productivity. Currently, the assignment of RVUs is under the discretion of a select committee known as the RUC (Relative Value Scale Update Committee), which has substantial influence in

determining RVU levels. Moreover, this committee is constrained by medicare budgetary restrictions, which effectively force them to decrease the RVU levels of some services when it recommends raising the RVU level of other services. Consequently, the process of assigning RVUs is highly subjective and predisposed to significant external forces [2]. Moreover, there is concern that RVU levels may not accurately reflect a surgeon's work, productivity, or "value" to his or her department, hospital, or community.

Given the increasing emphasis on measuring and tracking surgeon productivity, we sought to determine if primary procedure RVUs among general surgical operations would correlate with other markers of surgeon work. As our main outcome variables we chose to analyze operative time, length of stay (LOS), and morbidity and mortality rates, because these are proxies for the physical and cognitive time invested by surgeons in the care of their patients. We hypothesized that there would be poor correlation between primary procedure RVUs and these endpoints.

2.   Methods

The 2010 American College of Surgeons National Surgical Quality Improvement Program database was queried for all patients who underwent nonemergent, inpatient general surgical operations as defined by a LOS ≥1 d. We identified frequently represented primary procedural RVUs to arrive at eleven commonly performed general surgical procedures that represented the full breadth of surgical complexity. As depicted in the Table, to sample as diverse a group of procedures as possible across the RVU continuum, we included laparoscopic and open procedures, oncologic and non-oncologic procedures, and visceral *versus* nonvisceral procedures. To avoid skewing our data toward high volume, low RVU procedures, we chose to exclude appendectomy and cholecystectomy because these procedures appeared to dominate the dataset and therefore diluted the results and significance of other procedures. In addition, these two procedures were excluded to avoid possible heterogeneity in

patient and procedure risk factors associated with emergent operations compared with elective procedures.

To avoid possible confounding of our data from the effect of multiple procedures with overlapping and/or additive morbidities, we limited our cases to those where only one procedure was performed. We also excluded patients who were American Society of Anesthesiologists 1 or ≥4 to reduce the impact of co-morbid disease on our observed outcome variables. We were not able to capture data on the variation in hospital readmission or complications after 30 d by procedure or RVU level. We were not able to capture data on the number of postoperative visits or the generation of additional RVUs in the 90-d global period because of additional evaluation and management coding or for the surgical management of postoperative complications.

Linear regression was used to correlate operative time and LOS with RVUs. For this part of our analysis, patients who experienced any postoperative morbidity or mortality were excluded because the type and severity of the morbidity could function as a modifier variable and affect operative time and LOS independent of RVU. Multivariable linear regression using all preoperative NSQIP variables was then used to determine whether RVUs were significant predictors of these outcome variables. Descriptive statistics were used to analyze frequency of overall 30-d morbidity, SAEs, and mortality per primary procedural RVU. These outcomes were included as outcome variables in our analysis because the evaluation and management postoperative morbidity and mortality require time, work, and effort.

SAEs were defined as the presence of one or more of the following: organ space infection, wound dehiscence, septic shock, myocardial infarction, cardiac arrest, cerebrovascular accident, coma, renal failure, pneumonia, reintubation, pulmonary embolism, or bleeding [3,4]. We also performed multivariable logistic regression using all preoperative NSQIP variables, including RVUs, to determine if RVUs were significant predictors of overall morbidity, SAEs, and mortality. Missing variables were excluded, and statistical analyses were performed using STATA.

Because NSQIP patient information is deidentified, this study was exempt from the University of California, Davis Institutional Review Board approval.

Table – Case mix, operative time, LOS, morbidity, and SAEs by RVUs. Only patients with a single RVU coded were included (N = 14,481).

RVU	CPT	Procedure	n (%)	*Median LOS (IQR)	*Median OR time (IQR)	Morbidity (%)	SAEs (%)	Mortality (%)
11.92	49560	Repair of first abdominal wall hernia	533 (4)	2 (1–4)	88.5 (57–128)	11	3	<1
15.85	19303	Simple mastectomy	639 (4)	1 (1–2)	89 (64–130)	6	2	<1
16.22	60240	Total thyroidectomy	1470 (10)	1 (1–1)	110 (83–145)	2	1	0
18.1	43280	Laparoscopic Nissen fundoplication	1043 (7)	2 (1–2)	111 (84–151)	4	3	<1
22.59	44140	Open partial colectomy	1487 (10)	5 (4–7)	109 (82–147)	23	14	2
26.42	44204	Laparoscopic partial colectomy	2245 (16)	4 (3–5)	128 (99–170)	15	8	<1
29.4	43644	Laparoscopic roux-n-y gastric bypass	6306 (44)	2 (2)	117 (88–152)	5	3	<1
35.14	43632	Distal gastrectomy with gastrojejunostomy	88 (1)	7 (5–8)	149 (115–190)	20	11	3
39.01	47120	Partial liver resection	250 (2)	4 (3–6)	151 (113–201.5)	25	22	<1
44.18	43107	Transhiatal esophagectomy	19 (<1)	9 (8–11)	223 (194–281)	32	21	5
52.84	48150	Whipple	401 (3)	8 (7–11)	351 (280.5–421)	45	35	2

CPT = current procedural terminology; IQR = interquartile range; OR = odds ratio.
*Only patients without any postoperative morbidity or mortality were included in these calculations.