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A Cross-Sectional Study of Provider and Patient Characteristics Associated with Outpatient Disclosures of Dietary Supplement Use

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Abstract

Objective—Explore patterns in patients' disclosures of supplement use and identify provider and patient characteristics associated with disclosures.

Methods—Cross-sectional study of 61 outpatient primary care, integrative medicine, and complementary medicine providers, and 603 of their patients. Primary outcomes were supplement disclosures (based on audio recorded office visits, post-visit patient surveys and medical record abstractions for the day of the visits).

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Conflicts of interest:

The authors report no conflicts of interest.

Results—Seventy-nine percent of 603 patients reported on a post-visit survey that they took a total of 2107 dietary supplements. Of those taking supplements, 232 patients (48.6%) discussed at least one supplement with their provider on the day of their office visit. However patients disclosed only 714 (33.9%) of the 2107 supplements they were taking. Patients more frequently disclosed supplement use when they saw providers who attributed greater importance to asking about supplements. Patient characteristics, such as patient activation, number of medical conditions, and use of prescription medications were not associated with disclosure of supplement use.

Conclusions—Provider rating of the importance of asking about supplements is a major factor prompting patients' disclosures of supplement use.

Practice Implications—Provider-targeted interventions to encourage provider awareness about potential supplement-drug interactions are needed to increase disclosures about dietary supplement use.

Keywords

provider-patient relations; dietary supplements; complementary and alternative medicine; provider-patient communication

1. Introduction

Americans spend more than \$32 billion each year on dietary supplements,[1] and increasingly take dietary supplements concomitantly with prescription medications. In the 2002 National Health Interview Survey (NHIS), 21% of patients taking prescription medications also reported taking a non-vitamin dietary supplement in the past 12 months.[2] A 2005-2006 study showed that 52% of older adults taking prescription medications reported taking dietary supplements.[3]

Patients typically believe herbs and dietary supplements are safe because they are sold over-the-counter and are natural. But there are concerns about supplement-drug interactions,[4-7] efficacy,[8] and safety.[1, 6, 8-11] More than 15 million adults might be at risk for interactions between prescription medications and herbal supplements or high-dose vitamins.[12, 13] In addition, problems with toxicity, contamination, adulteration, standardization, and labeling have been reported.[6, 8-10, 14] Because of these potential adverse effects, the U.S. Food and Drug Administration (FDA) recommends that all patients consult a health professional before starting a dietary supplement.[15]

Studies have examined patient disclosure of CAM use,[12, 16] but only a few have specifically examined disclosures of dietary supplement use. The 2002 and 2007 NHIS surveys showed that 33% and 43%, respectively, of patients taking dietary supplements in the past 12 months disclosed their supplement use to a conventional healthcare provider. [17-19] These studies were based on patient report though, and are subject to the limitations of patient recall and their willingness to admit non-disclosure.

To enhance patient disclosures of supplement use, it is important to understand the factors influencing patient disclosures. Existing studies have predominantly focused on

relationships between patient characteristics and disclosure, but have not examined the provider's role in facilitating conversations. Therefore, the objectives of this study were: 1) to describe patterns of dietary supplement use disclosure among patients of primary care, integrative medicine and complementary medicine providers, and 2) to investigate provider and patient characteristics associated with disclosure.

2. Methods

2.1 Setting and Provider Recruitment

This cross-sectional study of provider-patient interactions was carried out in primary care, integrative medicine, and complementary medicine offices in the greater Los Angeles metropolitan area. Practicing primary care physicians (PCPs) were recruited from community clinics associated with LA Net (a practice-based research network), the University of California-Los Angeles (UCLA) Medical Group (an academic medical setting), and Kaiser Permanente, a group model HMO community setting. Integrative medicine physicians, who self-identified as combining mainstream medical treatments with complementary and alternative therapies, were solicited from an academic medical center and from local private practices. Complementary medicine providers (naturopaths, acupuncturists and chiropractors) also were recruited from private practices. We purposively sampled providers so that half were primary care, one-fourth were integrative medicine, and one-fourth were complementary medicine providers. Providers received \$250 for participating in the study.

2.2 Patient Recruitment

From November 2011 to May 2013, a research assistant approached patients in the waiting rooms of participating providers. Eligible patients were 18 years of age or older, spoke English or Spanish, and were willing to participate in a 30-minute semi-structured interview within 1 week of their office visit (not analyzed for this study). Patients were excluded if a research assistant deemed they were too ill to participate. For each participating provider, a maximum of 10 patients was recruited. Of 1512 patients approached in waiting rooms, 603 provided usable study data, 803 refused participation, 23 were ineligible, 28 agreed to participate but could not due to logistical issues, 3 withdrew from the study, and 52 could not be assessed for eligibility. The net response rate was 39.9% and the study completion rate among eligible patients was 40.1%. We believe that our recruitment rates reflect the inability of many patients to follow-up by telephone within 1 week of their office visit. Patients received \$25 for study participation on the day of the office visit. All subjects were initially told that the study was about provider-patient communication so that they would not be primed to talk about supplements during office visits. Patients were informed about the study's focus on supplements after they completed post-visit surveys, and providers were informed once they completed their audio-recorded patient visits.

2.3 Data Collection

The UCLA and Kaiser Permanente Institutional Review Boards (in accordance with The Code of Ethics of the Declaration of Helsinki) approved the study protocol. All subjects provided written informed consent prior to participating in the study. Provider-patient office

visits were audio-recorded, and providers filled out one self-administered survey following the completion of ten audio-recorded patient visits. Patients completed a structured survey on the day of their office visit, and a research assistant abstracted data from medical records for that visit.

2.4 Survey Contents

Patient surveys assessed age, gender, race / ethnicity, education, and hospitalizations in the past 12 months. Patients were asked whether the provider they saw was “the one you usually see if you need a check-up, want advice about a health problem, or get sick or hurt.” They also were asked whether they were currently taking any prescription medications or over-the-counter medications; whether their doctor prescribed a new medication during the office visit; and whether they spent more money on supplements than on prescription medications in the past 12 months. They also were asked if they had taken any vitamins, minerals or herbal supplements in the past 30 days. Those responding affirmatively were asked to list each of these vitamins, minerals or supplements. Patient activation, a measure of the knowledge, skills and confidence essential to managing health and healthcare, was assessed using the 3-item Patient Activation Measure (PAM).[20] The PAM categorizes patient activation into four levels, from lowest (Level 1) to highest (Level 4).

Provider surveys assessed age, gender, race/ethnicity, number of years in practice, and whether they had personally taken supplements in the past 12 months. Providers also were asked, “How much knowledge do you have about dietary supplements?” and “How important is it to ask patients about dietary supplement use?” Response options were based on 5-point Likert scales, with 5 indicating “excellent knowledge/very important” and 1 indicating “poor knowledge/unimportant.”

2.5 Medical Record Abstraction

Medical records for the day of the audio-recorded office visit were abstracted by trained research assistants for any documentation of the supplements patients reported taking. Patient medical conditions were assessed by abstracting charts for the 19 medical conditions comprising the Charlson Comorbidity Index.[21, 22] To calculate comorbidity index scores, conditions are assigned weights ranging from 1-6, with total scores ranging from 0-37. One point is added for each decade of life over the age of 50.

2.6 Patient Disclosure of Dietary Supplement Use

Patient disclosure of dietary supplement use on the day of their office visit (the primary outcome variable) was generated by combining data from: 1) patient surveys, which asked whether each supplement patients reported taking was “mentioned during today's doctor's visit;” 2) audio-recorded office visits, which were analyzed for disclosure of supplement use; and 3) medical record abstractions of documentation for the day of the office visit. Trained research assistants analyzed the audio recorded office visits for mentions of dietary supplements. A medical linguist experienced in provider-patient communication verified the findings, and consulted a practicing primary care physician (DMT) when questions arose. A supplement fulfilled the criteria for disclosure if it was discussed during an office visit OR was reported on a patient survey and documented in the medical record. Supplements

reported only on patient surveys or only documented in patient medical records were considered non-disclosed. Both patient-level disclosure (presence of disclosure of *any* of a patient's supplements) and supplement-level disclosure were analyzed.

2.7 Statistical Analyses

SAS version 9.4 was used for all statistical analyses. Modified Poisson regressions were performed to examine the independent associations of patient, provider, and supplement (nonvitamin non-mineral [NVNM] versus vitamin/mineral) characteristics on the probabilities of: 1) patient disclosure of any supplement use (patient-level analysis), and 2) patient disclosure of individual supplements (supplement-level analysis). Modified Poisson regression was chosen over logistic regression because disclosure of supplement use was not rare. Since each provider contributed up to 10 patients, generalized estimating equations (GEE) were used to control for the possible correlation of outcomes within the same provider (clustering) for the patient-level analysis, and within the same patient for the supplement-level analysis.[23] The models excluded patient activation, which was not significant in bivariate analyses. A sub-group analysis was conducted to examine predictors of supplement disclosures among PCPs.

3. Results

3.1 Patient Characteristics

Patients in the study were mostly female, 43.8% were non-Hispanic whites, and 31% were Hispanic. Almost 75% had at least some college education, and reported taking a prescription medication or an over-the-counter medication. Of the 603 patients in the study, 477 (79.1%) reported taking dietary supplements in the past 30 days (Table 1), and 256 (42.4%) were taking at least one NVNM supplement. Women, older patients, and patients with more education and more comorbidities were more likely to take supplements. Non-Hispanic whites and Asians were more likely to take supplements than patients of other races/ethnicities. Supplement users were more likely to be on a prescription medication or over-the-counter medication, and to have seen an integrative or complementary medicine provider, though 71% of patients who saw a PCP reported taking supplements.

3.2 Supplement Characteristics

Patients reported taking a total of 2107 dietary supplements, of which 1032 (49%) were vitamins or minerals, and 1075 (51%) were NVNM (Table 2). The most common supplements taken were calcium and/or vitamin D (272 supplements; 12.9% of total), multivitamins (228 [10.8%]) and fish oil/omega 3 products (174 [8.3%]). Patients of integrative and complementary medicine providers were more likely to take NVNM supplements than primary care patients, whereas primary care patients more frequently were taking multivitamins and prenatal vitamins/folic acid.

3.3 Provider Characteristics

Among the 61 providers enrolled in the study, there were 32 practicing PCPs (7 from UCLA Medical Group, 10 from Kaiser Permanente, and 15 from LA Net practices), 14 integrative medicine physicians (3 from the UCLA Center for East-West Medicine and 11 from private

practices), and 15 complementary medicine providers (5 acupuncturists, 5 naturopaths, and 5 chiropractors). Integrative and complementary medicine providers were more likely to have taken a dietary supplement in the past 12 months than PCPs. They also were more likely than PCPs to report having excellent knowledge about supplements, and to attribute greater importance to asking about supplement use (Table 3). Eighty percent of primary care patients reported that the provider they saw was the one they usually saw if they needed a check-up, advice about a health problem, or got sick or hurt, compared to 47.5% of integrative medicine patients and 42% of complementary medicine patients.

3.4 Disclosure of Any Supplement Use and of Individual Supplement Use

Overall, 232 (48.6%) of the 477 patients in the study disclosed their use of at least one dietary supplement to their provider (Table 4). Bivariate analyses showed that disclosures occurred more frequently when patients were female, non-Hispanic white, had more than a high school education, and were seen by integrative or complementary medicine providers (compared to PCPs). Patients who disclosed at least one of their dietary supplements were taking a mean of 5.9 (SD=5) supplements, compared to 3.0 (SD=3) supplements for those who did not disclose any of their supplements. There were no differences in patient activation between patients who did and did not disclose their supplement use. On the supplement level, patients disclosed 714 of the 2107 supplements they were taking (33.9%).

The multivariable Poisson regression analysis at the patient level (Table 5) showed that the probability of patients' disclosing both any supplement use and individual supplement use was significantly higher when providers reported it was "very important" to ask about supplement use (compared to being "moderately important" / "of little importance" / "unimportant"). The probability of disclosing any supplement was significantly higher when providers were integrative medicine providers (compared to PCPs), and the probability of disclosing individual supplements was significantly higher when providers reported having "excellent knowledge" about supplements (compared to "good knowledge" / "very good knowledge").

3.5 Disclosures to Primary Care Providers

A subgroup analysis, which examined only interactions with PCPs (Table 6), demonstrated that with these providers, the probability of patients disclosing both any supplement use and individual supplements was significantly higher when providers reported that it was very important to ask about supplements (compared to being moderately important / of little importance / unimportant). Disclosure of any supplement use was lower when providers reported taking at least 1 dietary supplement in the past 12 months. Asian and Hispanic patients also were more likely to disclose supplement use, while those who spent more money on supplements than on prescription medications were less likely to disclose.

4. Discussion and conclusion

4.1 Discussion

This is the first study to examine discussions about dietary supplements by linking audio recordings of office visits with patient and provider surveys. Study findings demonstrate that

within the context of outpatient office visits, stronger provider beliefs about the importance of asking about supplements are a major factor associated with patient disclosures about dietary supplement use. These findings are not surprising given that prior survey studies have shown that when providers fail to ask about dietary supplements, patients have significantly less disclosure of supplement use.[24] Our results suggest that provider education might increase patient dietary supplement disclosures. Yet education alone may not lead to full disclosure: 28% of patients seeing integrative medicine providers and 38% of those seeing CAM providers did not disclose any of the supplements they were taking.

The majority of the patient characteristics we examined were not associated with disclosures of supplement use. Prior studies showed that female, non-Hispanic white, and more educated patients[17, 18] had greater rates of supplement disclosures, but these studies did not concurrently examine the effect of provider characteristics. Our study found that in the primary care setting, Asians and Hispanics actually had greater rates of disclosures than non-Hispanic whites. Future studies are needed to investigate the role of provider-patient racial and /or language concordance on patient supplement disclosures, since these characteristics might influence patient perceptions about provider openness to supplement use.

Almost half of the patients in our study who were taking dietary supplements disclosed at least one of their supplements to their provider, and over one-third of all of the supplements patients were taking was disclosed. Though disclosure rates are low, the clinical significance of many of the non-disclosures is debatable. For example, multivitamins, which comprised about 10% of the supplements taken by this study's primary care patients, are unlikely to cause adverse events or to have drug-supplement or supplement-supplement interactions. [25] We expected to see more disclosures about NVNM supplements, which have potential drug-supplement interactions, but we found no significant associations between supplement disclosures and type of supplement taken (NVNMs versus vitamins/minerals), or patient use of prescription medication or over-the-counter medications. In fact, patients tended to disclose supplement use more frequently when they were not taking medications. These findings suggest that complete disclosure about patients' dietary supplement use is needed in order to adequately identify potential risks, because patients frequently do not recognize that there is potential for harm.^{24,25}[25, 26] Future studies are required to investigate what happens during office visits after patients disclose supplement use, namely whether providers adequately identify and discuss potential risks such as supplement-drug interactions or contraindications to supplement use, and whether they address the scientific evidence for taking the supplement. Patient disclosures also could promote more informed patient decision-making about supplement use. For example, disclosure about multivitamin use could lead to a discussion about the evidence against using multivitamins in healthy adults without nutritional deficiencies.[27] Additional analyses could examine the content of conversations about the scientific evidence for taking supplements, particularly when providers recommend supplements for their patients.

Our results suggest that efforts to increase patient disclosures of dietary supplement use should focus on both providers and patients. Studies have shown that providers have inadequate knowledge about the adverse effects of dietary supplements,[28] and that many

providers want more CAM training to communicate better with their patients about these treatments.[29] Primary care providers could benefit from training about the prevalence of supplement use and about the potential risks they carry, so that they can recognize the importance of asking patients about supplements. Patients may benefit from campaigns that educate them about the potential risks of supplements and that encourage them discuss their supplement use with their providers.

This study has several limitations. We audio-recorded only one provider-patient interaction per patient, and do not know if patients had previously disclosed their supplements to their provider. In addition, we did not examine the reason for patients' office visits or whether patients were known to the provider. More detailed history-taking about patient medications and dietary supplements might be expected during new patient visits or when patients are scheduled for physical examinations, compared to patient visits for an acute problem. We also did not assess when patients started taking their supplements. Those who recently started taking a new supplement may have higher rates of disclosure than those who have been taking a supplement for an extended period of time. This study may have overestimated disclosure rates, because we do not know whether patients remembered all of the supplements they were taking. Further, patients and providers may have changed their behaviors because they knew they were being audio-recorded (known as the Hawthorne effect). However, since neither party knew that the study was about dietary supplements, it is unlikely that behaviors around supplement discussions were affected. If discussions were affected, we would expect our results to reflect inflated rates of supplement disclosure. Lastly, the study was carried out in a single geographical area, albeit in multiple different health care settings, including three distinct primary care settings and two types of integrative medicine settings.

4.2 Conclusion

Provider characteristics, such as beliefs about the importance of asking about supplement use, are more important drivers of disclosure than patient characteristics. Inadequate disclosure of supplement use can result in missed opportunities for providers to identify drug-supplement interactions or adverse events. Future studies should investigate the conversations that occur after patients disclose supplement use, and examine how discussions influence patient decisions to take dietary supplements.

4.3 Practice Implications

This study suggests that provider education is needed to enhance provider queries about dietary supplement use during outpatient office visits. Interventions could encourage provider awareness about the prevalence of supplement use and the potential risks of supplement-drug interactions. Interventions targeting patient knowledge also could be developed to promote dietary supplement disclosures during office visits.

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Highlights

- 49% of patients disclosed at least one dietary supplement to their provider
- 34% of all dietary supplements were disclosed
- Disclosures occurred more often to providers who felt it was more important to ask
- Patient activation was not associated with disclosure of supplement use
- Prescription medication use was not associated with disclosure of supplement use

Table 1

Patient characteristics based on supplement use

Patient Characteristic	n	Took Supplement in Past 30 Days (Study Sample)	Did Not Take Supplement in Past 30 days
Total n	603	477	126
Age, mean (SD) [§]	603	48.7 (16.0)	42.0 (15.8)
Female, % [‡]	414	338 (70.9)	76 (60.3)
Race / ethnicity, % [§]			
White	264	231 (48.4)	33 (26.2)
Hispanic	187	124 (26.0)	63 (50.0)
Black	57	38 (8.0)	19 (15.1)
Asian	37	33 (6.9)	4 (3.2)
Other	58	51 (10.7)	7 (5.5)
Taking prescription or over-the-counter medication, % [‡]	442	359 (75.3)	83 (65.9)
Education, % [§]			
High school or less	147	90 (19.0)	57 (45.3)
Some college	157	130 (27.3)	27 (21.4)
College graduate	297	255 (53.7)	42 (33.3)
Comorbidity score, mean (SD) * [‡]	595	1.56 (2.0)	0.97 (1.4)
Hospitalized past 12 months, %	98	78 (16.3)	20 (15.9)
Specialty of provider seen, % [§]			
Primary care	314	216 (45.3)	98 (77.8)
Integrative medicine	139	128 (26.8)	11 (8.7)
Complementary medicine	150	133 (27.9)	17 (13.5)
Patient activation, %			
Level 1 (lowest activation)	27	25 (5.3)	2 (1.6)
Level 2	66	54 (11.3)	12 (9.5)
Level 3	196	155 (32.5)	41 (32.5)
Level 4 (highest activation)	314	243 (50.9)	71 (56.4)
Newly prescribed a medication, % [§]	103	66 (13.8)	37 (29.4)

* Comorbidity score ranges from 0-37, with greater numbers indicating more comorbidity

[‡]p 0.05[‡]p 0.01[§]p 0.001

Table 2

Major categories of dietary supplements taken by the 477 patients who reported taking supplements in the past 30 days*

Supplement Categories	n	Type of Provider Seen		
		Primary Care, n (%)	Integrative Medicine, n (%)	Complementary Medicine, n (%)
Vitamins / minerals				
Calcium and/or vitamin D	272	95 (25.9)	105 (28.3)	72 (24.5)
MVI [§]	228	111 (30.2)	62 (16.4)	55 (19.0)
Prenatal vitamins/folic acid [†]	48	26 (7.1)	11 (3.0)	11 (3.8)
Magnesium [†]	41	6 (1.6)	20 (5.4)	15 (5.1)
Iron	26	11 (3.0)	10 (2.7)	5 (1.7)
Other vitamins / minerals [§]	417	118 (32.2)	163 (43.9)	136 (46.3)
Total vitamins / minerals	1032	367	371	294
Non-vitamin/non-minerals (NVNM)				
Fish oil/omega 3 [§]	174	54 (29.8)	69 (13.6)	51 (13.2)
Coenzyme Q-10	53	13 (7.2)	28 (5.5)	12 (3.1)
Probiotic	48	3 (1.7)	23 (4.5)	22 (5.7)
Glucosamine and / or chondroitin [‡]	44	13 (7.2)	12 (2.4)	19 (4.9)
Adrenal support [†]	29	0	18 (3.5)	11 (2.9)
Melatonin	17	3 (1.7)	8 (1.6)	6 (1.6)
Resveratrol	16	3 (1.7)	5 (1.0)	8 (2.1)
Flaxseed oil / pills [‡]	14	6 (3.3)	2 (0.4)	6 (1.6)
Ginkgo biloba	11	1 (0.6)	6 (1.2)	4 (1.0)
Echinacea	10	2 (1.1)	2 (0.4)	6 (1.6)
Other NVNM [§]	659	83 (45.9)	335 (65.9)	241 (62.4)
Total NVNM	1075	181	508	386
Total number of supplements taken	2107	548	879	680

* # of dietary supplements taken ranged from 1 to 28, with 127 patients taking 1 supplement, 143 taking 2-3 supplements, and 207 patients taking 4 or more supplements

[†] p < 0.05

[‡] p 0.01

[§] p 0.001

Table 3

Provider characteristics based on practice specialty

Provider Characteristic	n	Primary Care (n=32)	Integrative Medicine (n=14)	Complementary Medicine (n=15)
Age, mean (SD) [‡]	60	50.4 (9.8)	42.4 (9.9)	41.2 (8.1)
Female, %	28	13(40.6)	6 (42.9)	9 (60.0)
Race / ethnicity, %				
White	28	11 (34.4)	9 (64.3)	8 (53.4)
Hispanic	12	9 (28.1)	1 (7.1)	2 (13.3)
Black	3	3 (9.4)	0	0
Asian	15	9 (28.1)	3 (21.5)	3 (20.0)
Other	3	0	1 (7.1)	2 (13.3)
Years in practice, mean (SD) [‡]	61	10.5 (7.5)	19.4 (10.6)	12.3 (8.9)
Took at least one supplement in past 12 months, % [†]	47	19 (59.4)	14 (100.0)	14 (93.3)
Knowledge about dietary supplements, % [§]				
Excellent	18	0	9 (64.3)	9 (60.0)
Very good / good	29	19 (59.4)	5 (35.7)	5 (33.3)
Fair / poor	14	13 (40.6)	0	1 (6.7)
Importance of asking about supplement use, % [§]				
Very important	27	5 (15.6)	11 (78.6)	11 (73.3)
Important	18	13 (40.6)	2 (14.3)	3 (20.0)
Moderately important / Of Little importance /Unimportant	16	14 (43.8)	1 (7.1)	1 (6.7)

[‡] p 0.01[§] p 0.001

Table 4

Disclosure of any supplement use on the day of their office visit based on patient characteristics

Patient Characteristics	n	Disclosed DS During Visit	Did Not Disclose DS During Visit
Total, %	477	232 (48.6)	245 (51.4)
Age, mean (SD)	477	48.5 (16.2)	49.0 (15.9)
Female, % [‡]	338	179 (53.0)	159 (47.0)
Race / ethnicity, % [‡]			
White	231	129 (55.8)	102 (44.2)
Hispanic	124	51 (41.1)	73 (58.9)
Black	38	14 (36.8)	24 (63.2)
Asian	33	16 (48.5)	17 (51.5)
Other	51	22 (43.1)	29 (56.9)
Taking prescription or over-the-counter medication, % [‡]	359	164 (45.7)	195 (54.3)
Education, % [‡]			
High school or less	90	31 (34.4)	59 (65.6)
Some college	130	65 (50.0)	65 (50.0)
College graduate	255	135 (52.9)	120 (47.1)
Comorbidity score, mean (SD) *	472	1.5 (1.9)	1.6 (2.1)
Hospitalized past 12 months, %	78	36 (46.2)	42 (53.8)
Specialty of provider seen, % [§]			
Primary care	216	57 (26.4)	159 (73.6)
Integrative medicine	128	92 (71.9)	36 (28.1)
Complementary medicine	133	83 (62.4)	50 (37.6)
Spent more \$ on DS than prescription drugs past 12 months, % [§]	233	140 (60.1)	93 (39.9)
Newly prescribed a medication, % [‡]	66	23 (34.9)	43 (65.1)
Number of supplements taken, mean (SD) [§]	477	5.9 (5.0)	3.0 (3.0)
Patient activation, %			
Level 1 (lowest activation)	25	9 (36.0)	16 (64.0)
Level 2	54	25 (46.3)	29 (53.7)
Level 3	155	76 (49.0)	79 (51.0)
Level 4 (highest activation)	243	122 (50.2)	121 (49.8)

* Comorbidity score ranges from 0-37, with greater numbers indicating more comorbidity

[‡] p < 0.05[‡] p 0.01[§] p 0.001

Table 5

Multivariable models predicting patient disclosure of any of their supplements (patient-level analysis) and of individual supplements (supplement-level analysis) taken in the past 30 days, including provider, patient, and supplement characteristics as independent variables

Independent Variables *	Probability Ratio (95% CI) of Any Supplement Disclosure	Probability Ratio (95% CI) of Individual Supplement Disclosure
Provider Characteristics		
Type of provider		
Integrative medicine	1.61 (1.00 - 2.60) [†]	1.35 (0.81 - 2.26)
Complementary medicine	1.37 (0.84 - 2.24)	1.34 (0.84 - 2.13)
Provider age	1.00 (0.98 - 1.01)	0.99 (0.98 - 1.01)
Female provider	1.17 (0.93 - 1.47)	1.23 (0.95 - 1.59)
Took at least 1 supplement in past 12 months	0.92 (0.56 - 1.51)	1.17 (0.72 - 1.88)
Knowledge about dietary supplements		
Fair / poor	1.16 (0.77 - 1.75)	1.27 (0.78 - 2.05)
Excellent	1.45 (0.97 - 2.16)	1.80 (1.06 - 3.08) [†]
Importance of asking about supplement use		
Important	1.35 (0.90 - 2.04)	1.34 (0.83 - 2.16)
Very important	1.79 (1.12 - 2.84) [†]	2.80 (1.06 - 3.08) [†]
Patient Characteristics		
Patient age	1.00 (0.99 - 1.01)	1.00 (0.99 - 1.01)
Female patient	1.14 (0.93 - 1.40)	1.05 (0.82 - 1.35)
Patient race / ethnicity		
Hispanic	1.13 (0.85 - 1.50)	1.04 (0.75 - 1.44)
Black	1.10 (0.73 - 1.66)	0.94 (0.62 - 1.42)
Asian	1.24 (0.88 - 1.76)	1.08 (0.68 - 1.72)
Other	0.94 (0.68 - 1.31)	0.91 (0.62 - 1.33)
Takes prescription or over-the-counter med	0.87 (0.70 - 1.08)	0.83 (0.66 - 1.06)
Education		
Some college	1.11 (0.79 - 1.57)	0.99 (0.65 - 1.49)
College graduate	1.04 (0.77 - 1.40)	0.75 (0.51 - 1.10)
# comorbid conditions	0.99 (0.93 - 1.06)	0.97 (0.91 - 1.05)
Hospitalized past 12 months	1.03 (0.81 - 1.31)	1.10 (0.84 - 1.45)
Spent more \$ on supplements than on prescription drugs in past 12 months	0.94 (0.77 - 1.14)	0.93 (0.74 - 1.16)
Newly prescribed a medication on day of visit	1.04 (0.74 - 1.47)	1.01 (0.70 - 1.48)
Number of supplements taken	1.02 (1.00 - 1.05) [†]	0.97 (0.95 - 1.00) [†]
Supplement Characteristics		
Non-vitamin non-mineral supplement	N/A	1.06 (0.96 - 1.17)

* Reference groups noted in parentheses: Type of provider (primary care); female provider (male provider); took at least 1 supplement in past 12 months (did not take at least 1 supplement); knowledge about dietary supplements (good / very good); importance of asking about supplement use (moderately important/of little importance/unimportant); female patient (male patient); patient race/ethnicity (white); takes prescription or over-the-counter med (does not take); education (high school or less); hospitalized past 12 months (not hospitalized past 12 months); spent more \$ on supplements than on prescription drugs in past 12 months (spent more \$ on prescription drugs than supplements); newly prescribed a medication on day of visit (not newly prescribed a medication); non-vitamin non-mineral supplement (vitamin or mineral supplement)

†
p < 0.05

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Table 6

Multivariable models of primary care office visits, predicting patient disclosure of any of their supplements (patient-level analysis) and of individual supplements (supplement-level analysis) taken in the past 30 days, including provider, patient, and supplement characteristics as independent variables

Independent Variables *	Probability Ratio (95% CI) of Any Supplement Disclosure	Probability Ratio (95% CI) of Individual Supplement Disclosure
Provider Characteristics		
Provider age	1.03 (1.00 – 1.06)	1.02 (0.99 – 1.05)
Female provider	1.21 (0.83 – 1.76)	1.21 (0.74 – 1.96)
Took at least 1 supplement in past 12 months	0.65 (0.47 – 0.90) [‡]	0.71 (0.41 – 1.21)
Knowledge about dietary supplements		
Fair / poor	1.31 (1.02 – 1.68) [†]	1.31 (0.82 - 2.09)
Importance of asking about supplement use		
Important	1.28 (0.92 – 1.78)	1.16 (0.71 – 1.91)
Very important	2.11 (1.10 – 4.05) [†]	2.17 (1.07 - 4.42) [†]
Patient Characteristics		
Patient age	1.00 (0.98 – 1.02)	1.00 (0.98 – 1.03)
Female patient	1.54 (0.96 – 2.46)	1.55 (0.88 – 2.70)
Patient race / ethnicity		
Hispanic	3.44 (1.39 – 8.50) [‡]	2.53 (1.15 – 5.54) [†]
Black	2.33 (0.96 – 5.65)	1.63 (0.68 – 3.93)
Asian	3.72 (1.54 – 9.03) [‡]	3.43 (1.54 – 7.63) [‡]
Other	2.66 (0.95 – 7.41)	2.18 (0.93 – 5.13)
Takes prescription or over-the-counter med	0.62 (0.35 – 1.09)	0.63 (0.38 – 1.05)
Education		
Some college	1.78 (0.95 – 3.32)	1.57 (0.84 – 2.93)
College graduate	1.74 (0.81 – 3.75)	1.42 (0.68 – 2.96)
# comorbid conditions	0.96 (0.79 – 1.16)	0.94 (0.79 – 1.12)
Hospitalized past 12 months	0.91 (0.50 – 1.65)	1.08 (0.61 – 1.92)
Spent more \$ on supplements than on prescription drugs in past 12 months	0.49 (0.26 – 0.95) [†]	0.43 (0.23 – 0.83) [†]
Newly prescribed a medication on day of visit	0.85 (0.50 – 1.44)	0.80 (0.47 – 1.38)
Number of supplements taken	1.20 (1.11 – 1.29)	1.17 (1.07 – 1.28) [‡]
Supplement Characteristics		
Non-vitamin non-mineral supplement		1.58 (0.98 – 2.54)

* Reference groups noted in parentheses: Female provider (male provider); took at least 1 supplement in past 12 months (did not take at least 1 supplement); knowledge about dietary supplements (good / very good); importance of asking about supplement use (moderately important/of little importance/unimportant); female patient (male patient); patient race/ethnicity (white); takes prescription or over-the-counter med (does not take); education (high school or less); hospitalized past 12 months (not hospitalized past 12 months); spent more \$ on supplements than on prescription drugs in past 12 months (spent more \$ on prescription drugs than supplements); newly prescribed a medication on day of visit (not newly prescribed a medication); non-vitamin non-mineral supplement (vitamin or mineral supplement)

[†]
p < 0.05

[‡]
p < 0.01

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