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Changes in Physician Antipsychotic Prescribing Preferences, 2002–2007

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Abstract

Objective—Evidence on antipsychotic comparative effectiveness, regulatory warnings, and formulary and other restrictions on antipsychotics may have influenced physician prescribing behavior. This study measured changes in the degree to which physicians customize treatment choices to individual patients and changes in physician preferences for specific agents following these events.

Methods—The study used 2002-2007 data from IMS Health Xponent™ and the AMA on the prescribing and characteristics of a longitudinal cohort of 7,399 physicians. Descriptive and multivariable regression analyses of the concentration of prescribing (physician-level Herfindahl index), and preferences for and likelihood of prescribing 2 first-generation antipsychotics and 6 second-generation antipsychotics adjusting for prescribing volume, specialty, demographics, practice setting and education were conducted.

Results—Antipsychotic prescribing was highly concentrated at the physician-level, with a mean unadjusted Herfindahl index of .33 in 2002 and .29 in 2007. Psychiatrists reduced the

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concentration of their prescribing more over time than did other physicians. High volume psychiatrists had a Herfindahl that was half that of low-volume physicians in other specialties (.18 vs. .36), a difference that remained significant (p<.001) after adjusting for physician characteristics. The share of physicians preferring olanzapine dropped from 29.9% in 2002 to 10.3% in 2007 (p<.001) while the share favoring quetiapine increased (from 9.4% to 44.5%, p<. 001). Few physicians (<5%) preferred a first-generation antipsychotic in 2002 or 2007.

Conclusions—Preferences for specific antipsychotics changed dramatically during this period. While physician prescribing remained heavily concentrated, it did decrease over time, particularly among psychiatrists.

Antipsychotics have been approved by the Food and Drug Administration (FDA) to treat schizophrenia, bipolar disorder, major depression and other mental disorders that impose an enormous morbidity and mortality burden(1, 2) and are used off-label for many other indications(3). Physicians now face a choice of over 90 antipsychotic products (24 molecules and their reformulations). Six second-generation antipsychotics introduced between 1989 and 2002 rapidly became first-line treatment for these conditions on the basis of early claims that they were more effective and safer than first-generation antipsychotics. Second generation antipsychotics continue to claim a majority of the market in spite of their higher costs(4).

However, comparative effectiveness research released 10 to 15 years after second generation antipsychotics were introduced indicates that they carry significant risks, and that, with the exception of clozapine, they may be no more effective than first-generation antipsychotics. For example, the Clinical Antipsychotic Trials of Intervention Effectiveness (CATIE), a widely-cited study published in 2005 that compared four second generation antipsychotics with one first-generation antipsychotic in patients with schizophrenia, found few differences among the drugs on all-cause discontinuation rates, the trial's primary measure of effectiveness. Notably, CATIE also found that the risk of adverse effects and reason for discontinuation differed widely between classes (second generation vs. first-generation), and among second generation antipsychotics(5).

While CATIE findings remain controversial(6, 7) one might nevertheless expect physicians to have changed their antipsychotic prescribing in response to it and other studies(8). Even before CATIE, the FDA issued safety warnings in 2003 and 2005(9),(10) in response to earlier studies pointing to risks(11) and consensus statements emphasized heterogeneous risk profiles across second generation antipsychotics(12). Prescribing preferences are also shaped by formularies and utilization management tools (13, 14), and some payers placed restrictions on some second generation antipsychotics during this period.(15, 16) Prescribers may have switched their preferred antipsychotic agent or stopped prescribing certain drugs in response to these changes. However, little is known about whether new evidence or changes in policy led clinicians to diversify their prescribing (17, 18). Studies of prescribing for depression and bipolar disorder indicate that physicians rely heavily on preferred agents(19-24) One study examined the degree of concentration in antipsychotic prescribing but results were reported at the facility, not at the provider-level, for a single year(25). We are aware of no studies that have examined changes over time in the degree of concentration of antipsychotic prescribing. In this study, we measured changes in physician antipsychotic prescribing behavior using data from a longitudinal cohort of physicians from multiple specialties between 2002 and 2007.

Methods

We used monthly physician-level data from IMS Health's Xponent™ database on the number of prescriptions dispensed for each first generation antipsychotic and second

generation antipsychotic between January 2002 and December 2007. Xponent™ directly captures over 70% of all U.S. prescriptions filled in retail pharmacies and utilizes a patented proprietary projection methodology to represent 100% of prescriptions filled in these outlets. Prescribing data were available for a 10% nationally-representative sample of physicians from ten specialties with the highest antipsychotic prescribing volume (internal medicine, general practice, family medicine, family practice, pediatrics, psychiatry, geriatric psychiatry, child and adolescent psychiatry, neurology, and child neurology) (n = 24,206). We limited the 10% sample to a longitudinal cohort of physicians who regularly prescribed antipsychotics (i.e., at least 20 dispensed antipsychotic prescriptions) both in 2002 and in 2007. Our rationale is that very low volume prescribers tell us little about the diversity of a physician's prescribing. For example, a physician who writes a single prescription will by definition be 100% concentrated on some drug. Thus, including a lot of observations for very low volume prescribers may lead to unstable or misleading results. We also emphasize that a threshold of 20 prescriptions is equivalent to two patients filling prescriptions for 10 months/year. This reduced sample of 7,399 accounts for 83% of all antipsychotic prescriptions among the 24,206 physicians in our sample in 2007. Sensitivity analyses including the larger sample yielded qualitatively similar results. We linked prescribing data to information on physician characteristics from the American Medical Association (AMA) Masterfile(26).

We examined prescribing patterns for six orally-administered second generation antipsychotics (clozapine, risperidone, olanzapine, quetiapine, ziprasidone, and aripiprazole). Aripiprazole was launched late in 2002 and few physicians in our sample prescribed it that year; thus, we do not report use of aripiprazole separately in some analyses. We also examined prescribing of two oral first-generation antipsychotics: haloperidol, the most commonly prescribed first-generation antipsychotic during our study period, and perphenazine, the only first-generation antipsychotic included in CATIE. We combined other first-generation antipsychotics into a single group. Prescriptions for reformulations (e.g., Zyprexa Zydis) were merged with the original ingredient (e.g., olanzapine).

Dependent variables

We analyzed trends in three aspects of prescribing behavior in this longitudinal cohort. First, we measured the concentration of a physician's prescribing by constructing a Herfindahl index, a metric traditionally used by economists to characterize the degree of competition in a market. Here we use it to describe the diversity of a physician's prescribing of antipsychotics to her patient population. The index is constructed as

$$H=\sum_{i=1}^{N} s_i^2$$

where s_i is the share of prescriptions for drug *i* in the antipsychotic market, and *N* is the number of drugs in the antipsychotic market. The smallest possible value of *H* is *1/N* while the largest is 1 – these correspond to prescribing each drug with the same frequency and to only prescribing one drug, respectively. An important point is that *H* is dependent on the volume of a physician's prescribing (e.g., *H = 1* by definition if they write a single prescription), which is why we exclude physicians prescribing fewer than 20 prescriptions from our primary analysis. We hypothesized that physicians would reduce the concentration of their prescribing in response to evidence of differential side effects. Second, we quantified changes in the specific drugs most preferred by physicians between 2002 and

2007. Specifically, for each physician we identified the drug with the most prescriptions filled in 2002 and then in 2007, yielding estimates of the proportion of physicians revealing stable (or unstable) preferences over time. Third, we assessed changes in the proportion of physicians with any prescriptions for each drug in 2002 vs. 2007. We hypothesized that physicians may have changed not only their preferences for but also their general use of specific agents based on risk of metabolic effects, potentially reducing use of drugs with the highest risk (olanzapine and clozapine), increasing use of drugs with intermediate risk (risperidone and quetiapine), and low risk (aripiprazole and ziprasidone)(12). We also examined whether physicians increased their use of lower-cost agents (first-generation antipsychotics) following evidence that these agents were cost-effective relative to second generation antipsychotics(27).

Key explanatory variables

We were interested in determining whether changes in prescribing behavior differed by physician specialty and prescribing volume. We classified physicians based on specialty into 2 groups: psychiatry (general, child and adolescent, and geriatric), vs. 'other,' which included neurologists (general and child), pediatricians, and physicians trained in internal medicine, family medicine, family practice, and general practice. General practitioners and other non-psychiatrist specialists were considered as a single group because they behaved similarly on the prescribing practices we observed. To assess prescribing volume, which may serve as a proxy for a physicians' experience prescribing antipsychotics or for the prevalence of severe mental illness among their patients, physicians were classified according to the total number of antipsychotic prescriptions their patients filled in 2001, the year before the start of the study period. Physicians with prescribing volume above the 50th percentile were considered high volume prescribers. We included a dummy variable in the concentration analysis for the 1.8% of physicians whose patients did not fill any antipsychotic prescriptions in 2001 for whom we could not estimate baseline antipsychotic volume.

Covariates

We included as covariates physician sex; age in 2002; practice setting (solo practice, two-person, other (e.g., locum tenens, medical school, inpatient attending only), or no classification available, with group practice as the reference category); whether the physician practiced in a hospital setting part- or full-time; whether the physician attended a medical school ranked in the top 25 by the 2010 *US News and World Report;* and whether the physician graduated from a foreign medical school, the latter to explore any differences in physicians who completed medical education in the U.S. vs. other countries where preferences for or availability of specific agents may have differed. As a potential proxy for less contact with the pharmaceutical industry we included an indicator of whether the physician requested that the AMA withhold their information from pharmaceutical sales representatives. State fixed effects were included to account for time-invariant geographic variation in prescribing practices(28) including Medicaid program restrictions on some antipsychotics in some states(15).

Analyses

To examine the concentration of antipsychotic prescribing we used generalized estimating equations (GEE) to account for repeated measurements made on the same physician each year. We used a gamma distribution with a log link function due to the skewed distribution of the Herfindahl index in our sample. We tested for differences in changes in the physician-level Herfindahl over time by specialty and/or volume by including three-way interaction terms between specialty, volume and time (yearly indicators), and the three two-way

interaction terms for these variables. In addition to these variables, the model adjusted for the other covariates listed above.

To explore the stability of preferences over time, we calculated the proportion of physicians preferring each drug (i.e., writing more prescriptions for it than for any other agent) in 2002. We then calculated the proportion still preferring that agent in 2007 and conducted a test of proportions by drug.

Finally, we describe changes in the unadjusted rate of physicians prescribing of each drug to any of their patients in 2002 and in 2007.

Results

Characteristics of study sample

Of the 7,399 sample physicians who regularly prescribed antipsychotics from 2002-2007, 2,437 were psychiatrists and 4,962 were in other specialties (4,398 general practitioners and 564 neurologists or pediatricians) (Table 1). Psychiatrists were more likely to be female, age 50 or older, and solo practitioners than physicians in other specialties. Psychiatrists' mean annual antipsychotic prescribing volume was 7 times that of physicians in other specialties (649 vs. 86 for general practitioners and other specialists).

Concentration of prescribing

Antipsychotic prescribing was highly concentrated in physicians' preferred agents. The unadjusted mean Herfindahl index for physicians was .33 in 2002 and .29 in 2007. Physicians in non-psychiatric specialties below the median antipsychotic prescribing volume had the most concentrated prescribing with an unadjusted Herfindahl of .36 compared to psychiatrists prescribing a high volume of antipsychotics who had a Herfindahl of .18.

Our initial model included the three-way interaction between specialty, volume and time and the three two-interactions involving the same variables. Because the third-order interaction explained almost no variation in the data we removed it and refit the model with the two-way interactions. We found two interactions, one between specialty and time and one between specialty and volume, were highly significant. Table 2 displays the results from the GEE model examining the effects of various provider characteristics on the concentration of antipsychotic prescribing.

The coefficients comprising the specialty by time interaction revealed that the concentration of psychiatrists has decreased over time and in a manner that is consistent across high and low volume prescribers. Specifically, the Herfindahl index decreased (i.e., prescribing is less concentrated) across time for psychiatrists relative to non-psychiatrists. For example, in 2002 the concentration of prescribing by psychiatrists was 4.92% lower than by non-psychiatrists with the same volume while in 2007 the concentration of psychiatrists was 10.52% lower than that of non-psychiatrists of the same volume ($p < .001$). The interaction between specialty and volume reveals that antipsychotic prescribing volume was also strongly associated with concentration after controlling for other factors and that its effect depends on specialty. Specifically, in the same year, high volume psychiatrists had a Herfindahl 44.69% lower that of low volume physicians in other specialties ($p<.001$) while low volume psychiatrists had a Herfindahl 4.92% lower that of low volume prescribers in other specialties (both cases $p < 0.001$).

Changes in preferred antipsychotics

Figure 1 displays the dramatic changes in physicians' preferred agents between 2002 and 2007. In 2002, few physicians favored a first-generation antipsychotic, with only 3.7% preferring haloperidol, .6% perphenazine, and 23.8% one of the other first-generation antipsychotics. Among second generation antipsychotics, more than two thirds of physicians favored risperidone (30.2%), olanzapine (29.9%), or quetiapine (9.5%), whereas only 1.8% preferred clozapine, and .5% ziprasidone in 2002.

By 2007, the vast majority of physicians shifted preferences to a different drug than that preferred in 2002 (all differences significant at p<.001-level) (Figure 1). Among the first-generation antipsychotics, even fewer physicians favored haloperidol (2%) or perphenazine (0.5%) in 2007 than in 2002. Half of the second generation antipsychotics experienced substantial reductions in the share of physicians preferring them. Olanzapine saw the largest decline in the share of physicians preferring it (from 29.9% to 10.3%), retaining only 16.4% of physicians who preferred it in 2002. Risperidone also lost a large share of physicians preferring it, from 30.2% of physicians in 2002 to 23.1% in 2007. Clozapine was the preferred agent for an even smaller share of physicians in 2007 (0.9%) than in 2002.

The antipsychotic experiencing the biggest gain was quetiapine -- the fifth of six second generation antipsychotics to be introduced -- which saw a more than four-fold increase (from 9.4% to 44.5%) in the share of physicians preferring it. Ziprasidone and aripiprazole also saw increases in the share of physicians preferring them although the absolute share was low; only 1.3% and 4.1% of physicians preferred ziprasidone and aripiprazole, respectively.

Figure 2 highlights the particularly dramatic shift in physicians' observed preferences among the 2,215 physicians who favored olanzapine above other antipsychotics in 2002. Over half (52.8%) of all prescriptions filled by patients of these physicians were for olanzapine in 2002. However, beginning in the second quarter of 2003 (long before CATIE results were released in 2005 and even before the FDA warning about metabolic effects), these physicians reduced their use of olanzapine such that by 2007, it accounted for only 17.8% of their prescriptions. These physicians shifted most of their prescribing to quetiapine and risperidone, which in 2007 accounted for 33.2% and 25.3% of prescriptions, respectively.

Changes in any prescribing of specific antipsychotics

From 2002 to 2007, the share of physicians with any prescribing of the two first-generation antipsychotics in their practice dropped slightly from 56% to 49% for haloperidol and from 20% to 19% for perphenazine (Figure 3). Among the second generation antipsychotics, the share of physicians prescribing olanzapine and risperidone to any of their patients decreased, with the largest decline occurring for olanzapine (from 87% to 76%). The share of physicians prescribing any quetiapine, ziprasidone, and clozapine increased, with the largest increase for quetiapine (from 66% to 92% of physicians prescribing it). All of these changes were statistically significant at the p<.001 level.

Discussion

We report three key findings. First, physicians' reliance on a preferred antipsychotic agent, as measured by the concentration of their prescribing, declined between 2002 and 2007 particularly among psychiatrists. Second, there are clear differences by specialty and prescribing volume in the concentration of a physician's antipsychotic prescribing. Third, there were substantial changes in which antipsychotic agent physicians preferred. These findings have a number of implications for clinicians, researchers, and policy makers.

We measured changes in the concentration of prescribing in the wake of high-profile FDA safety warnings, consensus statements issued from professional societies, a landmark comparative effectiveness study, expanded approval of new indications and off-label use, highly-publicized litigation against second generation antipsychotic manufacturers(29), and policy changes regarding coverage of these drugs. We hypothesized that evidence of substantial heterogeneity in risk profiles might have induced physicians to diversify their choice of agent, and we find evidence of this effect, particularly among psychiatrists. The rise in antipsychotic polypharmacy during this period may have increased the diversity of agents prescribed(30). We found a mean Herfindahl index of .27 to .33 depending on the year, which is slightly higher than that reported for antidepressants, suggesting greater concentration of antipsychotic than antidepressant prescribing(22, 24). Customizing drug treatment to individual patients requires more time and communication with patients, and can impose a significant cognitive burden on physicians(19). To reduce these costs, physicians often rely heavily on a few drugs per class,(19-21, 23, 24, 31) an approach often reinforced in clinical pharmacology education(32). However, heavy reliance by physicians on a few antipsychotics could be problematic for patients because of heterogeneity in their side effects.

That psychiatrists were so much less concentrated (more diversified) in their choice of antipsychotic suggests the capacity to customize treatment may vary by the degree of specialization, by experience, or with the severity of patient illness(33, 34). Psychiatrists generally focus their prescribing on a few therapeutic categories, whereas psychiatric medication makes up a smaller (if growing) part of primary care physicians' prescribing(35). Variability in concentration may also be related to inter-specialty differences in the clinical indications for use and/or patient severity. Importantly, the effects of specialty remained strong even after adjusting for volume differences. Given the dramatic expansion in antipsychotic prescribing in primary care settings, it is important to better understand these specialty differences,(36, 37) and their implications for quality of pharmacotherapy for mental disorders(38-40).

Even after controlling for specialty, antipsychotic prescribing volume was negatively associated with concentration, suggesting that physicians' ability to diversify medication choice may increase with experience prescribing antipsychotics. Perhaps the costs of customizing treatment are reduced when spread across a large number of patients. Thus, a physician with only a few patients might be less inclined to diversify and require definitive clinical evidence before starting a patient on a new drug. While a volume-quality relationship is well-documented in health care generally, we are unaware of evidence of such a relationship for prescribing(31).

Preferences for specific drugs changed dramatically. The antipsychotic experiencing the greatest decline was olanzapine, a change that began two years before CATIE results were published. The share of physicians prescribing any of the two first-generation antipsychotics we studied (haloperidol and perphenazine) also fell. The antipsychotic with the greatest increase in the share of physicians preferring it was quetiapine, whose share increased from 9% to 45%. How does one explain these shifts in physician preferences? We are unable to tease out the effects on prescribing behavior of any single event because all physicians are equally ‘exposed’ and we lack a comparison group. However, four important factors warrant discussion. First, metabolic effects were arguably one of the most salient issues influencing antipsychotic prescribing. Yet, the shifts in observed physician preferences cannot be entirely explained by these differences. Physicians increased use of one drug with intermediate risk (quetiapine), but not the other (risperidone), and a drug with low metabolic risk (ziprasidone) actually experienced a reduction in physician prescribing. Second, some shifts in preferences may have been driven by off-label use (e.g., quetiapine for sleep

disturbances)(3, 41). Third, the reduction in use of first-generation antipsychotics and clozapine suggests that physicians either were unaware of or not influenced by evidence of the cost-effectiveness of first-generation antipsychotics relative to second generation antipsychotics(27), and the greater effectiveness of clozapine relative to other second generation antipsychotics for treatment-resistant patients(42). Fourth, antipsychotics are heavily promoted by the pharmaceutical industry mostly through sales representatives, sponsorship of professional meetings, medical journal ads, and free samples(43) all of which can have a significant effect on physician prescribing preferences(44-46). Unfortunately, data on the exposure of individual physicians to promotion is not available. Notably, aripiprazole has been advertised to consumers as well, ranking 5th in direct-to-consumer advertising spending across all prescriptions drugs in 2010(43).

Our study has several limitations. First, we lack information on the patients filling the prescriptions, and therefore cannot identify the reason for antipsychotic use, determine the severity of illness, or distinguish between new treatment starts and patients who are stable on a medication. Second, while we selected our time period to coincide with key events such as FDA warnings and the CATIE trial, other underlying factors may have had an effect on prescribing behavior and we cannot infer a causal relationship between the release of studies or warnings and prescribing decisions. Third, we have data only on prescriptions filled through retail outlets (i.e., no mail order programs or long-term care facilities) and therefore do not observe changing preferences for drugs dispensed in these settings. Furthermore, to the extent that we only have data on prescriptions filled (not all those written), our results are confounded by factors affecting patient decisions to fill prescriptions. However, we do not expect discrepancies between prescriptions written and filled to differ systematically by drug. Finally, we are unable to adjust for some important influences on prescribing behavior such as manufacturer promotional efforts, which may vary by specialty, health systems within which physicians practice, and payers which may shape physician preferences through formularies and utilization management tools such as prior authorization (15, 16).

Conclusions

Physician preferences for specific antipsychotics changed dramatically from 2002 to 2007. Some physicians remained heavily concentrated in their antipsychotic prescribing whereas others diversified their choice of agent, with striking differences by specialty.

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References

1. Greenberg PE, Kessler RC, Birnbaum HG, et al. The economic burden of depression in the US: how did it change between 1990 and 2000? Journal of Clinical Psychiatry. 2003; 64:1465–1473. [PubMed: 14728109]
2. Wu EQ, Birnbaum HG, Shi L, et al. The economic burden of schizophrenia in the United States in 2002. Journal of Clinical Psychiatry. 2005; 66:1122–1129. [PubMed: 16187769]

3. Leslie DL, Mohamed S, Rosenheck RA. Off-label use of antipsychotic medications in the Department of Veterans Affairs Health Care System. Psychiatric Services. 2009; 60:1175–1181. [PubMed: 19723731]
4. IMS Health. Top-Line Market Data, 2010 US prescription sales information. 2010; 2012
5. Lieberman JA, Stroup TS, McEvoy JP, et al. Effectiveness of antipsychotic drugs in patients with chronic schizophrenia. New England Journal of Medicine. 2005; 353:1209–1223. [PubMed: 16172203]
6. Kraemer HC, Glick ID, Klein DF. Clinical trial design lessons from the CATIE study. American Journal of Psychiatry. 2009; 166:1222–1228. [PubMed: 19797435]
7. Lieberman JA, Stroup TS. The NIMH-CATIE Schizophrenia Study: what did we learn? American Journal of Psychiatry. 2011; 168:770–775. [PubMed: 21813492]
8. Lewis S, Lieberman JA. CATIE and CUtLASS: can we handle the truth? British Journal of Psychiatry. 2008; 192:161–163. [PubMed: 18310570]
9. Morrato EH, Druss B, Hartung DM, et al. Metabolic testing rates in 3 state Medicaid programs after FDA warnings and ADA/APA recommendations for second-generation antipsychotic drugs. Archives of General Psychiatry. 2010; 67:17–24. [PubMed: 20048219]
10. Dorsey ER, Rabbani A, Gallagher SA, et al. Impact of FDA black box advisory on antipsychotic medication use. Archives of Internal Medicine. 2010; 170:96–103. [PubMed: 20065205]
11. Lindenmayer JP, Czobor P, Volavka J, et al. Changes in glucose and cholesterol levels in patients with schizophrenia treated with typical or atypical antipsychotics. Am J Psych. 2003; 160:290–296.
12. American Diabetes Association, American Psychiatric Association, American Association of Clinical Endocrinologists, et al. Consensus Development Conference on Antipsychotic Drugs and Obesity and Diabetes. Diabetes Care. 2004; 27:596–601. [PubMed: 14747245]
13. Huskamp HA, Deverka PA, Epstein AM, et al. The effect of incentive-based formularies on prescription-drug utilization and spending. New Eng J Med. 2003; 349:2224–2232. [PubMed: 14657430]
14. Soumerai SB. Benefits and risks of increasing restrictions on access to costly drugs in Medicaid. Health Affairs. 2004; 23:135–146. [PubMed: 15002636]
15. Polinski JM, Wang PS, Fischer MA. Medicaid's prior authorization program and access to atypical antipsychotic medications: does Medicaid have the resources to respond to new drug safety issues? Health Affairs. 2007; 26:750–760. [PubMed: 17485754]
16. Donohue JM, Huskamp HA, Zuvekas S. Dual-eligibles with Mental Disorders and Medicare Part D: how are they faring? Health Affairs. 2009; 28
17. Carpenter WT, Buchanan RW. Lessons to Take Home from CATIE. Psychiatric Services. 2008; 59:523–525. [PubMed: 18451009]
18. Tandon R, Carpenter WT, Davis JM. First- and second-generation antipsychotics: learning from CUtLASS and CATIE. Archives of General Psychiatry. 2007; 64:977–978. [PubMed: 17679642]
19. Frank RF, Zeckhauser RJ. Custom-made versus ready-to-wear treatments: behavioral propensities in physicians' choices. Journal of Health Economics. 2007; 26:1101–1127. [PubMed: 18031852]
20. Coscelli A. The importance of doctors' and patients' preferences in the prescription decision. Journal of Industrial Economics. 2000; XLVIII:349–369.
21. Schneeweiss S, Glynn RJ, Avorn J, et al. A Medicare database review found that physician preferences increasingly outweighed patient characteristics as determinants of first-time prescriptions for COX-2 inhibitors. Journal of Clinical Epidemiology. 2005; 58102:98. [PubMed: 15649677]
22. Hodgkin D, Merrick EL, Hiatt D. The relationship of antidepressant prescribing concentration to treatment duration and cost. Journal of Mental Health Policy and Economics. 2012; 15:3–11. [PubMed: 22611088]
23. Hodgkin D, Volpe-Vartanian J, Merrick EL, et al. Customization in prescribing for bipolar disorder. Health Economics. 2011
24. Merrick EL, Hodgkin D, Panas L, et al. Is customization in antidepressant prescribing associated with acute phase treatment adherence. Journal of Pharmaceutical Health Services Research. 2011

25. Leslie DL, Rosenheck RA. Diversity vs. concentration in antipsychotic drug selection. Journal of Mental Health Policy and Economics. 2008; 11:107–112. [PubMed: 18806300]
26. American Medical Association. AMA Physician Masterfile.
27. Rosenheck RA, Leslie DL, Sindelar J, et al. Cost effectiveness of second-generation antipsychotics and perphenazine in a randomized trial of treatment for chronic schizophrenia. American Journal of Psychiatry. 2006; 163:2080–2089. [PubMed: 17151158]
28. Donohue JM, Morden N, Gellad WF, et al. Sources of regional variation in Medicare Part D drug spending. New England Journal of Medicine. 2012; 366:530–538. [PubMed: 22316446]
29. Berenson, A. Lilly to pay up to $500 million to settle claims. New York Times; Jan 4. 2007
30. Morjtabai R, Olfson M. National trends in psychotropic medication polypharmacy in office-based psychiatry. Archives of General Psychiatry. 2010; 67
31. Taub AAL, Kolotilin A, Gibbons RS, et al. The diversity of concentrated prescribing behavior: an application to antipsychotics. National Bureau of Economics Research (NBER) Working Paper. 2011
32. Schiff GD, Galanter WL. Promoting more conservative prescribing. Journal of the American Medical Association. 2009; 301:865–867. [PubMed: 19244196]
33. Sansone RA, McDonald S, Prutzman C, et al. The comfort level of internists with the prescription of psychotropic medication. International Journal of Psychiatry in Medicine. 2006; 36:85–92. [PubMed: 16927580]
34. Jones MI, Greenfield SM, Bradley CP. Prescribing new drugs: qualitative study of influences on consultants and general practitioners. British Medical Journal. 2001; 323:107.
35. de Bakker DH, Coffie DSV, Heerdink ER, et al. Determinants of the range of drugs prescribed in general practice: a cross-sectional analysis. BMC Health Services Research. 2007; 7
36. Aparasu RR, Bhatara V, Gupta S. US national trends in the use of antipsychotics during office visits, 1998-2002. Annals of Clinical Psychiatry. 2005; 17:147–152. [PubMed: 16433056]
37. Lieberman JA. Use of antipsychotics in primary care. Journal of Clinical Psychiatry. 2003; 5:3–8.
38. Kilbourne AM, Goodrich D, Miklowitz DJ, et al. Characteristics of patients with bipolar disorder managed in VA primary care or specialty mental health care settings. Psychiatric Services. 2010; 61:500–507. [PubMed: 20439372]
39. Kniesner TJ, Powers RH, Chroghan TW. Provider type and depression treatment adequacy. Health Policy. 2005; 72:321–332. [PubMed: 15862640]
40. Hermann RC, Yang D, Ettner SL, et al. Prescription of antipsychotic drugs by office-based physicians in the United States, 1989-1997. Psychiatric Services. 2002; 53:425–430. [PubMed: 11919355]
41. Correll CU, Manu P, Olshanskiy V, et al. Cardiometabolic Risk of Second-Generation Antipsychotic Medications During First-Time Use in Children and Adolescents. Journal of the American Medical Association. 2009; 302:1765–1773. [PubMed: 19861668]
42. McEvoy JP, Lieberman JA, Stroup TS, et al. Effectiveness of clozapine vs. olanzapine, quetiapine, and risperidone in patients with chronic schizophrenia who did not respond to prior atypical antipsychotic treatment. American Journal of Psychiatry. 2006; 163:600–610. [PubMed: 16585434]
43. Kornfield R, Donohue JM, Berndt ER, et al. Promotion of prescription drugs to consumers and providers, 2001-2010. PLOS ONE. 2013 in press.
44. Donohue JM, Berndt ER. Direct-to-Consumer Advertising and Choice of Antidepressant. Journal of Public Policy and Marketing. 2004; 23:115–127.
45. Berndt ER, Bui LT, Reiley DH, et al. Information, marketing, and pricing in the US anti-ulcer drug market. American Economic Review. 1995; 85:100–105. [PubMed: 10160519]
46. Van den Bulte C, Lilien GL. Medical innovation revisited: social contagion versus marketing effort. American Journal of Sociology. 2001; 106:1409–1435.

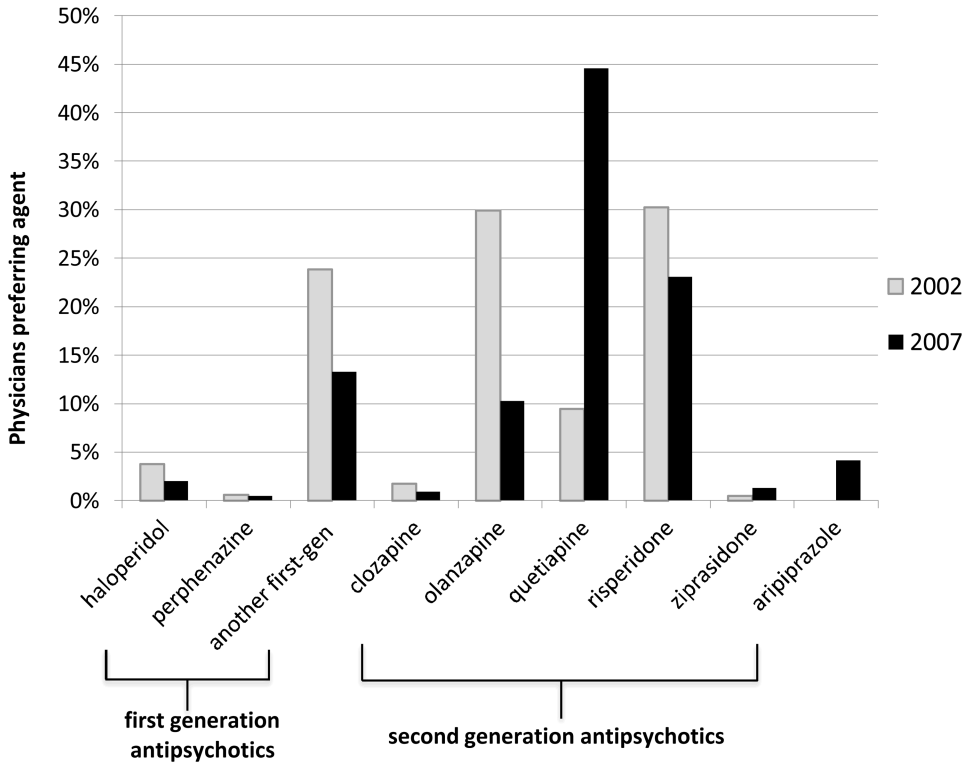

Figure 1. Changes in Physicians' preferred antipsychotic medication between 2002-2007

Notes:

Preferred agent is the product for which the physician's patients fill the most prescriptions in a given year

Source: IMS Xponent, 2001-2007, IMS Health, Inc.

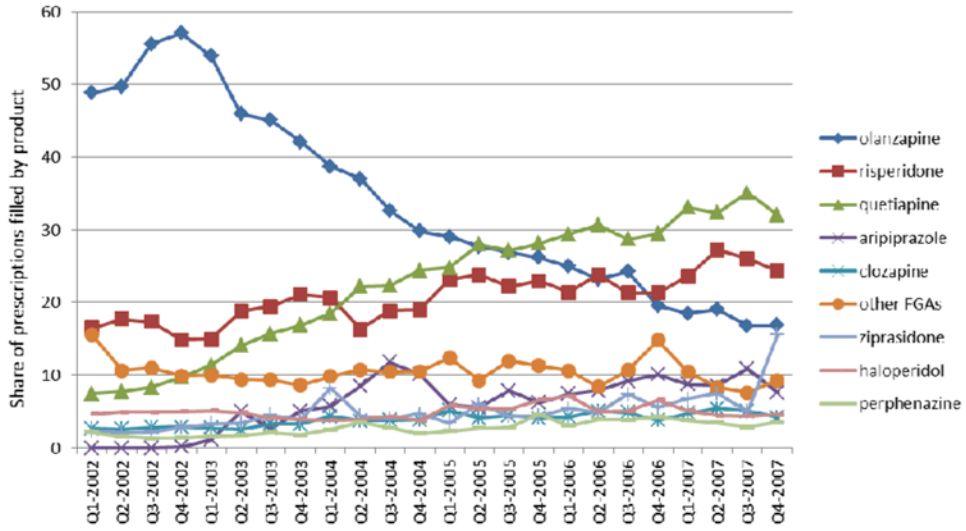

Figure 2. Among physicians preferring olanzapine in 2002, the share of prescriptions for olanzapine and for other antipsychotics, 2002-2007

Notes: Graph shows quarterly share of prescriptions written for each drug among 2,215 physicians who favored olanzapine above other antipsychotics in 2002.

Source: IMS Xponent, 2001-2007, IMS Health, Inc.

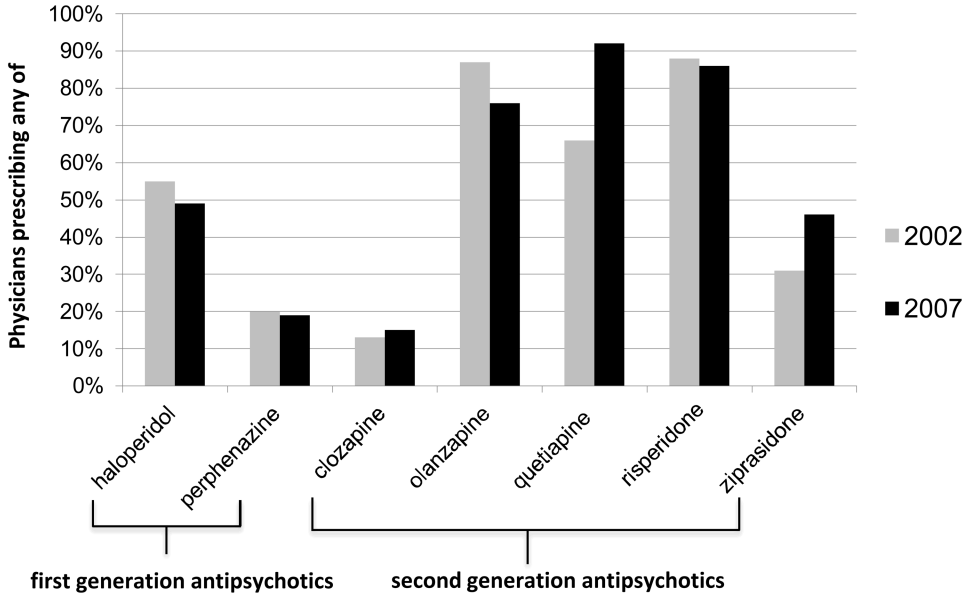

Figure 3. Proportion of physicians prescribing any of select antipsychotics
Source:
IMS Xponent, 2001-2007, IMS Health, Inc.

Table 1

Characteristics of antipsychotic prescribers by specialty, 2002

	Total sample N=7,399		Psychiatrists N=2,437		Other N=4,962	
Female (N, %)	1,561	21.1%	704	28.9%	858	17.3%
Age (N, %)						
<30 years	777	10.5%	168	6.9%	610	12.3%
30-39	2,375	32.1%	675	27.7%	1,702	34.3%
40-49	2,841	38.4%	909	37.3%	1,935	39.0%
50+	1,398	18.9%	685	28.1%	715	14.4%
Medical education (N, %)						
Top 25 medical school	829	11.2%	346	14.2%	481	9.7%
Foreign medical school	1,805	24.4%	734	30.1%	1,067	21.5%
Practice type (N, %)						
Solo	2,094	28.3%	838	34.4%	1,260	25.4%
Two person	348	4.7%	39	1.6%	308	6.2%
Group practice	3,130	42.3%	534	21.9%	2,595	52.3%
No classification	784	10.6%	380	15.6%	407	8.2%
Other	1,043	14.1%	648	26.6%	397	8.0%
Any hospital practice (N, %)	3,655	49.4%	1,080	44.3%	2,570	51.8%
Restriction on disclosure of prescribing to industry (N, %)	266	3.6%	63	2.6%	208	4.2%
Mean antipsychotic prescriptions/year		272 (591)		649 (893)		86 (156)
Annual prescribing volume quartile (N, %)						
1 (20-41)	1,872	25.3%	158	6.5%	1,717	34.6%
2 (42-77)	1,857	25.1%	222	9.1%	1,632	32.9%
3 (78-205)	1,820	24.6%	519	21.3%	1,305	26.3%
4 (206+)	1,850	25.0%	1,540	63.2%	308	6.2%

Notes:
General practitioners include internal medicine, family practice, and primary care physicians. Other specialties include neurology and pediatrics.
Sample includes physicians with 20 or more antipsychotic prescriptions both in 2002 and in 2007.
Sources: IMS Health, Xponent™, AMA Masterfile, 2002-2007.

Table 2

Predictors of the concentration of physician prescribing of antipsychotics

Parameter	Estimated Outcome Ratio	95% confidence limit		p-value
Intercept	0.441	0.427	0.455	<.001
Female	1.041	1.033	1.049	<.001
Age	1.002	1.002	1.003	<.001
Medical education				
Top 25 medical school	1.024	1.013	1.035	<.001
Foreign medical school	0.969	0.961	0.977	<.001
Practice Type				
Solo practice	1.020	1.011	1.029	<.001
Two person practice	0.987	0.972	1.003	0.119
No Classification (Group practice and other = reference)	1.001	0.991	1.010	0.898
Any Hospital Practice	0.993	0.986	1.000	0.067
Restriction on disclosure of prescribing to industry	0.989	0.971	1.007	0.227
Specialty and prescribing volume				
Psychiatrist (General practitioner, other = reference)	0.951	0.935	0.967	<.001
High volume prescriber	1.173	1.163	1.183	<.001
Psychiatrist * High volume	0.684	0.672	0.696	<.001
Missing volume info in 2001	1.025	1.016	1.033	<.001
Year				
2003	0.933	0.920	0.945	<.001
2004	0.869	0.854	0.884	<.001
2005	0.857	0.841	0.872	<.001
2006	0.859	0.843	0.875	<.001
2007	0.881	0.865	0.897	<.001
(2002 = reference)				
Time trend by specialty				
2003*psychiatrist	0.961	0.949	0.974	<.001
2004*psychiatrist	0.938	0.923	0.952	<.001
2005*psychiatrist	0.946	0.930	0.961	<.001
2006*psychiatrist	0.944	0.928	0.960	<.001

Parameter	Estimated Outcome Ratio	95% confidence limit		p-value
2007*psychiatrist	0.941	0.925	0.957	<.001
State fixed effects (included)				

Notes
Physician-level Herfindahl index estimated using a gamma regression model with a log link.
The exponentiated coefficients (ratios of expected outcomes) reported are marginal effects.
Sources: IMS Xponent, 2001-2007, IMS Health, Inc., AMA Masterfile, 2002-2007.

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