Original Investigation

Association of Marketing Interactions With Medical Trainees' Knowledge About Evidence-Based Prescribing
Results From a National Survey

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Supplemental content at jamainternalmedicine.com

IMPORTANCE In recent years, numerous US medical schools and academic medical centers have enacted policies preventing pharmaceutical sales representatives from interacting directly with students. Little is known about how pharmaceutical sales representatives affect trainees' knowledge about pharmaceutical prescribing.

OBJECTIVE To determine whether there is an association between medical trainees' interactions with pharmaceutical promotion and their preferences in medication use.

DESIGN, SETTING, AND PARTICIPANTS We surveyed a nationally representative sample of first- and fourth-year medical students and third-year residents by randomly selecting at least 14 trainees at each level per school.

EXPOSURES All trainees were asked how often they used different educational resources to learn about prescription drugs. Among fourth-year students and residents, we posed a series of multiple choice knowledge questions asking about the appropriate initial therapy for clinical scenarios involving patients with diabetes, hyperlipidemia, hypertension, and difficulty sleeping.

MAIN OUTCOMES AND MEASURES Evidence-based answers followed widely used clinical guidelines, while marketed-drug answers favored brand-name drugs over generic alternatives. We used survey answers to build an *industry relations index* assessing each trainee's level of acceptance of pharmaceutical promotion; we used proportional odds logistic regression models to estimate the association between the index and responses to the knowledge questions.

RESULTS The 1601 student (49.0% response rate) and 735 resident (42.9% response rate) respondents reported common use of unfiltered sources of drug information such as Google (74.2%-88.9%) and Wikipedia (45.2%-84.5%). We found that 48% to 90% of fourth-year students and residents accurately identified evidence-based prescribing choices. A 10-point higher industry relations index was associated with 15% lower odds of selecting an evidence-based prescribing choice (odds ratio [OR], 0.85; 95% CI, 0.79-0.92) ($P < .001$). There was also a significant association between the industry relations index and greater odds of choosing to prescribe brand-name drugs (OR, 1.08; 95% CI, 1.00-1.16) ($P = .04$).

CONCLUSIONS AND RELEVANCE Among physician trainees, our survey showed an association between positive attitudes toward industry-physician interactions and less knowledge about evidence-based prescribing and greater inclination to recommend brand-name drugs. Policies intended to insulate trainees from pharmaceutical marketing may promote better educational outcomes.

JAMA Intern Med. 2014;174(8):1283-1289. doi:10.1001/jamainternmed.2014.2202
Published online June 9, 2014.

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The pharmaceutical industry spends nearly $60 billion per year on marketing its products to the medical community, with the largest share going to personal interactions with physicians, usually mediated by sales representatives.[1] These interactions affect physicians' medication choices: an early study of primary care physicians found that physicians' knowledge of drug properties was more consistent with sales information than with the medical literature.[2] Marketing tools such as gifts and free meals also influence clinical decision making.[3]

Recently, policy changes by academic medical centers,[4] government,[5] and the drug industry[6] have sought to reduce undue influence of pharmaceutical marketing on physicians. Particular attention has been paid to trainees because the medical school and residency learning environment may influence subsequent professional development and behavior, including openness to pharmaceutical promotional messages.[7-11] For example, Stanford prohibits faculty and students from receiving gifts, meals, financial support, or other education directly from pharmaceutical companies.[12]

Policies limiting access of pharmaceutical sales representatives to medical schools have been controversial, with some faculty members and students arguing that they waste resources and prevent positive educational outcomes that might result from these interactions. Frequency of students' contact with pharmaceutical marketing activities predicts favorable attitudes toward industry interactions.[13] But not enough is known about how interactions with pharmaceutical sales representatives affect trainees' knowledge about evidence-based drug use.

In 2013, we reported the results of a large, random-sample national survey of medical students and residents to determine how their interactions with sales representatives affect attitudes and behavior.[14] The survey included objective questions testing students' knowledge about evidence-based prescribing in common clinical scenarios. We now report on the association between trainees' interactions with pharmaceutical promotion and their medication-use preferences.

Methods

This project was approved by the institutional review boards at Brigham and Women's Hospital and Harvard Law School. Participant informed consent was provided by voluntary completion of the survey.

Survey Design and Administration

The survey design was informed by previous experience in conducting studies of physician professionalism,[15] a review of the literature regarding pharmaceutical industry interactions with physicians and medical trainees, interviews with 2 interdisciplinary groups of key researchers in this field, and feedback from medical students. As described previously,[14] the survey population was obtained from the American Medical Association's Physician Masterfile, which lists all US physicians and trainees. We excluded osteopathic trainees and residents who were graduates of these programs, trainees educated in non-US medical schools, members of the armed services, and names without addresses in the file, yielding 16 299 first-year medical students, 14 804 fourth-year students, and 14 266 third-year residents. Each level of trainee was then stratified by medical school or, for residents, the medical school attended (120 schools for first-year students and 121 schools for fourth-year students and residents).

Next, we randomly selected 14 participants per school from the first-year student population and 15 per school from the fourth-year student and resident populations, resulting in a potential sample of 1680 first-year students, 1815 fourth-year students, and 1815 residents. There were 230 incorrect addresses for medical students and 100 for residents. The survey involved a presurvey mailing, a mailing with a cover letter, survey, postage-paid return envelope, cash honorarium ($2 for medical students and $5 for residents), an internet link to an online version of the survey, and up to 2 follow-up mailings for nonrespondents.

Survey Content

The survey consisted of 24 unique questions with 81 components. The first question asked trainees how often they used different educational resources to learn about drugs. The answer options were often, sometimes, rarely, and never. The resources listed were lectures or lecture notes; conversations with faculty, residents, or other physicians; textbooks; pharmaceutical representative information; peer-reviewed journal articles; drug company sources, such as sponsored educational events; UpToDate; Wikipedia; Google searches; iPhone or personal digital assistant (PDA) programs such as Epocrates; *Physicians' Desk Reference*, and clinical guidelines. Trainees were then presented with 19 questions addressing the frequency in the past 6 months of interactions with the pharmaceutical industry (including acceptance of gifts); their expected frequency of interactions in their future careers; the frequency with which trainees used specific educational sources to learn about pharmaceutical use; and their attitudes regarding pharmaceutical industry interactions, other pharmaceutical policy issues, and professionalism. Results from these questions were reported in our previously published study[14] and revealed a generally high level of interactions between trainees and pharmaceutical sales representatives, with the incidence increasing over the course of training.

We then presented trainees with 4 multiple-choice questions that posed short medical scenarios and asked them to provide the appropriate initial therapy for the common clinical conditions of diabetes, hyperlipidemia, hypertension, and difficulty sleeping. The first question asked "Which of the following would be a good choice for initial drug treatment of a patient with new-onset type 2 diabetes?" and instructed respondents to "check as many as apply" among all of the following: glyburide (Diabeta [Sanofi-Aventis], Micronase [Pfizer]), insulin glargine (Lantus [Sanofi-Aventis]), exenatide (Byetta [Amylin Pharmaceuticals, AstraZeneca]), sitagliptin (Januvia [Merck]), metformin (Glucophage [Bristol-Myers Squibb]), and none of the above. The second question asked "After attempting a regimen of diet and exercise, a patient has an LDL of 150 which you would like to bring down to 100. What would be a good choice for initial therapy?" and instructed respondents to "check as many as apply" among all of the following : atorvastatin (Lipitor [Pfizer]), niacin (Niaspan [Abbott Laboratories]), ezetimibe (Zetia [Merck]), lovastatin (Mevacor [Merck]), rosuvastatin (Crestor [AstraZeneca]), simvastatin (Zocor [Merck]), simvastatin-ezetimibe (Vytorin [Merck]), psyllium (Metamucil [Proctor & Gamble]), and none of the above. The third question asked "Which of the following would be a good first choice for initial drug treatment of an otherwise healthy patient with hypertension?" and instructed respondents to "check as many as apply" among all of the following : enalapril (Vasotec [BTA Pharmaceuticals]), aliskiren (Tekturna [Novartis]), hydrochlorothiazide (Hydrodiuril [Merck]), amlodipine (Norvasc [Pfizer]), losartan (Cozaar [Merck]), and none of the above. The final question asked "A new patient presents with difficulty sleeping. What would be a good initial treatment?" and instructed respondents to "check as many as apply" among all of the following: eszopiclone (Lunesta [Sonovion Pharmaceuticals]), zaleplon (Sonata [King Pharmaceuticals]), diazepam (Valium [Roche Pharmaceuticals]), zolpidem (Ambien [Sanofi-Aventis]), none of the above.

We excluded first-year students from our analyses of responses to these knowledge-based questions and dichotomized responses into 2 groups. The first were *evidence-based answers*, those that were most consistent with guidelines concerning first-line treatments for the relevant conditions: metformin or glyburide for diabetes; atorvastatin, lovastatin, rosuvastatin, or simvastatin for hypercholesterolemia; hydrochlorothiazide for hypertension; and no medication ("none of the above") as the best first-line recommendation for the difficulty sleeping scenario. Any answer containing these responses and nothing else was an evidence-based answer for that question.

The second category of answer was *marketed-drug answers*, those that included heavily marketed brand-name products: Januvia, Byetta, or Lantus as first-line drugs for diabetes; Crestor, Lipitor, Vytorin, Zetia, or Niaspan for elevated cholesterol; Tekturna or Cozaar for hypertension; and Lunesta or Sonata for difficulty sleeping. Any answer containing these responses was considered a marketed-drug answer for that question.

The survey was the same for medical students and residents except for minor word modifications necessary to target the questions to each population (eg, changes in tense when referring to medical school, ie "attended" vs "attending"). At the conclusion, we collected demographic information including age, medical school, expected career path (primary care vs specialty), personal or familial employment with a pharmaceutical company, and level of concern about educational debt (eAppendix in the Supplement).

Industry Relations Index

We used relevant questions addressing trainees' behaviors, attitudes, and perceptions of their learning environments to build an *industry relations index* to assess each trainee's level of acceptance of pharmaceutical promotion. Using a technique from past surveys to aggregate responses,[16] we categorized trainees based on the extent of their interactions with pharmaceutical sales representatives and their skepticism about the educational value of promotional material (eAppendix in the Supplement). For example, we assigned 1 point for often and sometimes responses to the use of promotional sources to learn about medications and subtracted a point for rarely and never responses. By contrast, for the question on using various resources to learn about drugs, we subtracted a point for often and sometimes responses to the use of evidence-based educational sources and added a point for rarely and never responses. We used this industry relations index to assess the association between students' acceptance of pharmaceutical marketing inputs and their responses to the knowledge-based questions.

Statistical Analysis

Survey response data were weighted for sampling probability, with *sample weight* defined at each school as the number of students or residents available to be surveyed divided by the number of responses received. We conducted χ^2 tests for bivariate linear trend to determine significant differences in responses to trainees' source of information comparing first-year students, fourth-year students, and residents.

We analyzed responses to the medication knowledge questions as 2 summary scores: (1) the number of questions with evidence-based answers; and (2) the number of questions with marketed-drug answers. Each summary score ranged from 0 to 4, 0 indicating no evidence-based (or marketed-drug) answers, and 4 indicating that an evidence-based (or marketed-drug) answer was given to all 4 questions. To estimate the linear association between the industry relations index and responses to the medication knowledge questions, each summary score served as the ordinal dependent variable in a separate proportional odds logistic regression model. This model assumes that estimated odds ratios (ORs) do not depend on what cut point is used to dichotomize the ordinal response. Thus, it can be thought of as using all cut points simultaneously. A separate model was estimated for each summary score and for fourth-year students alone, residents alone, and in the combined population (we did not consider first-year student responses to the knowledge-based prescribing questions). Model standard errors were adjusted to account for the clustering of students within medical schools.[17]

We report ORs for a 10-point difference in the industry relations index, corresponding to approximately 1 standard deviation (SD) in the index. In the analysis of evidence-based answers, the estimated OR compares the odds of giving evidence-based answers between trainees who differ in their industry relations index by 10 points. For example, an OR of 0.85 indicates that trainees with a 10-point higher industry relations index had 15% lower odds of evidence-based answers. Analyses were performed using *R* statistical software, version 3.0.0 (R Foundation for Statistical Computing).

Results

A total of 1601 medical students and 735 residents completed the survey, leading to a response rate of 49.0% of medical stu-

Table 1. Medical Students' and Residents' Use of Educational Sources to Learn About Drugs

Information Source[a]	Respondents Answering "Often" or "Sometimes," Weighted % (95% CI)		
	First-Year Students	Fourth-Year Students	Residents
Drug company sources, such as sponsored educational events	6.7 (6.4-6.9)	9.7 (9.3-10.0)	17.0 (16.6-17.5)
Pharmaceutical sales representative	7.9 (7.6-8.2)	9.7 (9.4-10.1)	20.0 (19.5-20.5)
Physicians' Desk Reference	19.0 (18.5-19.4)	18.2 (17.7-18.6)	15.5 (15.1-16.0)
Clinical guidelines	36.4 (35.9-37.0)	71.0 (70.5-71.5)	72.1 (71.6-72.6)
Peer-reviewed journal articles	47.3 (46.8-47.9)	70.9 (70.4-71.5)	74.7 (74.2-75.2)
UpToDate	47.5 (46.9-48.0)	90.9 (90.6-91.3)	79.9(79.3-80.3)
iPhone or PDA programs, such as Epocrates	53.4 (52.9-54.0)	89.4 (89.0-89.7)	74.3 (73.8-74.9)
Textbooks	62.9 (62.4-63.5)	69.3 (68.8-69.8)	62.3 (61.7-62.9)
Conversations with faculty, residents, or other physicians	63.2 (62.6-63.7)	94.4 (94.1-94.6)	94.9 (94.6-95.1)
Wikipedia	84.5 (84.1-84.9)	77.3 (76.8-77.7)	45.2 (44.6-45.8)
Google search	88.9 (88.3-89.0)	82.4 (81.9-82.8)	74.2 (73.7-74.7)
Lectures or lecture notes	89.5 (89.2-89.9)	67.5 (67.0-68.1)	54.0 (53.4-54.5)

Abbreviation: PDA, personal digital assistant.

[a] Sources listed in order of increasing frequency in first-year student answers.

dents and 42.9% of residents). In analyses restricted to fourth-year medical students, we used data from the 771 students who identified themselves as fourth-year students. The population was split evenly among men (51%) and women (49%), with mean ages of 25.2 years for first-year medical students, 28.3 years for fourth-year medical students, and 31.8 years for residents.

Sources Used to Learn about Medications

Trainees learned about medications from sources that varied widely according to their educational level (**Table 1**). Nearly all first-year medical students reported using lecture notes (89.5%), Google searches (88.9%), and Wikipedia (84.5%). By contrast, fourth-year medical students most commonly reported using iPhone or PDA programs (such as Epocrates) (89.4%), UpToDate (90.9%), and conversations with faculty and colleagues (94.4%). Fourth-year students still frequently used Google searches (82.4%) and Wikipedia (77.3%) as sources of information. Residents reported less use of Wikipedia (45.2%), Google searches (74.2%), and lecture notes (54.0%) and relied most heavily on conversations with faculty and other residents (94.9%). Only three-quarters (74.7%) of residents claimed that they used peer-reviewed journal articles to learn about medications. Reported use of pharmaceutical sales representatives as a source for drug information rose about 2-fold from first-year medical students (7.9%) to residents (20.0%), and reported use of drug-company-sponsored educational events rose about 3-fold (6.7% to 17.0%) ($P < .001$).

Responses to Knowledge Questions

We found a range of answers to the knowledge questions. The smallest percentages of evidence-based answers were seen for the treatment of difficulty sleeping and hypertension (**Table 2**). Among fourth-year students, 55.0% chose not to prescribe any medication for sleep before trying alternate solutions, as did 48.2% of residents. Hydrochlorothiazide (and nothing else) was selected by 75.0% of fourth-year students and 64.9% of residents as the best first-line management of hypertension in an uncomplicated patient. For the hypercholesterolemia question, an evidence-based response that included any statin (but nothing else) was offered by 86.9% of fourth-year students and 81.8% of residents. The diabetes scenario received the most number of answers consistent with evidence-based guidelines, with 90.6% of fourth-year students reporting that they would prescribe metformin or glyburide first, and 84.7% of residents reporting that they would do so.

Marketed-drug answers were relatively rare, except in response to the hyperlipidemia question, because the 2 highest-potency statins—rosuvastatin (Crestor) and atorvastatin (Lipitor)—were both brand-name products at the time of the survey. Residents were more likely than fourth-year students to choose marketed-drug answers in the diabetes and hypertension scenario. For the diabetes question, 5.2% of fourth-year students selected a brand-name drug among their answers compared with 11.1% of residents. For the hypertension question, 3.6% of fourth-year students selected marketed-drug answers (Tekturna [aliskiren] or Cozaar [losartan]) compared with 6.5% of residents. However, a similar number of fourth-year students and residents included marketed-drug answers to the question about a patient with difficulty sleeping.

Association of Survey Responses and Industry Relations Level

The mean score of respondents for our industry relations index was −13.0 (95% CI, −14.0 to −12.0) among fourth-year students and −9.3 (95% CI, −10.4 to −8.2) among residents. The full potential range of scores was −45, indicating a trainee with limited contacts with industry, to 49, indicating substantial contact with industry, but observed scores ranged from −42 to 25, with an interquartile range (IQR) of −22 to −1. We decided to analyze the results based on 10-point difference, which provided 6 full intervals from the lowest to the highest observed score and corresponded to approximately 1 standard deviation.

Among fourth-year students and residents combined, a 10-point higher industry relations index was significantly associated with 15% lower odds of selecting a drug answer most

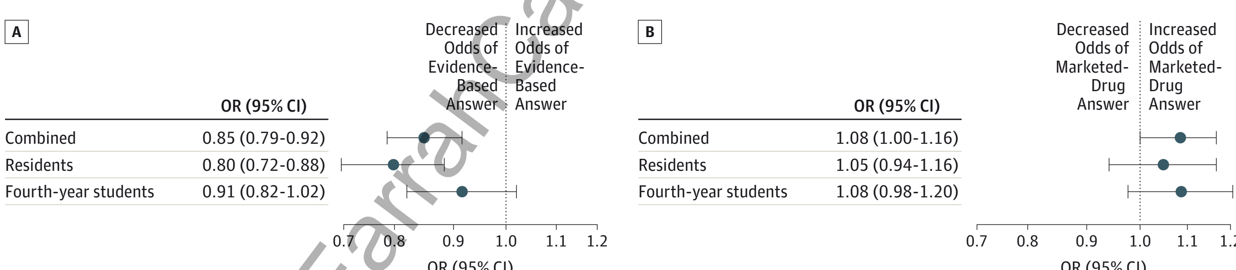
Table 2. Trainees' Answers to Questions on Prescribing Preferences

Summary of Question Prompt	Multiple Choice Answer Options[a]	Answer Categories	Fourth-Year Students, % (95% CI)	Residents, % (95% CI)
Diabetes				
Initial treatment for new-onset type 2 diabetes	Glyburide (Diabeta, Micronase), insulin glargine (Lantus), exenatide (Byetta), sitagliptin (Januvia), metformin (Glucophage), none of the above	Evidence-based answer: Metformin or glyburide (and nothing else)	90.6 (90.3-91.0)	84.7 (84.3-85.1)
		Marketed-drug answer: Januvia, Byetta, or Lantus	5.2 (3.8-6.9)	11.1 (8.9-13.5)
High cholesterol				
Initial treatment for patient with hyperlipidemia after diet and exercise were insufficient	Atorvastatin (Lipitor), niacin (Niaspan), ezetimibe (Zetia), lovastatin (Mevacor), rosuvastatin (Crestor), simvastatin (Zocor), simvastatin-ezetimibe (Vytorin), psyllium (Metamucil), none of the above	Evidence-based answer: any statin (and nothing else)	86.9 (86.5-87.3)	81.8 (81.3-82.2)
		Marketed-drug answer: Crestor, Lipitor, Vytorin, Zetia, or Niaspan	53.8 (50.3-57.3)	59.2 (55.6-62.7)
Hypertension				
Initial drug treatment for healthy patient with hypertension	Enalapril (Vasotec), aliskiren (Tekturna), hydrochlorothiazide (Hydrodiuril), amlodipine (Norvasc), losartan (Cozaar), none of the above	Evidence-based answer: hydrochlorothiazide (and nothing else)	75.0 (74.5-75.5)	64.9 (64.4-65.5)
		Marketed-drug answer: Tekturna or Cozaar	3.6 (2.5-5.1)	6.5 (4.9-8.5)
Difficulty sleeping				
Initial treatment for patient presenting with difficulty sleeping	Eszopiclone (Lunesta), zaleplon (Sonata), diazepam (Valium), zolpidem (Ambien), none of the above	Evidence-based answer: none of the above	55.0 (54.4-55.5)	48.2 (47.6-48.8)
		Marketed-drug answer: Lunesta or Sonata	11.9 (9.8-14.3)	9.5 (7.6-11.8)

Abbreviations: Statins, atorvastatin, lovastatin, rosuvastatin, simvastatin.

[a] Survey respondents were instructed to answer "all that apply." For the manufacturers of all brand-name drugs, see the "Survey Content" subsection of the "Methods" section.

Figure. Association Between Industry Relations and Responses to Clinical Scenarios Among Medical Trainees



Odds ratios (ORs) comparing the odds of an evidence-based answer (A) or marketed-drug answer (B) between trainees with a 10-point difference in their industry relations index.

consistent with evidence-based prescribing practices (OR, 0.85; 95% CI, 0.79-0.92) ($P < .001$) (**Figure**). This effect corresponds to an average evidence-based prescribing score that ranges from 3.51 to 3.12 among those with the highest and lowest industry relations scores, respectively. Among the 2 subgroups, a stronger effect size was observed for residents (20%, $P < .001$) than for fourth-year students (9%, $P = .11$).

For the combined sample, there was a significant association between the industry relations index and a greater odds of selecting a brand-name drug answer (OR 1.08, 95% CI 1.00 to 1.16, $P = .04$) (Figure). Across the observed range of the industry relations index, this model predicted the average number of marketed-drug answers to range from 0.73 to 0.95. A similar trend was seen in the fourth-year student and resident subgroups, but did not reach statistical significance in either of these smaller samples.

Discussion

Overall, we found that 48% to 90% of trainees were able to accurately identify evidence-based prescribing choices in questions about 4 common conditions. Trainees who reported higher levels of involvement in pharmaceutical marketing activities and stronger beliefs in the positive role of industry marketing in medical education were significantly less likely to provide evidence-based answers concerning appropriate drug choices and were more likely to identify brand-name drugs as the correct answers to these questions, even if they were not the most appropriate products.

A number of pathways could explain our primary finding that higher levels of interaction with industry sources of information were associated with diminished knowledge about evidence-based prescribing. Respondents who spent more time with pharmaceutical sales representatives were significantly more likely to have been encouraged to use brand-name drugs for diabetes, hyperlipidemia, hypertension, or difficulty sleeping, even if these were not the best evidence-based choices (or the most cost-effective ones). In the prescribing questions we presented, the best evidence favored first-line use of generic drugs or, in the case of difficulty sleeping, no medication therapy as the first therapeutic intervention. However, there is little active marketing or commercial outreach for generic drugs or behavioral interventions, and this imbalance in information appears to crowd out more evidence-based choices. Because our data confirm only an association between contact with industry and evidence-based prescribing knowledge, other confounding factors—such as institutional culture of the trainees' learning environment—may exist that influence the relationship.

While this was not a longitudinal study, we found that our cohort of fourth-year medical students were more likely to make evidence-based prescribing decisions than the third-year residents. One possible explanation for these findings is that these scenarios were all related to adult primary care situations. The fourth-year medical students in our survey may have been more recently exposed to this material than the cohort of residents, which was drawn from diverse specialties. Another possibility is that residents have increased exposure to pharmaceutical educational sources in the clinical setting. Recently, studies by Epstein et al[18] and King et al[19] have found that restricting access of marketing representatives to trainees during medical school and residency reduced subsequent prescribing of high-cost but low-value brand-name psychoactive drugs. However, their studies did not provide insight into how the restrictive policies might have produced the outcomes they observed. Our study suggests that one reason that trainees from schools insulated from pharmaceutical marketing may prescribe these drugs less often is that they are less likely to be influenced by promotional messages in formulating clinical management decisions and are less likely to prescribe brand-name drugs overall when comparably effective lower-cost generic options are available.

These results may also provide insight into the varying roles of different resources used by trainees to learn about prescription drugs. Very few first-year and fourth-year medical students reported getting their basic information about drugs from pharmaceutical sales representatives and other industry sources, but the number increased to nearly 1 in 5 for residents. Such a shift may be related to easier access to residents by industry marketing representatives in the hospital setting and sales representatives' greater incentives to disseminate their promotional materials to trainees with direct prescribing authority.

Other noteworthy shifts in trainees' educational sources that we discovered over the course of their medical training included increased use of peer-reviewed journal articles and clinical practice guidelines and reduced use of informal sources such as Wikipedia and Google searches to learn about prescription drugs. Such a shift could also demonstrate evolution in trainees' basic knowledge about prescription drugs and a greater understanding of the variable quality provided by different educational outlets. However, the fact that such a large fraction of residents still reported common use of unfiltered sources such as Google and Wikipedia is concerning because these sources are conduits for inaccurate or biased information. Even PDA and iPhone applications, generally considered to be more reliable resources, can present industry bias through paid advertisements by drug manufacturers.[20] More high-quality educational sources may need to be provided that can meet the demands of a new generation of physicians for easily searchable internet-based tools.

Our study had a number of limitations. First, while the association between the industry relations index and respondents' answers related to evidence and brand-name drugs was statistically significant, the magnitude of the OR was small. In part, this can be explained by the fact that we presented trainees with questions relating only to 4 common conditions. Even a small effect may be clinically significant, however, given the substantial number of therapeutic decisions involved in even a day of routine clinical practice for patients with these diagnoses.

Second, our industry relations index has not been formally validated. However, we believe its utility is supported by the fact that it was built out of a composite of survey questions including some from previous studies. Moreover, survey respondents were normally distributed across the index, supporting its use as a proxy for trainees' interactions with and acceptance of marketing-related communications.

Finally, survey response may be subject to social desirability bias, and at 43% to 49%, our survey response rate was moderate. However, following Johnson and Wislar,[21] we have previously evaluated the possibility for bias in our respondent population by using data in the sampling frame, comparing the survey sample with other data sources, and comparing early and late survey responder characteristics, attitudes, and behaviors.[14] These results showed moderate to high confidence in the representativeness of our sample on most indicators.

Conclusions

Despite the study limitations, our data add to the literature showing that pharmaceutical marketing is associated with less-evidence-based prescribing choices and greater inclination to prescribe brand-name products over less expensive generic options or nondrug treatment plans that have equal or greater comparative effectiveness. Overall, our finding that trainees with fewer connections to industry promotional activities had greater knowledge of evidence-based prescribing provides additional support for policies intended to insulate medical trainees from pharmaceutical marketing. In the past decade, numerous messages about the corrupting effect that pharmaceutical marketing can have on rational prescribing choices have been disseminated by physicians and policymakers, and dozens of hospitals and academic medical centers have limited access of pharmaceutical sales representatives to physicians and particularly to trainees. At the same time, state-based initiatives seeking to more tightly regulate pharmaceutical marketing have come under fire from courts and legislatures, including a repeal of "gift bans,"[22] creating a more conducive environment for marketing interactions with physicians. Our study is another reminder of the negative effects those interactions can have on the quality and cost of patient care.

ARTICLE INFORMATION

Accepted for Publication: March 14, 2014.

Published Online: June 9, 2014. doi:10.1001/jamainternmed.2014.2202.

Author Contributions: Dr Kesselheim 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.
Study concept and design: Austad, Avorn, Kesselheim.
Acquisition, analysis, or interpretation of data: Austad, Avorn, Franklin, Campbell, Kesselheim.
Drafting of the manuscript: Austad, Avorn, Franklin, Kesselheim.
Critical revision of the manuscript for important intellectual content: Austad, Avorn, Franklin, Campbell, Kesselheim.
Statistical analysis: Avorn, Franklin, Kesselheim.
Obtained funding: Austad, Kesselheim.
Administrative, technical, or material support: Austad, Avorn, Campbell.
Study supervision: Avorn, Kesselheim.

Conflict of Interest Disclosures: None reported.

Funding/Support: This study was funded by a grant from the Edmond J. Safra Center for Ethics at Harvard University. Dr Kesselheim is supported by career development award K08HS18465-01 from the Agency for Healthcare Research & Quality, a Greenwall Faculty Scholarship in Bioethics, and a Robert Wood Johnson Foundation Investigator Award in Health Policy Research. Dr Austad has been a member of the American Medical Student Association (AMSA) and has received funding from AMSA to support travel and lodging to attend AMSA conferences.

Role of the Sponsors: The funders had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Correction: This article was corrected on June 9, 2014, to insert the missing word "not" in the third sentence of the "Responses to Knowledge Questions" subsection of the Results section. The corrected sentence reads "Among fourth-year students, 55.0% chose not to prescribe any medication for sleep before trying alternate solutions, as did 48.2% of residents."

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