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PATIENT SAFETY

An educational intervention to increase awareness reduces unnecessary laboratory testing in an internal medicine resident-run clinic

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ABSTRACT

At our resident-run clinic in an underserved community, laboratory test costs in 2013 exceeded the government subsidy by $400 000. To optimize limited resources and improve patient care, an education program to reduce testing was implemented.

Between November 2014 and January 2015, residents attended lectures on utilization of laboratory testing, focusing on standard practice guidelines, and analyses of unnecessary tests. Multivariate nonparametric statistical methods and subgroup analysis were used to evaluate cost reduction.

There were 453 clinic visits during the intervention period and 471 visits during the control period. Lectures were independently associated with a significant laboratory cost reduction. Median laboratory cost per visit decreased from $106.00 to $74.00. Total cost in the study period decreased from $79 403 to $51 463. There were similar reductions of laboratory costs in two subgroups: age groups of <50 years and ≥50 years, new encounters, and follow-up visits . In the analysis of individual tests, the cost of TSH and Vitamin D tests had the greatest reduction ($8176 and $5088 respectively).

An appropriate physician education program can reduce laboratory tests and costs. Screening tests with inadequate evidence support were reduced most, whereas those with proven benefits did not decrease significantly.

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Laboratory testing; cost reduction; behavior modification; residency; educational intervention; patient care

1. Introduction

Laboratory testing accounts for 3–5% of the healthcare spend in the United States [1]. As much as 25% of diagnostic testing was considered redundant or of limited clinical value [2,3]. In clinical practice, residents tend to order multiple laboratory tests some of which are not needed. Overutilization of tests occurs for a number of reasons: ordering tests as 'panels', unnecessary repetition despite normal previous results, lack of guidelines, fear of uncertainty, defensive testing, poor understanding of laboratory costs, and annual 'routine labs'. Patient care could be compromised by overutilization of laboratory testing because the latter may increase false-positive results, and lead to more downstream tests and unnecessary intervention. At our resident-run federally qualified community-based clinic in St. Louis, Missouri, the cost of laboratory tests in 2013 exceeded the government subsidy by $400 000. In order to limit unnecessary blood draws, we implemented a 5-week intervention program to educate the residents on reduction of unnecessary laboratory testing in our clinic.

2. Methods

This study was conducted in the resident clinic in a federally funded outpatient clinic. The purpose of the study was to improve the quality of care and improve patient safety in the clinic. This study was conducted under direct supervision of the residency directors in compliance with the HIPAA (Health Insurance Portability and Accountability Act) regulations. Baseline (pre-intervention) data on number of patient encounters, number of laboratory tests ordered and associated costs were collected from November 2013 to January 2014. We conducted a five-week intervention when we educated all categorical internal medicine residents (total of 38 residents: 12 PGY1, 13 PGY2, and 13 PGY3). The residents received lectures every week for five weeks on appropriate utilization of laboratory testing. This educational program focused on the reinforcement of standard practice guidelines [4–11] for appropriate laboratory testing, and analyses of cases where unnecessary laboratory tests were ordered. Costs of commonly used laboratory tests were posted in the physician workstation to increase awareness. The post-intervention data was collected between November 2014 and January 2015.

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We compared the laboratory tests ordered during the pre-intervention and post-intervention periods. Multivariate nonparametric statistical methods (i.e. ordinal logistic regression) and sub-group analyses were used to evaluate the effect of this program on the pattern of laboratory testing.

3. Statistical analysis

The distributions of the total laboratory testing costs at each patient encounter before and after the intervention were presented using histograms and box plots. Ordinal logistic regression was used to evaluate the effect of the education program on cost reduction of laboratory testing. Age (≤ 50 year vs. >50 year) and encounter type (new encounter vs. follow-up visit) were introduced as confounding variables in the multivariate nonparametric statistical model. The effect size of the educational intervention was further assessed in subgroups stratified by age and encounter type using univariate analyses. The frequency of an individual lab order was compared before and after the intervention using Fisher's exact test with Bonferroni correction for multiple comparison. A double-sided *p*-value lower than 0.05 was considered statistically significant. The statistical analysis was conducted using R x64 3.1.2.

4. Results

There were a total of 453 clinic visits after the intervention between November 2014 and January 2015, and 471 clinic visits during the pre-intervention period between November 2013 and January 2014. The time of the year was matched in both groups to minimize the variation of laboratory orders due to possible seasonal variation. The numbers of residents in both the pre-intervention and post-intervention period were the same. Seventy different types of laboratory tests were ordered during these periods. The most common tests ordered were complete blood count, hemoglobin A1c, complete metabolic panel, and a lipid panel. The characteristics of both control group and intervention group are described in Table 1. The educational intervention was independently associated with a significant reduction of cost of laboratory tests (OR = 1.53, 95%; CI: 1.12–2.11) (Figure 1). With intervention, the median laboratory cost per visit decreased from $106.00 to $74.00 ($p < 0.001$) (Figure 2). The total cost of laboratory tests during the study period decreased from $79 403 to $51 463 ($p < 0.001$). This represents an extrapolated annualized cost reduction of $145 288 (from $422 895 to $267 607). A ratio of laboratory cost/encounter was used to compare the difference in the pre- and post-intervention period.

Table 1. Subgroup characteristics and main results.

	Pre-intervention	Post-intervention
Number of visits		
Total	471	453
Encounter type		
New	56	70
Follow-up	415	383
Age		
<=50 years	236	238
>50 years	235	215
Med lab cost($)	106	74
Total lab cost ($)	79 403	51 463
**Annual cost ($)	412 895.6	267 607.6

The intervention was associated with similar reductions of laboratory costs in the following two subgroups: age groups of ≤50 years (OR = 1.53, 95%; CI: 1.12–2.11) and >50 years (OR = 1.58, 95%; CI: 1.14–2.21); new clinical encounters (OR = 3.63, 95%; CI: 1.89–7.13) and follow-up visits (OR = 1.53, 95%; CI: 1.20–1.96). The patients were grouped in two age groups assuming that the older patients (>50 years old) would require more laboratory testing compared to younger patients. Likewise, an initial clinic visit likely requires more laboratory testing compared to a follow-up visit in an established patient (Figure 3). In the analysis of individual laboratory tests, the costs of TSH and Vitamin D tests showed the greatest reduction, $8176 and $5088, respectively (Figure 4). Other tests, including CBC, CMP, HbA1c, and lipid profile, were not significantly affected by the education program (Figure 4).

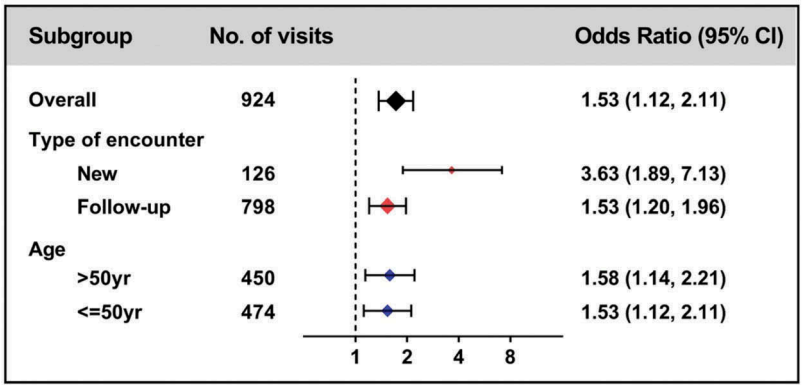

Figure 1. Forest plot of the odds ratio of laboratory cost reduction in subgroups.

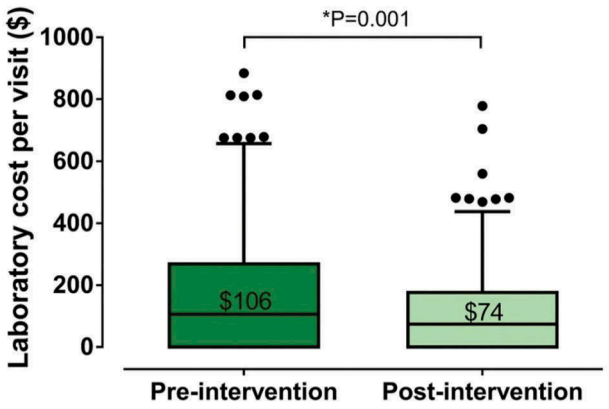

Figure 2. Box plots of the cost distribution of laboratory tests. *p* indicates statistical significance.

5. Discussion

There may be as much as 20% waste of health care resources in the United States [12]. According to the National Health Expenditure data, 2014, US healthcare spending increased from 5.3 percent following growth of 2.9 percent in 2013, and reached $3.0 trillion [13]. Spending on physician and clinical services increased 4.6 percent in 2014 to $603.7 billion following 2.5 percent growth in 2013 [13]. Repetitive and unnecessary lab testing increases costs and causes patient discomfort. Physicians are often unaware of the cost of diagnostic tests. Thus, efforts are being made to educate physicians to reduce inappropriate laboratory testing. Tierney et al. studied the effect of informing physicians of the charges for outpatient diagnostic tests in an outpatient academic medical practice. It showed that by displaying the charges for diagnostic tests, the number of tests ordered was reduced by 7.7% in the physicians' intervention group compared to the control group [14].

A study evaluated the trends of laboratory testing by residents in an inpatient setting. The intervention included lectures, chart audits, weekly feedback, and an administrative intervention [15]. While educational intervention reduced the number of tests ordered and decreased laboratory expenditures, the study additionally found that the proportion of clinically indicated tests was increased [15]. A similar study was conducted where internal medicine providers were educated through flyers displayed in offices, and periodic email communication reminding to order blood tests only if the results would change patient care in the inpatient setting [16]. They found a decrease in CBC and CMP ordered and reduced cost by $6.33 per day per patient. They concluded that ordering daily blood tests represented a habit and providers had grown accustomed to ordering unnecessary bloodwork [16]. In another study, the investigators provided physicians with cost information for the tests they ordered on a regular basis, and it improved the laboratory testing pattern and saved money. Providing cost information to the physicians allowed them to effectively select the highest yield test at the lower cost and avoid low-yield tests. They concluded that the ability to see changes on a regular basis, which resulted in feelings of empowerment and obligation to drive change [17]. A reduction in the number of laboratory tests ordered by improving the appropriateness of testing behaviors is essential for quality improvement [15,18]. As health care costs continue to rise in the US, laboratory testing is being recognized as a form of potential waste in health care utilization.

In this study, we have demonstrated significant reductions in laboratory testing and associated cost in a resident-run continuity clinic. The intervention used in this study included lectures to all residents and posting the prices of laboratory tests in the physician workstation. One limitation of our study is that the long-term effect of this educational intervention is unknown. We plan to continue the educational intervention annually and will evaluate the long-term effect in future study. Also, this study was done in an outpatient academic setting where most of the orders were placed by residents instead of attending physicians. As a result, it was relatively easy to make changes to current practice and we are

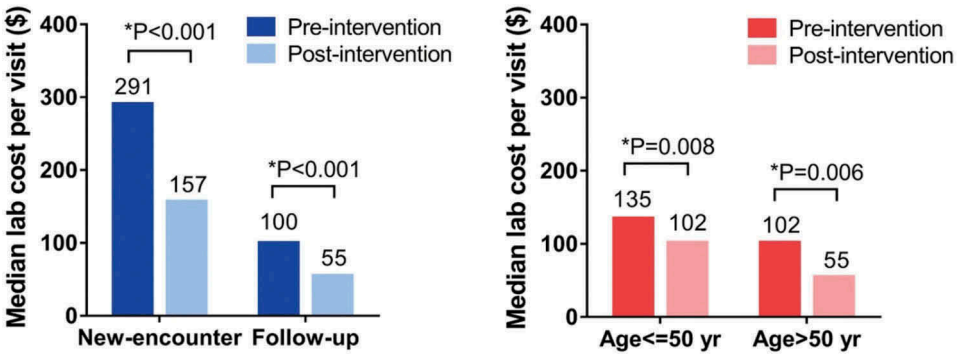

Figure 3. Median laboratory cost per visit in subgroups.

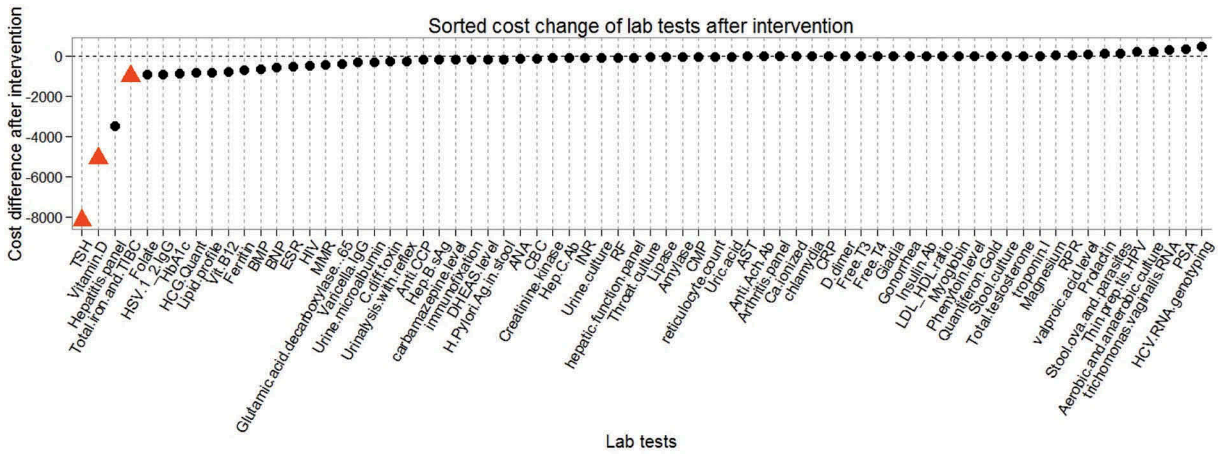

Figure 4. Sorted cost reduction of individual laboratory tests. Circles represent each laboratory test, triangles represent tests where cost reduction was statistically significant.

unsure if the observed effect can be reproduced in an outpatient clinic run by only attending physicians.

6. Conclusion

An appropriately designed physician education program is effective in reducing unnecessary laboratory tests and the associated costs. Screening tests with inadequate evidence were reduced most. Given that health care costs are rising and diagnostic testing has been overused, this is an effective method to reduce healthcare waste. This intervention showed that improved physician awareness of laboratory test waste can reduce unnecessary laboratory testing.

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Disclosure statement

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Author contributions

EL, SS, and HK developed the study protocol. All authors participated in data extraction. SS and EL did the analysis and interpretation of the data. EL and HK wrote the report. All other authors (OA, SS, JE, WN, YH, LR, FB) contributed to development of the study protocol, data collection and compilation. All authors have read and approved the final manuscript.

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