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Do Trainees or Attendings Know the Cost of Care? A Multidisciplinary Analysis

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Abstract

Purpose

The rising cost of healthcare has become a prominent topic in healthcare systems and medical education, with the ACGME specifically requiring residents to demonstrate competency in cost-efficient care and that faculty must demonstrate a commitment to cost-effective care. We hypothesize that physicians – both faculty and trainees – have limited knowledge of the cost of care they are providing.

Methods

Following informed consent, a survey was administered to faculty and trainees in the Departments of Surgery (GS), Obstetrics and Gynecology (OB), and Urology (URO) at a single academic center. Participants estimated the cost of three laboratory studies, two imaging studies, and two specialty-specific procedures. These estimates were compared against 2025 Medicare payment rates for all operations and Fair Health Consumer cost estimates for all inpatient laboratory and imaging tests.

Results

117 participants completed the survey, with the majority being trainees (63.2%). Participants overestimated costs on average, with normalized mean absolute percentage error (MAPE) ranging from 92.7% to 254.8%. No difference in MAPE was seen between faculty and trainees when estimating cost of procedures (184.8% vs. 265.3%, $p = 0.267$). Similar proportions of participants overestimated laboratory and imaging studies regardless of trainee level or specialty. However, significant differences were seen in both rates of overestimation and MAPE of procedures when stratified by specialty, with OB participants demonstrating lowest accuracy and highest rate of overestimation, followed by GS and URO.

Conclusion

Physicians across all training levels are expected to help reduce hospital system costs; however, they lack understanding of the cost of care they are directing. Our findings highlight a knowledge gap in both our trainees and their supervising faculty, identifying the opportunity for department-specific education on cost of care at academic centers.

Introduction

The cost of healthcare in the United States continues to reach unprecedented levels, with 2024 national health expenditures totaling $5.3 trillion and accounting for 18.0% of the nation's gross domestic product (GDP) [1]. Projections from the Centers for Medicare & Medicaid Services (CMS) suggest that these expenditures will continue to increase, potentially reaching 20.3% of the GDP by 2033 [2]. This trajectory has generated increasing scrutiny from health systems, legislators, and payors, all in an attempt to implement cost-containment strategies. Physicians and other healthcare providers are often the target of such strategies and feel the effects of efforts to reduce cost.

Physicians – including trainees – are often pressured to improve their efficiency of care, utilize lower-cost medications and materials, and expedite safe patient discharge to reduce global cost of care. In surgical specialties, this leads to increased focus on operating room utilization, disposable instrument use, and post-operative resource consumption. Graduate medical education (GME) has incorporated concepts of healthcare economics and stewardship into competency-based training requirements. The Accreditation Council for Graduate Medical Education (ACGME) specifically emphasizes cost-conscious care as a part of expected competencies for all residents [3].

Despite these pressures, physicians – trainees and attendings alike – have limited awareness of the cost of care they provide. A 2023 scoping review of 76 articles evaluating physician cost awareness found that the overwhelming majority (91%) demonstrated poor awareness of healthcare costs, including medications, diagnostic tests, procedures, and consumable supplies [4]. Additional studies focused on surgical trainees have consistently demonstrated poor estimation of operative supply costs and procedural expenditures despite institutional emphasis [5, 6].

Improved awareness of healthcare costs may represent an important opportunity to improve high-value surgical care while enhancing surgical education. The purpose of this study was to evaluate resident and faculty perception of healthcare costs across multiple specialties within an academic tertiary care facility. We hypothesized that surgeons at all levels of training have limited knowledge of the true costs associated with the care they provide.

Methods

Following Institutional Review Board approval (IRB #18937), a survey was developed to assess participants' knowledge of the cost of commonly utilized laboratory and imaging tests, as well as common specialty-specific procedures. Participants were identified utilizing internal departmental trainee and faculty lists. All trainees and faculty of the included departments were eligible for inclusion, and no exclusions were made. Participants were approached at department-specific educational conferences, as well as via departmental electronic mailing lists. Following informed consent, the survey was administered to participants from the departments of General Surgery (GS), Obstetrics and Gynecology (OB), and Urology (URO) at a single academic tertiary care center. Demographic data including age, training level, and specialty were collected. All participants, regardless of specialty, estimated the cost of three laboratory tests: complete blood count (CBC), basic metabolic panel (BMP), and complete metabolic panel (CMP); and two imaging tests: 1-view chest X-Ray (CXR) and computed tomography of the abdomen and pelvis with intravenous contrast (CT). Participants were then asked to estimate the cost of two procedures commonly performed by their specialty. GS participants estimated the cost of a laparoscopic cholecystectomy and laparoscopic appendectomy. OB participants estimated the cost of a laparoscopic tubal ligation and a Papanicolaou test (Pap smear). URO participants estimated the cost of cystogram with ureteral stent placement and a vasectomy. Participants were informed that cost for the purposes of the survey were based on publicly available reimbursement data

and were asked to avoid using any reference material during completion of the survey. All demographic questions were multiple-choice in nature, while cost estimate questions were open-ended.

Reference costs for laboratory and imaging tests were determined using FAIR Health Consumer Cost Estimates. FAIR Health is an independent national non-profit dedicated to providing reliable information about healthcare cost to consumers [7]. They estimate costs of common medical tests utilizing commercial healthcare claims from private and government payors. All estimates were calculated using the ZIP code of the primary facility of our academic health center and included both procedure cost and hospital facility cost for inpatient use. The 50th percentile billed estimates for an insured patient at the time of survey generation (September 2025) were utilized as reference costs for all laboratory and imaging tests.

Reference costs for procedures were determined using 2025 Medicare payment rates. These estimates incorporate both provider and facility fees, and were obtained for hospital outpatient surgical departments, with the exception of Papanicolaou tests. Cost estimates for a Papanicolaou test were obtained from the 2025 Medicare Physician Fee Schedule on an outpatient, non-facility basis [8]. A comprehensive list of tests and procedures with their associated billing codes and cost estimates can be found in Table 1. These estimates were utilized as the reference costs for accuracy calculations.

Table 1
Reference Costs for Laboratory Tests, Imaging, and Procedures

Procedure	Billing Code	Reference Cost	Source
Complete Blood Count (CBC)	85025*	$ 84.00	FAIR Health
Basic Metabolic Panel (BMP)	80048*	$ 65.00	FAIR Health
Complete Metabolic Panel (CMP)	80053*	$ 80.00	FAIR Health
1-View Chest X-Ray (CXR)	71045*	$ 160.00	FAIR Health
CT Abdomen/Pelvis w/ IV Contrast (CT)	74177*	$ 1,083.00	FAIR Health
Laparoscopic cholecystectomy	47562*	$ 5,186.00	Medicare
Laparoscopic appendectomy	44970*	$ 6,566.00	Medicare
Cystogram with stent placement	52332*	$ 2,979.00	Medicare
Vasectomy	55250*	$ 1,818.00	Medicare
Laparoscopic tubal ligation	58670*	$ 4,957.00	Medicare
Papanicolaou test	Q0091#	$ 43.34	Medicare

*CPT Code; #HCPCS Code

Accuracy of cost estimation was assessed by calculating Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE). These two calculations assess the magnitude of deviation from the reference cost without assessing direction of deviation. This was done to prevent the “canceling out” of over- and under-estimations in a simple average of estimates. MAPE was calculated to compare estimates of significantly differing costs, and to provide a more accurate measure with which to compare the performance of different specialty groups. Rates of overestimation were calculated to assess a group’s direction of deviation. For purposes of comparing procedures across specialties, the most expensive procedure for each specialty was designated “Procedure 1,” while the least expensive procedure designated “Procedure 2.” Details of each procedure designation with associated cost and specialty can be found in Table 2.

Table 2
Designated Procedure by Specialty

Specialty:	Procedure:		Cost:
General Surgery (GS)	Proc. 1	Laparoscopic appendectomy	$ 6,566.00
	Proc. 2	Laparoscopic cholecystectomy	$ 5,186.00
Obstetrics & Gynecology (OB)	Proc. 1	Laparoscopic tubal ligation	$ 4,957.00
	Proc. 2	Papanicolaou test	$ 43.34
Urology (URO)	Proc. 1	Cystogram with stent placement	$ 2,979.00
	Proc. 2	Vasectomy	$ 1,818.00

Bivariate analysis was performed to assess demographic and clinical differences between comparison groups. For categorical variables, Chi-square and Fisher's exact tests were used to evaluate associations. Continuous variables were analyzed using the Student's t-test for normally distributed data, and the Wilcoxon rank-sum test for non-normally distributed data. A p-value of less than 0.05 was considered statistically significant.

Results

117 individuals participated in the study, with the majority (63.2%) being trainees. All three specialties were well-represented with trainee response rates of 89.7% (GS), 92.0% (OB), and 84.2% (URO) and faculty response rates of 54.8% (GS), 53.3% (OB), and 26.7% (URO). GS had the highest number of participants in the survey (58) followed by OB (39) and URO (20). Participant demographics are detailed in Table 3. Trainees were well-distributed among PGY training levels in the overall cohort, and faculty were well-distributed among experience level. Participant age skewed younger, with the majority (77.7%) of participants being under 40 years of age, and 46.1% of participants being 30 years or younger. This is consistent with the high rate of trainee responses in the participant group.

Table 3
Demographic Characteristics of Survey Participants

Variables	N (%)	Variables	N (%)
Specialty		**Faculty Experience**	
General Surgery (GS)	58 *(49.6)*	0–5 years	14 *(12.0)*
Obstetrics & Gynecology (OB)	39 *(33.3)*	6–10 years	14 *(12.0)*
Urology (URO)	20 *(17.1)*	11 + years	15 *(12.8)*
Training Level		**Age**	
PGY1	14 *(12.0)*	<30 years	54 *(46.1)*
PGY2	14 *(12.0)*	31–40	37 *(31.6)*
PGY3	16 *(13.6)*	41–50	18 *(15.4)*
PGY4	13 *(11.1)*	51–60	5 *(4.3)*
PGY5	8 *(6.8)*	61+	3 *(2.6)*
PGY6+	9 *(7.7)*		

The three laboratory tests (CBC, BMP, CMP) were relatively similar in cost, ranging from $65.00 to $84.00. All three were consistently overestimated by the group, at rates ranging from 53.0% to 66.6%. Mean Absolute Error showed significant variation, with CBC overestimated by $77.86 (92.7%) on average, while CMP was overestimated by $167.55 (209.4%) on average. Both imaging tests (CXR, CT) were overestimated at similar rates (62.3% and 59.8%, respectively) and with similar proportions (MAPE 137.1% and 110.4%, respectively). Details on overall cohort cost estimation accuracy and overestimation can be seen in Table 4. Procedure 1, the most expensive procedure for each specialty, was overestimated by only 46.1% of participants, with a MAPE of 110.1%. Procedure 2, the least expensive procedure for each specialty, was overestimated by 60.7%, with an increased MAPE of 364.9%.

Table 4
Overall Cohort Cost Estimation Accuracy and Overestimation

Parameter	Cost (USD)	Overestimate, N (%)	MAE[#] (USD)	MAPE[+] (%)
Complete Blood Count (CBC)	$ 84.00	62 *(53.0)*	$ 77.86	92.7%
Basic Metabolic Panel (BMP)	$ 65.00	69 *(59.0)*	$ 92.00	141.5%
Complete Metabolic Panel (CMP)	$ 80.00	78 *(66.6)*	$ 167.55	209.4%
1-View Chest Xray (CXR)	$ 160.00	73 *(62.3)*	$ 219.35	137.1%
CT Abdomen/Pelvis w/ IV Contrast	$ 1,083.00	70 *(59.8)*	$ 1,195.92	110.4%
Procedure 1*	Variable*	54 *(46.1)*	Variable*	110.1%
Procedure 2*	Variable*	71 *(60.7)*	Variable*	364.9%

*Procedures 1 and 2 vary by specialty; see Table 2 for details; [#]Mean Absolute Error; [+]Mean Absolute Percentage Error

Diagnostic laboratory and imaging tests were overestimated at similar rates by each of the three specialties, and at similar levels. No statistically significant difference was seen in overestimation rate or MAE between GS, OB, and URO groups. Details of cost estimation accuracy and overestimation by specialty can be seen in Table 5. Both procedures were overestimated at differing rates by specialty. Procedure 1 was overestimated most often by OB (61.5%), followed by GS (41.4%), and least often by URO (30.0%), $p = 0.042$. Procedure 2 followed a similar statistically significant pattern ($p < 0.001$). Though no significant difference in MAPE was seen for Procedure 1 ($p = 0.629$), significant disparities in MAPE were seen by specialty for Procedure 2. OB showed the lowest accuracy (MAPE 770.0%), followed by GS (196.4%), then URO (67.1%), $p < 0.001$. Details of overestimation rates and estimation accuracy by training level is detailed in Table 6. No significant differences in estimation accuracy between trainees and faculty were seen except for CMP, which was more accurately estimated by faculty compared to trainees (MAE $111.88 vs. $199.89, $p = 0.035$). This significant difference was not demonstrated in any other diagnostic test or procedure, and no significant differences in overestimation rates were observed.

Table 5
Cost Estimation Accuracy and Overestimation by Specialty

Procedure	Rate of Overestimation				Mean Absolute Error (MAE)			
	GS	OB	URO	p-value	GS	OB	URO	p-value
CBC	50.0%	51.3%	65.0%	0.494	$ 84.02	$ 69.36	$ 76.60	0.749
BMP	56.9%	53.8%	75.0%	0.266	$ 100.12	$ 82.08	$ 87.80	0.736
CMP	62.1%	66.7%	70.0%	0.341	$ 173.72	$ 164.23	$ 156.10	0.956
CXR	56.9%	56.4%	55.0%	0.462	$ 187.36	$ 300.69	$ 153.50	0.074
CT A/P	63.8%	56.4%	55.0%	0.683	$ 1,509.98	$ 1,067.56	$ 535.46	0.074
Procedure 1*	41.4%	61.5%	30.0%	**0.042**	140.1%*	99.5%*	50.1%*	0.629
Procedure 2*	50.0%	92.3%	30.0%	**< 0.001**	196.4%*	770.0%*	67.1%*	**< 0.001**

*Procedures 1 & 2 vary by specialty. MAE normalized to MAPE by dividing by actual cost to compare procedures of differing costs.

Table 6
Cost Estimation Accuracy and Overestimation by Training

Procedure	Rate of Overestimation			Mean Absolute Error (MAE)		
	Trainee	Faculty	p-value	Trainee	Faculty	p-value
CBC	59.5%	41.9%	0.066	$ 80.22	$ 73.81	0.730
BMP	63.5%	51.2%	0.191	$ 101.34	$ 75.93	0.238
CMP	73.0%	55.8%	0.057	$ 199.89	$ 111.88	**0.035**
CXR	64.9%	58.1%	0.469	$ 246.05	$ 173.40	0.193
CT A/P	62.2%	55.8%	0.499	$ 1,232.95	$ 1,132.21	0.777
Procedure 1*	41.9%	53.5%	0.225	114.6%*	103.9%*	0.862
Procedure 2*	59.5%	62.8%	0.722	425.0%*	265.7%*	0.227

*Procedures 1 & 2 vary by specialty. MAE normalized to MAPE by dividing by actual cost to compare procedures of differing costs.

Discussion

In this survey study, we evaluated the ability of residents and faculty to estimate costs of commonly utilized diagnostic tests and procedures across three surgical subspecialties. A major finding of our study is that regardless of training level or experience, surgeons do not have a good grasp on the cost of care they provide. This is based on consistent rates of overestimation for laboratory and imaging tests, ranging from 53.0% to 66.6% for the entire cohort. MAPE's for the entire cohort ranged from 92.7% to 364.9%, showing a significant lack of accuracy in estimating costs, and these numbers were consistent regardless of training level or faculty status.

Our findings echo previous studies showing a lack of cost knowledge in procedural providers. A 2023 study at Yale University demonstrated misperceptions in the cost of single-use surgical items among surgical trainees. Similar to our study, they found that trainees tend to significantly overestimate costs for the majority of items, with the exception of the three highest-cost items [5]. A 2014 study from the same institution surveyed graduating senior residents from five specialties on attitudes and knowledge of cost of care, finding that only 4% of graduating residents felt they knew the cost of the care they were providing, and an only 25% rate of price estimation accuracy. This was true regardless of specialty [9]. A 2021 multi-institution study evaluated attitudes and knowledge of high-value care among surgical residents, with less than one-third reporting frequent exposure to cost considerations in their training [10].

This combination of knowledge deficit and poor understanding of cost considerations offers a prime opportunity for educational intervention. Given the ACGME requirement to teach residents about the economics of care delivery as a key competency of graduate medical education, academic medical centers are motivated to incorporate such concepts into formalized education programs. Our study found a disparity in cost awareness between the three specialties evaluated, highlighting that the opportunity for targeted education is present in diverse surgical specialties. A novel thoracic surgery-directed program at the University of Montreal provided real-time feedback on the cost of surgical equipment and generated post-op reports for surgeons detailing sources of high operative cost. This program saw a significant cost reduction for thoracoscopic lobectomies, demonstrating the utility of such an intervention [11]. This program has since been expanded to target cases in gynecology, colorectal, and plastic surgery with success [12]. Targeted educational programs have shown success in non-surgical fields as well, with a 2025 study from Children's Hospital of Philadelphia demonstrating improved confidence and knowledge of healthcare costs in pediatric residency trainees. This simulation-based curriculum resulted in a significant improvement, with 96% of participants reporting enhanced understanding of costs affecting pediatric patients and their families [13]. Regardless of specialty, significant opportunity exists to improve trainee understanding of healthcare costs in their specific role.

Our study demonstrated no significant difference in estimation accuracy between trainees and faculty at our academic health center, with both groups overestimating costs at similar rates and with poor accuracy. These findings demonstrate a common theme in the literature – surgeons regardless of training level or experience struggle to accurately estimate the cost of care. A 2018 study from the University of Vermont showed no difference between general surgery trainees and faculty in their ability

to estimate charge or reimbursement rates for commonly-performed procedures. Unlike our study, the authors identified systemic underestimation of procedural costs, possibly due to the differentiation of charge and reimbursement costs assessed in their survey study [6]. Likewise, a 2020 study from Johns Hopkins University demonstrated that this lack of cost awareness is not limited to physician members of the surgical team but extends to registered nurses and surgical technicians as well. Similar rates of estimation error were seen regardless of role or experience in the operating room [14]. A 2025 study of cost awareness at the Naval Medical Center San Diego show that this pattern persists even in the military, with an overall 22.9% accuracy among their multidisciplinary cohort, and no differences in accuracy on the basis of experience or training level [15]. Our study adds to the growing body of work that suggests that this lack of cost understanding is a systemic problem not unique to trainees, but rather a symptom of the complex economics of the United States healthcare system.

Significant challenges exist in conducting studies evaluating cost awareness among healthcare workers, in part due to the varying definition of cost of care. To a patient, “cost” is synonymous with out-of-pocket costs not covered by insurance. Providers are often asked to counsel patients on such costs, but these do not represent the entire cost associated with a particular diagnostic test, procedure, or care encounter. To a healthcare executive, “cost” may represent the charge amount on a patient bill, the reimbursement rate from government or private payors, or the cost of raw materials utilized during a patient encounter. With multiple reference points for cost estimation, it is likely that providers experience confusion on how to identify the exact costs associated with a patient’s care. Due to the complex nature of our healthcare system, use of Diagnosis Related Group (DRG)-based billing for inpatient care, and variability in insurance reimbursement rates, there is a significant learning curve to understanding how to estimate cost, and how to utilize this understanding in counseling patients. Without additional advanced degrees (MBA, MHA, etc), this learning curve may be prohibitive to many providers in the absence of targeted educational interventions.

This study is limited by its single-center nature, which may reduce applicability to other residency programs or non-academic practice environments. In addition, as a survey-based study, it is inherently subject to response and selection bias, as participants with greater interest in healthcare economics and resident education may have been more likely to respond. Due to the cross-sectional nature of the study, longitudinal trends in cost awareness could not be assessed. Healthcare pricing is inherently complex, and participants may have interpreted “cost” differently when responding to survey items. Finally, while our study evaluated cost awareness, it could not determine whether limited knowledge of cost directly influences clinical decision making or healthcare spending.

Physicians across all levels of surgical training are increasingly expected to participate in efforts to reduce healthcare expenditures and improve value-based care; however, our findings suggest that both faculty and trainees possess limited understanding of the true costs associated with the care they provide. This knowledge gap persists despite growing institutional and legislative emphasis on cost-conscious practice and resource stewardship. This study highlights an important opportunity for targeted educational initiatives focused on healthcare economics within surgical training programs and

academic departments. Incorporating cost-awareness education into residency curricula, faculty development, and perioperative practice may help improve physician understanding of healthcare expenditures and promote more informed clinical decision-making. Future work should focus on development and implementation of specialty-specific targeted educational curriculum to improve cost awareness among trainees and faculty alike.

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