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SURFACE

The Influence of New Medications on Prescribing Behavior by Practice Type: A Regression Analysis

Rita M. Pattarini

The Influence of New Medications on Prescribing Behavior by Practice Type: A Regression Analysis

A Capstone Project Submitted in Partial Fulfillment of the Requirements of the Renée Crown University Honors Program at Syracuse University

Rita M. Pattarini

Candidate for B.S. Degree
and Renée Crown University Honors

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Capstone Project Advisor: _____
Christopher Rohlfs

Honors Reader: _____
Deborah Freund

Honors Director:_____
Samuel Gorovitz

Date:_____

Abstract

Objective: To determine whether the type of practice to which physicians belong influences the types of medications they prescribe

Methods: The study used data from the National Ambulatory Medical Care Survey (NAMCS) to conduct a series of regressions for two pairs of medications. The first pair was for the treatment of high cholesterol. Advicor was the new medication and Lovastatin was the competitor. The second pair was for the treatment of arthritis. Humira was the new medication and Remicade was the competitor. For each pair, there were two sets of regressions that consisted of an unrestricted regression with all patients in the sample and a restricted regression limited to recipients of the two medications.

Results: The results of the study showed solo physicians were more likely to prescribe Advicor over Lovastatin, but less likely to prescribe Humira over Remicade.

Conclusions: The study suggests there is a difference present in the prescriptions written in solo versus group physicians and additional factors dealing with the specific drug must determine the direction of this difference.

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A Special Thank You To…

Professor Deborah Freund for her support both with this project and throughout my senior year. You helped me see what I could accomplish and gave me the tools to do it. You are a great mentor and a valued friend.

To my family, thank you for giving me permission to feel frustrated at times and encouraging my determination to stick it out to the end. It was so worth it.

Finally, a project as large as this one can be daunting – it made it so much easier having fantastic friends to share the process with. We did it Caitlin! I can't wait to see what's in store for us next!

All my love,

Rita

Introduction

This study explores whether the type of practice to which physicians belong influences the types of medications they prescribe. The type of practice is defined here as a solo practice or a group practice. A group practice consists of two or more physicians, with HMOs eliminated for consistency. In particular, I hypothesize that solo practice doctors might be less likely than group practice doctors to adopt new medications because, as owners, they face greater workloads and administrative burdens and are less exposed to peer consultation. The estimates presented in this paper can help to provide patients and health care professionals with information about how the choice of one doctor or another can affect treatment.

There is consistent agreement in the literature regarding the general benefits and consequences of solo and group practices. Solo practitioners lack peer consultation and ease of information sharing.[1,2] Solo physicians report severe job constraints such as a heavy workload, out of hours calls, and administrative burden.[3] Administrative issues have become too extensive to handle without staff assistance and multiple physicians.[4] Group practice can help alleviate these disadvantages, but solo practice physicians most frequently cite difficulty with cooperation and autonomy as a barrier to joining a large medical group.[5] Group practice also entails constant scrutiny, stricter adherence to quality and procedure, a sacrifice of professional status and a decreased possibility of earning a high income.[6] Interestingly, a 2000 study did report that the time pressure ratio was the

lowest with solo practitioners when compared with groups. Solo practitioners also seemed to spend the least amount of time stressed.[7]

To analyze the effect of the type of practice on the types of medications prescribed, the data for this study was taken from the National Ambulatory Medical Care Survey (NAMCS). I selected two pairs of prescription for my analysis: Lovastatin and Advicor (the "new" medication) are prescribed for high cholesterol; Remicade and Humira (the "new" medication) are commonly prescribed to treat rheumatoid arthritis. The prescriptions were chosen based on the criteria that were intended for a very common diagnosis in order to ensure a large sample size, the new medication had to be made available within the years 1997 and 2007 in order to be able to document a change within my dataset, and the medication could not be a completely new invention because there needed to be a commonly prescribed competitor for comparison.

Each pair of medications has two step-wise linear regression sets. The regressions estimate if there is a significant difference in the prescribing behavior of group and solo physicians for two different dependent variables measuring when the new medication was introduced: The first regression set is with an unrestricted sample where the dependent variable represents if a prescription was written for either medication to show if there is some difference between solo and group physicians that is inherent in the conditions themselves; the second regression set is a restricted sample where the dependant variable is the new medication.

The study did indicate some possible bias. The standard errors were high, especially for the Humira-Remicade set. In addition, the values showed some consistent variation across the step-wise linear restricted regressions, so there is a possibility that the effects are conservative due to a missing control. Group practices were not divided further to delineate small groups from large medical groups. Group practices were also not separated as single-specialty or multi-specialty groups. Such distinctions would be useful in providing more distinctive data concerning practice type. A log-regression function may be used in the future to get a more accurate assessment of the effects that were measured. Further research is necessary to confirm these findings and take the next step towards tempering differences in the healthcare system.

The results of the study showed there was a non-significant effect of the two conditions on solo and group practice behavior. There was a positive effect for Advicor after the approval date, indicating solo physicians were more likely to prescribe Advicor over Lovastatin. Interestingly, there was a negative effect for Humira after the approval date, indicating solo physicians were less likely to prescribe Humira over Remicade. The study suggests there is a measurable difference present in the prescribing behavior of solo versus group physicians when a new medication enters the market. However, additional factors special to the specific drug must determine the direction of this effect. One possible explanation for the discrepancy is Advicor incorporates Lovastatin plus a second drug together and purchasing one medication is cheaper than purchasing two separate ones.

The paper will progress in the following manner. The key institutional factors will discuss necessary basic facts concerning solo practice, group practice, and the medications involved in the study. Then there is a description of the dataset and some descriptive results. The next section is a presentation of the model followed by the results of the study. Lastly, the paper finishes with some concluding thoughts. The preliminary graphs are in the Figures section in the 'Appendices' at the end of the paper, followed by a descriptive table and regressions.

Key Institutional Factors

<u>Solo vs. Group Practice</u>

A discussion of group and solo practices is highly relevant. The latest data made available by the Bureau of Labor Statistics reports approximately 12% of physicians and surgeons were self-employed.[8] An important voice for medical group practices since its conception in 1926, the Medical Group Management Association (MGMA) defines a group practice as a "formal organization or legal entity of three or more physicians that share business and clinical facilities, records, and personnel."[9] The American Medical Association reported growing national numbers of group practices in 2003.[10] In 2007, the Department of Health and Human Services published a report of their own that supported and further explored these figures. The report found that in 2003-2004, "35.8 percent of physicians were in solo practices, 43.1 percent were in single-specialty group practices, and 21.1 percent were in multi-specialty group practices." In addition,

74.9% of "office-based physicians owned or were part owner of their practice."[11] These statistics illustrate the prevalence of group and solo practices and support my hypothesis that ownership status may be an important factor that influences prescribing behavior.

Selection of Prescriptions

There are two pairs of prescriptions examined in this study. The first pair includes Advicor and its predecessor Lovastatin, both prescriptions for high cholesterol. The National Health and Nutrition Examination Survey reported that in 2005-2006, 16% of adults had total cholesterol levels of 240 mg/dL or greater. These cholesterol levels are in the high-risk category for heart disease. Although the percent of adult screening has increased, 8% still have been found to have high cholesterol, but had not been diagnosed by a doctor.[12] A Morbidity and Mortality Weekly Report claimed a 10% decrease in total cholesterol levels might result in an estimated 30% reduction in the incidence of coronary heart disease.[13]

Lovastatin, with brand names Mevacor and Altoprev, is a cholesterol-reducing HMG-CoA reductase inhibitor.[14] Like other statins, Lovastatin lowers total bad cholesterol and increases good cholesterol in order to help slow coronary artery disease.[18] Advicor was the first drug to combine Lovastatin with Niacin into a single oral drug for lowering cholesterol. It is the same medication, but it is new in that it allows patients to only buy one prescription instead of two.[15] Advicor was approved by the FDA in 2001 and appears in the sample in 2002.

The second pair of drugs includes Humira (adalimumab) and its predecessor Remicade (infliximab), both prescriptions for rheumatoid arthritis. A 2007 study in the American Journal of Medicine cited that an estimated 25 men and 54 women per 100,000 in the population are afflicted with rheumatoid arthritis, making it the most common inflammatory arthritis. The article also included a statistic stating it was responsible for 250,000 hospitalizations and 9 million physician visits in the U.S. each year.[16] The National Institute of Arthritis and Musculoskeletal and Skin Diseases publishes a handout that claims 1.3 million adults, or 0.6% of the U.S. population, suffer from rheumatoid arthritis. This number is low when compared to previous estimates due to a recent re-defining of the condition, but still encompasses over 1 million people.[17]

Both Humira and Remicade are medications known as TNF-alpha blockers. TNF-alpha is a protein that can cause pain and inflammation as well as severe joint damage.[18] The FDA approved Remicade, the second TNF inhibitor, in 1999. The drug uses a combination of human and mouse proteins to create a monoclonal antibody. Humira is different because it is the first fully human monoclonal antibody.[16] The other important difference between Humira and Remicade deals with administration of the drug. Humira is self-administered as a biweekly subcutaneous injection whereas Remicade is an intravenous infusion only provided in the physician's office.[19] The first instance of Humira in the sample is in 2005 indicating a possible sample error as the FDA approved it a few years earlier. This discrepancy in time period is most likely a failure in the survey,

but is not expected to drastically skew results because two full years of data are still available for an accurate comparison.

Description of Data

Data Sources

My data is taken from the National Ambulatory Medical Care Survey (NAMCS). NAMCS is a national survey of a sample of visits to physicians that provide direct patient care on an outpatient basis. The specialties of anesthesiology, pathology, and radiology were excluded. The survey was conducted annually from 1973 to 1981, 1985, and every year after 1989. Data was collected from the physician over a randomly assigned one-week reporting period.[20] The data provides a patient weight in order to be able to extrapolate the findings of the sample to a national estimate.

My study will utilize the specific years of 1997-2007 because these years have the most detailed information on patient characteristics, physician characteristics, and from six to eight medications prescribed. With regard to patient characteristics, I have included the number of co-morbidities, the number of total medications prescribed, age, sex, race, and insurance. Physician characteristics were region, location in a metropolitan area, descriptors of the patient-physician relationship, descriptors of the visit, and employment status. These selections were made because they were the most consistently present in the data and are likely to have a possible effect on outcome.

<u>Descriptive Results</u>

The preliminary charts and graphs reveal a few interesting points about the sample. Figure 1 shows a graph for each pair of drugs; panel A shows the numbers of prescriptions of the cholesterol drugs, Advicor and Lovastatin, by year, and panel B shows the numbers of prescriptions of Humira and Remicade, the arthritis drugs, by year. The dashed line represents the new medication in both panels and the solid line represents the older competitor. Both y-axes are weighted to represent the national estimate. The x-axis for the Humira and Remicade graph begins with the year 2000 due to the availability of data in the sample.

Panel A shows the introduction of Advicor to the sample in 2002 and illustrates how vastly popular Lovastatin was, even after the introduction of Advicor. There is a sharp and mostly continuous increase in Lovastatin starting in 2002 that peaks at over 5,000,000 annual prescriptions. There is also a steady upward trend in Advicor, but at a slower rate than Lovastatin. In Panel B of Figure 1, there is an observable drop in prescriptions for Humira in 2006 that is most likely the result of a problem with the sample. Unlike Humira's jagged increase, Remicade steadily increases to around 900,000 annual prescriptions with the exception of one drop from 550,000 to 200,000 annual prescriptions in 2002 to 2003.

Figure 2 shows the number of prescriptions that were written in solo or group practices, clinics or urgicenters, health or mental health centers, family planning clinics, HMOs, and other practice types. Figure 2 is divided into two

panels: panel A shows the prescriptions written for Lovastatin vs. Advicor and panel B shows the prescriptions written for Remicade vs. Humira. Both panels are organized in a horizontal bar graph with the darker bar representing the newer medication. The x-axis was weighted to represent the national estimate.

Panel A and panel B both maintain that the majority of prescriptions written were in 'Solo and Group' practices. In panel A, there were about 4,000,000 prescriptions written in HMOs, but these were excluded given the almost 14,000,000 prescriptions written for Lovastatin in 'Solo or Group' and the fact that none of the other medications appeared in significant numbers for HMOs in the sample. Therefore, in order to simplify the regression and obtain the clearest results, group practices were isolated from HMOs and the term 'Non-Solo' in this study should be taken to mean a group practice of two or more physicians. There was a comparatively small number of prescriptions written for Lovastatin in the clinic/urgicenter, health or mental health center, and other practice types. In panel B, there were similarly small numbers of prescriptions written for Remicade in the clinic/urgicenter and health or mental health practice types. For the solo or group practice type, Remicade was measured at around 2,750,000 prescriptions and there were almost 1,000,000 prescriptions for Humira. Since the majority of prescriptions were written in solo or group practices, the data supports my decision to focus the analysis of this study on these two types.

Figure 3 further illuminates the sample size of the study in that it shows the estimated number of prescriptions that were written nationally in a solo versus

non-solo practice. The figure is organized as a vertical bar graph divided into four sections along the horizontal axis for each prescription. Each section contains two bars each for solo and non-solo practice types, with the darkest bar representing solo practices. Figure 3 includes a patient weight variable to be representative of the national estimate.

Every drug had significantly more prescriptions written in a non-solo setting, especially for Lovastatin. Lovastatin is clearly the largest in the sample for both types of practices with just over 14,000,000 prescriptions written in a non-solo practice and almost 4,000,000 prescriptions written in a solo practice. While Lovastatin is the largest in the sample, the prescriptions written for Advicor, Remicade, and Humira were similar in number and estimated at between around 500,000 and 2,000,000. Even Humira with the fewest prescriptions had a sample size of hundreds of thousands of prescriptions over the years based on the y-axis scale of 2,000,000.

Figure 5 is a series of four panels that shows the number of solo and non-solo practices in the sample that prescribed the medications each year. Panel A is a graph illustrating the breakdown of solo and non-solo practices prescribing Lovastatin; panel B is a similar graph for Advicor; likewise, panel C depicts Remicade and panel D, the final graph, depicts the practices prescribing Humira. In each panel, the dashed line represents the solo practice. Unlike the previous figures, Figure 5 is a pure description of the sample itself without weights.

Panel A (Lovastatin) shows an upward trend similar to the number of total annual prescriptions in Figure 1. Panel B (Advicor) and panel D (Humira) show

non-solo practices as significantly more prevalent in the sample. Panel B shows a two-tiered increase in non-solo practices with a slight dip between 2003 and 2005. The number of solo practices increases dramatically in 2003, but then sees a steady decline from 2004 onward. Panel D shows a sharp increase in solo practices starting in 2006 and a more jagged increase in non-solo practices beginning in 2004. Although panel C (Remicade) has higher values for non-solo practices, they track annually in a similar pattern to the solo practice values indicating tandem growth with the exception of a sharp jump in 2002 for solo practices.

The descriptive characteristics table [Table 1] contains sample means for solo versus non-solo practices with corresponding t-values in the far right column. The standard errors are located in parentheses beneath the sample means. Each variable represents a descriptor of the physician or the patient that is relevant to the regressions. The variables are divided into six categories of health status, demographics, physician descriptors, region, insurance variables, and employment.

Due to the large sample sizes and the resulting precision of the estimates, all the differences are statistically significant, but the differences between solo and group practices are not in general large enough or economically important. The high t-values also indicate significant similarity between the samples. The lack of stark contrast maintains the presumption that the patients treated in solo and non-solo practices are similar enough to avoid omitted variable bias in the

regression results. It is possible these variables are be a potential source of bias that is I will address by adding them as controls in my analysis.

Model

In order to properly control for extraneous influences, there are necessary characteristics that have to be considered for both the patients and the physicians. As in Table 1, these characteristics are split into six different categories as follows. Health status controls included the number of co-morbidities and the number of total medications prescribed to the patient. These variables were chosen because they are proxy measures of health status that could influence physician behavior. Demographic controls included age, race, and gender. Physician descriptors included the physician's status as the patient's primary, whether the physician had seen the patient before, whether the patient had contact with someone other than the physician such as a physician's assistant or nurse practitioner, and whether the practice was located in a metropolitan area. Region fixed effects partition the United States into the Northeast, Midwest, South, and the West. Insurance variables were identified as Medicare, Medicaid, Private Insurance, Worker's Compensation, Self-Pay, and No Charge. Finally, the last regression takes the employment status of the physician into account and indicates owner, employee, or contractor.

To accomplish the goals of the study, I will be utilizing the following linear structural model:

$$(1)\ \text{Prescription}_{it} = \beta_0 + \beta_1\text{SOLO}_{it} + \beta_2\text{SOLO}_{it}*I\{\text{YEAR}_t>=2002\} +$$

$$\beta_3 I\{\text{YEAR}_t>=2002\} + \mu´xit + \varepsilon$$

For each set, this model is used twice. The binary dependent variable for the first regression set is a prescription for either drug in the set, given whether the patient visited a solo or group practice in a certain year (SOLO_{it}), whether a patient visited a solo practice after the new medication was available ($\text{SOLO}_{it}*I\{\text{YEAR}_t>=2002\}$), whether the year was post-introduction of the new medication ($I\{\text{YEAR}_t>=2002\}$), and a set of controls that accounted for various patient and physician characteristics ($\mu´xit$). For Prescription_{it}, a one represented receiving either of the two medications and a zero represented all other outcomes. Likewise, SOLO_{it} and $\text{SOLO}_{it}*I\{\text{YEAR}_t>=2002\}$ are binaries with a one assigned for solo practice and a zero assigned for group practice. Using this model, I will be able to take prescription outcomes and isolate its correlation with physician practice type, while controlling for other factors. The second regression set follows the same model except the binary dependent variable is whether a prescription was written for the new or old medication. In this case, the new medication was assigned a one and the old medication was assigned a zero. A patient weight was used to expand the data to a national estimate.

Results

Tables 2 through 4 show the main results of this analysis. In Table 2, the sample includes all cases, and the binary dependent variable is an indicator for whether either Lovastatin or Advicor was prescribed in that case. A one was

assigned to the two drugs and a zero was given to all other cases. Each column

shows results from a different ordinary least squares (linear probability model)

regression. In each case, the coefficients of interest are an indicator for solo

practice, an indicator for Year ≥ 2002, and the interaction of these two variables.

The specification in column (1) includes those variables and no controls. In

column (2), controls for the patients' health status are added; demographic

controls are added in column (3); column (4) included physician descriptors;

region fixed effects are added in column (5); column (6) contains insurance

controls; column (7), the final column, included all these controls plus the

addition of employment variables. A step-wise regression table was used in order

to determine if any one group of controls drastically affected the results. The

bottom section indicates with a 'Yes' term the control categories that were

included in the regression. The last row is the R^2 for each regression.

In Table 2, the results were mostly consistent across all seven regressions.

Of all the non-significant measurements in column (7), the most significant

coefficient was for the year after 2002, which showed a .003. The variable for

either prescription after 2002 at a solo practice saw a .002 decrease in column (7).

The solo practice variable saw the biggest amount of variation, but the

coefficients were so small that it most likely indicates no effect at all. The solo

variable fluctuated from a -0.0001623 in column (1) to a .0004 in column (7).

Given these small numbers and the general consistency, it can be determined that

there was not a significant difference between solo and group physicians for the

prescribing of high cholesterol that is unrelated to the medications. It further

indicates additional controls did not heavily impact the regression and so the possibility that an unknown control may drastically sway these results is minimized.

Table 3 restricts the same to cases in which Lovastatin or Advicor was prescribed, and the binary dependent variable is an indicator for whether the newer drug (Advicor) was the one prescribed. A one indicated Advicor and a zero was assigned to Lovastatin. Similar to Table 2, each column shows results from a different ordinary least squares (linear probability model) regression. The columns add controls progressively in the same manner as Table 2.

Table 3 showed some significant indicators. The solo variable for the years after 2002 gradually increased from 0.088 in column (1) to .197 in column (7), illustrating an increasing effect with additional controls. Likewise, the solo variable for all the years steadily decreased from near zero in column (1) to -0.161 in column (7). Therefore, there is a possibility that the values in the seventh regression are still conservative due to some unaccounted for control. The adequacy of the model is demonstrated by the R^2 values. The final R^2 of .154 in column (7) suggests that a log regression may more be a more adequate model. The high standard errors also suggest the possibility of an error in the construction of the model. The most realistic regression, column (7) shows the positive effect of the solo practice variable for the years after 2002 was .197. The negative solo variable for all years (-0.161) may be explained by the fact that Lovastatin was vastly popular and continued to be so after Advicor entered the market, even though some solo physicians were changing their prescribing behavior. It is also

likely that some of the change is due to the fact that one prescription is generally less expensive than two prescriptions that are equivalent to Advicor.

Table 4 is organized in the same way as Table 2. The dependent variable is a binary indicator for whether Humira or Remicade was prescribed, with a one representing a prescription for either of the medications and a zero representing all other cases. In Table 4, the solo variable for the years after 2005 show a largely consistent .00012 across the columns. Solo practice varied from 0.0000775 in the first column to .00004 in column (7). Finally, the year variable stayed completely consistent at .00001. All of these coefficients are non-significant and although slightly more variable, the small values confirm the same conclusions as with the Advicor-Lovastatin set in Table 2. Additional unknown controls may cause some results to change, but most likely not to any significant amount. There is also no indication that there is any difference between solo and group physicians that is a product of the diagnosis and unrelated to the two medications.

Table 5 restricts the sample to cases in which one of those two drugs was prescribed, and the binary dependent variable is an indicator for whether the newer drug (Humira) was the one prescribed. In this table, a prescription of Humira was assigned a value of one and zero was given to prescriptions for Remicade. The organization for Table 5 was the same as the previous regression tables. The variation between the regressions in the solo variable was not a steady rise or decline, but rather showed some jumps. The effect of a solo practice is .110 in the fourth column, which is an increase from the previous columns, but by the

seventh and most complicated column the effect is at -0.080. The solo variable for

the years after 2005 does not fluctuate and indicates a significant and large effect

of -0.233 in column (7). The increasing R^2 with a value of .528 in the last column

is an encouraging indicator that this final regression model is a better fit for the

data, although the standard errors are still high.

Conclusion

This study attempted to ascertain whether the type of practice to which

physicians belong influences the types of medications they prescribe. The study

used two different pairs of medications: Advicor vs. Lovastatin, and Humira vs.

Remicade. The study also included a number of controls under the categories of

health status, demographics, physician descriptors, region, insurance variables,

and employment status.

The results revealed the following conclusions. Solo physicians were more

likely to prescribe Advicor over Lovastatin, but less likely to prescribe Humira

over Remicade. Although both sets of prescriptions failed to show the same

consistent trend, there was a significant difference in prescribing behavior for

both Advicor and Humira. This suggests that not only is there a difference present

in the prescriptions written in solo versus group physicians, but that there are

additional factors regarding the type of drug that determine the direction of this

difference. One possible explanation for the discrepancy is Advicor incorporates

Lovastatin plus a second drug together and purchasing one medication is cheaper

than purchasing two separate ones. Although this study determined an effect on

prescribing behavior, it was not designed to identify the actual source of the

observed effect. This represents a significant gap in our knowledge and

understanding of the physician-patient relationship.

Endnotes

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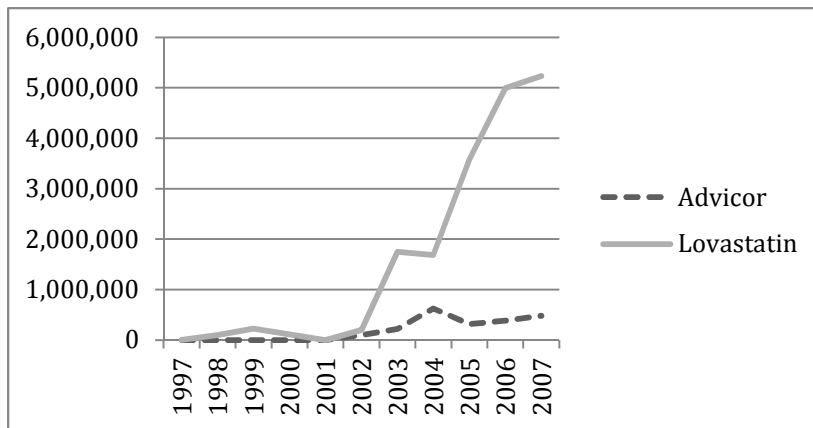**Appendices**

<u>Figures</u>

Figure 1 – Number of Annual Prescriptions

Panel A:

Panel B:
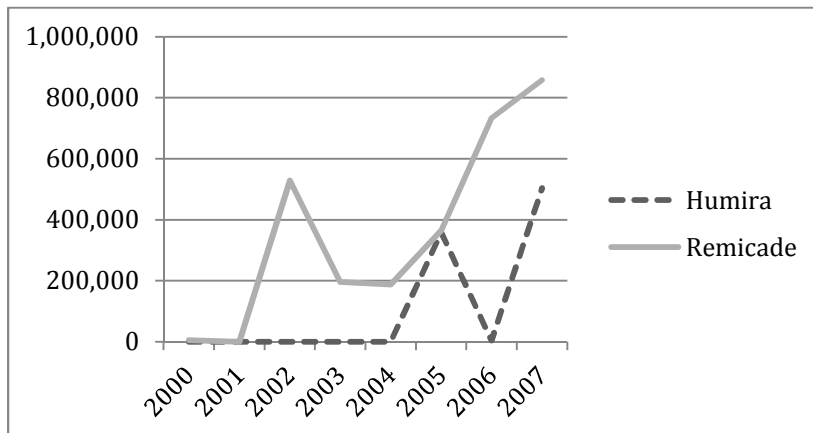
Figure 1 has a graph for each prescription pair and shows the number of prescriptions written for each drug by year. Both y-axes are weighted to represent the national estimate. The x-axis for the Humira and Remicade graph begins with the year 2000 due to the availability of data in the sample.

Figure 2 - Number of Prescriptions in Different Types of Practices

Panel A:
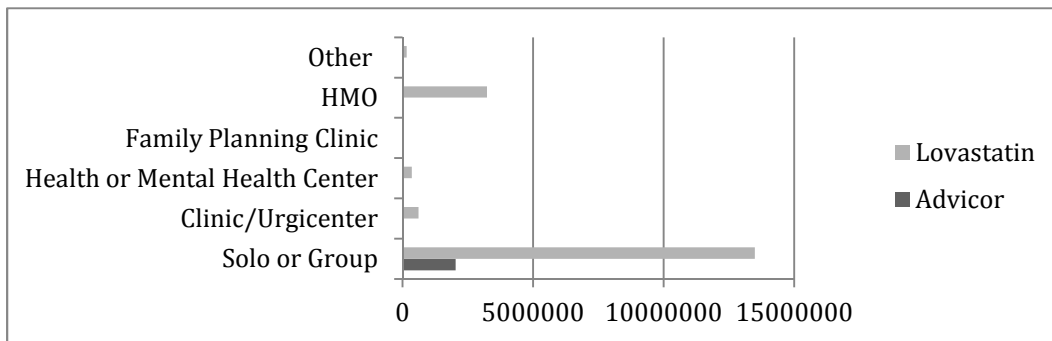
Panel B:
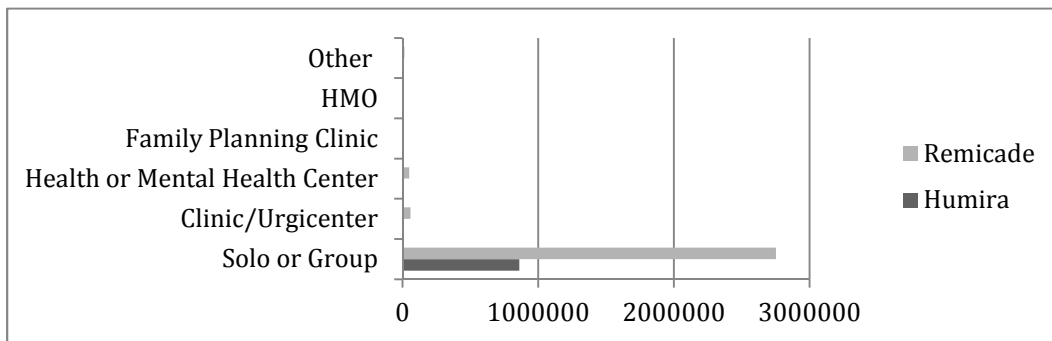
Figure 2 is split into two separate panels due to the significantly higher prevalence of Lovastatin. The x-axis was weighted to represent the national estimate.

Figure 3 – Estimated Number of Prescriptions Written Nationally In a Solo vs. Non-Solo Practice
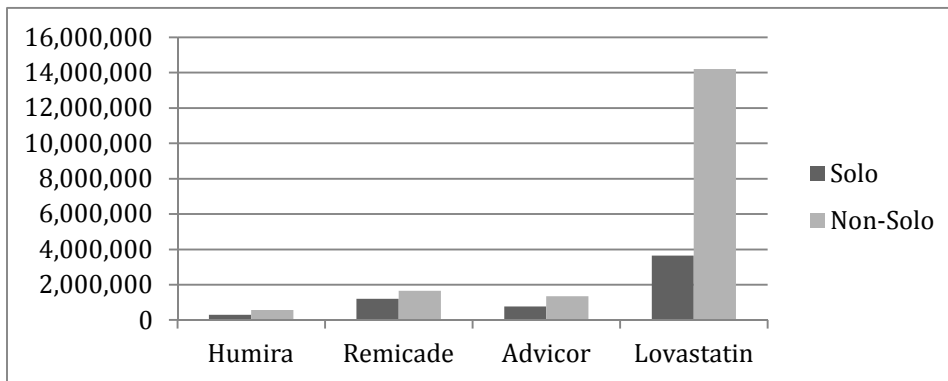
Figure 3 breaks the prescriptions written for each medication down into whether they originated from a solo or non-solo practice. It should be noted that Figure 3 also includes a patient weight variable to be representative of the entire country.

Figure 4 – Number of Solo and Non-Solo Practices in Sample That Prescribed Medications

Panel A
Lovastatin:

Panel B
Advicor:

Panel C
Remicade:

Panel D
Humira:

Figure 4 is a series of four panels, one per medication. Each medication is broken down into whether it was prescribed in a solo or non-solo practice by year. There is no weight alteration.

Tables

Table 1 – Descriptive Tables

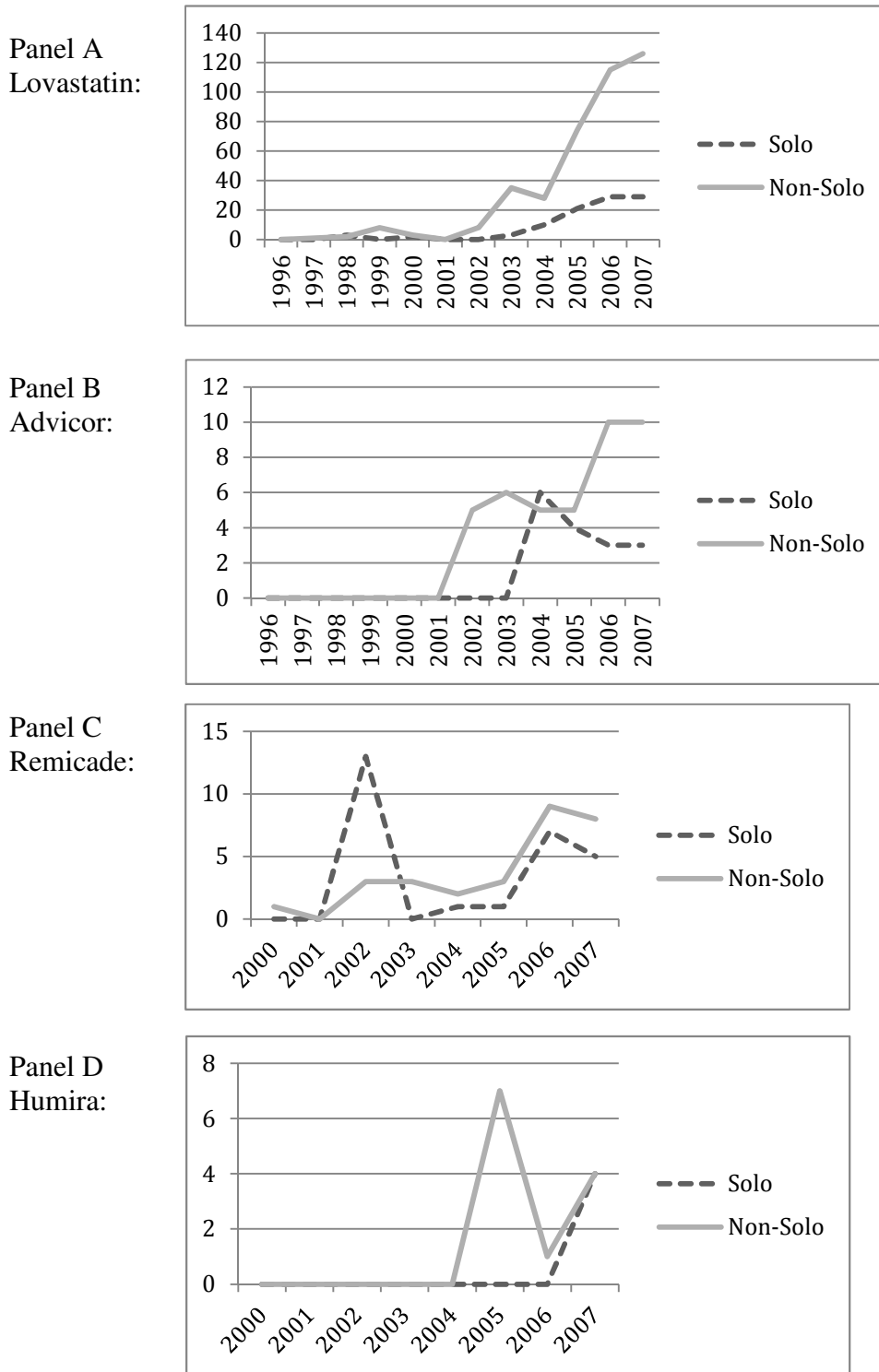| Descriptive Characteristics				
		Solo	Non-Solo	t
Health Status	Co-morbidities	0.700	0.660	-11.86
		(0.788)	(0.799)	
	Total Medications	1.550	1.760	-25.56
		(1.830)	(2.094)	
Demographic	Age	47.122	45.497	15.69
		(0.080)	(0.065)	
	Female	0.577	0.570	3.30
		(0.002)	(0.001)	
	White	0.859	0.867	-5.06
		(0.001)	(0.001)	
Physician Descriptors	Primary Care Physician	0.344	0.372	-13.96
		(0.002)	(0.001)	
	Seen Before	0.857	0.853	2.38
		(0.001)	(0.001)	
	Saw Physician	0.960	0.975	-18.32
		(0.001)	(0.000)	
	Saw Physician's Assistant	0.024	0.024	0.55
		(0.001)	(0.000)	
	Saw Nurse Practitioner	0.014	0.010	9.73
		(0.000)	(0.000)	
Region Fixed Effects	Metropolitan Area	0.826	0.864	-24.59
		(0.001)	(0.001)	
	Northeast	0.237	0.201	20.03
		(0.001)	(0.001)	
	Midwest	0.187	0.243	-32.54
		(0.001)	(0.001)	
	South	0.361	0.336	12.34
		(0.002)	(0.001)	
	West	0.216	0.220	-2.57
		(0.001)	(0.001)	
Insurance	Private Insurance	0.515	0.591	-35.95
		(0.002)	(0.001)	
	Medicare	0.251	0.244	3.78
		(0.001)	(0.001)	
	Medicaid	0.111	0.101	8.14
		(0.001)	(0.001)	
	Worker's Comp	0.017	0.016	0.78
		(0.000)	(0.000)	
	Self Pay	0.097	0.040	50.80
		(0.001)	(0.001)	
	No Charge	0.009	0.008	2.28
		(0.000)	(0.000)	
Employment Status	Owner	0.926	0.625	196.10
		(0.001)	(0.001)	
	Employee	0.050	0.334	-199.33
		(0.001)	(0.001)	
	Contractor	0.024	0.040	-22.65
		(0.001)	(0.001)	
	Group	0.000	0.838	-879.90
		(0.000)	(0.369)	

Table 1 contains sample means for solo versus non-solo practice with corresponding t-values in the far right column. The standard errors are located in parentheses beneath the sample means.

Table 2

Effect of Solo Practice Variation on Total Prescriptions (Unrestricted Sample)

Dependent Variable is an Indicator for Received Either Lovastatin or Advicor

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Solo * Year>=2002	-0.002 ***	-0.002 ***	-0.002 ***	-0.002 ***	-0.002 ***	-0.002 ***	-0.002 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Practice is Solo/100	-0.016 *	-0.005	-0.018 *	-0.016	-0.008	-0.006	0.040 *
	(0.000)	(0.028)	(0.008)	(0.008)	(0.008)	(0.009)	(0.016)
Year >= 2002	0.005 ***	0.003 ***	0.003 ***	0.003 ***	0.003 ***	0.003 ***	0.003 ***
	(0.000)	(0.020)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Health Status?		Yes	Yes	Yes	Yes	Yes	Yes
Demographic Controls?			Yes	Yes	Yes	Yes	Yes
Physician Descriptors?				Yes	Yes	Yes	Yes
Region Fixed Effects?					Yes	Yes	Yes
Insurance Controls?						Yes	Yes
Employment Controls?							Yes
R^2	0.002	0.009	0.010	0.010	0.010	0.011	0.011

The dependent variable for this unrestricted regression is an indicator for receiving either Advicor or Lovastatin. The regressions add additional controls as the columns progress from left to right as indicated by the 'Yes' term. The Practice is Solo variable was multiplied by one hundred for reading comprehension. A patient weight was used to represent the national estimate. '*' = p-value < .05; '**' = p-value <.01; '***' = p-value < .001.

Table 3

Effect of Solo Practice Visitation on Patient Medication Outcomes (Restricted Sample)

Dependent Variable is an Indicator for Received Advicor Instead of Lovastatin

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Solo * Year >=2002	0.088	0.081	0.099	0.105	0.166**	0.169**	0.197**
	(0.051)	(0.053)	(0.056)	(0.056)	(0.069)	(0.070)	(0.075)
Practice is Solo	0.000***	0.002	-0.026	-0.029*	-0.114*	-0.119*	-0.161*
	(0.000)	(0.025)	(0.030)	(0.030)	(0.050)	(0.052)	(0.058)
Year >=2002	0.089***	0.101***	0.005*	0.057*	0.024	0.021	0.003
	(0.016)	(0.020)	(0.026)	(0.027)	(0.032)	(0.035)	(0.044)
Health Status?		Yes	Yes	Yes	Yes	Yes	Yes
Demographic Controls?			Yes	Yes	Yes	Yes	Yes
Physician Descriptors?				Yes	Yes	Yes	Yes
Region Fixed Effects?					Yes	Yes	Yes
Insurance Controls?						Yes	Yes
Employment Controls?							Yes
R^2	0.017	0.034	0.081	0.085	0.128	0.143	0.154

The dependent variable for this restricted regression is an indicator for receiving Advicor instead of Lovastatin. The regressions add additional controls as the columns progress from left to right as indicated by the 'Yes' term. A patient weight was used to represent the national estimate. '*' = p-value < .05; '**' = p-value <.01; '***' = p-value < .001.

Table 4

Effect of Solo Practice Visitation on Patient Medication Outcomes (Unrestricted Sample)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Dependent Variable is an Indicator for Received Either Humira or Remicade					
Solo * Year>=2005;100	0.013	0.012	0.012	0.015	0.013	0.012	0.012
	(0.000)	(0.042)	(0.042)	(0.042)	(0.041)	(0.041)	(0.041)
Practice is Solo;100	0.008	0.013	0.013	0.009	0.008	0.009	0.004
	(0.000)	(0.008)	(0.009)	(0.009)	(0.009)	(0.009)	(0.010)
Year >= 2005	0.001 ***	0.001 **	0.001 **	0.001 **	0.001 **	0.001 **	0.001 **
	(0.000)	(0.000)	(0.000)	(0.020)	(0.000)	(0.000)	(0.000)
Health Status?		Yes	Yes	Yes	Yes	Yes	Yes
Demographic Controls?			Yes	Yes	Yes	Yes	Yes
Physician Descriptors?				Yes	Yes	Yes	Yes
Region Fixed Effects?					Yes	Yes	Yes
Insurance Controls?						Yes	Yes
Employment Controls?							Yes
R²	0.003	0.001	0.001	0.002	0.002	0.002	0.002

The dependent variable for this unrestricted regression is an indicator for receiving either Humira or Advicor. The regressions add additional controls as the columns progress from left to right as indicated by the 'Yes' term. The following variables were multiplied by one hundred for reading comprehension: Solo*Year, and Practice is Solo. A patient weight was used to represent the national estimate. '*' = p-value < .05; '**' = p-value <.01; '***' = p-value < .001.

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Table 5

Effect of Solo Practice Visitation on Patient Medication Outcomes (Restricted Sample)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
			Dependent Variable is an Indicator for Received Humira Instead of Remicade				
Solo * Year>=2005	-0.052	-0.181	-0.088	-0.194	-0.304	-0.22	-0.233
	(0.161)	(0.143)	(0.182)	(0.217)	(0.265)	(0.256)	(0.258)
Practice is Solo	0.300**	0.078	0.030	0.118	0.037	-0.099	-0.080
	(0.090)	(0.175)	(0.185)	(0.190)	(0.242)	(0.205)	(0.204)
Year >= 2005	0.325**	0.486***	0.426**	0.393**	0.444**	0.402**	0.487**
	(0.095)	(0.130)	(0.145)	(0.144)	(0.139)	(0.141)	(0.149)
Health Status?		Yes	Yes	Yes	Yes	Yes	Yes
Demographic Controls?			Yes	Yes	Yes	Yes	Yes
Physician Descriptors?				Yes	Yes	Yes	Yes
Region Fixed Effects?					Yes	Yes	Yes
Insurance Controls?						Yes	Yes
Employment Controls?							Yes
R^2	0.101	0.214	0.254	0.356	0.442	0.494	0.524

The dependent variable for this restricted regression is an indicator for receiving Humira instead of Remicade. The regressions add additional controls as the columns progress from left to right as indicated by the 'Yes' term. A patient weight was used to represent the national estimate. '*' = p-value < .05; '**' = p-value <.01; '***' = p-value < .001.

Summary

Healthcare is a system of asymmetrical information. Physicians are trained to properly diagnose and treat their patients. Patients, for their part, trust that the decisions made by their doctors are appropriate and in their best interest. However, healthcare is also a business and it has been well documented that the behavior of physicians is influenced by outside factors, in particular the type of practice a physician belongs to.

This study explores whether the type of practice to which physicians belong influences the types of medications they prescribe. The type of practice is defined here as a solo practice or a group practice. A group practice consists of two of more physicians, with HMOs eliminated for consistency. In particular, I hypothesize that solo practice doctors might be less likely than group practice doctors to adopt new medications because, as owners, they face greater workloads and administrative burdens and are less exposed to peer consultation. The estimates presented in this paper can help to provide patients and health care professionals with information about how the choice of one doctor or another can affect treatment.

To analyze the effect of the type of practice on the types of medications prescribed, the data for this study is taken from the National Ambulatory Medical Care Survey (NAMCS) from which I chose two different pairs of prescriptions. The prescriptions were chosen based on the criteria that were intended for a very common diagnosis in order to ensure a large sample size, the new medication had to be made available within the years 1997 and 2007 in order to be able to

document a change within my dataset, and the medication could not be a completely new invention because there needed to be a commonly prescribed competitor for comparison.

The first pair I chose was Advicor and its predecessor Lovastatin because of the millions of Americans affected by high cholesterol. Advicor was the first drug to combine Lovastatin with Niacin into a single oral drug for lowering cholesterol. It is the same medication, but it is new in that it allows patients to only buy one prescription instead of two. The second pair of medications consisted of Humira and its predecessor Remicade, which treat rheumatoid arthritis. Arthritis is another extremely debilitating condition with a large-scale impact. Humira is different from Remicade because it is a new antibody that expands on previous technology. Humira is also administered differently from Remicade.

Each pair of medications has two linear regression sets. The first regression set is with an unrestricted sample where the dependent variable represents if a prescription was written for either medication. For the Advicor-Lovastatin pair, the regression had non-significant results and showed there was no difference between solo and group practice physicians that was inherent in the condition. The first regression set for the Humira-Remicade pair replicated these results. It also found a non-significant effect and confirmed there was no underlying selection difference between solo and group practice physicians for patients with high cholesterol or arthritis.

The second regression set is a restricted sample where the dependant variable is receiving the newer of the two medications. For the Advicor-Lovastatin pair, the regression estimates whether the type of practice influences physicians prescribing behavior. The results revealed a positive effect for Advicor after the approval date, indicating solo physicians were more likely to prescribe Advicor over Lovastatin. Interestingly, the second regression set for the Humira-Remicade medication pair had different results. This restricted regression showed a negative effect for Humira after the approval date, indicating solo physicians were less likely to prescribe Humira over Remicade.

The study did have some flaws. The standard errors were high, especially for the Humira-Remicade set. In addition, the values showed some consistent variation across the step-wise linear restricted regressions, so there is a possibility that the effects are conservative due to a missing control. Group practices were not divided further to delineate small groups from large medical groups. Group practices were also not separated as single-specialty or multi-specialty groups. Such distinctions would be useful in providing more distinctive data concerning practice type. A log-regression function may be used in the future to get a more accurate assessment of the effects that were measured. Further research is necessary to confirm these findings and take the next step towards tempering differences in the healthcare system.

In conclusion, solo physicians were more likely to prescribe Advicor over Lovastatin, but less likely to prescribe Humira over Remicade. Both sets of prescriptions failed to show the same consistent trend, but there was a significant

effect on prescribing behavior measured in each case. This suggests that not only is there an difference present in the prescriptions written in solo versus group physicians, but that there are additional factors regarding the type of medication that determine the direction of this difference. One possible explanation for the discrepancy is Advicor incorporates Lovastatin plus a second drug together and purchasing one medication is cheaper than purchasing two separate ones. Although this study determined an effect on prescribing behavior, it was not designed to identify the actual source of the observed effect. This represents a significant gap in our knowledge and understanding of the physician-patient relationship.