ORIGINAL RESEARCH

The Impact of Cost Displays on Primary Care Physician Laboratory Test Ordering

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BACKGROUND: Physicians are under increased pressure to help control rising health care costs, though they lack information regarding cost implications of patient care decisions.

OBJECTIVE: To evaluate the impact of real-time display of laboratory costs on primary care physician ordering of common laboratory tests in the outpatient setting.

DESIGN: Interrupted time series analysis with a parallel control group.

PARTICIPANTS: Two hundred and fifteen primary care physicians (153 intervention and 62 control) using a common electronic health record between April 2010 and November 2011. The setting was an alliance of five multispecialty group practices in Massachusetts.

INTERVENTION: The average Medicare reimbursement rate for 27 laboratory tests was displayed within an electronic health record at the time of ordering, including 21 lower cost tests (< $40.00) and six higher cost tests (> $40.00).

MAIN MEASURES: We compared the change-in-slope of the monthly laboratory ordering rate between intervention and control physicians for 12 months pre-intervention and 6 months post-intervention. We surveyed all intervention and control physicians at 6 months post-intervention to assess attitudes regarding costs and cost displays.

KEY RESULTS: Among 27 laboratory tests, intervention physicians demonstrated a significant decrease in ordering rates compared to control physicians for five (19 %) tests. This included a significant relative decrease in ordering rates for four of 21 (19 %) lower cost laboratory tests and one of six (17 %) higher cost laboratory tests. A majority (81 %) of physicians reported that the intervention improved their knowledge of the relative costs of laboratory tests.

CONCLUSIONS: Real-time display of cost information in an electronic health record can lead to a modest reduction in ordering of laboratory tests, and is well received. Our study demonstrates that electronic health records can serve as a tool to promote cost transparency and reduce laboratory test use.

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INTRODUCTION

Healthcare in the United States is increasingly expensive, and these high costs of care do not translate to consistent improvements in quality of care and outcomes.[1,2] Laboratory testing is widely recognized as a key form of potential waste in health care utilization, with some estimating that as much as 25 % of diagnostic testing is either duplicative or of limited clinical value.[3,4] This has led to recommendations from multiple professional societies to reduce use of inappropriate laboratory testing,[5] while new payment models increasingly focus on reducing health care utilization and costs as integral to improving health care quality.[6,7]

Despite the increased policy attention toward reducing inappropriate utilization and its associated costs, there are little data to guide health care systems on effective interventions.[8,9] As the key decision makers in a large proportion of evaluation and management decisions, physicians represent an important potential lever to improve the use of laboratory testing. Many studies demonstrate that physicians may have a poor understanding of the costs of care and feel uncomfortable initiating discussions about costs with their patients.[10–13] However, recent promising data suggest that physicians are willing to engage in efforts to control the rising costs of health care.[14]

Electronic health records offer the opportunity to engage physicians in these cost-control efforts.[15] Substantial resources have been invested to support increased implementation and meaningful use of electronic health records,[16] creating the opportunity to demonstrate whether they can be used to promote cost transparency and improve the use of laboratory testing. The implementation of cost displays in the electronic health record is a potential intervention to accomplish these aims, and the majority of physicians nationwide support such initiatives.[14] We evaluated whether real-time, passive display of costs for common laboratory tests within the electronic health record impacted primary care physician ordering of laboratory tests in the outpatient setting.

METHODS

Design Overview

This study was conducted from April 2010 through November 2011 at Atrius Health, an alliance of five multispecialty physician group practices using an integrated electronic health record system (Epic Systems, Inc). Beginning in May 2011, primary care physicians practicing at one of the group practices received real-time information on laboratory costs for 27 individual tests at the time of electronic order entry (“intervention” physicians), while primary care physicians practicing at the remaining four group practices received no cost information (“control” physicians). We used a difference-in-differences approach to compare the change-in-slope of the monthly laboratory ordering rate between intervention and control physicians for 12 months pre-intervention and 6 months post-intervention. The Brigham and Women’s Hospital Human Studies Committee approved the study protocol.

Setting and Participants

Atrius Health consists of five multispecialty physician group practices in central and eastern Massachusetts. All physicians use a common electronic health record (Epic Systems), and data from this system have been used extensively in prior analyses of quality and costs of health care. Atrius Health participates in financial risk-bearing contracts with multiple commercial payers, and is also participating in the Medicare Pioneer Accountable Care Organization program. The leadership of one of the group practices opted to implement the laboratory cost displays within the electronic health record as a method to engage primary care physicians in controlling the rising costs of health care. The remaining four practices did not implement these new laboratory cost displays. We enrolled all general internists practicing at these five physician group practices who ordered at least one of the 27 targeted laboratory tests for patients 18 years or older during each month of the study period, including 153 intervention physicians and 62 control physicians. We used data from all patients 18 years and older who had at least one visit to an eligible study physician during the study period.

Intervention Description

For intervention physicians, the costs for 27 laboratory tests were displayed within the electronic health record at the time of ordering, based on the 2010 Medicare reimbursement rates (Fig. 1). The laboratory cost displays did not introduce a workflow stop or require acknowledgment by physicians prior

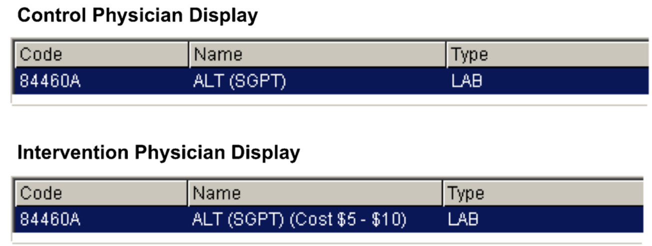

Figure 1. Laboratory ordering physician display, control versus intervention. The costs of laboratory tests were displayed within the electronic health record at the time of ordering. © 2012 Epic Systems Corporation. Used with permission.

to signing the order. Immediately prior to initiating the cost displays, an informational e-mail was sent to all intervention physicians describing that the goal of the project was to educate physicians regarding relative laboratory costs to help promote delivery of value-based care.

The Medicare reimbursement rate was selected for the cost displays to provide physicians with an understanding of the relative costs of a spectrum of laboratory tests. The laboratory tests were chosen by Atrius Health clinical leadership based on an analysis of the highest cost laboratory tests across the organization, either as a result of high volume or high unit cost. For our evaluation, we stratified the laboratory tests based on the Medicare reimbursement rate < $40 (lower cost) or > $40 (higher cost) (Table 1).

Data Collection and Outcome Assessment

For descriptive purposes, we collected the average age, gender, race, and insurance coverage distribution of patients seen during the study period for all intervention and control physicians. All other analyses were conducted at the physician level.

The primary study outcome was the monthly physician ordering rate for each laboratory test, defined as the number of laboratory test orders for a given physician divided by the number of patient visits for that physician. We collected these data directly from the electronic health record for all eligible intervention and control physicians for the 12 months prior to implementation of the cost displays and the 6 months following implementation of the displays. These data have been used extensively in prior analyses of quality of care in the ambulatory setting.[17–20]

We surveyed all intervention and control clinicians at the end of the study period using an initial paper mailing, followed by a reminder e-mail and a final paper mailing, achieving an 80 % response rate. The survey measured physician perceptions regarding health care costs, as well as perceptions regarding the laboratory cost displays (for intervention physicians only). The survey content was based on previously published survey items regarding physician perceptions of cost-effectiveness in patient care.[21] Survey responses were collected using 5-point scales that measured level of

Table 1. Higher and Lower Cost Laboratory Tests Included in the Cost Display Intervention *

Lower Cost Laboratory Tests (N=21)		Higher Cost Laboratory Tests (N=6)	
Lab Name	**Cost Displayed**	**Lab Name**	**Cost Displayed**
ALT	($5–$10)	Alpha-fetoprotein	($95–$100)
Basic metabolic panel	($10–$15)	B-type natriuretic peptide	($45–$50)
Blood urea nitrogen	($5–$10)	Chlamydia/GC genital screen	($70–$75)
Comprehensive metabolic panel	($15–$20)	Chlamydia/GC urine screen	($70–$75)
Creatinine	($5–$10)	Parathyroid hormone	($60–$65)
Electrolytes	($10–$15)	25-OH Vitamin D	($40–$45)
Ferritin	($15–$20)		
Glucose	($5–$10)		
Hemoglobin A1c	($5–$10)		
Hemogram with differential	($10–$15)		
Iron binding profile	($10–$15)		
Lipid profile	($15–$20)		
Pap smear	($35–$40)		
Prostate specific antigen	($25–$30)		
Sedimentation rate	($5–$10)		
Strep throat screen	($5–$20)		
Thyroid stimulating hormone	($20–$25)		
Tissue transglutaminase	($15–$20)		
Urinalysis	($3–$5)		
Urine culture	($10–$15)		
Urine microalbumin	($5–$10)		

** Lower cost laboratory tests defined as those with an average Medicare reimbursement rate < $40. Dollar amounts in parentheses indicate the costs displayed in real time to physicians at the time of ordering*

agreement (ranging from either "Strongly Agree" to "Strongly Disagree") or frequency (ranging from "Always" to "Never").

Statistical Analysis

To assess the impact of the intervention on laboratory ordering, we used an interrupted time series analysis to compare the change-in-relative-slope of the monthly laboratory ordering rate (Relative-Slope$_{\text{post-intervention}}$ – Relative-Slope$_{\text{pre-intervention}}$) among intervention physicians to the same change in relative-slope among control physicians. For each laboratory test, we used the GLIMMIX procedure within SAS version 9.2 (SAS Institute, Cary, NC) to fit a physician-level multivariable hierarchical binomial regression model with the number of laboratory orders per month, per physician, as the numerator of the dependent variable, and the total number of patient visits for each physician that month as the denominator of the dependent variable. By using a regression with a binomial outcome variable, our model accommodates physicians with widely differing numbers of patient visits. Fixed independent variables included continuous variables for time (months before, during, and after intervention implementation), an indicator variable for intervention status (intervention versus control physician), and three interaction terms between intervention status and time period. The latter terms captured: (1) differences in ordering rate time trends between intervention and control physicians prior to intervention; (2) the effect of the intervention on physician laboratory ordering rates for the 1-month period immediately following the intervention implementation, to account for any disproportionate immediate impact; and (3) the intervention effect on ordering rates in the post-intervention period compared to the pre-intervention period in intervention physicians compared to control physicians.

The model included random effects to account for repeated measures among physicians each month during the study period. By including the random effects, the modeling software estimates the change in slope of monthly ordering rates between the baseline and intervention time periods based on the patients seen by an individual physician, repeats this analysis for each physician, and then aggregates these slope changes across the intervention physicians and across the control physicians. Carrying out the analysis within physicians assures that physician and patient characteristics that remain stable over the study period cannot confound the study results.

The binomial regression model fits the patient outcomes on a logit scale, forcing interpretation through relative changes rather than directly through estimated slopes. For example, a reduction in the ordering rate from 20 % to 10 % over 12-months is considered a 50 % relative change and a relative slope of −4.17 % (e.g. -50 %/12) per month. Because we analyzed 27 laboratory tests, a two-sided Bonferroni-adjusted p value of less than 0.002 was used to determine statistical significance.

RESULTS

We studied 153 intervention and 62 control primary care physicians. The mean number of monthly patient visits was lower among the intervention compared to control group physicians (168 versus 258, p<0.001). Patients seen by physicians in the intervention and control group during the study period were similar in age, gender, and insurance status; there was a larger proportion of racial minorities seen by intervention physicians (Table 2).

Among the lower cost tests, four of 21 (19 %) demonstrated a statistically significant reduction in monthly laboratory ordering rates among intervention physicians compared to control physicians following implementation of the cost displays (Table 3). For each statistically significant test, the monthly ordering rate among intervention physicians decreased, while the ordering rate in control physicians either remained unchanged or increased. We estimate that the cost displays resulted in a modest reduction of 0.4 to 5.6 laboratory orders per 1,000 visits per month.

Table 2. Baseline Patient Characteristics *

	Intervention	Control
Mean age, yrs (standard deviation)	51.1 (7.1)	52.3 (5.9)
Female, %	60.2	61.0
Race, %		
White	70.8	92.9
Black	14.9	1.3
Asian	5.8	2.0
Hispanic	4.6	1.4
Insurance, %		
Medicare	24.2	26.8
Medicaid	7.6	6.9

** Based on aggregate physician-level demographic data*

Among the higher cost tests, one of six (17 %) tests demonstrated a statistically significant reduction in monthly laboratory ordering. No lower or higher costs laboratory tests demonstrated a statistically significant increase in monthly laboratory ordering rates among the intervention physicians compared to control physicians. Detailed results for all laboratory tests with no significant changes can be found in Appendix 1.

Clinician Survey

Nearly all physicians (99 %) endorsed the need for cost containment in today's healthcare environment (Table 4). In addition, a substantial majority was supportive of individual physicians playing a role in controlling costs (96 %) and considering costs when developing care plans (91 %). However, less than one-half (49 %) of physicians reported a firm understanding of the relative costs of care of tests they ordered.

Among intervention physicians, 30 % reported that they considered the information in the laboratory cost displays "always" or "usually" (compared to "sometimes", "rarely", or "never"). A small proportion (7 %) of intervention physicians reported that the displays "always" or "usually" impacted their decision to order a laboratory test, while 50 % reported that the displays "rarely" or "never" impacted their decision. A majority of physicians reported that the cost displays improved their knowledge of the relative costs of laboratory tests (81 %), and requested similar information on costs for medications and imaging studies (81 %).

DISCUSSION

Controlling the rising cost of health care is a critical priority for the US health care system. Reducing overuse of unnecessary health care services such as laboratory testing represents an important component of cost control efforts. We evaluated the impact of real-time display of laboratory costs to physicians at the time of ordering within an electronic health record and found a reduction in utilization for some, but not all, of these tests. The cost display intervention impacted utilization among both the lower cost and higher cost laboratory tests. In addition, physicians were generally very receptive to the intervention, with a majority reporting that it increased their knowledge regarding costs of care and requesting real-time cost information on an expanded set of health care services.

Table 3. Impact of Laboratory Cost Displays on Physician Ordering Rates*

			Percent Change in Monthly Lab Order Rate †				
Lab Name	Group	Baseline Average Monthly Lab Order Rate (orders/1,000 patient visits)	Pre-Intervention (%)	Post-Intervention (%)	Difference (%)	Reduction in Lab Orders (orders/1,000 visits/month)	P value ‡
Lower cost labs							
ALT	Intervention	14.5	2.8 %	0.5 %	−2.3 %	0.4	< 0.001
	Control	22.5	0.7 %	1.0 %	0.3 %		
Creatinine	Intervention	109.3	−0.5 %	−1.7 %	−1.2 %	5.5	< 0.001
	Control	5.4	−2.5 %	1.3 %	3.8 %		
Glucose	Intervention	123.8	−1.4 %	−4.0 %	−2.6 %	4.3	< 0.001
	Control	21.7	−0.8 %	0.1 %	0.9 %		
Lipid profile	Intervention	268.0	2.2 %	0.1 %	−2.1 %	5.6	< 0.001
	Control	317.4	0.4 %	0.4 %	0 %		
Higher cost labs							
Chlamydia/GC urine screen	Intervention	4.7	1.5 %	−1.0 %	−2.5 %	0.7	< 0.001
	Control	4.7	0.3 %	13.0 %	12.7 %		

** Results displayed for five of 27 tests demonstrating statistically significant reduction in physician ordering rates*
† Represents the percentage change in monthly ordering rates for the pre-intervention period (Month −12 to Month 0) and the post-intervention period (Month 1 to Month 5)
‡ P values obtained from multivariable regression models and represent test of statistical significance of change in monthly ordering rates between intervention and control physicians in the post-intervention period while controlling for changes in the pre-intervention period

Table 4. Physician Perceptions Regarding Costs of Care and Laboratory Cost Displays

	Proportion Agreeing N (%)*
All Physicians (n=172)	
"There is a legitimate need for cost containment in today's healthcare environment"	170 (99)
"As individual clinicians, physicians should play a direct role in helping to control health care costs"	165 (96)
"It is important for individual physicians to consider the costs of tests when developing patient care plans"	156 (91)
"I have a firm understanding of the relative costs of tests (laboratory or imaging studies) I routinely order for patient care"	84 (49)
Intervention Physicians Only (n=118)	
"The cost information displayed within Epic has improved my knowledge regarding the relative costs of laboratory tests that I routinely order."	96 (81)
"I would like additional cost information displayed within Epic at the time of ordering items such as imaging studies or medications"	96 (81)

* *Defined as those reporting "Strongly Agree" or "Somewhat Agree" on a 5-point scale ranging from Strongly Agree to Strongly Disagree*

Our results provide an important contribution to a somewhat mixed literature on the effectiveness of displaying costs to physicians when ordering tests or procedures. Older studies have indicated that such displays can reduce the ordering rate of laboratory tests in the ambulatory and emergency department setting,[22,23] while other studies from a similar time period indicate that costs displays in the inpatient setting have no effect on laboratory test utilization.[24] These studies included a focus on resident physicians in academic medical centers, and may not apply in today's health care environment, given the growing emphasis on cost control and wider prevalence of electronic health record use. A more recent study conducted in 2010 indicated that displaying costs of imaging studies in the inpatient setting of an academic medical center had no impact on overall utilization,[25] while another recent study found that presenting laboratory test fees within the electronic health record led to a modest decrease in test ordering in the inpatient setting.[26]

Our study is the first to our knowledge to focus on passive display of real-time laboratory cost displays in a primary care, nonacademic health care setting. Our intervention was modestly successful; however, it left substantial room for additional improvement. A number of alternative interventions aimed at reducing unnecessary utilization of laboratory tests have been studied, including educational didactic sessions, utilization reviews, and restriction of laboratory test availability by administrative leadership.[27–31] These interventions have yielded mixed results, and are often resource intensive, limiting their sustainability.

A substantial advantage of passive laboratory cost displays is that implementation requires minimal resource outlay, is adaptable to the changing cost landscape in healthcare, and is easily sustained within the electronic health record. In addition, real-time cost displays empower physicians through education and facilitation of informed decision-making during the clinical encounter. Physicians in our study did report considering the cost information in this context, and endorsed an overall improvement in their knowledge of the costs of laboratory tests. Given the substantial evidence-base indicating that physicians are uncomfortable with and have a poor understanding of health care costs, the effect of better educating physicians via this intervention should not be underestimated.

Our survey demonstrated that physicians have a strong commitment to controlling health care costs, including endorsement of the use of costs in the development of patient care plans. While most physicians reported that they did not act directly based on the cost information displayed, our survey findings provide hope that increasing cost transparency is a viable strategy to controlling the rising costs of health care.[32] The fact that most physicians were supportive of the intervention may relate to the design and implementation. Physicians were not required to act on the cost display information as the data were displayed passively, and physicians ultimately retained autonomy over their care decisions with no oversight by external bodies. Future work may seek to analyze the differential impact of cost display interventions on utilization according to physician self-reported support of such initiatives, and potentially tailor the intervention to physicians based on their level of support.

Our study has important limitations. We did not perform a randomized controlled trial. However, we implemented a robust study design that utilized a difference in differences approach to minimize the risk of confounding by comparing physicians to themselves pre-intervention and post-intervention, while also accounting for possible secular trends by comparing changes in the intervention groups to a contemporary control group.

While our study design minimized the potential for confounding by patient characteristics, the physician-level design did not allow us to analyze the impact of the intervention according to individual patient characteristics. Future analyses will need to focus on the impact of such initiatives on specific patient populations, including those with limited health insurance coverage, differing socio-demographic backgrounds, and varying chief complaints and medical comorbidities.

We did not conduct a complete analysis of the cost savings associated with the intervention, as this would require an estimate of the savings related to avoiding downstream costs of evaluating incidental laboratory findings. However, we estimate that the average cost savings among the five laboratory tests demonstrating a statistically significant reduction in utilization was $45.45 per 1,000 visits per month (range, $3.03–$107.46 per 1,000 visits per month). Future research will need to focus on the total cost implications associated with cost transparency interventions.

We also conducted our analyses within physician group practices with existing financial risk-bearing payer contracts, and the effect of our intervention in pure fee-for-service environments is not known. However, there is an increased focused on reducing overuse of health services of unclear value across all provider settings. Finally, we do not know if the decision not to order a given laboratory test as a result of the cost displays was clinically appropriate. This is an exceedingly difficult metric to measure in the ambulatory setting given the wide range of laboratory tests analyzed and the varying clinical encounters during which these tests were ordered.

In conclusion, our study demonstrates that electronic health records can serve as a tool to promote cost transparency, educate physicians, and reduce potentially unnecessary laboratory test use by integrating the relative cost of care into providers' decision making processes. Cost displays were well received by primary care physicians, and therefore may be extended to other health care services. Future work should focus on the impact of cost displays for medications, procedures, and advanced imaging use, and also on how to most effectively deliver cost information using relative or absolute scales, benchmarks, and graphical displays.[33]

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Thomas D. Sequist had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Conflict of Interest Disclosures: *The authors declare that they do not have any conflicts of interest.*

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APPENDIX 1

Table 5. Impact of Laboratory Cost Displays on Physician Ordering Rates (Nonsignificant Labs)*

Lab Name	Group	Baseline Average Monthly Lab Order Rate (orders/ 1000 patient visits)	Percent Change in Monthly Order Lab Rate† Pre-Intervention (%)	Post-Intervention (%)	Difference (%)	P value‡
Lower cost labs						
Basic metabolic panel	Intervention	46.3	3.5 %	3.1 %	−0.4 %	0.34
	Control	86.3	0.7 %	1.3 %	0.6 %	
BUN	Intervention	3.7	−1.9 %	−2.3 %	−0.4 %	0.03
	Control	3.2	−2.7 %	1.1 %	3.8 %	
Comprehensive metabolic panel	Intervention	11.0	0.0 %	0.7 %	0.7 %	0.94
	Control	131.0	−0.1 %	0.4 %	0.5 %	
Electrolytes	Intervention	9.4	−1.9 %	−1.5 %	0.4 %	0.02
	Control	1.0	−3.2 %	1.2 %	4.4 %	
Ferritin	Intervention	15.8	0.4 %	2.2 %	1.8 %	0.71
	Control	15.8	0.0 %	1.8 %	1.8 %	
Hemogram with differential	Intervention	73.8	−1.2 %	1.3 %	2.5 %	0.55
	Control	54.5	−1.4 %	0.6 %	2.0 %	
Hemoglobin A1c	Intervention	119.6	4.6 %	3.4 %	−1.2 %	0.04
	Control	86.8	0.1 %	0.7 %	0.6 %	
Iron binding profile	Intervention	17.6	0.2 %	1.0 %	0.8 %	0.15
	Control	0.7	0.0 %	3.7 %	3.7 %	
Pap smear	Intervention	40.9	−0.5 %	0.0 %	0.5 %	0.72
	Control	11.5	−0.2 %	0.0 %	0.2 %	
Prostate specific antigen	Intervention	41.4	0.5 %	1.1 %	0.6 %	0.27
	Control	21.9	0.4 %	2.1 %	1.7 %	
Sedimentation rate	Intervention	22.6	−1.0 %	2.4 %	3.4 %	0.57
	Control	22.7	−1.8 %	0.6 %	2.4 %	
Strep throat screen	Intervention	8.2	2.6 %	−5.5 %	−8.1 %	0.39
	Control	2.4	3.0 %	−3.9 %	−6.9 %	
Tissue transglutaminase	Intervention	4.2	0.3 %	0.5 %	0.2 %	0.32
	Control	2.0	0.6 %	4.1 %	3.5 %	
TSH	Intervention	174.1	0.2 %	−0.5 %	−0.7 %	0.04
	Control	140.3	0.1 %	0.4 %	0.3 %	
Urinalysis	Intervention	45.2	−0.2 %	1.3 %	1.5 %	0.1
	Control	4.7	0.0 %	−0.3 %	−0.3 %	
Urine microalbumin	Intervention	84.4	1.4 %	2.5 %	1.1 %	0.49
	Control	64.8	0.0 %	−1.8 %	−1.8 %	
Urine culture	Intervention	32.3	0.4 %	4.0 %	3.6 %	0.77
	Control	35.8	−0.8 %	3.0 %	3.8 %	
Higher cost labs						
Alpha-fetoprotein	Intervention	1.5	3.0 %	0.8 %	−2.2 %	0.95
	Control	0.6	9.2 %	4.7 %	−4.5 %	
B-type natriuretic peptide	Intervention	3.1	−1.9 %	−1.2 %	0.7 %	0.84
	Control	1.4	−0.7 %	−0.4 %	0.3 %	
Chlamydia/GC genital screen	Intervention	7.4	−0.9 %	0.3 %	1.2 %	0.21
	Control	3.0	−1.6 %	2.4 %	4.0 %	
Parathyroid hormone	Intervention	2.6	1.6 %	3.3 %	1.7 %	0.77
	Control	3.9	1.6 %	2.5 %	0.9 %	
25-OH Vitamin D	Intervention	37.1	−0.7 %	−1.2 %	−0.5 %	0.29
	Control	50.2	−0.3 %	−1.5 %	−1.2 %	

* *Results displayed for 22 of 27 tests that did not demonstrate a statistically significant change in physician ordering rates*
† *Represents the percentage change in monthly ordering rates for the pre-intervention period (Month −12 to Month 0) and the post-intervention period (Month 1 to Month 5)*
‡ *P values obtained from multivariable regression models and represent test of statistical significance of change in monthly ordering rates between intervention and control physicians in the post-intervention period while controlling for changes in the pre-intervention period*