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Pharmacists' Knowledge of the Cost of Laboratory Testing

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Abstract

Purpose: The objective of this study was to ascertain baseline knowledge of pharmacists and pharmacy residents concerning the cost of laboratory tests for monitoring medications, and to determine whether an educational session delivered to pharmacy residents improves their knowledge of these costs. **Methods:** An online survey was provided to pharmacists and pharmacy residents, testing their knowledge of 15 common laboratory tests used to monitor the safety and efficacy of medications. One of the researchers presented a lecture to all pharmacy residents that detailed individual laboratory costs; after that, the researchers delivered a follow-up survey to assess the effectiveness of the educational session. **Results:** Baseline knowledge of pharmacists showed that greater than 64% of the responses were more than 30% away from the actual cost of the laboratory test for all 15 tests. Baseline knowledge of pharmacy residents showed that greater than 58% of the responses were more than 30% away from the actual cost of the laboratory test for each individual test. Although there was no statistically significant improvement in individual cost prediction after the educational session, 2 laboratory values showed improvement in margins of error post intervention: alanine aminotransferase/aspartate aminotransferase and lipids ($P = .008$ and .014, respectively). **Conclusions:** Pharmacists and pharmacy residents poorly predicted the costs of common laboratory tests. A brief lecture discussing the cost of laboratory tests demonstrated minor improvement in pharmacy residents' knowledge of the costs reviewed. Pharmacists need to be educated on the cost of laboratory tests to better understand the profession's contribution to health care expenditures.

Keywords

health care costs, laboratory, pharmacist

There has been a persistent rise in the cost of health care in the United States. Hospital expenditures rose from $933.5 billion to $971.8 billion (an increase of 4.1%) in 2014.[1] A component of the growth in expenditures is the laboratory testing ordered. The cost of any single laboratory test is not staggering; but because of the volume of laboratory testing ordered for each patient every day, the total impact can be substantial, especially when serial levels are followed over a period of time. In 2008, the cost of medical diagnosis, including the laboratory testing, accounted for $250 billion in the United States, which is roughly 10% of all medical costs.[2]

Several studies have shown that physicians, medical residents, and medical students are unaware of the economic impact they have when ordering frequent laboratory tests.[3-10] Starting as early as 1976 and as recently as 2014, studies have repeatedly demonstrated that health care personnel lack knowledge regarding the costs of laboratory tests.

The health professional overlooked in all of these studies is the pharmacist. Pharmacists may be contributing to the rise in costs, and they may be unaware of their role in the mounting expenses related to drug monitoring. The pharmacists' scope of practice is expanding under protocols and collaborative practice agreements regarding their ability to order laboratory tests for monitoring the efficacy and toxicity of medications. It is not known whether pharmacists are aware of the costs associated with monitoring drug therapy. The objective of this study was to determine baseline knowledge of pharmacists and pharmacy residents in regard to the costs associated with having laboratory tests performed. In addition, this study endeavored to determine whether an education session delivered to pharmacy residents improved their baseline knowledge of these costs.

Methods

Study Population

All pharmacists who perform pharmacokinetic services at 9 participating hospitals in a limited region of a Midwest state and all pharmacy residents in this same region enrolled in a

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teaching program during a single residency year were invited to participate in the study. This totaled 304 pharmacists and 34 pharmacy residents.

Survey Design and Distribution

The survey was developed in QuestionPro, an online survey tool. Pharmacists and pharmacy residents were asked to enter a value to estimate the cost of 15 laboratory tests to the nearest dollar. The prices of these tests were ascertained from a local health institution based on Medicare and Medicaid reimbursement rates. In addition, participants were asked to rate their level of agreement with 3 statements focused on how knowledge of laboratory costs would impact their current drug monitoring practices using a 10-point Likert scale. Demographics regarding the participants were obtained.

The survey link was distributed by the principal investigator via a secure-encryption e-mail to a contact person at each of the participating hospital sites. The contact person distributed the survey link to all eligible participants. A reminder e-mail was sent 2 weeks following the initial e-mail, and the survey closed 4 weeks after the first e-mail was sent. Pharmacy residents were asked to complete the same online survey to assess their baseline knowledge, which was then closed after 4 weeks. All survey responses were anonymous.

A brief lecture detailing the costs of individual laboratory tests, in the form of patient cases, was presented to the pharmacy residents after the close of the initial survey. The lecture was limited to the pharmacy residents due to logistics. One month after completion of the education session, a follow-up survey link was distributed via e-mail to determine the effectiveness of the lecture. A reminder e-mail was sent 2 weeks following the first e-mail. The follow-up survey was available for 4 weeks.

This study was approved by the institutional review board.

Statistics

Survey data were automatically collected via the Web-based survey program and were downloaded directly into IBM SPSS (version 22.0; IBM, Inc, Armonk, New York) for statistical analysis. Estimates of cost were categorized into 4 groups based on margin of error from the actual cost of the laboratory test. The 4 margin of error groups were as follows: 0% to 10%, 10.01% to 20%, 20.01% to 30%, and greater than 30%. A Mann-Whitney *U* test was used to compare pharmacy resident responses before and after the lecture intervention to assess improvement from baseline.

Results

A total of 81 out of 338 pharmacists and pharmacy residents responded to the initial survey, representing an overall response rate of 24%. Five of the surveys were not complete; however, all responses were used when provided. The demographics are shown in Table 1.

Table 1. Demographics of Survey Respondents.

Demographics	Survey respondents, n (%)
Position	
Pharmacy resident	19 (24.7)
Staff pharmacist	23 (29.9)
Clinical pharmacist	35 (45.4)
Years in practice	
Less than 1 y	18 (22.7)
1-5 y	26 (32.9)
6-10 y	9 (11.3)
10-15 y	8 (10.1)
More than 15 years	18 (22.7)
Years able to independently order labs	
Less than 1 y	21 (26.9)
1-5 y	27 (34.6)
6-10 y	9 (11.54)
10-15 y	9 (11.54)
More than 15 years	12 (15.38)

Overall, the cost estimates ranged from $1 to $500. The highest correct responses were for gentamicin and tobramycin serum concentrations (17.1% and 18.4%, respectively, of estimates within 10% of the correct answer). Greater than 64% of all responses were outside the 30% margin of error from the actual cost for all 15 laboratory tests. The laboratory cost that represented the highest number of estimates greater than 30% away from the actual cost was for serum creatinine. The detailed results are provided in Table 2.

When evaluating the results of the statements presented in the survey, it was found that the majority of pharmacists reported that they did not have sufficient knowledge of the cost of laboratory tests. Pharmacists were neutral (with 5 being the most frequent response on the Likert scale) regarding whether or not the cost of the laboratory values influenced their drug monitoring or whether or not better knowledge of costs would change how they monitor drug therapy.

Posteducation Session Follow-Up

A total of 19 pharmacy residents responded to the initial survey and 10 residents responded to the follow-up survey. Two surveys were not completed; however, all responses were used where provided. There were no significant differences in cost estimation from baseline. When the data were analyzed in the groups with respect to error ranges, it was found that ALT/AST and lipid panel tests had *P* values of .008 and .014, respectively, showing improvement in cost knowledge. The residents estimated the costs of ALT/AST and vancomycin within 10% of the actual cost 40% of the time. The test that elicited the most divergent approximations from actual

Table 2. Percentage of Responses in Each Margin of Error Group.

	Percent of estimates within 0%-10% of true costs	Percent of estimates within 10.1%-20% of true cost	Percent of estimates within 20.1%-30% of true cost	Percent of estimates over 30% of true cost
Vancomycin level	3.95	3.95	22.37	69.74
Gentamicin level	17.11	11.84	6.58	64.47
Tobramycin level	18.42	9.21	6.58	65.79
Phenytoin level	6.58	6.58	17.11	69.74
Free phenytoin level	14.47	2.63	7.89	75
Albumin	14.47	6.58	2.63	76.32
PT/INR	13.16	3.95	0	82.89
aPTT	7.89	3.95	2.63	85.53
Serum creatinine	5.19	0	5.19	89.61
Basic metabolic panel	1.3	11.69	2.6	84.42
Complete metabolic panel	6.58	3.95	2.63	86.84
Platelet count	6.58	11.84	2.63	78.95
Complete blood count	3.95	2.63	14.47	78.95
ALT/AST	9.21	1.32	7.89	81.58
Lipid panel	2.63	10.53	3.95	82.89

Note. PT/INR = prothrombin time/international normalized ratio; aPTT = activated partial thromboplastin time; ALT/AST = alanine aminotransferase/aspartate aminotransferase.

Table 3. Percentage of Responses in Each Margin of Error Group Pre and Post Intervention.

	Percent of estimates within 0%-10% of true costs		Percent of estimates within 10.1%-20% of true cost		Percent of estimates within 20.1%-30% of true cost		Percent of estimates over 30% of true cost		
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	*P* value
Vancomycin level	5.88	40	17.65	0	11.76	10	64.71	50	.209
Gentamicin level	5.88	10	11.76	40	11.76	10	70.59	40	.084
Tobramycin level	5.88	10	11.76	40	5.88	10	76.47	40	.055
Phenytoin level	5.88	30	11.76	10	23.53	30	58.82	30	.078
Free phenytoin level	17.65	20	11.76	10	5.88	20	64.71	50	.512
Albumin	11.76	10	0	0	0	0	88.24	90	.929
PT/INR	11.76	0	5.88	20	0	0	82.35	80	.943
aPTT	5.88	0	0	0	0	20	94.12	80	.284
Serum creatinine	5.56	27.27	0	0	5.56	9.09	88.89	63.64	.071
Basic metabolic panel	5.56	0	16.67	27.27	0	0	77.78	72.73	.727
Complete metabolic panel	0	0	5.88	18.18	5.88	18.18	88.24	63.64	.082
Platelet count	11.76	0	5.88	20	5.88	20	76.47	60	.47
Complete blood count	5.88	30	0	10	17.47	0	76.47	60	.195
ALT/AST	5.88	40	5.88	0	0	20	88.24	40	.008
Lipid panel	5.88	27.27	23.53	45.45	5.88	9.09	64.71	18.18	.014

Note. PT/INR = prothrombin time/international normalized ratio; aPTT = activated partial thromboplastin time; ALT/AST = alanine aminotransferase/aspartate aminotransferase.

cost was albumin, with 90% of respondents estimating greater than 30% margin of error (Table 3).

Discussion

Several studies have evaluated the knowledge of medical students, medical residents, physicians, and medical faculty regarding the cost of diagnostic and laboratory tests.[3-9] The results of these studies have been consistent through time and without regard to years of experience. The accuracy rate of the students and physicians regarding laboratory costs ranged from 2% correct within a 10% margin of error to 50% correct within a 50% margin of error.[3-9] A systematic review estimated that when the margin of error was set at 25% of the

true cost, 33% of the students and physicians identified the actual cost of the laboratory tests correctly.[10]

Collectively, these studies demonstrate the universal deficiency of cost awareness in our educational and clinical inpatient settings. However, there is a desire on the part of practitioners to improve their knowledge in this regard. One study found that physicians had a significant desire to know more and agreed that the cost of a test affects their decision to order it.[9] They felt that improved access to cost information would affect their ordering behavior.[9] There was not a clear relationship between knowing the costs of laboratory tests and ordering behavior, as ordering behavior may be influenced by protocols at the health institution.[9]

Our study demonstrates that pharmacists' knowledge of laboratory costs is similar to those of physicians. The opinions of the pharmacists who stated that they did not have sufficient knowledge regarding the cost of laboratory data correspond with the overall results. Although knowledge of costs regarding only 2 of the tests showed statistical improvement after an educational session, positive trends were seen with other laboratory tests.

Study Limitations

There was a low response rate of 23.9% to the initial survey. One possible explanation for the low response rate is that there was no mechanism to ensure that the e-mails were sent out by the hospital pharmacy contact person, so everyone may not have received the e-mails or the reminders. The response rate to the postintervention survey was 29.4%. However, more pharmacy residents were expected to respond during both stages of the study because the researchers met with them face-to-face during the educational session. The standard deviation of responses was 2 to 3 times larger than anticipated, and the effect size was set at 10%. The combination of the above factors eroded the power to roughly 30%.

Another limitation is the lecture intervention itself. The presentation was fast-paced and provided limited active learning. The residents may have not received adequate time to observe and digest the individual costs of the chosen laboratory tests.

Last, it is possible that the pharmacists could have researched the cost of the laboratory tests at the time of taking the survey. If this was the case, our results appear better than the true knowledge of the pharmacists.

Conclusion

Overall, pharmacists poorly predicted the costs of common laboratory tests. A short lecture regarding laboratory costs demonstrated minor improvement in the participants' knowledge of the cost of laboratory tests reviewed. A pharmacy student curriculum or pharmacist continuing education program should incorporate the costs of laboratory tests as part of the pharmacist scope of practice. This will enable practicing pharmacists to identify their impact on the costs associated with health care.

Declaration of Conflicting Interests

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