Practice patterns of academic general thoracic and adult cardiac surgeons

Michael T. Ingram, Jr, MS,^a David H. Wisner, MD,^b and David T. Cooke, MD^{a,b}

Objective: We hypothesized that academic adult cardiac surgeons (CSs) and general thoracic surgeons (GTSs) would have distinct practice patterns of, not just case-mix, but also time devoted to outpatient care, involvement in critical care, and work relative value unit (wRVU) generation for the procedures they perform.

Methods: We queried the University Health System Consortium-Association of American Medical Colleges Faculty Practice Solution Center database for fiscal years 2007-2008, 2008-2009, and 2009-2010 for the frequency of inpatient and outpatient current procedural terminology coding and wRVU data of academic GTSs and CSs. The Faculty Practice Solution Center database is a compilation of productivity and payer data from 86 academic institutions.

Results: The greatest wRVU generating current procedural terminology codes for CSs were, in order, coronary artery bypass grafting, aortic valve replacement, and mitral valve replacement. In contrast, open lobectomy, video-assisted thoracic surgery wedge, and video-assisted thoracic surgery lobectomy were greatest for GTSs. The 10 greatest wRVU-generating procedures for CSs generated more wRVUs than those for GTSs ($P < .001$). Although CSs generated significantly more hospital inpatient evaluation and management (E & M) wRVUs than did GTSs ($P < .001$), only 2.5% of the total wRVUs generated by CSs were from E & M codes versus 18.8% for GTSs. Critical care codes were 1.5% of total evaluation and management billing for both CSs and GTSs.

Conclusions: Academic CSs and GTSs have distinct practice patterns. CSs receive greater reimbursement for services because of the greater wRVUs of the procedures performed compared with GTSs, and evaluation and management coding is a more important wRVU generator for GTSs. The results of our study could guide academic CS and GTS practice structure and time prioritization. (*J Thorac Cardiovasc Surg* 2014;148:1162-6)

In the community, mixed practice cardiothoracic surgeons are common. Nationally, surgeons defined as adult cardiac surgeons (CSs) perform 40% and 39% of pneumonectomies and lobectomies, respectively.¹ However, in a recent study, our group demonstrated that surgeons defined as general thoracic surgeons (GTSs) performed most of the complex noncardiac thoracic surgery performed in academic medical centers in the United States.²

The practice patterns of academic GTSs, which have tended to be elective and oncology based, might intuitively be expected to differ from the practice patterns of academic adult CSs, which have tended to be more inpatient based and critical care oriented, with more of an emergency or urgent patient population. We hypothesized that academic CSs and GTSs would have distinct practice patterns,

including case mix, time devoted to outpatient care, involvement in critical care, and work relative value unit (wRVU) generation. To test this hypothesis, we queried the Faculty Practice Solution Center (FPSC) database, a national US database used for collating coding and billing data from participating academic practices. Objective coding and billing data were used to determine the practice patterns of academic CSs and GTSs.

We sought to determine the relative importance of the evaluation and management (E & M)-generated wRVUs compared with procedural coding-generated wRVUs to CS and GTS academic practices and the contributions of critical care. The results of the present study might bring value to the thoracic surgery specialty by guiding academic CS and GTS practice structure and prioritization and be instructional for professional development.

METHODS

Database

The present study was a retrospective cohort analysis using the University Health System Consortium and Association of American Medical Colleges FPSC database. The FPSC database is a compilation of billing, coding, productivity, and payer data from 86 academic institutions (all affiliated with a Liaison Committee on Medical Education-accredited US medical school) and includes >60,000 physicians in multiple specialties, as described in previous reports.^{2,3} Only data from clinically active faculty who had spent >60% of clinical time in a specific clinical

From the Section of General Thoracic Surgery^a and Department of Surgery,^b University of California Davis Medical Center, Sacramento, Calif.

Disclosures: Authors have nothing to disclose with regard to commercial support.

Received for publication June 7, 2013; revisions received April 12, 2014; accepted for publication April 17, 2014; available ahead of print May 15, 2014.

Address for reprints: David Tom Cooke, MD, Section of General Thoracic Surgery, University of California Davis Medical Center, 2221 Stockton Blvd, Suite 2117, Sacramento, CA 95817 (E-mail: david.cooke@ucdavis.ucdmc.edu).

0022-5223/\$36.00

Copyright © 2014 by The American Association for Thoracic Surgery

<http://dx.doi.org/10.1016/j.jtcvs.2014.04.035>

Abbreviations and Acronyms

CABG	= coronary artery bypass grafting
CPT	= current procedural terminology
CS	= cardiac surgeon
E & M	= evaluation and management
FPSC	= Faculty Practice Solution Center
GTS	= general thoracic surgeons
wRVU	= work relative value unit

pursuit (eg, CS and GTS) were included in the benchmarking process. We queried the FPSC database for the 3 fiscal years 2007-2008, 2008-2009, and 2009-2010. Of the 796 faculty participants included for fiscal year 2007-2008, 257 were identified as academic GTSs and 539 as CSs. Of the 874 faculty participants included for fiscal year 2008-2009, 279 were academic GTSs and 595 were CSs. Finally, of the 933 faculty participants included for fiscal year 2009-2010, 303 were academic GTSs and 630 were CSs. The data collected were de-identified, and the centers had contributed voluntarily. The University of California Davis Medical Center institutional review board approved the present project.

Search Criteria

Current procedural terminology (CPT) codes were categorized as either procedural or E & M.⁴ The mean wRVUs and billing frequencies were abstracted for CSs and GTSs. The average wRVUs and billing frequencies for each CPT code were defined for the CSs and GTSs for the 3-year period. The most common procedures and procedures that generated the most wRVUs and the distribution of the procedural and E & M codes were determined for both CSs and GTSs. The frequency and wRVU generation for outpatient versus inpatient E & M coding and the frequency and wRVU generation of critical care E & M codes were also calculated for both groups.

Statistical Analysis

Student's *t* test was used when comparing the continuous variables between the 2 groups. The results from all *t* tests were considered statistically significant if $P \leq .05$. All statistical calculations and analyses were performed using Microsoft Excel for Windows 7 (Microsoft, Redmond, Wash).

RESULTS

Billing Frequency Characteristics

Of the 10 most frequently billed procedures from the CSs, all were cardiac-associated procedures (Table 1). For GTSs, only 1 of the top 10 most frequently billed procedures was cardiac in nature, coronary artery bypass grafting (CABG), single arterial graft. In order, the 3 most frequently billed procedures for CSs, expressed as 3-year averages, were CABG, single arterial graft; endoscopy, surgical, for CABG procedure (representing endoscopic vein harvest); and aortic valve replacement. Of the top 10 most frequent procedures for the CSs, 6 were CABG related, representing 30.1% of total CS procedures. For the GTSs, the top 3 in order were diagnostic bronchoscopy, regional thoracic lymphadenectomy, and mediastinoscopy. For the

GTSs, CABG, single arterial graft, was the 10th most frequent procedural code (13.2 cases annually; 1.8% of total procedures).

The inpatient versus outpatient distribution of E & M CPT codes was compared for the 2 disciplines (Figure 1). For GTSs, the office outpatient services for new or established patients constituted 81.8% of total E & M billing and was greater than that for the CSs (62.0%; $P = .01$). The hospital inpatient services represented a larger percentage of total E & M billing for CS practice (37.9%) than for GTS practice (18.2%, $P < .001$). For both CS and GTS, critical care services represented a small fraction of the total E & M billing (1.5% for both).

wRVU Characteristics

The average top wRVU generating procedural CPT and E & M codes for the study period are listed in Table 2. CABG, single arterial graft, was the greatest wRVU-generating code for CSs (15.4% of total) and [open] lobectomy, single lobe, the greatest for GTSs (7.4% of total procedural and E & M wRVUs). Within the top 10 wRVU-generating codes for CSs, none were E & M codes. In contrast, 3 of the top 10 codes for the GTSs were E & M codes, all generated in the outpatient setting. Nine of the top wRVU-generating CPT codes for the CSs were strictly cardiac procedures, with the 10th being exploration of the chest. Exploration of the chest was defined as exploration for post-operative hemorrhage, thrombosis, or infection.⁴ For the GTSs, CABG, single arterial graft, was the fourth greatest wRVU-generating code.

The 20 greatest wRVU-generating procedure codes for each specialty were analyzed as 3-year averages (Table 3). Of the top 20 procedures for the CS, 19 were purely cardiac in nature, with the 10th code, exploration of the chest, somewhat ambiguous regarding whether it applied to CS or GTS. For the GTSs, 3 of the top 20 greatest wRVU-generating procedures were cardiac surgical procedures. The 3 greatest wRVU-generating procedures for the CSs, in order, were CABG, single graft (2032.3 wRVUs), aortic valve replacement (1171.1 wRVUs), and mitral valve replacement (657.2 wRVUs). The 3 greatest wRVU-generating procedures for the GTSs, in order, were [open] lobectomy, single lobe (701.1 wRVUs); thoracoscopy, surgical, with wedge resection of the lung (454.3 wRVUs); and thoracoscopy, surgical, with lobectomy, total or segmental (384.1 wRVUs). CABG, single graft, was the fourth greatest wRVU-generating procedure for GTSs, with lobectomy and thoracoscopy not included in the top 20 for CSs.

Of the wRVUs generated by the top 50 procedural and E & M CPT codes for GTSs during the study period, 18.8% were generated by E & M codes compared with only 2.5% for CSs (Figure 2).

TABLE 1. Top 10 most frequently billed procedural codes per year per surgeon for fiscal years 2007-2010

TABLE 1. Top 10 most frequently listed procedural codes per year per surgeon for mean years 2007-2010						
Pt. no.	CS			GTS		
	Procedure	Average cases/y	% of total procedures	Procedure	Average cases/y	% of total procedures
1	CABG, single arterial graft*	68.8	11.1	Diagnostic bronchoscopy	76.6	10.2
2	Endoscopy, surgical, for CABG procedure*	51.3	8.3	Regional thoracic lymphadenectomy	42.2	5.6
3	AVR*	33.5	5.4	Mediastinoscopy	38.7	5.2
4	CABG, 2 venous grafts*	31.2	5.1	Thoracoscopy, surgical, with lung wedge resection	37.9	5.0
5	CABG, single vein graft*	18.8	3.0	Lobectomy, single lobe	28.2	3.7
6	Reoperation of CABG or valve procedure*	18.1	2.9	Bronchoscopy, with bronchial alveolar lavage	17.7	2.4
7	CABG, 3 venous grafts*	16.7	2.7	Thoracoscopy, surgical, with lobectomy	16.2	2.2
8	MVR*	14.3	2.3	Removal of lung, wedge resection	15.7	2.1
9	Repair of ASD*	12.1	2.0	Diagnostic endoscopy, upper GI	13.6	1.8
10	Unlisted cardiac surgery procedure*	11.5	1.9	CABG, single arterial graft*	13.2	1.8

Pt. no., Patient number; CS, cardiac surgery; GTS, general thoracic surgery; CABG, coronary artery bypass grafting; AVR, aortic valve replacement; MVR, mitral valve replacement; ASD, atrial septal defect; GI, gastrointestinal. *Adult cardiac surgical procedure.

DISCUSSION

Intuitively, it would seem logical that the practice patterns of academic GTSs, which have tended to be elective and oncology based, would differ from the practice patterns of academic CSs, which have tended to be more inpatient based and critical care oriented and concerned more with an emergency or urgent patient population. The results from our FPSC query demonstrated that the practice patterns do differ, not just in the obvious procedural mix, but also in wRVU generation and the importance of the outpatient clinic. Nationally, CSs perform a large amount of non-cardiac GTS. In a recent volunteer survey by Shemin and Ikonomidis⁵ of combined academic and community CSs, 37.4% of respondents stated they performed pulmonary procedures and 15.2% performed esophageal procedures. Our data, however, have illustrated that although academic CSs might perform some non-cardiac general thoracic procedures, they represent a small fraction of the billed clinical activity.

FIGURE 1. Percentage of total evaluation and management (E & M) work relative value units (wRVUs) for fiscal years 2007 to 2010. CS, Cardiac surgery; GTS, general thoracic surgery; NS, not significant. *Critical care services was also included in the hospital inpatient services.

Several reports have documented the decline of CABG rates in the previous decade.^{6,7} Mack et al⁶ reviewed the Hospital Corporation of America case mix database from 1999 through 2002 and found a 1.9% decline in CABG volume annually. Epstein et al⁷ abstracted the Healthcare Cost and Utilization Project Nationwide Inpatient Sample for 2001 through 2008 and found that the median CABG surgery caseload per hospital had decreased by 28% and the number of CABG surgery hospitals providing <100 CABG surgeries annually had increased from 11% to 26% during the study period. Despite the decline in surgical revascularization, CABG has remained a significant billing component of academic CS practices. For academic GTSs who perform adult cardiac surgery, most procedures have been coronary revascularization.

In our study, E & M coding represented 19% of wRVU generation for GTSs compared with only 2.5% for CSs. This most likely was attributable to the longitudinal outpatient component that is a part of most academic GTS practices, including, generally, 5 years of follow-up for resected thoracic oncologic disease processes such as lung cancer. Also, GTSs often play a critical outpatient multidisciplinary role in staging and formulating treatment algorithms for patients with suspected or newly diagnosed thoracic malignancy. In addition, the wRVUs generated from common CS procedures were much greater ($P < .001$) than were the wRVUs generated from GTS procedures.

Our results might provide insight for structuring CS and GTS practices to optimize efficiency. The outpatient clinic plays an important role in the wRVU generation of an academic GTS practice; therefore, perhaps the outpatient clinic should be guaranteed blocked, much the same as operating room time is blocked. For an academic CS practice, the outpatient clinic plays less of a role in wRVU generation, and the wRVU assignments of common adult cardiac procedures were so great, perhaps the CS focus

TABLE 2. Top wRVU-generating procedural and E & M codes annually per surgeon for fiscal years 2007 to 2010

Pt. no.	CS		GTS	
	Procedure	Total procedural and E & M wRVUs (%)	Procedure	Total procedural and E & M wRVUs (%)
1	CABG, single arterial graft*	15.4	Lobectomy, single lobe	7.4
2	Aortic valve replacement*	8.9	Thoracoscopy, surgical, with lung wedge resection	4.8
3	Mitral valve replacement*	5.0	Thoracoscopy, surgical, with lobectomy	4.1
4	Heart transplant*	3.4	CABG; single arterial graft*	4.0
5	Repair of mitral valve with prosthetic ring*	3.2	Removal of lung, wedge resection	3.7
6	Ascending aorta graft with or without valve suspension*	3.1	Mediastinoscopy	2.9
7	Reoperation of CABG or valve procedure*	2.9	Office consultation, new or established patient, level 4	2.7
8	Ascending aorta graft (with aortic root replacement using composite prosthesis and coronary reconstruction)*	2.8	Transhiatal esophagectomy	2.7
9	Repair of mitral valve, radical reconstruction with or without ring*	2.6	Office consultation, new or established patient, level 5	2.5
10	Exploration of chest	2.2	Office or outpatient visit, established patient, level 3	2.2

Pt. no., Patient number; CS, cardiac surgery; GTS, general thoracic surgery; E & M, evaluation and management; wRVUs, work relative value units; CABG, coronary artery bypass grafting. *Adult cardiac surgical procedure.

should be concentrated on inpatient activity. Thus, it might be more efficient for CSs to concentrate on new and high acuity patients in outpatient clinics, with more routine

postoperative and simple longitudinal follow-up examinations performed by midlevel providers such as nurse practitioners and physician assistants. These scenarios might be

TABLE 3. Top 20 greatest wRVU-generating procedures annually per surgeon for fiscal years 2007 to 2010

Pt. no.	CS		GTS	
	Procedure	Average wRVUs/y	Procedure	Average wRVUs/y
1	CABG; single arterial graft*	2032.3	Lobectomy, single lobe	701.0
2	Aortic valve replacement*	1171.1	Thoracoscopy, surgical, with wedge resection of lung	454.3
3	MVR*	657.2	Thoracoscopy, surgical, with lobectomy, total or segmental	384.1
4	Heart transplant*	454.5	CABG, single arterial graft*	381.4
5	Valvuloplasty, mitral valve*	422.5	Removal of lung, wedge resection	353.9
6	Ascending aorta graft*	415.5	Mediastinoscopy	273.2
7	CABG, 2 coronary arterial grafts*	388.5	Transhiatal esophagectomy	253.4
8	Ascending aorta graft*	374.0	Regional thoracic lymphadenectomy	202.33
9	Valvuloplasty, mitral valve*	350.2	Aortic valve replacement*	172.2
10	Exploration of chest	290.4	Diagnostic bronchoscopy	171.2
11	CABG, 2 venous grafts*	237.0	Ivor-Lewis esophagectomy	148.1
12	Repair of ASD*	236.2	Thoracoscopy, surgical, with pleurodesis	114.4
13	Transverse aortic arch graft*	215.5	Thoracoscopy, surgical, with total pulmonary decortication	112.1
14	Unlisted cardiac surgery procedure*	193.8	Ascending aorta graft*	101.5
15	Valvuloplasty, tricuspid valve*	177.8	3-Hole esophagectomy	92.9
16	Reoperation of CABG or valve procedure*	174.7	Total pulmonary decortication	85.2
17	CABG, 3 venous grafts	168.5	Segmentectomy, single segment	84.4
18	CABG, single coronary venous graft	154.5	Thoracoscopy, surgical, with thoracic sympathectomy	84.3
19	Valvuloplasty, tricuspid valve	120.5	Tracheostomy, planned	81.45
20	CABG, 2 coronary venous grafts	109.5	Laparoscopy, surgical, esophagogastric fundoplasty	69.3

wRVU, Work relative value unit; Pt. no., patient number; CS, cardiac surgery; GTS, general thoracic surgery; CABG, coronary artery bypass grafting; MVR, mitral valve replacement; ASD, atrial septal defect. *Adult cardiac surgical procedure.

FIGURE 2. Percentage of total work relative value units (wRVUs) attributable to procedural or evaluation and management (E & M) billing for fiscal years 2007 to 2010. GTS, General thoracic surgery; CS, cardiac surgery.

apropos in a setting in which academic GTSs and CSs will be evaluated and promoted according to their total wRVU generation.

The focus is growing within the thoracic community for cardiothoracic clinicians to be involved in critical care at both a leadership level and in the development of educational curriculum.^{8,9} In the survey conducted by Shemin and Ikonomidis,⁵ 60% of the CS respondents had dedicated CS intensive care units in their hospitals, with 39% of the unit directors being CSs. Of the GTSs surveyed, 20% of the respondents reported practicing in a hospital with a dedicated general thoracic surgical intensive care unit, with 9% of the directors being GTSs.⁵ Our study has demonstrated that critical care E & M accounted for <2% of the academic GTS and GS total E & M billing, suggesting that although the importance of CS and GTS involvement in critical care is acknowledged, (1) only a fraction of academic adult cardiothoracic surgeons are significantly involved in critical care services, (2) a significant amount of cardiothoracic surgery critical care activity is not being accounted for, (3) cardiothoracic surgeons provide critical care services but do not code them as such, or (4) adult cardiothoracic surgeons are inefficient in their critical care billing practices. The critical care billing patterns observed in the present study should influence CSs and GTSs to review their own practices and determine whether their critical care billing has been accurate and has not significantly underestimated their clinical work.

The study limitations included a lack of clinical outcomes data and that our data reflected only how CSs and GTSs billed for their practices, not necessarily exactly what they did. For example, the low level of critical care E & M billing by CSs might have been because most CS patients immediately enter the intensive care unit

postoperatively, and the care has been bundled as part of their initial operation. Thus, no code or revenue would be generated, despite the critical care delivered by the CS. In addition, CABG was the 10th most billed code for GTSs. The high presence for this billed code might have resulted from a small group of GTSs with mixed practices or who take CS on-call responsibilities but nevertheless identify themselves as GTSs. Moreover, our analysis could not assess the quality of care provided or the perioperative outcomes. The findings we have presented also might not be applicable to a nonacademic environment.

Our results have demonstrated, however, that academic CSs and GTSs have distinct practice patterns with little overlap. CSs received a greater level of reimbursement for the services they rendered than did the GTSs, in part because of the greater wRVU values for the procedures they performed. E & M coding was more important for generating wRVUs for GTSs than for CSs, and critical care was not a major billing component for either group. Our results could help guide academic CS and GTS practice structure and prioritization.

Although the practice pattern differences between the CSs and GTSs were significant, we have not proposed using our results as a blueprint to develop compensation plans nor would we advocate separating the specialties. However, outside the United States, CSs and GTSs have been separated at the training and regionally specific certification level. The reasons against dividing GTS and CS in the United States are numerous, granular, and beyond the scope and design of the present study. The finding that the coding and billing practices were different for CSs and GTSs would not, by itself, be enough justification for separating the specialties.

References

- Schipper PH, Diggs BS, Ungerleider RM, Welke KF. The influence of surgeon specialty on outcomes in general thoracic surgery: a national sample 1996 to 2005. *Ann Thorac Surg*. 2009;88:1566-72.
- Cooke DT, Wisner DH. Who performs complex non-cardiac thoracic surgery in United States academic medical centers? *Ann Thorac Surg*. 2012;94:1060-4.
- Galante JM, Pham HH, Wisner DH. Trauma surgery to acute care surgery: defining the paradigm shift. *J Trauma*. 2010;68:1024-31.
- Abraham M, Beebe M, Dalton JA, Evans DDD, Glenn RL, Green G, et al, eds. *Current Procedural Terminology: CPT 2009*. Chicago: American Medical Association; 2009.
- Shemin RJ, Ikonomidis JS. Thoracic Surgery Workforce: report of STS/AATS Thoracic Surgery Practice and Access Task Force—snapshot 2010. *Ann Thorac Surg*. 2012;93:348-55, 355.e1-6.
- Mack MJ, Brown PP, Kugelmass AD, Battaglia SL, Tarkington LG, Simon AW, et al. Current status and outcomes of coronary revascularization 1999 to 2002: 148,396 surgical and percutaneous procedures. *Ann Thorac Surg*. 2004;77:761-6.
- Epstein AJ, Polsky D, Yang F, Yang L, Groeneveld PW. Coronary revascularization trends in the United States, 2001-2008. *JAMA*. 2011;305:1769-76.
- Katz NM. The emerging specialty of cardiothoracic surgical critical care: the leadership role of cardiothoracic surgeons on the multidisciplinary team. *J Thorac Cardiovasc Surg*. 2007;134:1109-11.
- Katz NM. It is time for certification in cardiothoracic critical care. *J Thorac Cardiovasc Surg*. 2013;145:1446-7.