

Demographics, Practices, and Prescribing Characteristics of Physicians Who Are Early Adopters of New Drugs

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ABSTRACT

We conducted an analysis to determine the factors that influence physicians' decisions to adopt a new drug by examining their demographics, practices, and prescribing characteristics. In addition to the level of marketing support expended by a company for its newly launched drugs, several physician-specific variables (e.g., age, specialization, and prescribing practice) are critical in quantifying the likelihood of new drug adoption.

INTRODUCTION

As total expenditures related to health care grow each year, pharmaceuticals play an ever-increasing role in medical care. Prescription drugs now account for a larger percentage of health care costs than ever before.^{1,2} Physicians remain the gatekeepers to the widespread use of a new drug.³ Although a fairly large amount of research has focused on factors that influence a physician's decision to adopt a new drug, little research has examined the demographics, practices, and prescribing characteristics of physicians who are the first to adopt new drugs. This article examines that issue.

A substantial amount of research has addressed the channels of information concerning new drugs and the factors that influence an individual physician's decision to prescribe. Sometimes the research refers to a new drug on the market or to an existing drug first prescribed by the physician. A wide variety of research has shown that interpersonal communication between opinion leader-physicians and their peers can be (and many times has been) the critical factor in the rapid, wide-scale acceptance of innovative drugs.⁴⁻⁶

A report in the *Journal of the American Medical Association* from 2000 estimated that of the \$11 billion spent each year by pharmaceutical companies for promotion and marketing, almost 50% of that went to sales representatives.⁷ The same study found that interactions with drug salespeople had a very strong impact on preference and rapid prescribing of new drugs. Many other studies have echoed these findings, listing the pharmaceutical sales representative as one of the most im-

portant factors in influencing doctors' adoption of a new drug, even if physicians sometimes minimize the importance they place on pharmaceutical salespeople.^{3,8,9}

Many research studies highlight the role that medical bulletins and journals play as sources of information on new drugs. Although some researchers have debated the value of peer-reviewed journals as a source of information on new drugs,¹⁰ other data indicate that medical bulletins and journal articles do represent an important channel of information about both old *and* new drugs.¹⁻³

Specialist meetings, presentations, conferences, and symposia form a communication channel that appears to be particularly important for disseminating information about new drugs. The literature indicates that these forums provide a highly valued source of information and facilitate interaction among physicians and can have a noticeable influence on the adoption of new drugs.^{1-3,11}

Direct-to-consumer (DTC) advertising, although it is allowed only in the U.S. and New Zealand, has also become an important tool for pharmaceutical companies in marketing their new drugs, especially antidepressants, antihistamines, antihyperlipidemic agents, and anti-inflammatory agents.³ Whether DTC advertising is actually effective in getting physicians to write prescriptions, however, is still being debated. Even though many pharmaceutical companies have dramatically increased their spending on DTC advertising, visits by sales representatives who bring free samples still constitute a much larger percentage of U.S. pharmaceutical company promotional spending and has proved to be more effective.

The literature is scant in covering the practices and patterns of physicians who adopt new drugs early on. The limited research that has been done suggests that the following categories of physicians tend to be early adopters of new drugs:^{1,2,9,12}

- young physicians—or at least those who have been practicing for a shorter period of time
- male physicians, when compared with female physicians¹³
- board-certified doctors²
- physician graduates from the most recently established medical schools¹⁴

Drawing upon multivariate models, this paper describes the characteristics of U.S. physicians who are the first to adopt new



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Physicians and Early Adoption of New Drugs

drugs in their prescribing practices. The research focuses on those characteristics as they relate to the adoption of both therapeutically novel drugs (i.e., *first-in-class* drugs) and later *follow-on* drugs in drug classes already established.

METHODS

We examined the prescribing behavior of 3,646 physicians in relation to the introduction of 32 new drugs on the market from 1997 through 2000. The data reflected writing prescriptions for one drug per physician, with the physicians randomly

distributed among all of the 32 drugs. The drugs were indicated for the outpatient treatments of asthma and allergic rhinitis, hypertension, osteoarthritis and rheumatoid arthritis, depression, pneumonia, hypercholesterolemia, and diabetes. The list of drugs appears in Table 1.

Although hospital pharmacies are a major source of prescription fulfillment, it is often difficult to link an individual prescription to a particular physician. Therefore, by concentrating on outpatient indications, we were able to better ensure the comprehensiveness of the prescribing data for each physician appearing in the study.

We originally designed the sample to test the relationship between participation in a clinical trial and subsequent prescribing of the study drug. The original analysis compared physicians who had participated in a clinical trial with a matched set of (control) physicians who had not participated in clinical trials of any sort in the previous five years. An analysis of both the clinical and the control physicians demonstrated that clinical trial physicians were more likely to prescribe a study drug after it had been on the market for a period of at least 18 months.¹⁵

Approximately 50% of the study's physicians had served as clinical investigators, and 50% constituted the matched control set. As with the general physician population in the U.S., most clinical trial sites are office-based, not hospital-based. One particular type of hospital—the major academic medical center—sometimes receives extensive press coverage for its work in clinical research. However, these centers constitute a decreasing proportion of all phase 3 clinical trial sites, and they perform a minority of all phase 3 studies. Most clinical investigators see patients in their office-based practice and enroll patients for clinical studies from these practices.¹⁶

We conducted a comparative analysis (tests of statistical independence) between the two investigator and control groups of physicians and analyzed other variables that might have affected new drug-prescribing behavior. We found that although physicians who had worked as clinical investigators were more likely to prescribe the study drug when it arrived on the market, the relationship of the other demographic, practice, and prescribing variables in explaining new drug prescribing did not differ in any meaningful theoretical or statistical way. Hence, we decided to combine both sets of physicians into one data set, and, during subsequent analyses, to statistically control for the impact on new drug prescribing levels of a physician's participation in at least one phase 3 clinical trial for the new drug. The analysis always tested for the appearance of statistical interaction between the two sets of physicians, the independent variables, and the likelihood of a physician's being an early new drug adopter.

Study Population

We obtained the names of physicians from the IMS Health, Inc., database of active prescribing U.S.

Table 1 Study Compounds Introduced to the Market from 1997 Through 2000

Beclomethasone dipropionate (Qvar®, Ivax)
Beclomethasone dipropionate inhaler (Vanceril®, Key)
Budesonide (Rhinocort® Aqua, AstraZeneca)
Budesonide inhalation powder (Pulmicort® Turbuhaler, AstraZeneca)
Budesonide inhalation suspension (Pulmicort® Respules, AstraZeneca)
Candesartan cilexetil (Atacand®, AstraZeneca)
Celecoxib (Celebrex®, Pfizer)
Cerivastatin (Baycol®, Bayer)*
Cyclosporine (Neoral®, Novartis)
Diclofenac/misoprostol (Arthrotec® 75, Pfizer)
Etodolac (Lodine® XL, Wyeth)
Flecinolax (Solvay)
Glimepiride (Amaryl®, Aventis)
Insulin aspart (Novolog®, Novo Nordisk)
Insulin lispro (Humalog®, Lilly)
Irbesartan (Avapro®, Bristol-Myers Squibb)
Leflunomide (Arava®, Aventis)
Levofloxacin (Levaquin®, Ortho-McNeil)
Loratidine (Claritin®, Schering)
Meropenem (Merrem®, AstraZeneca)
Mibefradil (Posicor®, Roche)*
Mometasone (Nasonex® Nasal Spray, Schering)
Mometasone furoate inhalation powder (Asmanex®, Schering-Plough)
montelukast sodium (Singulair®, Merck)
Moxifloxacin (Avelox®, Bayer)
Naproxen (Naprelan®, Elan)
Olanzapine (Zyprexa®, Lilly)
Quinupristin/dalfopristin (Synercid®, Monarch)
Repaglinide (Prandin®, Novo Nordisk)
Rofecoxib (Vioxx®, Merck)*
Sibutramine (Meridia®, Abbott)
Sparfloxacin (Zagam®, Bertek)
Telmisartan (Micardis®, Boehringer Ingelheim)
Troglitazone (Rezulin®, Parke-Davis)*
Valsartan (Diovan®, Novartis)
Valsartan/HCT (Diovan® HCT, Novartis)
Venlafaxine (Effexor® XR, Wyeth)
Zafirlukast (Accolate®, AstraZeneca)
Zileuton (Zyflo®, Abbott)

* Four of study drugs were later withdrawn from the market: mibefradil (Posicor®), cerivastatin (Baycol®), troglitazone (Rezulin®), and rofecoxib (Vioxx®). Eighteen-month prescribing data were available for cerivastatin and troglitazone; six-month prescribing data were available for mibefradil.

HCT = hydrochlorothiazide.

Physicians and Early Adoption of New Drugs

Table 2 Study Population and Physician Demographics in the U.S.

	Study
<i>Practice location</i>	
Office-based	79
Hospital-based and other	21
<i>Five largest states</i>	
California	13
Florida	8
Texas	8
New York	5
Pennsylvania	4
Average age	53

physicians (Table 2).¹⁷ Compared with known parameters of the U.S. prescribing physicians, the study population was slightly older and more likely to be based in an office rather than in a hospital.¹⁶

Physicians were enrolled from all 50 states, corresponding with the distribution of active physicians within the U.S. A Spearman Rank Order correlation of .932 between the number of physicians in the study and the number of physicians active within each state (as indicated in the American Medical Association's annual survey of practicing physicians maintained by IMS Health, Inc.) indicated a strong rank order match between the two sets of data.

Dependent Variable

The dependent variable is dichotomous. Physicians were characterized as either new drug adopters or not new drug adopters. The new drug adopters prescribed the new drug at some time during the first six months after its launch and continued to prescribe it for the next 12 months. We chose an initial timeline of six months (a commonly used industry convention). The date of the product launch was calculated as the date of the drug's first prescription, as recorded by IMS Health, Inc.

All other physicians were characterized as not being new drug adopters. Physicians who prescribed the drug during the first six months—but who did not continue to prescribe the drug over the next 12 months—were not considered to be adopters of the new drug.

The term "early adopters" is derived from Rogers,¹⁸ who stated that "innovators" and "early adopters" made up 16% of individuals overall. In our study, the new adopters constituted 22% of the total number of physicians in the study.

Drugs are designated by their Uniform System of Classification (USC) code. IMS Health, Inc., and a majority of pharmaceutical manufacturers created the USC in 1975. The system uses five digits to standardize and categorize all pharmaceuticals in the U.S. on the basis of product type. USCs are used in the U.S. and Canada. In Europe, the equivalent classification is called an Anatomical Therapeutic Chemical (ATC).

USCs have four levels of hierarchy. USC2 is the broadest cat-

egory, and USC5 is the most detailed category, allowing for more specificity within a category. The study used the USC5 level of specificity. For example:

- USC2: respiratory therapy
- USC3: bronchodilators, general
- USC4: beta agonists
- USC5: beta agonists, aerosol

New drug prescribing data were available for all the physicians in the study.

Independent Variables

The independent variables can be divided into several categories:

- physician demographics
- the physician's practice and prescribing behavior
- the pharmaceutical marketing effort
- the drug's therapeutic novelty

The data on the physician's sex and age; whether the physician is based in a hospital or in an office; the physician's specialty; and the physician's board certification were derived from the AMA's annual survey of practicing physicians.

The IMS Health database provides the information for the prescribing variables used as independent variables (Table 3):

- Total Pre-product Launch Prescribing Volume
- Total Pre-product Launch Drug Class Prescribing
- Pre-product Launch Company Prescribing Loyalty

Prescribing data were available only at the Total Volume level for these variables, not for the individual drugs within each of the prescribing categories. A drug was classified as either "first in class" or as "follow-on," according to its respective order of appearance on the market in accordance with the IMS Health, Inc., USC coding scheme.

IMS Health, Inc., also provided the rank order of spending data used for the variable *Pharmaceutical Marketing Support*. Although this variable was not a physician demographic or a practice characteristic, we included it in a control function. The various drugs in our analysis came from companies in the largest revenue category to those with sales under \$1 billion. The use of this variable helped to control for the role of differential marketing expenditures in understanding new drug adoption and thus helped to isolate the explanatory importance of physician demographic and practice characteristics.

We obtained information about a physician's participation in a drug's phase 3 clinical trials from a pharmaceutical industry database of clinical trials and the U.S. Food and Drug Administration's (FDA's) database of 1572 Forms, filed as part of new drug clinical trial activity.¹⁹ Missing data never exceeded 2% of any variable.

Logistic Regression

The analysis employed *binomial (binary) logistic regression*, which is used when the dependent variable is categorical and the independent variables are either categorical or interval. Lo-

Physicians and Early Adoption of New Drugs

gistic regression is considered to have overcome many of the restrictive assumptions of *ordinary least squares (OLS) regression*. It does not require the assumption of a linear relationship between the independent and dependent variables, and it is not necessary for the dependent variable to be normally distributed. There is no assumption of homogeneity of variance, one does not need to assume normally distributed error terms, and the independent variables do not need to be unbounded.

Logistic regression applies a maximum likelihood estimation after transforming the dependent into a *logit* variable, or the natural log of the odds of the dependent occurring or not. Logistic regression estimates the probability of a certain event occurring in the dependent variable; it calculates changes in the log odds of the dependent variable, not the changes in the dependent variable itself, as OLS regression does. It is the likelihood, or probability, that the observed values of the dependent variable may be predicted from the observed values of the independent variables. The likelihood probability, like any probability, varies from zero (0) to one (1).

The *log likelihood* (LL) is its log, and it varies from 0 to minus infinity; it is negative because the log of any number less than 1 is negative. LL is calculated through iterations, making use of the *maximum likelihood estimation* (MLE).

The log-likelihood test of a model can be used to estimate the statistical significance of the entire model. Frequently called the “model *chi*-square test” or the “likelihood ratio test,” it is based on $-2LL$ (deviance). It is an alternative to the Wald statistic. The model *chi*-square provides the most frequently

used significance test for a logistic model. A well-fitting model has a *P* value (Sig.) of .05 or lower; that is, we want model *chi*-square to be significant at the .05 level or better.

The significance of individual parameters can also be estimated. *Logit coefficients*, also called *unstandardized logistic regression coefficients*, are similar in interpretation to the *b* (unstandardized regression) coefficients in OLS regression. Logits are simply the natural log of the odds; they are used in a logistic regression equation to estimate the log odds that the dependent equals 1 in a binomial logistic regression.

Partial R is a method of assessing the relative importance of the independent variables, similar to beta weights or standardized partial regression coefficients in OLS regression.

The *odds ratio* is another method of determining the relative importance of the independent variables. It avoids some of the interpretative difficulties involved with the Wald statistic, particularly the greater possibility of type II errors. In this study, the odds ratio is used to help readers understand the relative importance of each independent variable.

Hosmer and Lemeshow²⁰ and Menard²¹ present a more extensive discussion of logistic regression.

RESULTS

We divided new drug introductions into two steps: (1) first-in-class drugs to reach the market and (2) later follow-on drugs in established therapeutic categories (i.e., with previously existing USC codes). In this research, our analysis used two logistic regression models: one for first-in-class drugs and a second for follow-on drugs. First-in-class drugs represent a

Table 3 Independent Variables in the Early Drug Adoption Logistic and Ordinary Least Squares Models

Name of Variable	Description of Variable
• Gender	• Physician's sex
• Age	• Physician's age
• Board Certification	• Physician board-certified (or not)
• Practice Type	• Physician office-based or hospital-based
• Total Pre-product Launch Prescribing Volume	• Physician's total pre-product launch (3 months) prescribing volume in the absolute number of prescriptions
• Total Pre-product Launch Drug Class Prescribing	• Physician's total pre-product launch (3 months) prescribing USC share in the drug class of the new drug
• Pre-product Launch Company-Prescribing Loyalty	• Physician's total pre-product launch (three-month) prescribing USC share of all the respective drug's company products as a percentage of all the prescriptions written by the physician
• Pharmaceutical Marketing Support	• The rank order of the pharmaceutical company's total spending on the study drug during the pre-launch and first six months after launch of the study drug
• Specialty	• Physician's classification as a specialist in the respective specialty of the study drug or as a generalist (e.g., internist, family practitioner)
• Clinical Investigator Experience	• Physician's participation as a clinical trial investigator for the study drug (or not)

USC = Uniform System of Classification.

Physicians and Early Adoption of New Drugs

Table 4 "Model 1": Early Adoption of First-in-Class Drugs

Variable	B	SE	Wald	df	Sig	Log Odds
Pre-product Launch Company Prescribing Loyalty	.2489	.0556	20.0256	1	.0000	1.2826
Total Pre-product Launch Prescribing Volume	.0020	.0002	91.1086	1	.0000	1.0020
Age	-.0300	.0078	14.6299	1	.0001	.9704
Pharmaceutical Marketing Support	-.0977	.0173	31.9412	1	.0000	.9069
Practice Type	-.8042	.1752	21.0578	1	.0000	.4475
Clinical Investigator Experience	-.9969	.1546	41.5744	1	.0000	.3690
Specialty	-1.5390	.2174	50.1052	1	.0000	.2146
Constant	2.6832	.4542	34.9050	1	.0000	

B = unstandardized regression coefficient; df = degrees of freedom; SE = standard error; Sig = significance; Wald = Wald statistic.

Table 5 "Model 2": Early Adoption of Follow-on Drugs

Variable	B	SE	Wald	df	Sig	Log Odds
Total Pre-product Launch Drug Class Prescribing	.0067	.0010	41.7224	1	.0000	1.0067
Total Pre-product Launch Prescribing Volume	.0006	7.580E-05	59.6952	1	.0000	1.0006
Pharmaceutical Marketing Support	-.1282	.0127	101.3537	1	.0000	.8797
Board Certification	-.3075	.1497	4.2185	1	.0400	.7353
Practice Type	-.8278	.1255	43.4914	1	.0000	.4370
Specialty	-.9624	.1237	60.5777	1	.0000	.3820
Clinical Investigator Experience	-1.0418	.1001	108.3756	1	.0000	.3528
Constant	.8920	.1307	46.5718	1	.0000	

B = unstandardized regression coefficient; df = degrees of freedom; SE = standard error; Sig = significance (P value); Wald = Wald statistic.

potentially greater innovation than follow-on drugs, which enter the market at a later date in an existing drug class.

First-in-Class Drugs

The first-in-class logistic model has a significant model *chi* square of .0000 and correctly predicts a robust 80% of the cases (Table 4). In the final logistic regression model, seven variables were statistically significant. In order of relative importance, as measured by the log odds, these variables were: (1) Pre-product Launch Company Prescribing Loyalty, (2) Total Pre-product Launch Prescribing Volume, (3) Age, (4) Pharmaceutical Marketing Support, (5) Practice Type, (6) Clinical Investigator Experience, and (7) Specialty.

Early adopters of first-in-class drugs tended to write a greater percentage of their prescriptions, three months before product launch, for drugs from the pharmaceutical company marketing the new drug than were physicians who were not early adopters. *Pre-product Launch Company Prescribing Loyalty* was the most significant variable in the model explaining adoption of first-in-class drugs.

Second in importance was the absolute number of pre-

scriptions that the physician wrote three months before a product launch (i.e., *Total Pre-product Launch Prescribing Volume*). The greater the number of total prescriptions written for all types of drugs, the greater the chances of writing prescriptions for the new drug. High prescribing volume may indicate a high patient flow. Physicians with a high patient flow may be particularly alert to new drugs to address the unfulfilled medical needs of some of their patients.

Age was inversely related to the likelihood of being a new drug adopter, although the relationship was not completely linear. The youngest doctors, those under 36 years of age, and the oldest doctors, those over 65, were the least likely to be new adopters. However, these age groups represented reasonably small groups in this study: 3% and 12%, respectively.

The relative level of *Pharmaceutical Marketing Support* put behind the new drug was also a key variable. The more money spent in support of the new product launch, the greater the chance of that drug's early adoption by the physicians in this study. This marketing support may include such activities as increased product detailing and free samples provided by company sales representatives, larger DTC advertising, and more advertising in professional publications. The relative role of each could not be assigned in this study.

The nature of the practice (*Practice Type*) was critical as well. Office-based physicians were more likely to adopt a first-in-class drug than were hospital-based doctors, who might work with more restrictive formularies. For example, hospital-based physicians may see a higher percentage of patients who are taking a product on some type of public formulary. Even if these physicians wished to prescribe the new drug, they might be unable to do so early in the new drug-adoption process.

Physicians who participated in at least one of the phase 3 clinical trials of the new drug had a greater chance of being early adopters (*Clinical Investigator Experience*). They were familiar with the drug for some time, and they had the most extensive experience using the drug in clinical settings.

Consistent with findings in other literature, specialists in the drug's therapeutic area tended to be early adopters more often than generalists or other specialists (*Specialty* in Tables 3, 4, and 5).

Neither the physician's *Board Certification* nor *Sex* appeared

Physicians and Early Adoption of New Drugs

in the model. Board-certified physicians in this study population were actually more likely to adopt a first-in-class drug; however, the variable was no longer significant as part of a multivariate model.

Follow-on Drugs

The follow-on drug logistic model also had a highly significant model *chi* square of .0000 and correctly predicted a strong 75% of the cases (see Table 5). Some variables in the second model were similar to those in the first-in-class model, and several had distinctly different explanatory roles.

The most important variable in the second model, *Total Pre-product Launch Drug Class Prescribing*, was able to be present only in a model that examined drugs for which an established therapeutic category existed at the time of the new drug launch. The number of prescriptions written in the new drug's therapeutic class was a key explanatory variable for understanding the adoption of another drug in that therapeutic class. The more prescriptions written in a drug class by a physician, the greater the likelihood that the physician would adopt a new drug in that therapeutic class.

Physicians who did not write any prescriptions at all in the drug class were unlikely to prescribe a new drug in that class. New adopters in this drug class may be prescribing these new, but non-novel, drugs for patients who have not responded well to older drugs already on the market in that drug class. Non-prescribers in that drug class may not have patients who are appropriate candidates for drugs within that class, or they might simply not be convinced of that drug class' medical value and thus might not be disposed to prescribing any new drug in that class.

Total Pre-product Launch Prescribing Volume constituted the second most important variable in predicting whether a doctor would be an early adopter of a new drug, as was the case with first-in-class drugs. The more prescriptions a physician has written, the greater the chance that he or she will become a new drug adopter for follow-on drugs as well.

The relative amount of money spent in support of the new drug by the pharmaceutical company, the *Pharmaceutical Marketing Support*, was the third most significant explanatory variable.

Board Certification was a statistically significant variable in this model, although it was not in the first model.

Office-based physicians, specialists, and those who participated in a drug's phase 3 clinical trials tended to be early adopters of follow-on drugs in this study (*Practice Type, Specialty, and Clinical Investigator Experience* in Table 3).

In stark contrast to the first model, *Pre-product Launch Company Prescribing Loyalty* was not a significant variable. *Age* was not an important explanatory variable in the follow-drug model.

The *Sex* of a physician was not a significant factor in either model. Female physicians were less likely to be new drug adopters, but the difference was not statistically significant.

Several variables were common to the adoption models for both types of drugs, including (1) *Total Pre-product Launch Prescribing Volume*, (2) *Clinical Investigator Experience*, and (3) *Specialty* and *Office-Based Practices*. The most striking difference, though, between the two models was the role played by *Pre-product Launch Company Prescribing Loyalty*. It was not pre-

sent in the follow-on drug model, yet it was the most important variable in the first-in-class model. In this case, the higher the percentage of drugs represented by the launch company in a physician's total prescribing, the more likely that physician was to be an early adopter of a drug from that company. It may well be that the variable reflected increased detailing by a pharmaceutical company to that physician. However, the variable might also indicate a degree of confidence and trust in that company, or in that company's sales representatives, by the physician prescribing a therapeutically novel new drug from that company.

Because a novel drug represents a new class of drug, company trust may be a factor in a physician's decision to be an early adopter of a novel drug from that company. If increased detailing were the only factor at work in explaining the importance of this variable, we would expect to see the variable in both models; however, it was present only in the first-in-class model.

The explanatory importance of trust was further supported by an examination of the subset of physicians who tried the first-in-class drug within the first six months of a product's launch but who later stopped prescribing that drug. These physicians were statistically similar in virtually every respect to the early adopters (physicians who continued to prescribe the new drug after its adoption within the first six months). This similarity included demographic variables such as age and sex as well as the practice and prescribing variables.

The one important exception was *Pre-product Launch Company Prescribing Loyalty*. Early adopters demonstrated a statistically significantly higher percentage (.0001) of their drugs from the pharmaceutical company marketing the new drug than did physicians who first prescribed the drug but who eventually stopped prescribing it. The willingness of some physicians to be early adopters of a first-in-class drug was highly related to their total level of prescribing drugs from the company bringing the new novel drug to market, and it probably reflected a degree of trust by the physicians in that company and their representatives to provide a safe and efficacious novel drug.

After reviewing the results by indication as part of our overall analysis, we found no significant, systematic differences in the overall pattern of results between the chronic and acute (short-term) indications.

LIMITATIONS

The study design had several limitations:

1. The data were restricted to drugs for selected outpatient indications. The dynamics might differ for in-patient or other outpatient indications.
2. Although the study population covered a broad range of physicians, it was not a statistically projectable sample to the entire U.S. physician population.
3. The study covered U.S. data only. The U.S. is the only major pharmaceutical market that currently allows data on individual physician prescribing patterns to be tracked and sold without explicit physician approval. Most countries prohibit the selling of these data under any circumstances, and a few countries allow the data to be sold with

Physicians Who Are Early Adopters of New Drugs

the express agreement of the physician. It is probably impossible at present to replicate this study outside the U.S. because of the absence of widespread individual physician-prescribing data.

DISCUSSION

Prescription drugs represent a growing cost in the provision of health care. New drugs are now used in treatments for which older drugs were not developed. In addition, existing drug treatments are being replaced by newer, sometimes more costly, drugs.

Much has been written about the influences on physicians to prescribe newer drugs. These pressures originate from pharmaceutical companies, through their efforts to market and detail newer drugs; the medical literature; professional meetings; patients themselves; and the increasing use of DTC advertising for some medical indications.

In contrast, the literature on the characteristics of new drug adopters is sparse. In most of these studies, interviews and reported behavioral data have been the sources of the information. The few studies that have used prescription data have not been able to link individual physicians with their specific prescribing behavior.

Similarly, little use has been made of multivariate models to examine new drug adoption. Our study examined individual physicians and their actual prescribing behavior from this type of multivariate view. It also examined new drug adoption by new drug novelty (first-in-class) and follow-on drugs (those in an established class).

The level of marketing support expended by a company for its newly launched drug is an important explanatory variable in understanding new drug adoption; in our analysis, it was used as a control variable.

CONCLUSION

Several physician-specific variables are critical in quantifying the likelihood of new drug adoption. A physician's Total Prescribing Volume is essential in understanding the likelihood that the physician will adopt a new drug, whether or not that drug is first in its therapeutic class. Physicians who participated in a drug's phase 3 clinical trials or who were specialists in the drug's therapeutic area were more likely to adopt a new drug, whether or not it was therapeutically novel.

Younger physicians were more likely to adopt a novel new drug, as were physicians who already prescribed a higher percentage of all their drugs from the company launching the novel new drug. Total Prescribing Volume within the drug class of a follow-on drug was also a significant predictor of new follow-on drug adoption. Office-based and board-certified

physicians were also more likely to adopt a new follow-on drug.

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