Physician Prescribing Behavior and Its Impact on Patient-Level Outcomes

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Objectives: Concerns over rising drug costs, pharmaceutical advertising, and potential conflicts of interest have focused attention on physician prescribing behavior. We examine how broadly physicians prescribe within the 10 most prevalent therapeutic classes, the factors affecting their choices, and the impact of their prescribing behavior on patient-level outcomes.

Study Design: Retrospective study from 2005 to 2007 examining prescribers with at least 5 *initial* prescriptions within a class from 2005 to 2007. Medical and pharmacy claims are linked to prescriber information from 146 different health plans, reflecting 1975 to 8923 unique providers per drug class.

Methods: Primary outcomes are the number of distinct drugs in a class initially prescribed by a physician over 1- and 3-year periods, medication possession ratio, and out-of-pocket costs.

Results: In 8 of 10 therapeutic classes, the median physician prescribes at least 3 different drugs and fewer than 1 in 6 physicians prescribe only brand drugs. Physicians prescribing only 1 or 2 drugs in a class are more likely to prescribe the most advertised drug. Physicians who prescribe fewer drugs are less likely to see patients with other comorbid conditions and varied formulary designs. Prescribing fewer drugs is associated with lower rates of medication adherence and higher out-of-pocket costs for drugs, but the effects are small and inconsistent across classes.

Conclusions: Physicians prescribe more broadly than commonly perceived. Though narrow prescribers are more likely to prescribe highly advertised drugs, few physicians prescribe these drugs exclusively. Narrow prescribing has modest effects on medication adherence and out-of-pocket costs in some classes.

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In 2004, pharmaceutical firms spent more than $57 billion on marketing in the United States, roughly twice their expenditure on research and development.[1] Most of this spending targeted physicians through sales representatives (detailing), sampling (provision of drugs at no cost), physician meetings, and advertisements in medical journals.[2] For example, industry-sponsored promotional events increased from 120,000 in 1998 to 371,000 events in 2004.[3] There has also been a significant increase in the frequency and size of federal and state penalties for illegal promotion of drugs and pricing irregularities.[1]

These trends have raised the concern that pharmaceutical companies might have undue influence on the prescribing behavior of physicians. In particular, there is concern that a significant percentage of physicians might be prescribing a narrow range of heavily promoted drugs, or might be exclusively prescribing branded drugs to the detriment of patient welfare. However, empirical evidence on the prescribing behavior of physicians and its consequences for patients is limited. Some studies suggest that physicians exhibit narrow prescribing behavior, particularly general practitioners, but much of this evidence is decades old.[4-8] More recent work finds that the prescribing patterns of physicians are substantially more concentrated than the aggregate market in each class, and that physicians differ in their preferred drug within a class.[9,10]

While theory suggests that habitual prescribing can be both clinically suboptimal and economically wasteful, the appropriateness of broad versus narrow prescribing is likely to depend on the composition of the drug class. Narrow prescribing patterns may be optimal when 1 drug is clearly superior to the others, or if all the drugs in the class act in a similar way. For example, prescribing only a generic or low-cost brand in a largely homogeneous class may be beneficial given that lower patient cost-sharing is associated with improved adherence.[11-13] In addition, most generics are inherently safer than newer drugs because of their longer track record in clinical practice and known side effects.[14,15] Alternatively, some drug classes are characterized by heterogeneous effects, where a specific drug provides therapeutic benefit to some patients and little to others, or has known side effects that are problematic for a subset of patients. If the heterogeneous benefits and side effects of these drugs are known *ex-ante*, a better informed physician will engage in broader prescribing be-

havior, taking into account the specific medical characteristics of each patient. Levine-Taub and colleagues[9] found that psychiatrists have broader prescribing patterns than general practitioners within the atypical antipsychotic class, but they cannot determine how much of the difference is explained by variation in the case mix of patients seen by psychiatrists versus nonspecialists.[9]

Take-Away Points

Physicians prescribe more broadly than commonly perceived. Although most physicians have a "favorite" drug, they are not reluctant to try new therapies. Physicians who prescribe broadly see more patients with varied comorbidities and formulary designs. Prescribing fewer drugs is associated with lower rates of medication adherence and higher out-of-pocket costs, but the effects are small and inconsistent across classes. Broad prescribing may be due to:

- The increasing number of drugs in a class.
- Pharmaceutical marketing, particularly direct-to-physician promotions.
- The role of pharmacy benefit managers and third-party payers.

Beyond the challenge of predicting a drug's therapeutic value for a new patient, an unrelated factor further complicates the prescribing decision; plan formularies. Most modern drug classes include an array of similar products that compete for essentially the same population of patients, and health plans typically choose a small subset of these products to offer at low cost-sharing rates. In addition, direct-to-consumer advertising has emboldened patients to request specific treatments.[16-18] How these factors have affected physicians' choice of drug therapies is uncertain.

In this paper, we examined the prescribing patterns of physicians in 10 large drug classes with several similar-acting agents. We measured the number and type (generic or brand) of different drugs prescribed as initial prescriptions by each physician and the factors that affected their choices. We then examined whether broad or narrow prescribing is associated with patient-level outcomes, such as rates of medication adherence, therapeutic switching, and out-of-pocket drug spending. We know of no other study that examines the relationship between how broadly physicians prescribe and patient-level outcomes (eg, adherence, medical care use) that can proxy for clinical measures.

METHODS

Data

We used unique data, matching prescriptions to prescribing physicians. The data included medical and pharmaceutical claims from 29 large employers in the United States from 2003 to 2007. The drug claims included information on the type of drug, drug name, National Drug Code, dosage, days supplied, and place of purchase (retail or mail order). Starting in 2005, all pharmacy claims identify the prescriber by masked Drug Enforcement Administration number; thus, from 2005 to 2007, we could observe prescriptions made by the same physician to different patients in different insurance plans. We did not have any additional information about the prescribers. To be eligible for the sample, a patient had to be at least 18 years of age, and continuously enrolled for at least 1 year before initiating therapy and for at least 6 months afterward.

We used the IMS Advertising Database to measure the degree of drug promotion for each product. The advertising data were reported quarterly and contained expenditures on direct-to-consumer and direct-to-physician advertising for each drug, including medical journal advertisements, promotional visits to physicians, and drug samples.

Measurement

We use a common classification scheme—the 2007 *Red Book* published by Thomson—to associate each drug with a therapeutic class. Table 1 shows the 10 most common therapeutic classes (in terms of dollars spent) in our sample for 2005. These are cholesterol-reducing drugs, antidepressants, non–histamine-2 receptor antagonist (H2A) stomach drugs, antihistamines, nonsteroidal anti-inflammatory drugs (NSAIDs), opiates, beta-blockers, calcium channel blockers, angiotensin-converting enzyme (ACE) inhibitors, and antidiabetic drugs, excluding insulin. To further narrow the classes, we focused on statins within the cholesterol-reducing drugs (dropping ezetimibe, fibrates, and others), on selective serotonin reuptake inhibitors (SSRIs) and serotonin and norepinephrine reuptake inhibitors (SNRIs) within the antidepressants (keeping bupropion formulations and dropping tricyclic antidepressants), and on proton pump inhibitors (PPIs) within the non-H2A stomach drugs. In the antihistamine class, we dropped promethazine, which is prescribed primarily as an acute treatment and often used as a sedative or antiemetic rather than for allergy treatment. We defined an initial prescription as the absence of any pharmacy claim in the same therapeutic class for at least 12 months.

As most plans assign lower copayments to generic drugs, and often charge the same copayment for all generics, narrow prescribing patterns are most likely to impact average costs in classes where brand drugs are dominant. For this reason, some analyses focused on the 5 drug classes in which more than 50% of initial prescriptions are for brand drugs: statins, SSRIs/SNRIs, PPIs, antihistamines, and calcium channel blockers. We called these the "brand-dominated" classes.

In 3 of these classes, 1 major drug became available as a generic during the study period: simvastatin (statin, starting

Table 1. Distribution of Brand and Generic Prescribing in 10 Therapeutic Classes, Initial Prescriptions Only

Therapeutic Class	Generic Prescribing Share	Percent of Prescribers		
		Physicians Prescribing Only Generics	Physicians Prescribing Only Brands	Physicians Prescribing Brands and Generics
ACE inhibitors	86.3	53.8	0.7	45.5
SSRI/SNRI	44.6	3.0	8.4	88.6
Antihistamines	37.8	2.1	14.0	84.0
Beta-blockers	57.1	11.5	3.0	85.5
Calcium channel blockers	40.3	2.7	9.7	87.6
Antidiabetics	61.3	15.9	3.9	80.2
NSAIDs	83.9	39.1	0.9	60.0
Opiates	98.6	89.7	0.0	10.3
PPIs	20.9	0.9	34.8	64.3
Statins	23.8	0.6	27.6	71.9

ACE indicates angiotensin-converting enzyme; NSAID, nonsteroidal anti-inflammatory drug; PPI, proton pump inhibitor; SSRI/SNRI, selective serotonin reuptake inhibitor/serotonin and norepinephrine reuptake inhibitor.

June 2006), sertraline (SSRI, June 2006), and fexofenadine (antihistamine, September 2005). In the calcium channel blocker class, 2 generics entered the market toward the end of our study period (2007); amlodipine in March and amlodipine/benazepril in May. In measuring the number of drugs prescribed, we treated brand and generic formulations of a multisource product as different drugs; however, the results are not sensitive to this choice.

We restricted the sample to physicians with at least 5 initial prescriptions within a class from 2005 to 2007. We focused on initial prescriptions because refills may reflect the prescribing decisions of other providers. This yielded a sample of 74,163 initial statin prescriptions, prescribed by 8923 unique providers. The corresponding prescription/provider counts for the other brand-dominant classes were PPIs (52,978/6621), SSRI/SNRI (46,040/5866), antihistamines (39,644/4788), and calcium channel blockers (13,633/1975). We categorized providers within each class by the number of distinct drugs prescribed as initial prescriptions over the sample period (2005-2007). For example, a doctor with 2 initial prescriptions of escitalopram, 3 initial prescriptions of sertraline, and 1 initial prescription of duloxetine is categorized as prescribing 3 drugs in the SSRI/SNRI class.

Given that new drugs may have entered the market and additional clinical evidence may have emerged over the 3-year study period, we also categorized physicians based on the number of distinct drugs prescribed each year. This reduced our sample substantially, as two-thirds to three-fourths of physicians (depending on the class) in the 3-year sample did not have 5 initial prescriptions within a calendar year. To facilitate comparison with other studies of prescribing concentration, we also calculated the share of prescriptions for each physician's "favorite" drug.

Statistical Analyses

We examined the use of the top-selling and most heavily promoted drugs in the class, as well as rates of generic drugs, by prescriber type. We also calculated the share of a physician's observed prescriptions that are in the relevant therapeutic category (eg, cardiovascular drugs for statin prescriptions) as a proxy for their degree of specialization.

To assess factors that influenced the breadth of a physician's prescribing, we estimated a Poisson regression with the number of different drugs prescribed in a class as the dependent variable (categorized as 1, 2, 3, 4, or 5+ drugs prescribed as initial prescriptions). Estimates from the Poisson regressions were used to predict the number of drugs prescribed by each physician given the characteristics of their patients and formulary designs. We then classified each physician as *high*, *medium*, or *low* in breadth (concentration) of prescribing based on how their actual number of drugs prescribed deviated from the predicted value. We used this classification to assess whether narrow prescribing was associated with 3 patient-level outcomes: medication adherence, therapeutic switching (changing medications within a class), and out-of-pocket drug costs. We measured each patient's adherence at the class level based on the medication possession ratio (MPR) over the 6 months following the initial prescription. The MPR was expressed as a percentage, and defined as the number of days supply of a medication (ie, possession) over the 6 months following the initial prescription. Therapeutic switching rates are generally low in the 5 brand-dominated

classes, ranging from 9% for statins to 17% for SSRIs/SNRIs. This underscores the importance of the initial drug choice in determining the patient's course of treatment.

The independent variables included age and its square, gender, and median household income (by 3-digit zip code). We also have salary information (in buckets) for 56% of patients. Since two-thirds of those with salary information fall in the "below $50,000" category, we included binary indicators for a high salary (>$50,000) and missing salary information. Since patients receiving prescriptions from specialists are more likely to adhere, we used a proxy for specialist, defined as the share of all of a physician's observed prescriptions that were in the relevant category, for example, cardiac drugs. We also measured the complexity of formulary designs facing each physician in 2 ways. First, we counted the number of observed health plans represented by a physician's patients. Second, we computed the number of unique pharmacy benefit designs facing each physician based on the *ordering* of copayments for the most prescribed brand drug, the second most prescribed brand drug, and the top generic drug in the class.

Finally, we controlled for comorbid conditions related to a drug class using a set of disease indicators identified in the medical claims based on *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnoses. For example, we included binary indicators for hyperlipidemia, diabetes, hypertension, chronic heart failure, cardiac disease, vascular disease, and stroke for statin users (full model results are available from the corresponding author). We also included quarterly expenditures on direct-to-consumer and direct-to-physician advertising for each drug, geographic identifiers, and in some models, plan formulary design and initial drug to control for plan- and drug-specific effects.

RESULTS

Table 1 shows the distribution of brand and generic prescribing within each of the 10 classes. Most physicians did not prescribe brand or generic medications exclusively, with some notable exceptions. Nearly half of the physicians prescribing ACE inhibitors and NSAIDs, and 90% of physicians prescribing opiates, prescribed only generic drugs in the class. By contrast, less than 1% of physicians prescribed only generic statins or PPIs. As the share of generic prescribing in a class increased, the proportion of physicians prescribing only generics increased and the share prescribing only brands decreased. In the 5 classes where the generic share is closest to one-half (38%-61%), between 80% and 89% of physicians prescribed both brand and generic medications as initial prescriptions.

The distribution of the number of drugs prescribed per physician is shown in **Table 2**. To put these numbers into context, we also report the number of drugs that accounted for 75% of initial prescriptions in a class, and the market share of the top-selling drug. Only a small percentage of physicians prescribed a single drug in a class, ranging from less than 1% for SSRIs/SNRIs to 15% for ACE inhibitors. In 8 of the 10 classes, the median physician prescribed 3 or 4 different drugs. This reflected broad prescribing patterns given that the median number of initial prescriptions per physician in our sample ranged from 6 to 8 in the 10 classes. The case of SSRI/SNRI antidepressants was particularly striking: 45% of physicians prescribed 5 or more different drugs in the class. Of the 1659 physicians for whom we observed 8 to 12 initial prescriptions, 72% prescribed 5 or more different drugs and less than 2% prescribed 1 or 2 drugs.

Table 3 shows the distribution of physician prescribing in the 5 brand-dominated classes. Physicians prescribing 1 or 2 drugs were more likely to prescribe the leading drug in a class, which in most cases was the most heavily promoted drug. For example, among physicians prescribing just 1 statin, 80% prescribed the market leader and most heavily promoted drug. The generic share increased with the number of initial drugs prescribed in 3 of the 5 classes, while PPIs and antihistamines exhibited a different pattern.

In the PPI class, which had only 1 generic drug (omeprazole) during 2005 to 2007, the generic share decreased monotonically with the number of drugs prescribed (as did the share of the top brand drug), indicating that prescribers with narrow prescribing patterns in this class were split between high prescribers of the top (brand) drug and high prescribers of generic omeprazole. Perhaps due to the degree of similarity between these 2 products (esomeprazole, the top brand, and generic omeprazole), physicians generally prescribed one drug or the other. For example, among the 1229 physicians prescribing just 2 drugs in the class, only 23% prescribed both esomeprazole and omeprazole, while 46.5% prescribed the leading brand and another brand drug, and 20% prescribed generic omeprazole and another brand drug. By contrast, the leading brand and generic antihistamines have different active ingredients and most physicians prescribed both. Overall, as physicians showed broader prescribing patterns, they moved away from the most prescribed drug in a class toward generics and/or less common brands.

Physicians treating patients with different comorbidities had broader prescribing patterns. This pattern occurred in all 5 classes and is nearly monotonic (Table 3). Further, physicians treating patients from a larger number of health plans (and formularies) were more likely to have broader prescribing

Table 2. Breadth of Physician Prescribing in Brand-Dominant and Generic-Dominant Classes

	Percent of Prescribers									
	Primarily Brand Drug Classes					Primarily Generic Drug Classes				
	Statins	PPIs	Calcium Channel Blockers	Anti-histamines	SSRIs/ SNRIs	Beta-Blockers	Anti-diabetic	ACE Inhibitors	NSAIDs	Opiates
Physicians prescribing 1 drug	2.6	3.9	2.6	6.5	0.6	3.6	9.8	15.4	8.7	15.0
Physicians prescribing 2 drugs	14.3	18.6	13.5	33.7	5.4	17.3	23.6	38.4	19.6	36.0
Physicians prescribing 3 drugs	31.4	37.6	28.9	42.9	19.5	34.6	28.6	29.0	27.8	29.6
Physicians prescribing 4 drugs	28.8	27.8	28.8	16.5	30.3	27.3	22.4	12.5	23.0	13.6
Physicians prescribing 5+ drugs	22.9	12.1	26.3	0.5	44.2	17.2	15.6	4.6	20.9	5.9
N (unique prescribers)	8923	6621	1975	4788	5866	3974	1531	4008	13,674	35,180
Average share of prescriptions for "favorite" drug, 2005-2007	51.4	54.4	50	61.3	41.7	53.8	60	69	59.2	70
Average share of prescriptions for "favorite" drug, 2007	60.4	60	48.9	73.2	47.7	54.3	64.1	74.2	68	73.2
Generic prescribing share	23.8	20.9	40.3	37.8	44.6	57.0	61.3	86.3	83.8	98.6
Market share of leading drug in 2007	36.1	30.5	35.8	50.2	20.0	23.4	51.9	64.1	28.0	55.4
Number of drugs accounting for 75% of initial prescriptions in 2005-2007	4	4	6	2	7	4	4	3	7	3
Number of drugs accounting for 75% of initial prescriptions in 2007	4	3	6	2	5	4	4	2	6	3

ACE indicates angiotensin-converting enzyme; NSAID, nonsteroidal anti-inflammatory drug; PPI, proton pump inhibitor; SSRI/SNRI, selective serotonin reuptake inhibitor/serotonin and norepinephrine reuptake inhibitor.
In each column, the cell containing the median prescriber is boxed.
Therapeutic classes defined by the *Red Book* 2007 classification. Antidiabetic excludes insulin. Antihistamines excludes those used for acute symptoms such as nausea. Antihistamines and NSAIDs exclude products available over the counter.

habits. These results were robust to multivariate models that controlled for detailed patient and plan characteristics (results not shown; see **Appendix**).

If prescribers with broader prescribing habits are better able to match a patient to their optimal drug, we might observe better adherence to medications and less switching within class. We found that broader prescribing was associated with modestly better adherence in 2 of the 5 classes (**Table 4**). Patients prescribed PPIs and antihistamines by a physician in the broadest category of prescribing were 7% to 8% more likely to continue use for 6 months than a patient treated by a physician who prescribes with the most narrow prescribing patterns. However, we found no statistically significant differences for SSRIs/SNRIs and calcium channel blockers, and a small opposite effect (lower adherence) for statins. Similarly, we found little evidence to suggest that broader prescribing significantly affected switch rates or the average out-of-pocket cost per 30-day prescription.

There is a widespread perception that physicians prescribe a narrow range of drugs within a therapeutic class. This is often attributed to 2 primary factors. The first is clinical experience, wherein physicians gain knowledge of a particular drug through experience and then prescribe it to most of their other patients who require a drug in that class. The second factor is pharmaceutical marketing. Prior work has established that detailing has a significant effect on prescribing behavior and brand loyalty, particularly among physicians with limited access to colleagues.[2]

Despite these perceptions, we find surprisingly broad prescribing across 10 prominent classes. While 40% to 60% of their prescriptions are for 1 drug, the median physician in our sample prescribed at least 3 different drugs for incident users in 8 of the 10 classes. These results were even more striking considering the small number of initial prescriptions per physician (median = 8), and the dominance of brand drugs in 5 of the 10 classes studied. Physicians whose patients were covered by a wider array of health plans and formularies tended to have broader prescribing habits, as did physicians who treated patients with varying comorbidities. This suggests that attempts to match specific drugs to a patient's health condition and formulary design were important factors in deviating from their favorite drug. While physicians whose prescribing habits

Table 3. Distribution of Physician Prescribing, by Type of Drug and Patient Characteristics

	Type of Drug Prescribed			Patient Heterogeneity Within Physicians	
	Generic	Top Drug in Class	Direct to Physician Promotional Expenditures	No. of Plans	Combinations of Chronic Conditions
Statins					
Physicians prescribing 1 drug	2.8	79.9	$159,955	3.59	4.07
Physicians prescribing 2 drugs	17.2	53.6	$121,118	3.53	4.26
Physicians prescribing 3 drugs	21.8	38.9	$101,349	3.77	4.55
Physicians prescribing 4 drugs	25.3	30.8	$88,774	4.13	5.06
Physicians prescribing 5+ drugs	27.3	25.5	$79,845	4.95	6.42
Total	23.8	34.5	$93,882	4.10	5.07
N	74,163	74,163	73,872	8923	8923
PPIs					
Physicians prescribing 1 drug	24.1	46.3	$67,463	3.36	2.60
Physicians prescribing 2 drugs	23.4	39.8	$66,810	3.48	2.62
Physicians prescribing 3 drugs	22.1	34.0	$65,853	3.61	2.77
Physicians prescribing 4 drugs	20.3	29.6	$65,222	4.12	2.95
Physicians prescribing 5+ drugs	17.2	27.8	$64,800	5.21	3.48
Total	20.9	32.7	$65,644	3.91	2.87
N	52,978	52,978	52,585	6621	6621
SSRIs/SNRIs					
Physicians prescribing 1 drug	26.1	41.9	$73,763	3.70	3.81
Physicians prescribing 2 drugs	36.8	37.5	$63,081	3.33	3.63
Physicians prescribing 3 drugs	39.6	29.0	$56,487	3.46	3.76
Physicians prescribing 4 drugs	43.7	22.5	$50,626	3.52	3.88
Physicians prescribing 5+ drugs	47.0	17.1	$46,189	4.18	4.97
Total	44.6	21.1	$49,587	3.79	4.33
N	46,040	46,040	45,092	5866	5866
Antihistamines					
Physicians prescribing 1 drug	29.8	63.5	$21,458	3.61	2.40
Physicians prescribing 2 drugs	43.2	42.5	$18,571	3.97	2.57
Physicians prescribing 3 drugs	37.6	37.0	$22,704	4.43	2.74
Physicians prescribing 4 drugs	33.5	33.1	$23,999	5.53	3.15
Physicians prescribing 5+ drugs	30.6	25.0	$19,418	5.14	3.14
Total	37.8	38.9	$21,747	4.41	2.73
N	39,644	39,644	39,627	4788	4788
Calcium Channel Blockers					
Physicians prescribing 1 drug	19.8	60.1	$10,122	2.96	3.90
Physicians prescribing 2 drugs	26.0	56.6	$12,582	3.23	4.19
Physicians prescribing 3 drugs	35.9	41.7	$11,896	3.23	4.38
Physicians prescribing 4 drugs	43.0	31.8	$10,705	3.27	4.60
Physicians prescribing 5+ drugs	48.2	25.5	$9695	3.56	5.47
Total	40.3	35.8	$10,894	3.32	4.69
N	13,633	13,633	13,337	1975	1975

PPI indicates proton pump inhibitor; SSRI/SNRI, selective serotonin reuptake inhibitor/serotonin and norepinephrine reuptake inhibitor.

Table 4. Adherence, Out-of-Pocket Costs, and Switching Rates, by Physician Prescribing

Degree of narrow (concentrated) prescribing	Statins	PPIs	SSRIs/SNRIs	Antihistamines	Calcium Channel Blockers
	Predicted MPR Within a Class Within 6 Months of an Initial Prescription[a]				
High	0.77	0.58[b]	0.66	0.35[b]	0.77
Medium	0.76	0.60	0.66	0.37	0.76
Low	0.75[c]	0.61	0.66	0.37	0.76
Total average MPR	0.76	0.60	0.66	0.36	0.77
N	60,366	42,057	36,039	32,191	10,844
	Predicted Annual Copay (Patient Cost of 1-Year Supply) Within a Class[d]				
	Statins	**PPIs**	**SSRIs/SNRIs**	**Antihistamines**	**Calcium Channel Blockers**
High, $	144.03[b]	208.51	146.94	177.68[c]	123.97[e]
Medium, $	139.77	208.51	145.47	170.72	116.75
Low, $	139.77	214.86[e]	141.17[c]	179.47[e]	108.85[b]
Mean average annual copay, $	141.17	210.61	144.03	175.91	116.75
N	41,566	26,508	31,163	18,767	8715
	Predicted Switching Within a Class During 6 Months After an Initial Prescription[f]				
	Statins	**PPIs**	**SSRIs/SNRIs**	**Antihistamines**	**Calcium Channel Blockers**
High	0.10	0.19	0.20	0.15	0.19[c]
Medium	0.10	0.18	0.20	0.15	0.21
Low	0.12[b]	0.18	0.22[e]	0.14	0.20
Total probability of switching	0.11	0.18	0.21	0.15	0.20
N	41,621	19,930	20,436	6585	7594

MPR indicates medication possession ration; PPI, proton pump inhibitor; SSRI/SNRI, selective serotonin reuptake inhibitor/serotonin and norepinephrine reuptake inhibitor.
[a]Dependent variable was calculated as total daily doses purchased within 180 days of initial prescription, divided by 180. Categories of narrowness were tertiles of the percent deviation of each physician's number of drugs prescribed from predicted number of drugs prescribed.
[b]Statistical significance at the 1% level relative to medium prescribing.
[c]Statistical significance at the 10% level relative to medium prescribing.
[d]Dependent variable is calculated as the year-equivalent total copay amount, based on the average copayment per daily dose in the 6 months following an initial prescription. To capture plan formulary characteristics, we controlled for the mean brand copay in the class for each patient's plan, as well as the mean copay difference between brand and generic drugs. We excluded plans in which these values could not be determined (see **Appendix**).
[e]Statistical significance at the 5% level relative to medium prescribing.
[f]Dependent variable was binary, equal to 1 if the patient was observed filling a prescription for another drug in the class, written by the same prescriber as the initial prescription, within 6 months following an initial prescription. For this analysis, we excluded patients who discontinued therapy in a class within the first 6 months, and we controlled for the drug initially prescribed.

were narrow were more likely to prescribe highly advertised drugs, few doctors prescribed these drugs exclusively.

Our results suggest that physician prescribing habits were less entrenched than commonly perceived. Why we observed these patterns is unclear. Broad prescribing patterns may simply reflect the increasing number of drugs in a class, many of which act in a similar way and share common side-effect profiles. Broad prescribing may also reflect the influence of pharmaceutical marketing, but with less pernicious effects. Surveys of physicians reveal that detailing is an important source of information for many providers, and that drug samples provide greater flexibility in prescribing to low-income patients.[19] The widespread availability and use of drug samples may provide the clinical experience physicians depend on to assess the efficacy and benefits of new products.

An alternative explanation for the observed breadth of prescribing is the influence of manufacturers, pharmacy benefit managers, and third-party payers. Through explicit campaigns that promote switching to "featured" products or financial incentives inherent in the formulary design, physicians and patients may be steered toward a wider array of products than in the past.[20] These incentives may interact, as prior research suggests that advertising affects demand only for drugs that have preferential status on the patient's formulary.[21]

There were several possible reasons why prescribing of antidepressants, in particular, was so diffuse. First, we categorized SNRIs and SSRIs into a single class. More than one-third of physicians in the sample prescribed drugs from all 3 categories, 61% prescribed both SSRIs and SNRIs, and only 17% pre-

scribed SSRIs only. This suggests that physicians view these subclasses distinctly and include more than the dominant SSRIs in their prescribing patterns. Further, there were 22 different drugs in the class by product name, but only 8 active ingredients. If we recalculate the number of drugs prescribed based on distinct active ingredients, we find that 32.8% of the physicians (vs 45%) prescribed 5 or more drugs. However, the share of physicians prescribing 1 or 2 drugs rises only from 6% to 8%, and the median physician still prescribed 4 drugs in the class.

Our findings suggest that the vast majority of physicians are not wedded to a "favorite" drug, nor reluctant to try new therapies as more clinical information becomes available or new products enter the market. This is an important finding given the potential social costs of habitual prescribing, where physicians make prescription decisions based on incomplete information.[22] Nonetheless, the use of a few drugs may be associated with optimal prescribing in some therapeutic classes.[5,14]

Our analysis had several limitations. First, pharmacy claims do not solely reflect the choice of physicians, but also the preferences of patients and the input of the pharmacist and health plan. The actual prescribing patterns of physicians are likely to be more narrow than observed in our analysis if patient preferences and formulary incentives lead to therapeutic substitutions at the pharmacy. While recent evidence suggests that patients have an impact on prescribing decisions, physician preferences dominate.[23,24] Second, we only observed a subset of each physician's patients, specifically those enrolled in the set of employer-sponsored plans covered by our data set. Thus, we may understate how many different drugs each physician prescribes to incident users. Third, we examined physician prescribing over a 3-year period to increase the number of physicians and initial prescriptions in our sample. However, additional drugs may have entered the market and new clinical information may have emerged over this period that would cause physicians to change their choice of drugs. Analyzing prescribing patterns over a 1-year period reduces the average number of drugs prescribed in a class, but the median physician still prescribed 3 drugs or more in 7 of the 10 classes. Fourth, we lacked detailed demographic information on physicians. However, we estimated their degree of specialization by measuring the percentage of a physician's observed prescriptions in the relevant therapeutic category. Finally, some of the patients classified as incident users in our sample already had experience with a drug in the class beyond our 1-year "clean window," which may inform the physician's current choice of medication. To test the extent of this error, we examined patients with a 2-year clean window prior to their initial prescription. Although this reduced our sample size by more than half, it did not substantively change our results.

While we observed broad prescribing in 1 dimension, we cannot separate the independent effects of the physician from that of the patient and the formulary. The use of electronic prescribing will allow future studies to examine differences in what is prescribed by the physician and what is dispensed at the pharmacy. More detailed data are needed to understand how prescribing practices vary by physician age, gender, specialty, and practice setting. For instance, prescribing patterns may be quite different in fully integrated health systems or in plans with pharmacists embedded in clinical teams. Future work also should explore the appropriateness and clinical effects of broad versus narrow prescribing, which is likely to vary across therapeutic classes. We found that broader prescribing had small and inconsistent effects on several patient-level outcomes, but more work in this area is needed.

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Appendix. Poisson Regressions of Narrowness of Prescribing on Characteristics of Physicians and Patients

	(1) Statins	(2) PPIs	(3) SSRIs/SNRIs	(4) Antihistamines	(5) Calcium Channel Blockers
Y = Number of drugs prescribed as initial prescriptions					
Combinations of chronic conditions	0.144[a]	0.179[a]	0.274[a]	0.0317	0.172[b]
	(0.0197)	(0.0543)	(0.0383)	(0.0471)	(0.0705)
Combinations of chronic conditions (squared)	–0.00691[a]	–0.0191[b]	–0.0225[a]	0.00174	–0.0114
	(0.00134)	(0.00799)	(0.00340)	(0.00679)	(0.00596)
Different copay orderings	–0.0106	0.0442[b]	0.0776[a]	0.123[a]	0.0901[b]
	(0.0170)	(0.0172)	(0.0217)	(0.0171)	(0.0399)
Number of plans	0.108[a]	0.0707[a]	0.0814[c]	0.00421	0.118
	(0.0177)	(0.0168)	(0.0295)	(0.0138)	(0.0768)
Number of plans (squared)	–0.00670[a]	–0.00315[c]	–0.00808[c]	0.0000271	–0.0198[b]
	(0.00136)	(0.00109)	(0.00252)	(0.000762)	(0.00907)
Initial prescriptions observed	0.122[a]	0.119[a]	0.265[a]	0.0231[c]	0.427[a]
	(0.00969)	(0.0148)	(0.0216)	(0.00716)	(0.0405)
Initial prescriptions (squared)	–0.00167[a]	–0.00168[a]	–0.00226[a]	–0.000399[c]	–0.0105[a]
	(0.000221)	(0.000411)	(0.000476)	(0.000140)	(0.00148)
Patients with prior use in class	0.0936[a]	0.0917[a]	0.131[a]	0.0822[a]	0.0134
	(0.0138)	(0.0177)	(0.0216)	(0.0128)	(0.0431)
Patients with prior use (squared)	–0.00166	–0.00701[c]	–0.00914[c]	–0.00216	0.00681
	(0.00145)	(0.00234)	(0.00281)	(0.00117)	(0.00674)
Half years with a prescription observed	0.159[a]	0.0793[a]	0.155[a]	0.137[a]	0.102[c]
	(0.0152)	(0.0166)	(0.0244)	(0.0148)	(0.0346)
Observations	8923	6621	5866	4788	1975
ll	–15357.9	–10940.8	–10619.1	–7370.9	–3474.9
ll_0	–15906.1	–11174.1	–11293.6	–7465.4	–3589.9

PPI indicates proton pump inhibitor; SSRI/SNRI, selective serotonin reuptake inhibitor/serotonin and norepinephrine reuptake inhibitor.
[a]Statistical significance at the 1% level relative to medium prescribing.
[b]Statistical significance at the 10% level relative to medium prescribing.
[c]Statistical significance at the 5% level relative to medium prescribing.