Internal Medicine Physicians' Knowledge of Health Care Charges

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Abstract

Background Concerns over the rising costs of health care have increased interest in educating residents about the cost impact of medical decisions. While many programs educate residents about the effectiveness of care, little is known about how well residents and faculty know charges of diagnostic tests or both groups' interest in this topic.

Methods We surveyed internal medicine residents and faculty at an academic tertiary care hospital. Both groups rated their agreement with a series of statements about health care charges on a Likert scale of 1 (strongly disagree) to 9 (strongly agree), and they estimated the charges for 15 commonly ordered diagnostic tests. Estimates within 25% of the true charge were considered correct. The Wilcoxon rank sum test was used to compare responses between residents and faculty.

Results Seventy of 126 eligible participants (56%) returned surveys. Participants showed poor knowledge of health care charges but expressed a desire to learn more. Physicians also felt that cost-effectiveness should be considered when ordering diagnostic tests, although faculty members felt more strongly about this than did residents. In estimating the charges for diagnostic tests, less than a quarter of all responses were within 25% of the true charge.

Conclusions Internal medicine physicians poorly estimate the charges for diagnostic tests but have a strong desire to improve their knowledge, suggesting a possible intervention to improve the cost-effectiveness of medical care.

Background

Health care expenditures in the United States exceeded $2.3 trillion in 2008, accounting for 16% of the gross domestic product.[1] Per capita, the United States spends more than $7500 a year on health care, a figure 2 to 3 times that of other industrialized countries.[2] Despite this monetary investment, the United States lags behind other countries in many key health measures.[3] The Congressional Budget Office has estimated that $700 billion (roughly 5% of the nation's gross domestic product) is spent on medical tests and procedures that do not improve health outcomes.[4] Concern over this gap between costs and outcomes has resulted in growing interest in improving the cost-effectiveness of care provided by practicing physicians and in teaching medical students and residents about cost-effectiveness and the financial impact of their clinical decisions.[5,6] In the 2009 Accreditation Council for Graduate Medical Education (ACGME) Program Requirements for Residency Education in Internal Medicine, training of residents in cost-effective care is required as part of the patient care and systems-based practice competencies.[6,7]

While judging the effectiveness of medical interventions is a major part of training, doctors are often unaware of the charges for these interventions, which can vary considerably in different health systems.[8,9] A number of states have passed legislation attempting to improve the transparency of health care pricing but compliance is often poor.[10,11] A systematic review of physician knowledge of diagnostic and nondrug therapeutic costs done in 2008 included 14 studies and found that only one-third of physician estimates were within 20% to 25% of the true costs.[12] It is unclear how well these results correlate to the US health care system,

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since most studies included in the review were done in countries with national health care systems and the only US study included from the last 2 decades looked at a specific diagnostic test.[13] To address this gap in the literature, we designed a study to assess how well residents and faculty at an academic institution estimate the charges for a variety of diagnostic tests and to gauge their interest in knowing this information.

Methods

Setting

Oregon Health & Science University (OHSU) is a tertiary care university hospital in Portland, Oregon. An electronic medical records system (Epic Hyperspace, Epic Systems Corporation, Verona, WI) is used in both the inpatient and outpatient settings. All orders, including those for medications and diagnostic tests, are placed through a computerized order entry system. No charge information is provided to the physician at the time of order placement.

Study Subjects

Eligible subjects included all internal medicine faculty members and residents at OHSU. Faculty members (professor, assistant professor, associate professor, or instructor of medicine) work solely at OHSU Hospital and associated clinics. Residents work at both OHSU and the affiliated Portland Veterans Affairs Medical Center, splitting their time roughly equally between the 2 locations. Physicians working solely in subspecialties of internal medicine, subspecialty residents in a preliminary year of internal medicine, physicians with clinical responsibilities solely at other clinics or hospitals, physicians who were involved in pilot-testing the survey, and physicians not practicing clinical medicine at the time of survey distribution were excluded. A total of 126 physicians were eligible to receive the survey.

Survey Design and Distribution

The first section of the survey included 6 statements about health care charges. Respondents were asked to rate their agreement with each statement on a Likert scale ranging from 1 (strongly disagree) to 9 (strongly agree).

In the second section of the survey, subjects were asked to estimate the charges for 15 diagnostic tests. Notably, subjects were asked for the *charge* (the amount billed to the patient or insurance carrier, before any discounts), as opposed to the *cost* (the amount that the hospital paid for the test). Laboratory tests were chosen to include those ordered commonly (eg, basic metabolic panel and complete blood count) and more selectively (eg, D-dimer and anti-nuclear antibody) in both inpatient and outpatient practice. Imaging studies were selected to represent a range of modalities and anatomic areas. For imaging studies, participants were asked to estimate the charge for only the imaging test itself (not professional or reading fees).

TABLE 1 **Respondent Characteristics**

	Survey Respondents, No. (%)
Level of training	
R1	10 (14)
R2	12 (17)
R3	22 (31)
Faculty	26 (37)
Sex	
Female	42 (61)
Age[a]	
25–30	33 (48)
31–40	24 (35)
>40	12 (17)
Practice setting	
Inpatient only	6 (9)
Outpatient only	7 (10)
Both	57 (81)
Primary clinic site	
OHSU	43 (62)
Time at OHSU, y	
<2	27 (39)
2–5	29 (41)
5–10	9 (13)
>10	5 (7)

Abbreviations: OHSU, Oregon Health & Science University; R, resident.

[a] One respondent did not answer age question.

The final section of the survey collected demographic information. This section also included an open-response area for respondents to note particular charge information they would find helpful. Besides the demographic information, surveys were otherwise anonymous.

The study was considered exempt from review by the university's Institutional Review Board. The survey was pilot-tested by 6 internal medicine physicians and modified to ensure clarity before its distribution at monthly staff meetings and weekly clinic conferences by the principal investigator over a 1-month period. Surveys were mailed to physicians not present at any of the scheduled meetings.

TABLE 2 **Physician Beliefs**[a]

	Overall Mean (95% CI)	Resident Mean (95% CI)	Faculty Mean (95% CI)	*P* Value[b]
1. The charge of an imaging or laboratory test influences my decision to order it.	6.41 (6.04–6.79)	6.16 (5.67–6.65)	6.85 (6.27–7.43)	.09
2. I have adequate knowledge of the charges associated with medical tests.	2.59 (2.29–2.88)	2.50 (2.15–2.85)	2.73 (2.16–3.30)	.62
3. I would like to know more about the charges of specific medical tests.	8.21 (7.95–8.48)	8.25 (7.93–8.57)	8.15 (7.65–8.66)	.92
4. Improved access to medical test charges would affect my ordering.	7.43 (7.13–7.73)	7.25 (6.88–7.62)	7.73 (7.23–8.24)	.12
5. The patient's insurance status affects my ordering of medical tests.	6.21 (5.66–6.77)	5.70 (5.01–6.40)	7.08 (6.21–7.95)	.012
6. Physicians should consider cost-effectiveness when selecting what tests to order for their patients.	8.07 (7.80–8.34)	7.89 (7.56–8.22)	8.38 (7.93–8.84)	.017

[a] For all statements, responses range from 1 (strong disagreement) to 9 (strong agreement).
[b] By Wilcoxon rank sum test.

Statistical Analysis

Means and 95% confidence intervals were calculated for the 6 statements assessing physician attitudes, and the Wilcoxon rank sum test was used to compare responses between faculty and residents. The actual charges for laboratory tests were obtained from the Division of Laboratory Medicine Charge Description Master, and charges for imaging tests and electrocardiograms were obtained from the performing departments. Each estimated charge was compared to the actual charge and a percentage error was calculated with the following equation:

$$\%\ \text{Error} = [(\text{Actual Charge} - \text{Estimated Charge})/\text{Actual Charge}] \times 100$$

To aid the comparison between results from previous studies done in other settings, those estimates within 25% of the actual charge were labeled as "correct."[12,14,15] Stata, version 10.1 (StataCorp, College Station, TX), was used to perform statistical analyses.

Results

A total of 70 surveys were returned for a response rate of 56%. Of these, 4 had missing data, including 3 surveys missing charge estimations (n = 3 for D-dimer, n = 2 for anti-nuclear antibody, and n = 1 for troponin) and 1 missing demographic information (age and year of graduation from medical school). Respondent demographics are shown in TABLE 1. Respondents were generally similar to nonrespondents with the exception that third-year residents and faculty were more likely than first- and second-year residents to return the survey.

Responses to the attitudinal statements are displayed in TABLE 2. While participants reported having inadequate knowledge of the charges for medical tests, most also reported that the charge of a test affects their decision to order it (statements 1 and 2). Respondents had a significant desire (agreeing more strongly than to any other statement) to know more about the charges of diagnostic tests and felt that improved access to charge information would affect their ordering behavior (statements 3 and 4). There were no statistically significant differences between resident and faculty respondents except for the statements regarding insurance coverage and cost-effectiveness. Faculty physicians were more likely to report that a patient's insurance status affects their ordering behavior (statement 5) and also were more likely to feel that physicians should consider cost-effectiveness when ordering tests (statement 6).

Results of participants' estimations of test charges are shown in TABLE 3 (and SUPPLEMENTAL FIGURE). The percentage of correct estimates (defined as those within 25% of the actual charge) ranged from a high of 39% for brain magnetic resonance imaging to a low of 3% for D-dimer test. Overall, less than a quarter (24%) of all estimates were in the correct range. For most tests, the plurality of responses were underestimates; only the basic metabolic set, liver panel, lipid panel, and abdominal ultrasonography had a higher percentage of overestimates than underestimates (no test had a plurality of correct estimates). The tendency for respondents to underestimate test charges was particularly pronounced for higher-charge

TABLE 3 **Charge Estimations by Test**

Diagnostic Test	Correct Estimates,[a] %	Underestimates, %	Overestimates, %	Median % Error,[b]	Median Error, $	Minimum Estimate, $	Maximum Estimate, $
D-dimer	3	90	8	71	124	5	500
Troponin I	4	96	0	70	118	2	200
CT chest with contrast	16	81	3	59	1107	100	3000
Electrocardiogram	19	67	14	44	59	5	450
Thyroid-stimulating hormone (TSH)	23	61	16	47	35	5	250
Duplex ultrasonography of single extremity	23	74	3	61	310	50	1500
Basic metabolic panel (BMP)	24	31	44	53	23	2	200
Complete blood count (CBC) with differential	24	73	3	52	55	2	150
Liver panel	27	19	54	65	29	5	230
Abdominal ultrasonography, complete	30	34	36	34	128	90	2000
Anti-nuclear antibody (ANA)	32	40	28	50	50	10	300
Blood culture (each)	33	35	32	44	40	10	350
Lipid panel	33	29	39	52	32	2	400
PA/LAT chest radiography	34	62	4	40	98	25	500
MRI brain with contrast	39	43	19	40	669	250	3000

Abbreviations: CT, computed tomography; MRI, magnetic resonance imaging; PA/LAT: posterioanterior/lateral.

[a] Within 25% of the true charge. Totals may not add to 100% due to rounding.
[b] % Error = [(Actual Charge – Estimated Charge)/Actual Charge] × 100.

laboratory tests. The most expensive laboratory tests in our survey (troponin I and D-dimer) were by far the most commonly underestimated and the most commonly incorrect overall.

In the last part of the survey, faculty and residents were asked to note any charge information that they would find particularly useful. Responses generally fit in 1 of 3 categories, as shown in TABLE 4.

Discussion

The results from our survey of internal medicine physicians at 1 academic institution in the United States suggest that physicians have very poor knowledge of the charges for diagnostic tests, as less than a quarter of total charge estimations were within 25% of the true charge. Of the 15 diagnostic tests included in our survey, only 4 (blood culture, lipid panel, chest radiography, and brain magnetic resonance imaging) had correct response rates of greater than 33%. Our results are similar to those from a prior systematic review, which included mostly studies done in countries with national health care systems, in which only a third of diagnostic cost estimates were between 20% and 25% of the true cost.[12]

These results highlight the need for better education of both resident and faculty physicians on the charges of diagnostic tests. It is notable that faculty felt as uncomfortable as residents at charge estimation, suggesting that little has been done to train physicians in this area to

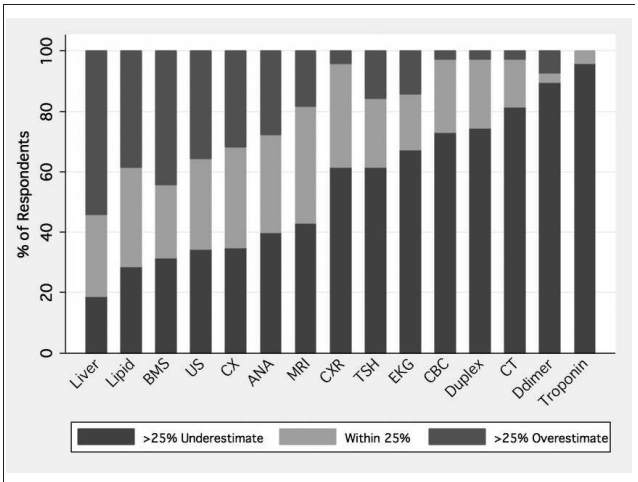

FIGURE **Physician Charge Estimates by Test**

Percentage of respondents who underestimated, correctly estimated (within 25%), or overestimated the charge for each diagnostic test.

date. A recent study showed low levels of feedback to residents on their resource utilization,[16] which may in part be due to the uncertainty faculty members feel regarding their knowledge on this topic. Therefore, it would seem that any intervention would need to target both trainees and their supervising physicians. Our results suggest that both groups are quite open to educational interventions that target this area of need.

Our respondents also felt that improving knowledge of charges would affect their ordering behavior. Given the societal interest in controlling health care costs, it would seem that a fairly straightforward intervention would be to simply improve the transparency of charges. Would such an intervention really change ordering behavior? Several studies, involving both written scenarios[17,18] and real-world settings,[19–24] have shown a decrease in test ordering after physicians were provided charge information. In those studies done in real-world settings, providing physicians the charges for select diagnostic tests at the time of ordering (either on an order sheet or in a computer order entry system) produced a 10% to 30% decrease in test ordering and total charges without any significant increase in adverse events. Use of additional educational methods (such as didactic sessions on health care economics or computerized feedback on utilization of services) would most likely provide additional benefit. A recent review on cost-effectiveness and cost-containment curricula in graduate medical education found that interventions that used multiple simultaneous educational strategies were most successful in achieving positive outcomes.[25]

Our study does have several limitations. As it was performed at a single academic institution and included a specific group of physicians, generalizability is limited. Research in a variety of settings, ranging from community family medicine physicians and residents in British Columbia, Canada, to anesthesiologists at university-affiliated hospitals in Denmark, has found similar results.[15,26–28] Performing a similar study in the United States involving multiple institutions would be useful but difficult owing to the significant variation in charges across health care systems. Another limitation of our study is that a relatively high percentage of physicians did not return their surveys, leading to possible response bias. While it seems unlikely that these physicians had significantly different knowledge of charges, it is possible that their beliefs regarding charges might have been different (eg, not

TABLE 4 **Charge Information Requested by Respondents**

Category	Example Comments
General charge information	"Lab charges are important to know, especially in the inpatient setting where we tend to follow BMPs and CBCs daily, mainly based on convention."
	"It would be great to simply have a list of costs. As a new doc we get very little info on best costs and I imagine knowing the costs would encourage more complete examination of the need for test(s) rather than ordering labs out of habit."
	"The charge should be in the order when I place it."
Charge to the patient	"Cost to the patient (with a breakdown)."
	"The end cost to patients (not what the hospital bills insurance)."
	"Would be helpful to see what patient will be charged for all orders (labs, meds, diagnostics, etc) prior to signing orders."
Cost-effectiveness or comparison data	"Comparison data—ie, for gallstones, cost of RUQ vs total abdominal ultrasound."
	"Pop-up reminders regarding charges and suggestions for cost savings."
	"Listing (pocket and online) of charges. Clinical decision support to help make better, more cost-effective decisions (eg, the charge for a glucose level vs a complete chemistry panel)."

Abbreviations: BMPs, basic metabolic panels; CBC, complete blood count; RUQ, right upper quadrant.

completing the survey might be indicative of having less interest in knowing the charges for diagnostic tests). There is also the question of how best to determine the range for "correct" estimations. We chose to use a percentage range, rather than an absolute dollar figure or other measurement, which is in line with the methods used in prior studies.[13] This means, of course, that the correct range of estimations for expensive tests is larger than that for inexpensive tests. This did not seem to have that significant of an impact, however, as the more expensive laboratory tests actually had more incorrect responses than the less expensive ones.

Conclusion

Our results are consistent with the need to better educate internal medicine physicians on the charges associated with diagnostic testing. Both faculty and resident physicians have a strong interest in improving their knowledge and it seems likely that better knowledge of charges will lead to more appropriate ordering of diagnostic tests. Further research should focus on identifying the optimal methods to disseminate charge information and improve knowledge of cost-effective care.

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