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The Effect of Physician Workload on an Educational Intervention to Increase Vitamin D screening

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Abstract

Rationale, Aims and Objective—Changes in physician behavior are difficult to accomplish. We hypothesized measuring physicians' vitamin D levels would increase measurement of their patients' levels.

Methods—We recruited faculty via email. We measured physicians' serum 25(OH)D levels and asked them to complete a questionnaire created to assess the risk of vitamin D deficiency. Physicians received their vitamin D test results by mail. We monitored physicians' vitamin D testing rate per 100 patient visits in the twelve weeks before and after receipt of their own vitamin D test result.

Results—Twenty-eight (22%) of 126 primary care physicians participated in the study; all were Caucasian and 17 (61%) were women. Gender, type of practice and year of graduation from medical school were similar in participants and non-participants. Over half of participants took a multivitamin and one third took a vitamin D supplement. Although six (21%) reported a recent fracture, only one physician carried a diagnosis of osteopenia or osteoporosis. At baseline, geriatricians ordered 14 vitamin D tests per 100 patient visits, while internists and family practitioners ordered substantially fewer tests (2 and <1 tests per 100 visits, respectively). After study participation, vitamin D testing rates increased significantly among family practitioners (rate ratio 3.27, 95% CI 1.29–8.33) and internists (rate ratio 3.19, 95% CI 1.12–9.07). Physicians with heavier clinic workloads were half as likely (rate ratio 0.50, 95% CI 0.32–0.76) as those with lighter clinic workloads to increase vitamin D testing rates. Surprisingly, physicians with hypovitaminosis D demonstrated no change in vitamin D testing rates.

Conclusions—Physicians with low vitamin D testing rates were receptive to a personal intervention involving measurement of their own vitamin D levels. High workload appeared to

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attenuate this effect. These novel but preliminary observations require confirmation in future studies.

Keywords

education; patient; physician; practice improvement; vitamin D; workload

Introduction

Hypovitaminosis D, defined as a serum 25(OH)D <30 ng/ml by radioimmunoassay, is common in Americans including inpatients,[1] post-menopausal women with osteoporosis,[2] internal medicine residents[3] and adolescents.[4] Vitamin D is an essential steroid hormone regulating calcium homeostasis. After skin synthesis, the hormone undergoes two hydroxylation steps to a bioactive form (1,25$(OH)_2$D) that increases intestinal calcium absorption.[5] Hypovitaminosis D permits decreased calcium absorption, leading to a decline in serum ionized calcium levels, release of parathyroid hormone and osteoclastic bone resorption. This cascade of events maintains normocalcemia in the short term, but if untreated may eventually cause bone loss presenting as osteoporosis or osteomalacia.[5]

Individuals at risk of hypovitaminosis D include those with limited exposure to sunlight, low intake of dairy products, malabsorption, malnutrition and those taking medications that interfere with vitamin D metabolism.[5, 6] Although experts suggest measurement of serum vitamin D in these individuals,[6, 7, 8] we observed locally that many such patients did not undergo testing. We thus identified the need for an educational intervention to increase the rate of vitamin D testing in patients with risk factors or signs of vitamin D deficiency.

Although educators frequently use didactic lectures to teach physicians, such lectures generally do not affect patient care.[9] Handouts can enhance practice improvement following a didactic lecture.[10, 11] Interactive sessions involving learning stations and patients are more successful at changing physician behavior than didactic lectures.[9] A physician's own medical experience might also influence patient care. Indeed, internal medicine residents' health behaviors predicted the preventative services and screening tests they recommended to their patients.[12]

We hypothesized that measurement of physicians' vitamin D levels would increase testing for hypovitaminosis D in their patients. We designed a study to test this hypothesis. The primary study outcome was the change in the frequency by which physicians measured serum 25(OH)D in patients after study participation. Secondary outcomes included whether a handout or the presence of hypovitaminosis D in physicians affected the frequency by which physicians ordered 25(OH)D levels in their patients.

Methods

Through mass email, we invited 126 faculty physicians employed by the University of Wisconsin (UW) General Internal Medicine and Geriatric Sections and Family Practice Department to participate in our study. Faculty physicians who provided primary care to outpatients at least one-half day weekly were eligible for participation. During the consent process, we informed physicians that we would measure their 25(OH)D levels and monitor the frequency that they ordered 25(OH)D levels in their patients. Each consenting participant received a twenty-dollar honorarium.

Following informed consent, each physician completed a questionnaire[13] created to assess the risk of vitamin D deficiency. Physicians answered questions reflecting intake of

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nutritional supplements and sun seeking habits. The questionnaire asked physicians to report chronic diarrhea, Crohn disease, ulcerative colitis or celiac sprue, any of which might lead to vitamin D deficiency via malabsorption. On the questionnaire, participants also recorded symptoms or signs of suboptimal vitamin D status including muscle pain or weakness, fracture within five years, height loss or a diagnosis of osteopenia or osteoporosis. Physicians could skip any question they felt uncomfortable answering.

We collected blood from each participant and measured serum 25(OH)D and whole parathyroid hormone (PTH) levels. The UW Clinical Laboratory performed 25(OH)D assays using a reverse phase high performance liquid chromatography (HPLC) assay.[14] We defined hypovitaminosis D as a serum 25(OH)D level <25 ng/ml, based upon a study showing that a serum 25(OH)D of ~30 ng/ml by radioimmunoassay corresponds to a level of ~25 ng/ml by HPLC (unpublished data). Scantibodies Laboratory, Incorporated (Santee, CA) performed whole PTH measurements. Each physician received their test results by mail, along with an explanation of the results. Half of physicians received a handout describing the potential medical consequences of hypovitaminosis D.

The UW Information Technologies Department and UW Laboratory provided the number of vitamin D tests ordered on patients of each physician in the twelve weeks before and following receipt of their test results. Since faculty physicians typically keep a consistent clinic schedule over a span of three months, this period served as a reasonable interval for interactions with patients. To adjust for patient volume in each twelve-week interval, we determined each physician's vitamin D testing rate per 100 patient visits. The IRB protocol number for this study was 2004–1096.

Analysis

The primary study outcome was the change in vitamin D testing rate in the twelve weeks after study participation, compared to the twelve weeks prior to participation. We normalized the vitamin D testing rate to clinical workload by calculating the testing rate per 100 patient visits. We estimated sample size based on the assumption that each participant would order serum 25(OH)D in five patients over a three-month span pre-intervention and in ten patients over a three-month span post-intervention. Using a two-sided 5% level test, a sample size of 26 physicians was required to detect this change with 90% power.

Descriptive statistics (mean ± SD for continuous variables and n (%) for categorical variables) were tabulated for all participants. Demographic factors included physician gender, specialty practice, year of graduation from medical school and patient workload (the total number of patient visits in twenty-four weeks). Health factors included use of multivitamin or vitamin D supplements and presence of prior fracture, height loss or myalgia. Study factors included receipt of a handout and a diagnosis of hypovitaminosis D in physicians.

We assessed associations between participant characteristics and baseline rates of serum 25(OH)D testing using negative binomial regression models with a log link function. We included the (log) number of patient visits in the model as an offset term. Univariate models were fit including covariates individually. We considered two multivariate models, one including all covariates and one including a subset of covariates selected via backwards elimination to maximize Aikaike's information criterion (AIC), a measure of the goodness of fit of two statistical models.

We assessed changes in rates of serum 25(OH)D testing post-intervention within participants using logistic regression models. We included the (log) ratio of patient visits post-intervention to pre-intervention in the model as an offset term. Univariate models were

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fit including covariates individually. We estimated ratios of serum 25(OH)D testing rates, post-intervention relative to pre-intervention, for individual covariate values and estimated potential differential effects by covariate levels using appropriate interaction tests. We considered two multivariate models, one including all covariates and one including a subset of covariates selected via backwards elimination to maximize Aikaike's information criterion (AIC).

Results

We sent letters of invitation via email to faculty physicians in General Internal Medicine (n=81), Geriatrics (n=16) and Family Practice (n=30) Departments. Twenty-eight of 127 physicians, representing 22% of invited faculty, agreed to participate in the study. All physicians were Caucasian, 17 (61%) were women and six (21%) had hypovitaminosis D (Table 1). Participation rates were similar across specialties (p>0.05 for comparisons between participants and non-participants, Table 1) with 21% (n=17) internists, 19% (n=3) geriatricians and 27% (n=8) of family practitioners participating. Gender did not seem to influence the decision to participate, as 17 of 28 participants and 43 of 99 non-participants were female (p=0.11, Table 1). Years of experience likewise did not appear to influence participation, as responders completed medical school in (mean ± SD) 1986 ± 10 years and non-responders completed medical school in 1985 ± 10 years (p=0.80, Table 1).

Physicians completed a questionnaire created to identify risk factors for and signs of vitamin D deficiency.[13] As shown in Table 1, over half of participants took multivitamins and one third took vitamin D supplements. Although six physicians (21%) reported a fracture within the past five years, none had a diagnosis of osteoporosis and only one participant reported osteopenia. Three participants reported muscle pain but none endorsed muscle weakness. Two participants reported a diagnosis of inflammatory bowel disease or celiac sprue, one of whom also reported diarrhea within the past two weeks.

When investigating factors associated with the baseline vitamin D testing rates, physician specialty and number of patient visits were significant in both univariate and multivariate analyses (Table 2). Geriatricians ordered 13.7 tests per 100 patient visits. By contrast, internists ordered 1.6 tests per 100 visits (RR 0.11, 95% CI 0.02–0.69 univariate; RR 0.22, 95% CI 0.04–1.32 multivariate) and family practitioners ordered only 0.2 tests per 100 visits (RR 0.01, 95% CI 0.00–0.11 univariate; RR 0.02, 95% CI 0.00–0.18 multivariate). Physicians with heavier workloads ordered fewer vitamin D tests (RR 0.24, 95% CI 0.06–0.95 univariate; RR 0.33, 95% CI 0.11–1.04 multivariate). Other demographic, health and study factors did not associate with baseline vitamin D testing rates.

Univariate analyses revealed small changes in vitamin D testing rates in the twelve weeks following study participation (Table 3). We found a significant reduction in vitamin D testing rates post-intervention in physicians with heavy workloads (over 1000 patient visits in the 24-week study period) (RR 0.75, 95% CI 0.58–0.97) which persisted after adjustment for other factors (RR 0.50, 95% CI 0.32–0.76). Multivariate analyses showed that, after adjusting for the confounding effects of physician workload and other factors, there were significant increases in vitamin D testing rates among family practitioners (RR 3.27, 95% CI 1.29–8.83) and internists (RR 3.19, 95% CI 1.12–9.07) compared to geriatricians. Notably, these physician groups had very low testing rates at baseline, suggesting that the low testing rate was the primary factor driving the change in testing.

When we designed the study, we hypothesized that physicians diagnosed with hypovitaminosis D would be more likely to increase their vitamin D testing rate. Surprisingly, we found that a physician's vitamin D status had no apparent influence on the change in testing rate. Six physicians had hypovitaminosis D including three physicians who increased their testing rate and three who did not increase their testing rate after study participation (p=0.72). Receipt of a handout likewise had no effect on vitamin D testing rates. Multivariate analyses controlling for other factors confirmed univariate analyses.

Discussion

Several studies emphasize a lack of change in patient care following a single didactic lecture.[9, 15, 16] Interactive programs are most likely to improve patient care.[16] We thus hypothesized that measurement of physicians' own vitamin D levels might alter the frequency by which they ordered the test in their patients. Internist and family practitioners, who at baseline ordered fewer vitamin D tests than geriatricians, showed a three-fold increase in the rate of testing following study participation thus reducing, but not eliminating the testing gap. Additionally, clinic workload associated with change in performance following the intervention. When compared to physicians with a lighter clinic schedule, physicians with a heavier schedule were half as likely to increase vitamin D testing rates following study participation. Thus, our personal intervention appeared to influence testing rates, although the effect seemed limited to physicians with a lighter patient workload.

The impact of workload on physician response to quality improvement efforts is scarcely studied, despite ample documentation of time pressures faced by primary care physicians when caring for patients.[17, 18, 19] Time constraints might impact patient care directly[20] or indirectly through low morale[17] or other mechanisms. For example, physicians identified lack of time as the greatest barrier to provision of dietary counseling to patients.[20] Our data support the concept that providers with less demanding workloads are more successful at incorporating changes into their clinical practice. These novel but preliminary observations require confirmation in future studies.

Our study has several limitations. The first is a small sample size, which limits the ability to detect all physician factors associated with a change in patient care following an educational intervention. Our study focused on the number of 25(OH)D tests ordered in a specific interval, without regard to whether a patient had risk factors, signs or symptoms of deficiency meriting such measurement. While experts[6, 7, 8] recommend vitamin D measurement in patients taking medications that interfere with vitamin D metabolism and those with limited sun exposure, lactose intolerance, malabsorption, malnutrition, we did not review the patient charts of physicians participating in this study, to determine which patients met indications for vitamin D testing. Moreover, we studied testing rates in three different physician groups. As geriatricians care for elderly patients who commonly suffer from osteoporosis, it is not surprising that geriatricians had a higher baseline vitamin D testing rate. Additionally, we studied changes in testing rates over a short interval; whether a similar intervention can alter long-term practice is unknown. Finally, we studied faculty at a single academic institution. Other physician groups or health care providers might manifest a greater or lesser change in practice performance following measurement of their own vitamin D levels.

Our study suggests that a simple intervention, measuring vitamin D levels in physicians, has an effect on vitamin D testing rates in their patients. Workload, baseline performance and specialty associated with increased vitamin D testing rates following measurement of their own levels. If future research confirms the influence of workload, baseline performance or specialty on practice improvement efforts, educators could use such knowledge to enhance educational interventions toward physicians.

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References

1. Thomas MK, Lloyd-Jones DM, Thadhani RI, et al. Hypovitaminosis D in medical inpatients. The New England Journal of Medicine Mar 19;1998 338(12):777–783. [PubMed: 9504937]
2. Lips P, Hosking D, Lippuner K, et al. The prevalence of vitamin D inadequacy amongst women with osteoporosis: an international epidemiological investigation. J Intern Med Sep;2006 260(3): 245–254. [PubMed: 16918822]
3. Haney EM, Stadler D, Bliziotes MM. Vitamin D insufficiency in internal medicine residents. Calcif Tissue Int Jan;2005 76(1):11–16. [PubMed: 15478001]
4. Gordon CM, DePeter KC, Feldman HA, Grace E, Emans SJ. Prevalence of vitamin D deficiency among healthy adolescents. Arch Pediatr Adolesc Med Jun;2004 158(6):531–537. [PubMed: 15184215]
5. Holick, MF.; Garabedian, M. Vitamin D: Photobiology, Metabolism, Mechanism of Action, and Clinical Applications. In: Favus, MJ., editor. Primer on the Metabolic Bone Diseases and Disorders of Mineral Metabolism. 6th ed.. American Society for Bone and Mineral Research; Washington, D.C.: 2006. p. 106-114.
6. American Gastroenterological Association medical position statement: guidelines on osteoporosis in gastrointestinal diseases. Gastroenterology Mar;2003 124(3):791–794. [PubMed: 12612916]
7. Sweet MG, Sweet JM, Jeremiah MP, Galazka SS. Diagnosis and treatment of osteoporosis. Am Fam Physician Feb 1;2009 79(3):193–200. [PubMed: 19202966]
8. Vondracek S, Linnebur S. Diagnosis and management of ostoeporosis in the older senior. Clin Inverv Aging 2009;4:121–136.
9. Davis D, O'Brien MA, Freemantle N, Wolf FM, Mazmanian P, Taylor-Vaisey A. Impact of formal continuing medical education: do conferences, workshops, rounds, and other traditional continuing education activities change physician behavior or health care outcomes? JAMA Sep 1;1999 282(9): 867–874. [PubMed: 10478694]
10. Casebeer LL, Strasser SM, Spettell CM, et al. Designing tailored Web-based instruction to improve practicing physicians' preventive practices. J Med Internet Res Jul–Sep;2003 5(3):e20. [PubMed: 14517111]
11. Thomas R, Russell M. Quality, care, safety, and pay for performance: the future in now. The American Journal of Surgery 2007;193:298–300.
12. Delnevo CD, Steinberg MB, Abatemarco DJ, Hausman AJ. Correlates of clinical preventive practices among internal medicine residents. Prev Med Jun;2003 36(6):645–651. [PubMed: 12744906]
13. Bolek-Berquist J, Elliott ME, Gangnon RE, et al. Use of a questionnaire to assess vitamin D status in young adults. Public Health Nutr Feb;2009 12(2):236–243. [PubMed: 18752694]
14. Lensmeyer GL, Wiebe DA, Binkley N, Drezner MK. HPLC method for 25-hydroxyv itam in D measurement: comparison with contemporary assays. Clin Chem Jun;2006 52(6):1120–1126. [PubMed: 16574756]
15. Fordis M, King JE, Ballantyne CM, et al. Comparison of the instructional efficacy of Internet-based CME with live interactive CME workshops: a randomized controlled trial. Jama Sep 7;2005 294(9):1043–1051. [PubMed: 16145024]

16. Bloom BS. Effects of continuing medical education on improving physician clinical care and patient health: a review of systematic reviews. Int J Technol Assess Health Care Summer;2005 21(3):380–385. [PubMed: 16110718]

17. Huby G, Gerry M, McKinstry B, Porter M, Shaw J, Wrate R. Morale among general practitioners: qualitative study exploring relations between partnership arrangements, personal style, and workload. Bmj Jul 20;2002 325(7356):140. [PubMed: 12130611]

18. Schattner PL, Coman GJ. The stress of metropolitan general practice. Med J Aust Aug 3;1998 169(3):133–137. [PubMed: 9734508]

19. Linzer M, Konrad TR, Douglas J, et al. Managed care, time pressure, and physician job satisfaction: results from the physician worklife study. J Gen Intern Med Jul;2000 15(7):441–450. [PubMed: 10940129]

20. Kushner RF. Barriers to providing nutrition counseling by physicians: a survey of primary care practitioners. Prev Med Nov;1995 24(6):546–552. [PubMed: 8610076]

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Table 1

Physician Characteristics

	Participants n=28	Non-Participants n=99
Demographic Factors		
Female Gender	17 (61%)[a]	43 (43%)[a]
Specialty		
Geriatrics, n=16	3 (19%)[b]	13 (81%)[b]
Family Practice, n=30	8 (27%)[c]	22 (73%)[c]
Internal Medicine, n=81	17 (21%)[d]	64 (79%)[d]
Year Graduated Medical School	1986 ± 10 years[e]	1985 ± 10 years[e]
Patient Visits per Physician	1045 ± 448	-
Health Factors		
Multivitamin Use	16 (57%)	-
Vitamin D Supplementation	9 (32%)	-
Prior Fracture	6 (21%)	-
Height Loss	4 (14%)	-
Myalgia	3 (11%)	-
Study Factors		
Receipt of Handout	14 (50%)	-
Hypovitaminosis D Diagnosis	6 (21%)	-
25(OH)D, ng/mL	32 ± 10	-
PTH, pg/mL	37 ± 12	-

Data are presented as mean ± SD for continuous variables and n (%) for categorical variables. We compared participants and non-participants according to various demographic factors

[a] denotes a p-value of 0.80 for gender

[b] denotes a p-value of 1.0 for geriatric specialty

[c] denotes a p-value of 0.49 for family practitioners

[d] denotes a p-value of 0.70 for internal medicine practice

[e] denotes a p-value of 0.80 for year of graduation from medical school.

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Table 2

Physician Characteristics Associated With Vitamin D Testing Rates at Baseline

	Univariate		Multivariate‡	Multivariate§
	Rate*	**RR† (95% CI)**	**RR† (95% CI)**	**RR† (95% CI)**
Demographic Factors				
Gender				
Female	1.25	1.00	1.00	
Male	0.91	0.73 (0.16, 3.35)	0.82 (0.17, 3.92)	
Specialty				
Geriatrics	**13.69**	**1.00**	**1.00**	**1.00**
Family Practice	**0.20**	**0.01 (0.00, 0.11)**	**0.01 (0.00, 0.10)**	**0.02 (0.00, 0.18)**
Medicine	**1.57**	**0.11 (0.02, 0.69)**	0.15 (0.02, 1.46)	0.22 (0.04, 1.32)
Patient Visits				
1–1000	**2.28**	**1.00**	1.00	1.00
1001–2000	**0.54**	**0.24 (0.06, 0.95)**	0.54 (0.11, 2.65)	0.33 (0.11, 1.04)
Health Factors				
Multivitamin Use				
No	0.84	1.00	1.00	
Yes	1.34	1.58 (0.35, 7.11)	0.50 (0.13, 1.90)	
Vitamin D Supplement				
No	0.88	1.00	1.00	
Yes	1.76	2.00 (0.42, 9.42)	3.20 (0.69, 14.81)	
Prior Fracture				
No	1.27	1.00	1.00	
Yes	0.64	0.50 (0.08, 3.16)	0.61 (0.08, 4.71)	
Height Loss				
No	1.01	1.00	1.00	
Yes	1.86	0.61 (0.23, 14.53)	2.43 (0.37, 15.96)	
Myalgia				
No	1.03	1.00	1.00	
Yes	1.85	1.79 (0.17, 18.48)	0.97 (0.07, 14.26)	
Study Factors				
Receipt of Handout				
No	1.39	1.00	1.00	
Yes	0.87	0.63 (0.14, 2.74)	1.03 (0.32, 3.32)	
Hypovitaminosis D				
Yes	1.70	1.00	1.00	
No	1.00	0.59 (0.09, 3.96)	0.22 (0.04, 1.18)	

*Tests per 100 visits

† Rate ratio (relative to reference category)

‡ Adjusted for demographic, health and study factors

§ Adjusted for practice and total visits (selected by Aikaike's information criterion)

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Table 3

Physician Characteristics Associated With Vitamin D Testing Rates per 100 Patient Visits Post-Intervention

	Univariate		Multivariate‡	Multivariate§
	RR* (95% CI)	Effect† (95% CI)	Effect† (95% CI)	Effect† (95% CI)
Demographic Factors				
Gender				
Female	0.90 (0.75, 1.09)	1.00	1.00	1.00
Male	1.03 (0.83, 1.26)	1.14 (0.86, 1.51)	2.46 (0.94, 6.45)	2.46 (0.96, 6.33)
Specialty				
Geriatrics	0.97 (0.76, 1.25)	1.00	1.00	1.00
Family Practice	1.86 (0.83, 4.18)	1.91 (0.82, 4.54)	**3.97 (1.43, 11.00)**	**3.27 (1.29, 8.33)**
Medicine	0.92 (0.77, 1.10)	0.95 (0.70, 1.28)	**3.41 (1.04, 11.18)**	**3.19 (1.12, 9.07)**
Patient Visits				
1–1000	1.07 (0.90, 1.26)	1.00	1.00	1.00
1001–2000	**0.75 (0.58, 0.97)**	**0.70 (0.52, 0.96)**	**0.35 (0.16, 0.78)**	**0.50 (0.32, 0.76)**
Health Factors				
Multivitamin Use				
No	0.86 (0.69, 1.07)	1.00	1.00	
Yes	1.03 (0.86, 1.24)	1.19 (0.90, 1.59)	0.95 (0.44, 2.06)	
Vitamin D Supplement				
No	0.97 (0.80, 1.16)	1.00	1.00	
Yes	0.94 (0.76, 1.17)	0.98 (0.74, 1.30)	0.84 (0.42, 1.67)	
Prior Fracture				
No	0.99 (0.85, 1.16)	1.00	1.00	
Yes	0.83 (0.60, 1.14)	0.84 (0.59, 1.19)	0.87 (0.33, 2.29)	
Height Loss				
No	0.94 (0.80, 1.09)	1.00	1.00	
Yes	1.07 (0.75, 1.53)	1.14 (0.77, 1.68)	0.59 (0.23, 1.48)	
Myalgia				
No	0.95 (0.82, 1.11)	1.00	1.00	1.00
Yes	0.98 (0.64, 1.51)	1.03 (0.65, 1.63)	0.39 (0.08, 1.85)	0.37 (0.13, 1.06)
Study Factors				
Receipt of Handout				
No	0.95 (0.79, 1.14)	1.00	1.00	1.00
Yes	0.97 (0.78, 1.21)	1.02 (0.77, 1.36)	1.61 (0.83, 3.11)	1.32 (0.93, 1.87)
Hypovitaminosis D				
Yes	1.02 (0.76, 1.37)	1.00	1.00	
No	0.94 (0.80, 1.10)	0.92 (0.66, 1.29)	1.55 (0.62, 3.89)	

*Rate Ratio relative to baseline

[†]Relative change in rate ratio compared to reference category

[‡]Adjusted for demographic, health and study factors

[§]Adjusted for gender, practice, handout, myalgia and total visits (selected by Aikaike's information criterion)

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