Variations in Patient Response to Tiered Physician Networks

Anna D. Sinaiko, PhD

ABSTRACT

Objectives: Prior studies found that tiered provider networks channel patients to preferred providers in certain contexts. This paper evaluates whether the effects of tiered physician networks vary for different types of patients.

Study Design: Cross-sectional analysis of fiscal year 2009 to 2010 administrative enrollment and claims data on nonelderly beneficiaries in Massachusetts Group Insurance Commission health plans.

Methods: Main outcome measures are physician market share among new patients and the percent of physician's patients who switch away. We utilized estimated fixed effects linear regression models that were stratified by patient characteristics.

Results: Physicians with the worst tier rankings had lower market share among new patients who are older and sicker, or male, representing losses in market share of 10% and 15%, respectively, than other tiered physicians. A poor tier ranking did not affect physician market share of new patients who are female or younger. There was no effect of a physician's tier ranking on the proportion of patients who switch to other doctors among any groups of patients.

Conclusions: Loyalty to their own physicians is pervasive across groups of patients. Physicians with poor tier rankings lost market share among new patients who are older and sicker, and among new male patients. Together, these findings suggest that tiered network designs have the potential for the greatest impact on value in healthcare over time, as more patients seek new relationships with physicians.

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Tiered physician networks are a managed care network design used by payers to contain healthcare costs and improve value in the healthcare system. Physicians are sorted into strata within the network based on their performance on quality and cost-efficiency measures, and patients are assessed lower co-payments for visits with physicians in preferred (eg, better-performing) tiers. This network design aims to channel patients to preferred physicians by virtue of the quality and value signal provided through the rating system, the financial incentive provided through the lower co-payment, or both simultaneously. Motivating providers to improve their performance so as to improve their tier ranking, either to prevent a loss in market share of patients or simply for its own sake, is a second aim of this network design.

Increases in patient out-of-pocket medical costs are known to decrease the amount of medical care that patients use,[1] but the majority of evidence on patient response to changes in physician cost sharing is based on price changes that affect all physician services, not just a select, or tiered, group of physicians. Tiered network plans are relatively common in private health insurance—19% of all firms report offering a tiered network in the health plan with the largest enrollment[2]—but the evidence on the impact of tiered physician networks on patient choices is sparse. In previous work, I found that physicians with nonpreferred tier rankings and a $10- to $20-higher co-payment for an office visit earned a 12% lower market share of new patients than their top- or average-tiered colleagues, but were not more likely to have their existing patients switch away.[3]

Tiered networks can also focus on hospitals, and inter-tier cost-sharing differences are usually much larger. Scanlon et al found that workers in one union were more likely to select a preferred hospital for medical visits, which allowed them to avoid 5% coinsurance (equivalent to approximately $400 in out-of-pocket payments), while workers in a second

union and all patients admitted for a surgical diagnosis were no more likely to choose within the preferred tier of hospitals.[4] More recently, Frank et al evaluated the Blue Cross Blue Shield of Massachusetts tiered hospital network, where patients saved $900 out of pocket ($690) if they chose a top-tiered (middle-tiered) hospital relative to the worst-tiered hospitals, finding increased patient use of hospitals on the preferred and middle tiers relative to the nonpreferred tier.[5]

A related form of physician network design are "narrow networks" (also called "limited networks") that exclude physicians with the worst performance on quality and cost-efficiency measures from the network, and provide little to no reimbursement to patients for healthcare services received from out-of-network providers. Following the narrowing of a PPO network in Las Vegas, Nevada, that increased patient out-of-pocket costs to see excluded physicians from a $10 co-payment to 40% of allowed charges, nearly 9 out of 10 patients of affected physicians switched away.[6] However, sicker patients were observed to be more loyal to excluded physicians.

There is no evidence on whether the impact of tiered physician networks varies across patients, and the expected impact is uncertain. On one hand, older and sicker patients are likely to use more medical care and, thus, would have a greater net benefit from receiving care from better-tiered physicians. However, physician concerns about reliability of measurement (eg, if the measures used to evaluate performance do not adequately account for additional complexities and resources needed to treat sicker populations) and misclassification risk may make avoidance of higher-risk patients a potential unintended consequence of tiering.[7] Information about response gradients across patients is also important if tiered networks are to achieve their greatest impact, as they will need to channel sicker patients—who are associated with the highest proportion of medical spending—to higher-value providers. In contrast, savings due to tiered networks will be less if only the youngest, healthiest patients respond. More evidence can also inform the implementation of tiered networks and the focus of marketing and outreach.

This paper analyzes data from 5 commercial health plans in Massachusetts to test whether the impact of tiered physician networks varies across different groups of patients. Specifically, I assessed whether tier ranking affects physician market share among new patients or the proportion of patients who switch to other physicians for male versus female patients, older versus younger patients, and sicker versus healthier patients.

Take-Away Points

This paper evaluates whether the effects of tiered physician networks vary for different types of patients. I find that:

- Patients' loyalty to their own physicians is pervasive, as all patients were no more likely to switch away from worst-tiered physicians than any other physicians.
- Physicians with the worst tier rankings lost market share among new older, sicker patients.
- Tiered networks have promise as one of a set of mechanisms to increase the value of healthcare spending.
- Targeting these interventions at patients when they are choosing a new doctor may be more effective than strategies that interrupt existing care relationships.

METHODS

Group Insurance Commission Tiered Physician Networks

The Massachusetts Group Insurance Commission (GIC) is a quasi-state agency that provides health benefits to over 400,000 state and municipal employees, as well as retirees and their dependents. In fiscal year (FY) 2009 and FY2010, a 3-tiered physician network was included in all GIC non-Medicare health plans, with approximately 20% of physicians in the top tier, 65% classified in the middle, and 15% assigned to the bottom (or worst-performing) tier at each plan. In FY2009, the range of office visit co-payments was from $10 to $15 for the preferred tier, $20 to $25 for the middle tier, and $25 to $35 for the worst-performing tier; co-payments increased by $5 to $10 at all levels in FY2010.

Tier rankings were assigned based on physician quality performance first, and efficiency performance second, using a common, cross-health plan database of performance profiles. Physicians with insufficient data were assigned to the middle tier. Tiered networks in all health plans included cardiologists, endocrinologists, gastroenterologists, obstetricians/gynecologists, orthopedists, and rheumatologists. Plans could choose to implement tiered networks for additional specialties, and several also tiered allergist/immunologists, dermatologists, general surgeons, internal medicine, neurologists, ophthalmologists, and otolaryngology (for additional detail on tiering methodology and specialties, see the **eAppendix** [available at **www.ajmc.com**]).

Data Source

Administrative enrollment and claims data, for all non-Medicare individuals enrolled in 5 of the 6 GIC health plans over July 2006 to June 2010 (FY2007-FY2010), were

obtained. Data included patient age and gender, diagnosis code, and the providing physician's name, practice tax identifier, and tier ranking. Data also included a physician identifier variable—unique to each physician—and specialty designation for the providing physician on each claim. This was the same physician identifier used to construct the tiered physician networks by the plans, and allowed for reliable observation of unique physicians across claims data from different health plans. Claims where this identifier was unavailable were dropped (6% of claims).

Data Analysis

The analysis sample consisted of physicians in a tiered network in FY2009 and FY2010; the sample included 15,401 physician-year observations, of which 6236 were included in multiple plans' tiered networks. The main outcomes were the physician's market share among new patients, stratified by patient characteristics, and the percent of a physician's patients that switch to another doctor, also stratified by patient characteristics.

Following methods published previously, all office visits with tiered physicians were assessed for whether they were with a new physician or if the patient was a "potential switcher."[3] Patients who switched health plans during this period were excluded, because switches could be based (at least in part) on tiering (eg, to switch to a plan where one's physician has a better tier ranking) and subsequently bias the results. A patient is defined as "new" if neither the patient nor any other person in the patient's family had a visit within the same specialty in the previous 2 years. "Potential switchers" are patients who had at least 2 visits in prior years with a specific tiered physician and then had an office visit with any physician of the same specialty type in FY2009 or FY2010. Patients who saw a new, different doctor are classified as switchers. Patients who return to see the previous doctor are classified as non-switchers.

The effect of tiering on these outcomes was assessed within 6 subgroups of patients: 1) "older" patients, who were 46 years or older—the median patient age of patients of tiered physicians; 2) "younger" patients, who were younger than the median age; 3) "sicker" patients, who had a diagnosis in the study year or earlier in one of the 70 condition categories identified for risk adjustment in the Medicare CMS-Hierarchical Condition Categories (HCC) models[8]—this method for risk-adjustment was used because it focused on identifying individuals expected to have higher than average medical expenditures, and because it does not require information about the Diagnosis-Related Group assigned to hospitalizations, which was not available in our data; 4) "healthier" patients, who did not have any of these prior diagnoses; 5) males; and 6) females.

Each physician's market share of new patients by plan and patient group was calculated (eg, Dr Smith's share of new male patients in health plan X, Dr Smith's share of new male patients in health plan Y) as the physician's total number of new patients within a patient group and plan (eg, the number of Dr Smith's new male patients enrolled in health plan X) divided by the total number of new patients in that group and enrolled in that plan (eg, the total number of new male patients enrolled in health plan X). The percent of a physician's patients by plan and patient group who switched away was equal to the number of switchers among each group of patients and each plan (eg, the number Dr Smith's male patients in plan X who switched away) divided by the number of potential switchers in each group and plan (eg, the number Dr Smith's male patients in plan X who were potential switchers). To avoid misclassifying visits where a patient is seeking a second opinion as a switch, in sensitivity analyses a requirement was imposed that a switch entail a minimum of 2 visits with the new physician in a year.

Following earlier methods, I estimated multivariate models to analyze the impact of tiering. Models included dummy variables for plan, year, and specialty to control for differences in plan benefits, generosity, and tiered-network structures. The key empirical fact is over half (53%) of physicians tiered by at least 2 GIC health plans had different tier rankings across plans (eg, Dr Smith was ranked in the most-preferred tier in Plan A and the middle tier in Plan B in the same year). These differences occurred because the actual cut-points between tiers varied across plans, plans may have considered additional data (beyond the cost and quality ratings calculated from all-payer data aggregated by the GIC) on performance when determining tier rankings, and because plans with more selective or smaller networks may have ranked the same physician lower (in percentile terms) than a broad network simply because they excluded lower-performing physicians from the network. Models included a dummy variable for each physician to control for unmeasured differences among physicians that might differentially attract new patients (eg, reputation). With this control, the coefficient on the variable indicating a physician's tier ranking is the effect of tiering.

Results are presented as predicted probabilities based on regression models. Additional detail on data and methods is provided in the eAppendix. The Harvard T.H. Chan School of Public Health Institutional Review Board approved this study.

RESULTS

Among patients who had an office visit with a tiered physician in FY2009 or FY2010, 97,896 patients were new patients and 109,270 were potential switchers. New patients were more likely to be female (63%) and 41% had a prior diagnosis of a major medical comorbidity (Table 1). Potential switchers had similar characteristics, but were sicker (eAppendix Table).

Physicians with the worst tier rankings (eg, they had the lowest performance scores and highest office visit copayments) earned lower market shares of new patient visits among male patients and new older patients (Table 2). In contrast, tier rankings did not affect physician market share of new patients who were female or younger. Relative to their average-tiered colleagues, physicians with the worst tier ranking have a predicted market share of new male patients that is 0.08-percentage points lower (market share of 0.76% vs 0.88%), and of new older patients that is 0.12-percentage points lower (market share of 0.81% vs 0.69%). Although the magnitude of these differences is small, it is meaningful on a relative basis as it represents losses in market share of 15% among new male patients (ie, [0.89%-0.76%]/0.89% = 15%) and 15% of older patients.

Physicians with the worst tier rankings earned a lower market share of new patients with and without a major medical comorbidity; however, age and the number of comorbidities are highly correlated. To assess which of these characteristics is driving the results, I looked within the group of sicker patients and analyzed older patients versus younger patients. Physicians with the worst tier ranking did not lose market share among sicker, but rather, younger patients relative to their average-tiered colleagues (Table 2). However, among older and sicker patients who were selecting a new physician, physicians with the worst tier rankings experienced market share that was 0.11-percentage points lower than that earned by their top- and average-tiered colleagues. This is equivalent to a relative loss in market share of 10% among these patients.

There was no effect of physician tier ranking on the proportion of a physician's patients who switch to other doctors within any of the groups of patients. This result was unchanged in sensitivity analyses where patients were classified as having switched physicians only if they had a minimum of 2 visits with the new physician in a year.

Table 1. Characteristics of New Patients, 2008-2010

Characteristic	Number or %
Number of new patient visits[a]	88,926
Female	63.0%
Age group	
0-17 years	11.3%
18-30 years	14.0%
31-40 years	16.4%
41-50 years	23.8%
51-64 years	34.5%
Has any comorbidity[b]	41.1%
Most prevalent comorbidities	
Diabetes	13.0%
Heart disease	12.5%
Depression	10.3%
Cancer	9.3%

[a]New office visits are those where neither the patient nor a family member had a visit within the same specialty in the previous 2 years.
[b]Comorbidities include those identified by Medicare CMS-Hierarchical Condition Categories model (Pope et al 2011).
Source: Author's analysis of Massachusetts Group Insurance Commission administrative and medical claims data, July 1, 2008, to June 30, 2010.

DISCUSSION

This paper is one of the first to examine whether tiered physician networks have different effects on different types of patients. Patients' "stickiness" to their own physicians is pervasive, as all patients—including men, women, and patients who are older, younger, sicker, or healthier—were no more likely to switch away from lower-tiered physicians than higher-tiered physicians. When choosing a physician for the first time, however, tiered physician networks channeled new older, sicker patients, and new male patients away from tiered physicians with the worst ranking.

Multiple mechanisms could be at work, as patient choice of new physician could be a result of patients deciding for themselves, physicians using tier-ranking information in their decisions about where to refer their patients, or both. Regardless of whether certain demographic groups or their physicians are more likely to make different choices, the effect of tiering is that the worst-ranked physicians earned lower market share of certain groups of new patients. Another question arising from these findings is why tiering consistently channeled groups away from the worst performers with no movement between the average and the best tier levels. One explanation, is that individuals evaluate options not in terms of absolutes, but relative to reference points. Thus, patients may simply want to avoid physicians with the worst rankings but not move all the way to the top tier. It is also possible that a low number of top-tiered physicians, and capacity constraints in their practices, will prevent patients who want to choose them from doing so.

Table 2. Predicted Market Share of New Patients Within Sub-Group, FY2009-FY2010[a,b,c]

	Top Tier	Average Tier	Bottom Tier
Gender			
Male	0.88%	0.89%	0.76%[d]
Female	0.67%	0.68%	0.62%
Age, years			
<46	0.73%	0.75%	0.68%
≥46	0.78%	0.81%	0.69%[d]
Health status			
"Healthier" patients[e]	0.73%	0.74%	0.65%[d]
"Sicker" patients[f]	0.78%	0.80%	0.72%[d]
Among "sicker" patients			
<46	1.14%	1.20%	1.20%
≥46	1.02%	1.06%	0.95%[d]

[a]Sample includes 15,401 physician-plan observations, encompassing all tiered physicians with new patients in ≥2 plans in the fiscal year.
[b]Tiered physicians include allergy/immunology, cardiology, dermatology, endocrinology, gastroenterology, general surgery, neurology, orthopedic surgery, otolaryngology and rheumatology, internal medicine, family practice, obstetrics/gynecology, and pediatrics.
[c]Marginal effect based on linear regression of market share on physician tier status, controlling for plan, physician, and plan specialty–year fixed effects.
[d]Statistically significant difference from effect of being tiered in the average tier, $P < .05$.
[e]"Healthier" patients indicates no prior Hierarchical Condition Categories diagnoses.
[f]"Sicker" indicates 1 or more Hierarchical Condition Categories diagnoses.
Source: Author's analysis of Massachusetts Group Insurace Commission administrative and medical claims data.

The most prevalent conditions observed among the "sicker" patient subgroup were diabetes, heart disease, and depression (Table 1)—3 chronic conditions associated with high use of the healthcare system and older age. The finding of the responsiveness among this patient group makes economic sense, as it suggests that tiering is having an effect on choices among the population most likely to consume more care and, thus, who has more to gain from choosing a higher-performing physician and more to save with lower co-payments if they expect to have multiple visits. It is also possible that these patient flows are due to actions on the part of the worst-tiered providers to avoid these patient groups as older patients with these conditions may be more complicated. Further research should investigate this question.

The finding that tiered networks are channeling male patients, but not women, is more surprising. Men and women are known to have different rates of utilization of healthcare services across all types of care due both to healthcare needs and behavioral and attitudinal differences.[9,10] Kozhimannil et al found that men were more responsive to the introduction of a high-deductible health plan than women, cutting back on use of care—specifically emergency department visits—more than women, and suggesting that men respond to cost-sharing incentives in health insurance differently than women.[11]

Within a tiered-network design, patients can continue to see nonpreferred physicians if they are willing to pay a higher co-payment for each visit. Unlike "narrow network" health plans, which provide patients with almost no coverage for services provided by out-of-network providers, tiered networks allow patients to have continued access to a broad network of providers for nominal increases in cost sharing, and, therefore, are likely to be preferable to many consumers who value having a choice of physician. If tiering providers in a network, instead of excluding them, can still channel patients to more efficient, higher-quality physicians, they offer a tool to improve value that is less severe than narrowed networks.

For physicians, the fact that tiered networks could channel patients with the highest medical spending away from certain physicians could be, in some cases, to the advantage of those facing global budgets.However, under new payment models, such as accountable care organizations (ACOs), where physicians are financially accountable for the care their patients receive outside the ACO, as well as within (often called "patient leakage"), these selection effects may be unfavorable. In fact, these findings suggest that tiering is potentially a tool to encourage high-value choice in the context of ACOs and similar accountability models.Tiered network designs could be used to encourage patients to seek care within an ACO, for example, by sorting specialty physicians into tiers according to their ACO affiliation so that patients would pay lower co-payments for visits to physicians within their ACO, thereby aligning patient incentives with those of the ACO providers. Currently, there are no such incentives for patients to seek care within ACOs.

Limitations

There are a few important limitations. This analysis uses data from the late 2000s, which was a different environment than exists today. However, these data are from a unique natural experiment, and as the prevalence of tiered networks has continued to grow, understanding variations in impact within subpopulations of patients has remained an unanswered question. The focus of this study is a commercially insured, employed population in 1 state. Although GIC beneficiaries consist of a diverse range of workers, the study setting may limit the generalizability of these findings. The financial incentives in the tiered networks studied here are minor, and, thus, this analysis is not a test of the impact of tiered networks when

incentives are large; however, many tiered physician networks in commercial plans include financial incentives of this magnitude. The study period focuses on the first few years of the GIC tiered networks initiative, and choices of physician may change as consumers become more familiar with the networks in their health plans, and as healthcare markets change. Finally, data limitations prevent the study of whether tiered networks vary for patients along other important dimensions besides age, gender, and health status, such as income, geography, and racial/ethnic gradients, which are also important in evaluations of the costs and benefits of tiered network designs.

CONCLUSIONS

Although there is no easy solution to reducing cost and improving efficiency in healthcare, tiered networks seem to have promise as a part of a set of mechanisms to increase the value of healthcare spending—particularly among those patients associated with the highest proportion of medical spending. Targeting these interventions to encourage patients to make higher-value choices so they reach patients when they are choosing a doctor to see for the first time may be better received by patients, and be more effective than strategies that interrupt existing care relationships. Future work should focus on potential adverse effects of this network design, such as provider avoidance of high-risk patients or patient decisions to stop going to the doctor altogether rather than to switch to a lower-cost one. Such evidence will allow for refinements to the design and implementation of physician networks to maximize their benefits while limiting harm and inequity.

Author Affiliation: Department of Health Policy and Management, Harvard T. H. Chan School of Public Health, Boston, MA.

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Address correspondence to: Anna D. Sinaiko, PhD, Department of Health Policy and Management, Harvard T.H. Chan School of Public Health, 677 Huntington Ave, Rm 409, Boston, MA 02115. E-mail: asinaiko@hsph.harvard.edu.

REFERENCES

1. Newhouse JP; the Insurance Experiment Group. *Free for All? Lessons from the RAND Health Insurance Experiment*. Cambridge, MA: Harvard University Press; 1993.

2. 2014 Employer Health Benefits Annual Survey. Kaiser Family Foundation website. http://kff.org/health-costs/report/2014-employer-health-benefits-survey/. Published September 10, 2014. Accessed May 22, 2016.

3. Sinaiko AD, Rosenthal MB. The impact of tiered physician networks on patient choices. *Health Serv Res*. 2014;49(4):1348-1363. doi: 10.1111/1475-6773.12165

4. Scanlon DP, Lindrooth RC, Christianson JB. Steering patients to safer hospitals? the effect of a tiered hospital network on hospital admissions. *Health Serv Res*. 2008;43(5, pt 2):1849-1868. doi: 10.1111/j.1475-6773.2008.00889.x.

5. Frank MB, Hsu J, Landrum MB, Chernew ME. The impact of a tiered network on hospital choice. *Health Serv Res*. 2015;50(5):1628-1648. doi: 10.1111/1475-6773.12291.

6. Rosenthal MB, Li Z, Milstein A. Do patients continue to see physicians who are removed from a PPO network? *Am J Manag Care*. 2009;15(10):713-719.

7. Adams, JL, A Mehrotra, JW Thomas, and EA McGlynn. Physician cost profiling—reliability and risk of misclassification. *N Engl J Med*. 2010;362(11):1014-1021. doi: 10.1056/NEJMsa0906323.

8. Pope GC, Kautter J, Ingber MJ, Freeman S, Sekar R, Newhart C. Evaluation of the CMS-HCC Risk Adjustment Model. CMS website. www.cms.gov/Medicare/Health-Plans/MedicareAdvtgSpecRateStats/downloads/evaluation_risk_adj_model_2011.pdf. Published March 2011. Accessed (May 22, 2016)

9. Owens GM. Gender differences in health care expenditures, resource utilization, and quality of care. *J Manag Care Pharm*. 2008;14(suppl 3):2-6.

10. Vaidya V, Partha G, Karmakar M. Gender differences in utilization of preventive care services in the United States. *J Womens Health (Larchmt)*. 2012;21(2):140-145. doi: 10.1089/jwh.2011.2876.

11. Kozhimannil KB, Law MR, Blauer-Peterson C, Zhang F, Wharam JF. The impact of high-deductible health plans on men and women: an analysis of emergency department care. *Med Care*. 2013;51(8):639-645. doi: 10.1097/MLR.0b013e31829742d0. ■

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eAppendix

This supplemental eAppendix provides additional detail on the data and methods used in the analyses reported in the paper "Do different patients respond to tiered physician networks differently?"

GIC Tiered Physician Networks

Physician tiering was based on "efficiency" and "quality" performance profiles. A common database of physician-level performance profiles was developed using pooled data from the entire books-of-business from all of the GIC's health plans in order to maximize sample size and to eliminate conflicting performance measurement. Efficiency was calculated using the Symmetry Episode Treatment Group (ETG) methodology, which forms clinically homogeneous episodes of care that are adjusted for patient severity and compares resource utilization within episodes across providers (Optum Insight 2012). Quality scores were calculated by Resolution Health, Inc using standard claims-based process measures of ambulatory care quality that can be reliably captured through claims data.

Implementation of tiered networks began in FY2008 and were completed in all plans for FY2009. The GIC informed its beneficiaries about the tiered networks through a multi-pronged communications campaign that included quarterly GIC newsletters open enrollment publications and health fairs. Individual health plans also distributed marketing and education materials.

Data

The data for this analysis are administrative enrollment and claims data for all non-Medicare individuals enrolled in five of the six GIC health plans over July 2004 – June 2010 (FY2005-FY2010). The claims data include patient age and gender, diagnosis code, and the providing physician's name, practice tax identifier, and tier ranking. We also obtained the unique physician identifier and specialty designation for the providing physician on each claim for over 94% of the data in 2008-2010, 77% of the data in 2007 and 57% of the data in 2006 for five health plans; this is the same physician linking identifier and specialty designation used to construct the tiered provider networks in the GIC health plans. Methodology for assignment of unique ID and specialty code to providers across plans is based on a proprietary algorithm created and implemented by the GIC and its data vendors. Unique ID is based on National Provider Identifier (NPI), demographics and other data from the National Plan & Provider Enumeration System (NPPES). Provider specialty is assigned based on information on provider specialty submitted by the health plans. GIC health plans review and validate the results of provider linking and specialty assignment on an annual basis.

Claims where the physician linking identifier was missing were linked over time by matching on full name and practice tax ID. Claims where we were unable to match on this combination, and thus where the unique physician ID was missing, were dropped from the analysis (6% of physician claims). We also excluded claims where there were, most likely because of coding errors in the claims, conflicting tier rankings for a physician within a plan-year (3.5% of claims). For physicians in our data with missing information on specialty (<1% of claims), we assigned them to the specialty from which they billed the majority of their claims (at least 50.5%).

Analysis Sample and Methods

The analysis sample includes all tiered physicians who had at least one patient office visit with a patient who did not switch plans during the study period. Office visits are identified as claims with CPT codes: 99201 – 99205; 99211 – 99215; 99381-99390, 99391-99405; 99241 – 99245, 99406-99409, 99410-99429, 99246-99255, 99354-99355.

To evaluate variations in the effect of tier rankings on a physician's market share of new patient visits, we identify "new visits" in FY2009 or FY2010 as an office visit within a specialty in which neither the patient nor or any other person in the patient's family had a visit in the previous two years. We summed the total number of "new visits" for each physician, *i,* in specialty *s* and plan *j* among all patients and within each of six sub-groups *sg* of patients: males, females, "older," "younger," "sicker" and "healthier," as $visits_{isjt,sg}$. "Older" patients are those who are older than 46, the median age of the patients within study sample, "younger" patients are younger than the median age. Sicker patients are those who had a diagnosis in the study year or earlier in one of the 70 condition categories identified for risk-adjustment in the Medicare CMS-HCC models (Pope et al 2011). "Healthier" patients do not have any of these prior diagnoses.

We calculate physician *i*'s market share of new visits within a patient sub-group/plan as the number of a physician's new visits in that subgroup and plan-year divided by the total number of new visits in our data by patients in that sub-group, within that specialty in that plan-year.

$$Market\_share_{isjt,sg} = (visits_{isjt,sg})/(visits_{sjt,sg}) \quad (1)$$

A second analysis examined the impact of tiering on the percent within patient sub-groups of a physician's existing patients who switched to other physicians in FY2009 and FY2010. For each of these years *t*, we

identified "potential swithcers," patients with two visits with a particular physician over a three year pre-period (i.e. any of years *t-3*, *t-2*, and *t-1*), one of which must be in the immediate prior year (i.e. year *t-1*), AND a visit with the same specialist type in year *t*. Characteristics of potential switchers are presented in **Table A1**

Table A1. Characteristics of Potential Switchers, 2008-2010[+]

Number of new patient visits	109,270
Female	63.5%
Age group	
0-17	13.5%
18-30	8.8%
31-40	12.1%
41-50	23.3%
51-64	42.0%
Has any comorbidity	51.7%
Most prevalent comorbidities:	
Diabetes	20.8%
Heart disease	15.5%
Depression	11.5%
Cancer	12.7%

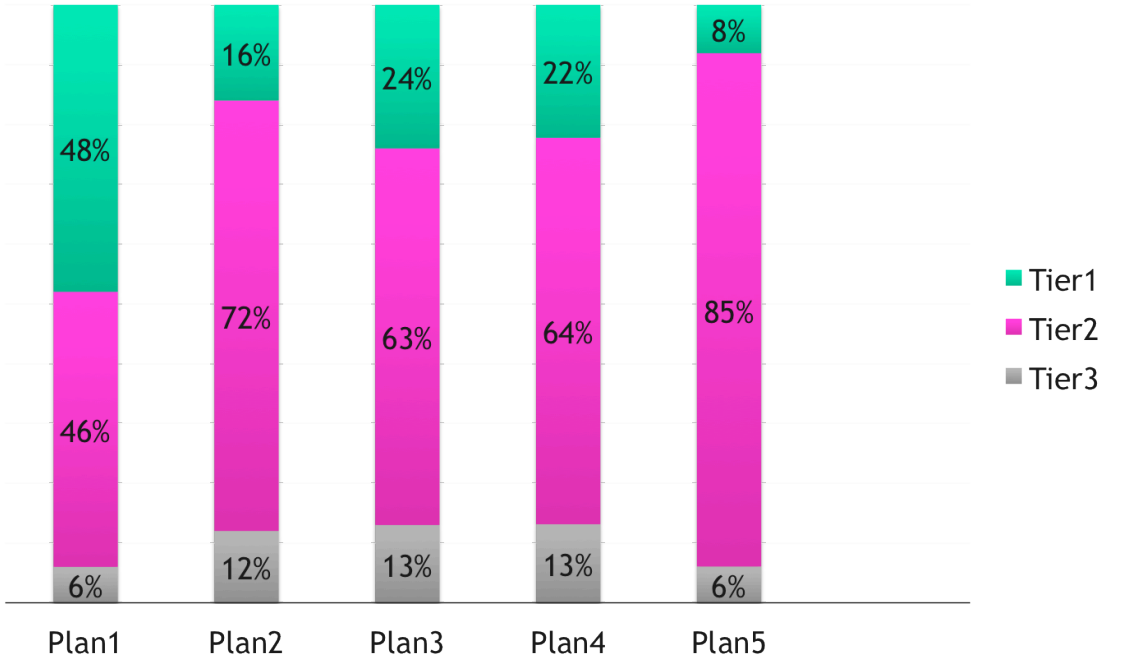
Comorbidities include those identified by Medicare CMS-HCC models (Pope et al 2011).

Source: Author's analysis of GIC administrative and medical claims data, July 1, 2008- June 30, 2010.

We then identified which patients returned to see the same doctor versus those who switched to a new doctor in year *t* without returning to see their prior doctor again that year. We sum for every physician-plan-year a count of the patients who returned to see them in year *t* and a count of those who switched to another physician, and calculate the percent switched. We also calculated the percent of a physician's patients who switch to another physician within each sub-group. As a sensitivity analyses we repeated these analyses classified patients as having switched physicians only if they had a minimum of two visits with the new physician in a year. Because of insufficient sample size, we dropped the smallest plan from these physician loyalty analyses.

A multivariate model was used to analyze the impact of tiering on the two outcomes of interest: a physician's market share of new patients within each sub-group, and on the percent of a physician's patients within each sub-group that switch to another doctor. Our empirical strategy exploited the fact that just over half of physicians included in tiered networks at more than one plan within a fiscal year had different tier rankings across plans.

Figure. Allocation of Physicians Across Tiers by Plan, FY2009



As noted in the text, these differences occurred because the actual cut-points between tiers varied across plans (**Figure**), plans may have considered additional data (beyond the cost and quality ratings calculated from all-payer data aggregated by the GIC) on performance when determining tier rankings, and because plans with more selective or smaller networks may have ranked the same physician lower (in percentile terms) than a broad network simply because they excluded lower-performing physicians from the network. Among physicians tiered in multiple plans' tiered networks in a year, we analyzed physician market share of new patient visits and the percent of a physician's patients who switched to another physician using linear regression models with robust standard errors.

Models included variables indicating if a physician's tier ranking is tier1 (the best) or tier3 (the worst) in a plan-year, which are the key independent variables of interest. Physician fixed effects are added to control for potentially observable (eg, through reputation) but unmeasured differences among physicians that may be correlated with tier status, and a full set of plan-specialty-year fixed effects to control for differences in benefit design and generosity, differences in access to physicians over time and across plans, and differences in plans' tiered networks structures across specialties. With the addition of these controls, the coefficient on the variable indicating a physician's tier ranking is the effect of tiering.

Each model was estimated separately for each of the six patient sub-groups, where the dependent variables were a physician's market share of new visits made by patients in one sub-group and the percent of patients who switch to another physician among patients in one sub-group only (equations (2) and (3)).

$$Mshare_{ipt,sg} = \beta_0 + \boldsymbol{\beta_1}(tier1_{ipt}) + \boldsymbol{\beta_2}(tier3_{ipt}) + physician_{\boldsymbol{i}} + (plan_p * specialty_i * year_t) + \varepsilon_{\boldsymbol{ipt}} \quad (2)$$

$$\%switch_{ipt,sg} = \beta_0 + \boldsymbol{\beta_1}(tier1_{ipt}) + \boldsymbol{\beta_2}(tier3_{ipt}) + physician_{\boldsymbol{i}} + (plan_p * specialty_i * year_t) + \varepsilon_{\boldsymbol{ipt}} \quad (3)$$