Do emergency physicians know the costs of medical care?

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ABSTRACT

Objectives: To estimate the level of knowledge that Canadian emergency physicians have of the costs of common diagnostic tests and interventions in the emergency department (ED).

Methods: In a cross-sectional survey, 75 emergency physicians from 7 community and academic EDs were asked to estimate the cost of 60 of the most commonly ordered imaging modalities, laboratory tests and pharmaceuticals. Their estimates were compared to actual costs obtained from hospital finance departments. For each test or pharmaceutical, physician error was calculated as a percentage of the actual value, using the formula [(actual – estimated) / actual] × 100. For each item, the proportion of responses that were underestimates, the proportion that were overestimates and the proportion that were accurate within 25% were reported.

Results: Mean error of the physicians' estimates was 40% (95% confidence interval [CI], 35%–45%) for imaging studies, 153% (95% CI, 128%–178%) for lab investigations, and 218% (95% CI, 179%–257%) for pharmaceutical costs. Rates of underestimation vs. overestimation were 68% vs. 16% for imaging modalities, 23% vs. 56% for laboratory tests, and 21% vs. 64% for pharmaceuticals.

Conclusions: Emergency physicians have a limited knowledge of the costs of the tests and interventions they use on a daily basis. They tend to overestimate lab and pharmaceutical costs but underestimate imaging costs. Cost-awareness programs for emergency physicians are most likely to be beneficial if they focus on imaging modalities.

RÉSUMÉ

Objectif : Évaluer le niveau de connaissance des urgentologues canadiens quant aux coûts des épreuves diagnostiques et des interventions courantes au département d'urgence (DU).

Méthodes : Lors d'une enquête transversale, on demanda à 75 urgentologues travaillant dans 7 DU communautaires et universitaires d'estimer le coût de 60 produits pharmaceutiques, techniques d'imagerie et épreuves de laboratoire les plus couramment demandés. Leurs estimations furent comparées aux coût réels obtenus des départements des finances des hôpitaux. Pour chaque épreuve ou produit pharmaceutique, l'erreur du médecin fut calculée sous forme de pourcentage de la valeur réelle, à l'aide de la formule suivante : [(réel – estimé) / réel] × 100. Pour chaque item, on rapporta la proportion de réponses qui étaient des sous-estimations, la proportion de celles qui étaient des surestimations et la proportion de réponses exactes à 25 % près.

Résultats : L'erreur moyenne pour les estimations des médecins était de 40 % (IC à 95 %, 35 %–45 %) pour les études d'imagerie, de 153 % (IC à 95 %, 128 %–178 %) pour les épreuves de laboratoire et de 218 % (IC à 95 %, 179 %–257 %) pour les coûts pharmaceutiques. Les taux de sous-estimation par rapport à la surestimation étaient de 68 % vs 16 % pour les techniques d'imagerie, de 23 % vs 56 % pour les épreuves de laboratoire et de 21 % vs 64 % pour les produits pharmaceutiques.

Conclusions : Les urgentologues ont une connaissance limitée des coûts des épreuves et des interventions qu'ils utilisent quotidiennement. Ils ont tendance à surestimer les coûts des épreuves de laboratoire et des produits pharmaceutiques mais à sous-estimer les coûts de l'imagerie. Les programmes de sensibilisation aux coûts destinés aux urgentologues devraient se concentrer sur les techniques d'imagerie.

Key words: emergency department, health economics, utilization, cost, cost-effectiveness

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Introduction

In 1990, Canadians made over 15 million visits to hospital emergency departments (EDs).[1] At an average cost of $50 per visit, total cost to the health care system was approximately $900,000,000.[2,3] ED care is perceived as expensive and ED costs are viewed as a threat to the health care system.[4–6]

In recent years, an aging population, advancing technology, rising expectations and heavy utilization by patients and doctors have driven health care costs up. At the same time, federal cuts to Canada Health and Social Transfers[7] have led to budget crises, hospital bed closures, overcrowding, treatment delays and increasing emphasis on cost-effective medicine.

Cost-reduction strategies focus on reducing ED utilization by patients[5,8,9] and reducing resource utilization by physicians. Williams[10,11] determined that diverting patients from EDs will not lead to meaningful health care savings; therefore future cost-reduction strategies should focus on modifying physician utilization — most likely through the use of decision rules, rationing strategies, audit and feedback, and educational programs.[12–22]

Physicians admit patients to hospitals, order tests, perform procedures and prescribe medications. These actions account for a large proportion of health care costs,[20,23] and it seems reasonable that physicians should have some awareness of the expenses they generate. Increasing physician cost awareness is a common strategy,[15,16,19–21] but if cost-awareness programs are to be effective, the following conditions should exist: 1) physicians must have poor baseline cost awareness and should generally underestimate costs (if they overestimate costs, then greater cost awareness may increase utilization); 2) improved cost awareness should lead to reduced utilization, and this effect should persist beyond the intervention period; 3) decreased utilization must not lead to a worsening of patient outcomes.

Since many ED tests do not substantially alter patient management or outcome[24,25] it is possible that targeted cost-awareness strategies may reduce utilization and decrease ED costs without negatively impacting patient outcomes. Assessing physician cost awareness is the first step in this process.[23,26–31] No previous studies have looked at medical cost awareness among Canadian emergency physicians (EPs).

The study objectives were to determine the actual costs of common ED tests and interventions, to estimate EPs' knowledge of these costs and to determine whether EPs generally underestimate specific costs or cost groups. The hypothesis was that most physicians do not know (within 25%) the costs of tests and interventions they use on a daily basis and that they routinely underestimate these costs.

Methods

Study design

In this cross-sectional survey, EPs from 7 hospital emergency departments were asked to estimate the costs of 60 of the most frequently ordered imaging modalities, laboratory tests and pharmaceuticals in the ED. The study did not involve human experimentation and was considered exempt from review by the university's research ethics committee.

Population and setting

The EDs of 7 hospitals in the Greater Vancouver area were chosen to participate, based on geographic proximity and staffing by full-time emergency physicians. The hospitals are a mix of urban and suburban centres, with annual volumes that range from 20,000 to 65,000. Four of the 7 are teaching hospitals, and all survey responders were full-time EPs.

Survey instrument

Using hospital finance department data, a list was compiled of the 22 diagnostic imaging tests, 18 laboratory tests and 20 pharmaceuticals that contribute the greatest to total ED costs, based on both unit cost and frequency of use. A survey was developed, which asked respondents to estimate the true hospital cost (not charge) for each item. Respondents were instructed to consider only the cost of performing the test (including technician time) and not to include costs associated with physician interpretation (e.g., radiologist fees). The survey was pilot tested on several EPs and modified to ensure clarity.

To enhance response rate and reliability, all surveys were presented by one of the investigators (J.M.) at ED departmental meetings in a "face-to-face" fashion. Respondents were not told in advance about the specific nature of the questions and did not have access to reference materials.

Actual costs

The finance department of each participating hospital was asked to provide actual costs for the survey items; however, only 2 hospitals were able to provide ED cost data. Actual costs from both hospitals (A and B) and mean costs for the 2 hospitals are presented. For study purposes, the "actual" (reference standard) cost of an item was defined as the range between the costs provided by the 2 hospitals. Costs are reported in 1997 Canadian dollars. When a physician's estimate was below both hospital costs, it was considered "low." When it was above both hospital's costs, it was considered "high." If the EP estimate fell between the 2 hospitals' costs, it was considered exactly correct. Median EP cost estimate and range was determined for each item.

Estimation error

For each item, the proportion of low, correct and high estimates was reported. EP estimation error was determined by subtracting the respondent's estimate for a given item from the closest corresponding hospital cost, using the formula:

$$[(\text{actual} - \text{estimated}) / \text{actual}] \times 100$$

Mean error for each item and category (imaging, laboratory and pharmaceutical) was calculated, as was the proportion of physicians who estimated within 25% of the closest hospital value.

Results

Seventy-five full-time ED physicians were approached; 24 from community hospitals and 51 from academic centres. All 75 agreed to participate in the study. The participants provided 4,495 cost estimates for 60 items. Five physicians failed to estimate the cost of octreotide, but apart from this there were no "missing" data.

Tables 1 to 3 show actual costs, EP estimates (mean and range) and EP estimation error for the imaging, laboratory and pharmaceutical items surveyed. Mean error of the physicians' estimates was 40% (95% CI, 35%–45%) for imaging studies, 153% (95% CI, 128%–178%) for lab tests and 218% (95% CI, 179%–257%) for pharmaceutical costs. Physician estimates fell within 25% of the closest "actual" hospital cost 35% of the time for imaging modalities, 32% of the time for lab tests and 23% of the time for pharmaceuticals. Figures 1 to 3 show the proportion of low, correct and high EP estimates for each item. Rates of underestimation vs. overestimation were 68% vs. 16% for imaging modalities, 23% vs. 56% for laboratory tests and 21% vs. 64% for pharmaceuticals.

Discussion

Previous studies indicate that physicians have poor medical care cost awareness.[15–31] The current study suggests that Canadian EPs also have limited knowledge of the costs of the tests and treatments they use on a daily basis. This rela-

Table 1. Actual and estimated costs for diagnostic imaging modalities

Imaging modality	Actual item cost, $			EP estimates, $ n = 75		EP % error mean (and SD)	No. (and %) < 25% error
	Hospital A	Hospital B	Mean	Median	Range		
CT							
Body	249.50	423.67	336.59	375	55–2000	42 (63)	49 (65)
Head	115.78	133.88	124.83	250	30–800	97 (94)	16 (21)
IVP	142.23	205.23	173.73	100	30–300	34 (22)	26 (35)
Perfusion scan, lung	171.50	187.62	179.56	125	20–400	44 (28)	19 (25)
Ventilation scan, lung	145.50	180.34	162.92	100	25–400	47 (28)	14 (19)
Ultrasound, abdomen	88.25	153.71	120.98	80	10–300	25 (22)	49 (65)
Doppler, leg	59.89	69.49	64.69	75	30–300	39 (52)	37 (49)
Ultrasound, pelvis	82.90	127.27	105.09	80	25–300	26 (22)	50 (67)
Flat plate, abdomen	79.79	72.97	76.38	45	15–125	41 (24)	15 (20)
X-rays							
Ankle	70.42	44.12	57.27	25	6–100	39 (22)	23 (31)
C-spine	102.69	73.19	87.94	40	15–175	43 (25)	18 (24)
Chest	68.18	51.07	59.63	30	10–125	40 (26)	27 (36)
Clavicle	60.92	41.34	51.13	25	5–75	42 (22)	16 (21)
Face	99.56	62.84	81.20	35	15–150	40 (23)	28 (37)
Femur	79.00	53.23	66.12	30	10–125	39 (27)	29 (39)
Foot	70.56	44.43	57.50	25	10–125	41 (23)	23 (31)
Knee	75.79	44.89	60.34	25	10–100	39 (22)	24 (32)
Lumbar spine	86.50	67.76	77.13	40	10–150	44 (24)	16 (21)
Pelvis	85.17	50.10	67.64	30	10–125	37 (25)	27 (36)
Rib	63.13	58.21	60.67	30	10–125	44 (25)	24 (32)
Shoulder	80.57	63.31	71.94	30	10–125	47 (23)	22 (29)
Wrist	69.15	43.64	56.40	25	10–100	40 (21)	22 (29)
Mean						40	26 (35)

Note: CT = computed tomography; IVP = intravenous pyelogram

Table 2. Actual and estimated costs for laboratory tests

Laboratory test	Actual test cost, $			EP estimates, $ n = 75		EP % error mean (and SD)	No. (and %) < 25% error
	Hospital A	Hospital B	Mean	Median	Range		
Acetaminophen	16.08	10.82	13.45	20	2–150	99 (131)	28 (37)
Arterial blood gas level	8.91	19.03	13.97	20	3–100	57 (70)	34 (45)
Digoxin level	20.83	10.01	15.42	30	1–125	77 (94)	26 (35)
Ethanol level	17.08	8.42	12.75	20	1–100	69 (95)	39 (52)
Serum lactate	10.20	7.65	8.93	20	1–150	210 (265)	15 (20)
Serum osmolality	23.80	29.52	26.66	20	1–100	47 (45)	31 (41)
Chemistry 1*	4.14	5.70	4.92	15	1–200	307 (548)	14 (19)
Chemistry 2†	4.41	5.95	5.18	20	2–250	421 (670)	14 (19)
Chemistry 3‡	4.41	5.77	5.09	20	3–275	457 (697)	12 (16)
Chemistry 4§	5.03	6.27	5.65	20	1–300	445 (671)	8 (11)
Salicylate level	16.08	6.58	11.33	20	3–75	76 (84)	27 (36)
Urine dip	0.29	4.98	2.64	5	0.20–30	85 (96)	19 (25)
Urine test for pregnancy	4.40	26.08	15.24	10	0.75–50	43 (23)	27 (36)
Blood culture	46.40	51.26	48.83	35	10–150	47 (37)	24 (32)
Coagulation profile	10.34	18.11	14.23	25	3–150	93 (130)	32 (43)
Electrocardiogram	25.48	49.34	37.41	20	2–150	35 (33)	39 (52)
Hematology profile	13.22	17.21	15.22	15	2–150	72 (124)	31 (41)
Urine micro exam	7.56	9.56	8.56	15	2–75	109 (131)	17 (23)
Mean						153	24 (32)

*Measures one of: carbon dioxide, chloride, creatinine, glucose, potassium, sodium or urea.
†Measures one of: albumin, alkaline phosphatase, alanine transaminase (ALT), aspartate transaminase (AST), calcium, lactic dehydrogenase (LDH), phosporus, protein or uric acid.
‡Measures one of: amylase, bilirubin, creatine phosphokinase (CPK) or gamma-glutamyl-transpeptidase (GGT).
§Measures serum iron or magnesium.

Table 3. Actual and estimated costs for pharmaceuticals tests

Pharmaceutical, dose	Actual pharmaceutical cost, $			EP estimates, $ n = 75		EP % error mean (and SD)	No. (and %) < 25% error
	Hospital A	Hospital B	Mean	Median	Range		
Cefazolin, 1 g IV	1.74	3.53	2.64	15	2–100	590 (655)	4 (5)
Cefuroxime, 750 mg IV	6.02	8.08	7.05	30	3–100	377 (316)	8 (11)
Charcoal, 50 g po	5.25	8.33	6.79	10	0.50–60	71 (121)	43 (57)
Clindamycin, 300 mg	2.18	3.83	3.01	20	2–110	722 (724)	3 (4)
Furosemide, 40 mg IV	0.40	2.27	1.34	5	0.20–50	224 (386)	10 (13)
Gentamicin, 80 mg IV	2.31	3.28	2.80	8	0.30–50	297 (353)	11 (15)
Hyoscine, 20 mg IV	3.80	5.90	4.85	10	0.50–50	142 (174)	22 (29)
Lidocaine 1%, 5 mL	0.14	3.26	1.70	3	0.05–50	134 (214)	11 (15)
Lidocaine gel 2%, 10 mL	2.61	4.92	3.77	5	0.30–25	69 (100)	41 (55)
Midazolam, 2 mg IV	1.49	5.41	3.45	10	1–100	210 (273)	13 (17)
Naloxone, 0.4 mg IV	3.27	6.97	5.12	10	0.50–60	145 (166)	7 (9)
Salbutamol, 2.5 mg	0.62	2.43	1.53	5	0.40–50	294 (438)	21 (28)
Tetracaine, 1 mL	1.35	3.43	2.39	2	0.20–50	96 (175)	3 (4)
Octreotide, 0.1 mg IV*	8.95	11.36	10.16	50	5–300	491 (487)	2 (3)
Verapamil, 5 mg IV	7.61	7.70	7.66	10	1–50	126 (142)	4 (5)
Flumazenil, 0.3 mg IV	22.58	29.17	25.88	30	3–200	66 (100)	28 (37)
Ceftriaxone, 1 g IV	33.98	35.93	34.96	60	10–250	116 (147)	19 (25)
Adenosine, 6 mg	31.64	32.93	32.29	40	12–250	92 (134)	31 (41)
Streptokinase, 1.5 Mu	369.80	382.10	375.95	300	15–1500	63 (63)	18 (24)
Alteplase, 100 mg	2089.00	2704.00	2397.00	2000	30–3600	27 (28)	46 (61)
Mean						218	17 (23)

**n* = 70 estimates for octreotide

tive ignorance is probably born in medical school, where health economics is underemphasized, and it is nurtured in residency training, where physicians learn the liberal application of advanced tests and treatments but seldom concern themselves with cost.[26] Physicians are rarely told about the expenses they generate, and costs are excluded from industry advertising aimed at them. Third parties cover most patient bills, so ability to pay is rarely an issue. In addition, many physicians shun the concept of economic accountability and equate "cost-effectiveness" with poor medical ethics.[16,30] These experiences and attitudes translate into a general disregard for the cost of the care delivered.[30]

The primary goal of cost-effectiveness is not to reduce costs by limiting utilization, but to achieve maximum health benefit with the funds available. In these days of health care cutbacks, when the limit of available funding is reached and physicians can no longer provide timely care to all those who need it, every dollar spent unnecessarily is a dollar taken from a patient in need. If this is the case, then it is both ethical and important to spend health care dollars in a cost-effective fashion.[30] However, without an awareness of medical care costs, physicians may find it difficult to practise cost-effectively.

Previous research shows that perceived cost influences utilization,[15,16,20,22,26,32,33] and that physicians who underestimate costs order more diagnostic tests than those who estimate accurately or overestimate.[22] Several investigators have shown that cost-awareness programs reduce utilization and expenditure.[15,16,26,32–34] This suggests that cost awareness may be a modifiable determinant in utilization behaviour. The current study was performed to help determine the need for cost-awareness education and to target where such efforts might be most beneficial.

This study confirmed the authors' hypothesis: that, overall, EPs at the study hospitals had a limited knowledge of common ED costs. Tables 1 to 3 show that EPs estimated within 25% of the actual range only 30% of the time. The largest relative estimation error (mean = 218%) occurred

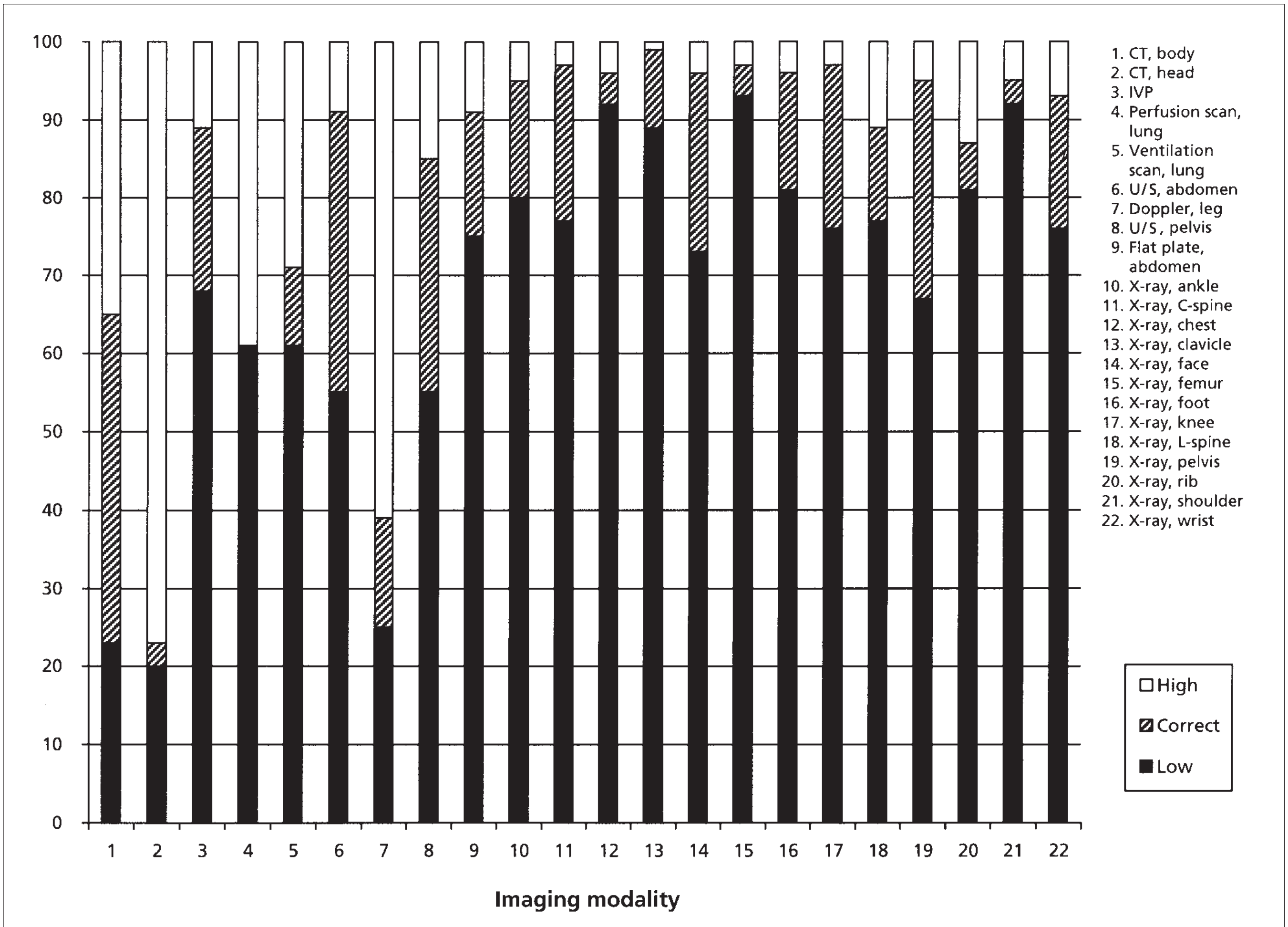

Fig. 1. Proportion of low, correct and high estimates for imaging modalities, %. IVP = intravenous pyelogram; U/S = ultrasonography.

with pharmaceutical agents and the smallest (mean = 40%) with imaging modalities. The data also show that the physicians tended to overestimate the cost of inexpensive items and underestimate the cost of expensive items.

Our belief is that cost-awareness programs are most likely to reduce unnecessary utilization when physicians underestimate costs.[22] Of interest, we found that the EPs underestimated only 21% of pharmaceuticals and 23% of laboratory tests, suggesting that increasing physician cost awareness for these items is less likely to reduce utilization. Conversely, physicians underestimated imaging costs 68% of the time and plain radiographs 81% of the time. This, along with the fact that imaging modalities carry a higher unit cost than drugs and lab tests, suggests that ED cost-awareness programs are most likely to be effective if they are aimed at x-ray utilization.

One of the study's most interesting findings was that hospitals' finance departments also had a poor knowledge of medical care costs. Of the 7 hospitals surveyed, only 2 could provide ED cost data, and many of the "actual" costs differed substantially between hospitals. This is not a study flaw; it merely points out the disconcerting fact that, for hospital-based tests and imaging modalities, there is no such thing as an "actual cost."

Costs can be divided into "fixed" costs (e.g., equipment, maintenance of equipment, clerical staff, worker benefits, proportional hospital maintenance, heating and utilities) and variable costs (e.g., reagents, supplies, test kits, film and radiologist fees). Many costs, like reagents and supplies, are volume dependent and therefore vary from hospital to hospital. To complicate matters, some costs, like technician salaries, can be considered both fixed and variable. For example, if an ED reduced x-ray utilization by 5%, this would not reduce technician salaries, since the same number of technicians would still be required. However, reducing utilization by 20% would reduce technician salaries if it allowed the hospital to hire one less technician. In hospitals with only one technician on duty at night, reducing night x-rays by 50% would not reduce technician costs, since the technician would still be required to perform urgent studies.

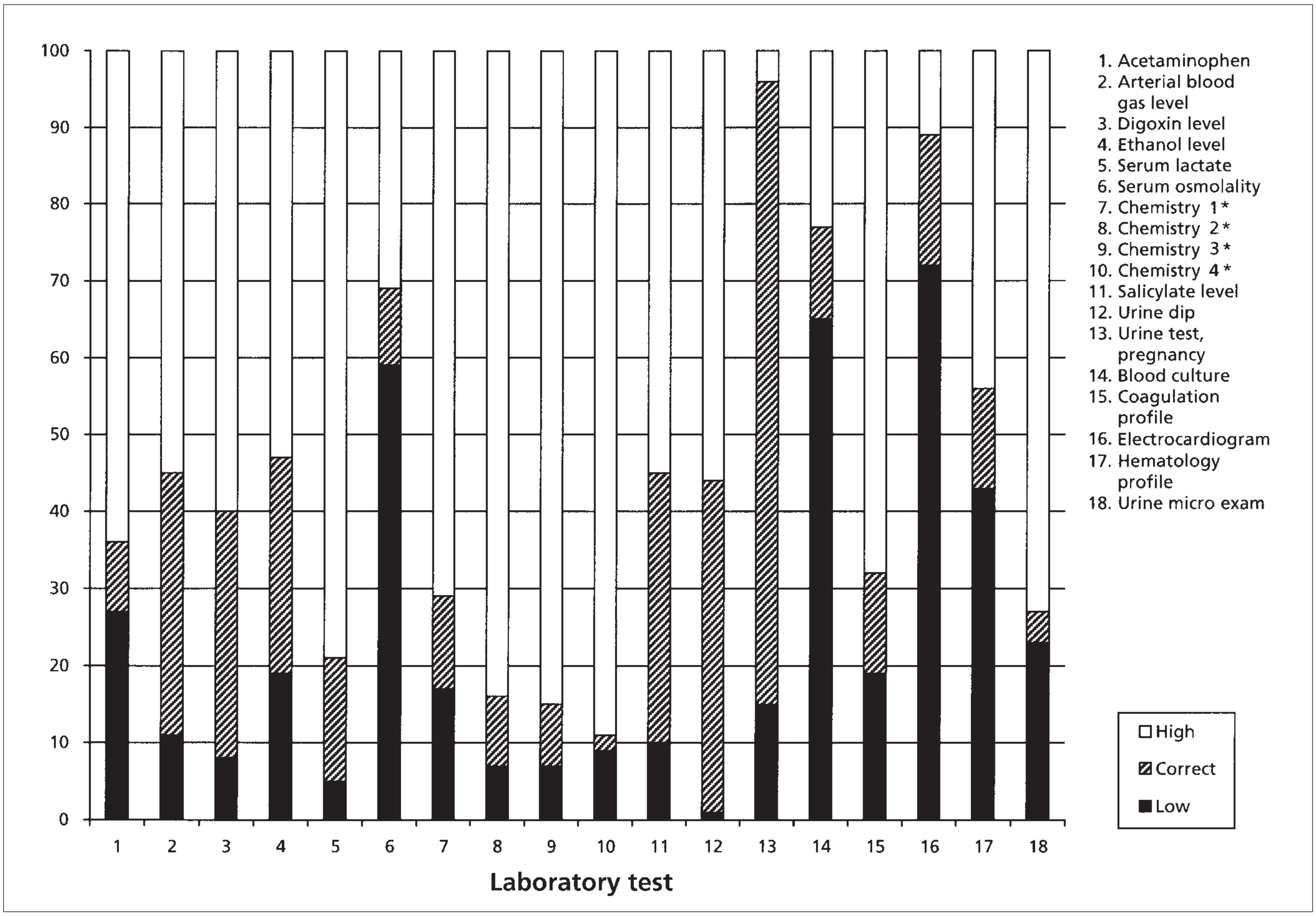

Fig. 2. Proportion of low, correct and high estimates for laboratory tests, %.
***Refer to Table 2 for description.**

Conversely, avoiding one CT scan (and the associated overtime technician callback) every other night would reduce costs substantially.

For all these reasons, "actual" unit costs do vary from hospital to hospital, depending on the equipment, the level and pattern of technician staffing, employee contracts, the volume of tests performed and the nature of supplier contracts. Some of the "actual cost" variability seen in this study (e.g., body CT) also reflects different accounting practices, cost averaging and cost shifting within hospitals.

Most previous studies avoid cost uncertainty by reporting hospital charges rather than costs; however, while charges are easier to measure, they incorporate institutional profit margins and are less reflective of the resources expended performing the test, hence less valid. This is especially true in the "not-for-profit" Canadian system.

Given the uncertainty surrounding "actual" costs, some might criticize the ability of this study to assess physician cost awareness. To balance this uncertainty and give the physicians the benefit of the doubt, the range between hospital values was considered as correct, and estimates within 25% of the upper and lower values were accepted as "good knowledge." Previous investigators have used similar methods. Skipper and colleagues defined cost estimates within 25% of a single actual value as "good knowledge" and found that 45% of attending physicians achieved this level of precision.[29] Other researchers[22,26,28,35–37] have also used 20% or 25% as the cutoff level for "good" knowledge and found that 25%–47% of physicians estimate costs within this range. Apart from the population sampled (emergency physicians), the methods and results of this study are directly comparable to previous studies.

Limitations

This study addresses only cost awareness; it does not demonstrate inappropriate utilization, nor prove the opportunity for cost reduction. Because this survey was performed in a geographically circumscribed urban setting, it is unclear whether the conclusions can be generalized to other regions of the country.

The appearance of octreotide (a drug rarely prescribed by EPs) on the study's top 20 list reflects a problem EDs are increasingly forced to deal with. With the lack of inpatient beds, many patients languish in the ED long after admis-

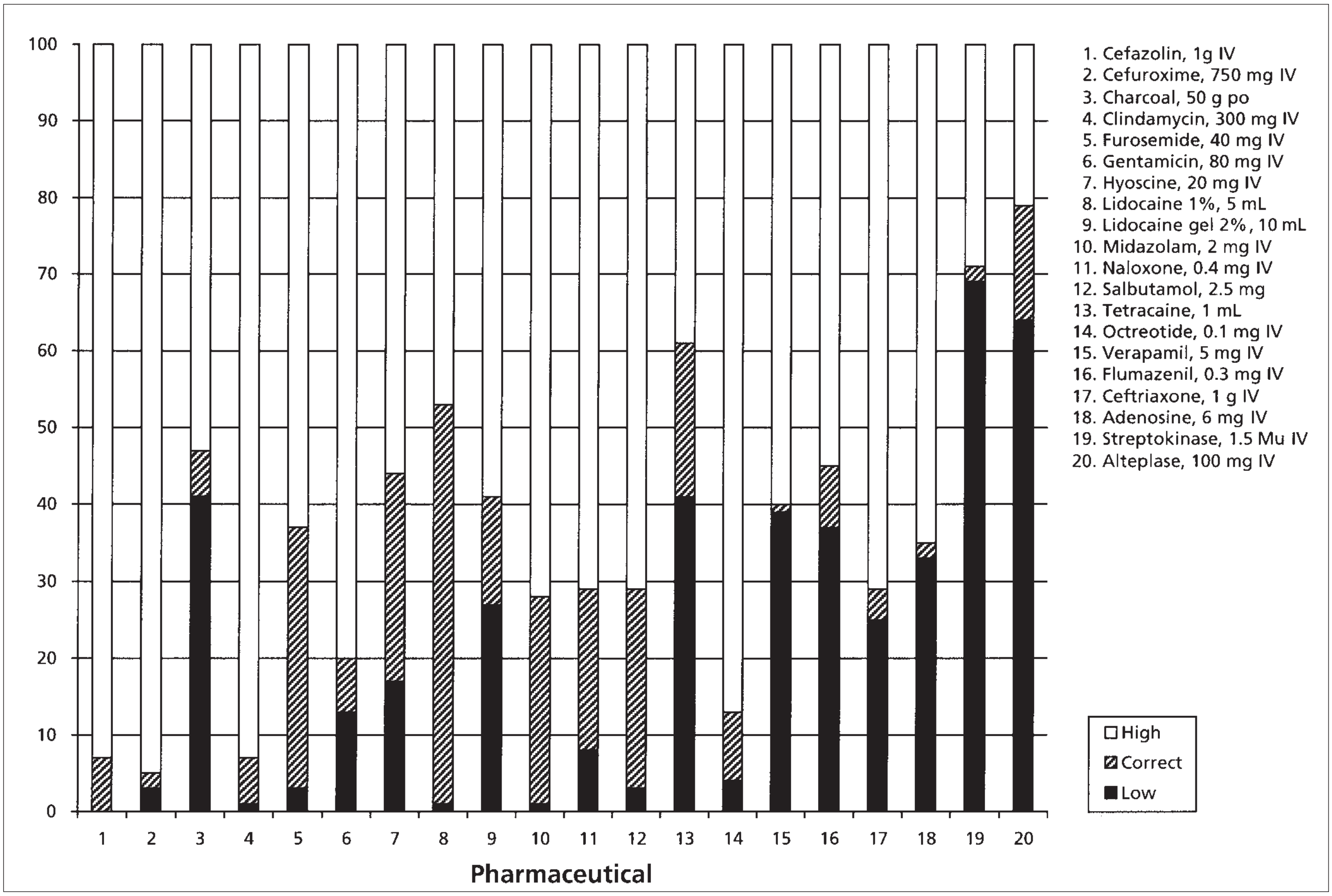

Fig. 3. Proportion of low, correct and high estimates for pharmaceuticals, %.

sion. In the study hospitals, because of poor information systems that do not link utilization to the responsible physician, tests and interventions (e.g., octreotide) ordered while patients remain physically in the ED are automatically and incorrectly attributed to the EP. Clearly EPs should not be expected to have cost awareness for agents they do not use.

Conclusions

Emergency physicians have limited knowledge of common medical care costs. They overestimate pharmaceutical and laboratory costs and underestimate diagnostic imaging costs. Cost-awareness programs for EPs are most likely to be effective if they focus on imaging modalities, particularly plain film x-rays.

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