HAS THE MALPRACTICE CRISIS IN FLORIDA REALLY AFFECTED ACCESS TO CARE?

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Abstract

Objective. To examine the effects of the recent malpractice crisis in Florida on access to care and physician activity levels, focusing on high risk neurosurgery and obstetrics.

Data sources. Hospital inpatient records from Florida and California for the years 1996, 1998, 2000, 2002, and 2004.

Study design. To determine whether the malpractice crisis affected access to care, we compared changes in high-risk patients' travel times in Florida during the crisis period with changes in travel times for several other comparison groups, including comparable patients in California. To assess the impact on physician activity levels, we examine changes in the numbers of high- and low-volume physicians and changes in the exit rates of high- and low-volume physicians.

Data extraction methods. From all hospital inpatient records in Florida and California for the above-mentioned years, we selected all patients undergoing neurosurgery or giving birth. Patients undergoing a craniotomy or a delivery with complications were classified as high risk.

Principal findings. We find that travel times for craniotomies in Florida have increased by approximately three minutes relative to trend. Travel times for high risk deliveries increased by one minute, but the increase is not significant. Further, we find that the number of low volume physicians in Florida fell during the crisis. Case studies show that rural exits were infrequent and that markets responded to the exit of physicians in a variety of ways.

Conclusions. Although rapid increases in malpractice rates are a legitimate problem, the evidence does not suggest that they have caused problems with patients' access to care.

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1. Introduction

According the American Medical Association (AMA, 2005), at least 20 states are currently in "full-blown crisis" due to escalating medical malpractice premiums. A 2003 General Accounting Office report suggests that the impact on access has been relatively limited, a finding that the AMA and other provider organizations have questioned (GAO, 2003). A recent survey of Florida physicians paints a different picture; over half of respondents claimed to have decreased or eliminated services (Brooks et al., 2005). While this is suggestive of an impact on access, it falls short of hard evidence, since physicians may have incentives to overstate the impact of the crisis.

In this paper, we examine the impact of the crisis in Florida, an AMA crisis state with rapidly increasing malpractice premia. We compare Florida with California -- a non-crisis state with relatively flat malpractice premia. Our study extends through 2004, well into the crisis period. We examine access, as measured by patient travel times, as well as physician activity levels, as measured by the number of high risk procedures performed. The latter analysis is restricted to Florida due to data availability. We focus on two specialties -- obstetrics and neurology -- that have been especially hard hit by malpractice premium increases and that play a prominent role in news accounts of the crisis.[1]

We find that one way travel times for craniotomy patients increased by about 5 minutes between 2004 and 2000. This exceeds trends in several different comparison groups in Florida and California by about 2-3 minutes. Among obstetrics patients, we find that travel times for

high risk patients increased by less than 1 minute between 2000 and 2004. This increase is not materially different from trends in other comparison groups. Turning to physician activity, we find that there was a large and statistically significant concentration of high risk deliveries among high volume providers. There was no similar pattern observed for craniotomies. Patterns of exit are consistent with these trends.

We wrap up with case studies of several zip codes with significant rural populations that have experienced substantial exit of physicians performing high risk procedures. We found that few rural zip codes experienced substantial exit and in most of those cases, new or existing physicians picked up the slack in nearby hospitals.

2. Background on the Current Malpractice Crisis

There is little doubt that there are affordability and availability problems in the medical malpractice marketplace. Numerous publications confirm that premiums, or the price of the insurance contract, have risen dramatically in the past few years.[2] The Medical Liability Monitor's survey of 'base rate' premiums for a typical policy by state and medical specialty showed overall increases between 2001 and 2004 of well over 50 percent for the five states with highest increases, including Florida.[3] Some states, such as California, experienced nearly flat premiums. Finally, a number of medical malpractice insurers have recently left the market or greatly reduced their volume of business, increasing availability problems.[4] We will not examine the causes of these trends, but will instead focus on their effects.

To date, most of the evidence on malpractice effects is either anecdotal or derived from surveys of doctors. In addition to the Florida survey cited above, a survey of member companies by BlueCross BlueShield (BCBS 2002) revealed that over half the plans in crisis states reported doctors refusing to perform some high risk procedures and that more doctors are leaving

practices or retiring. Numerous accounts can also be found in the general press.[5] However, the GAO report cited above questioned whether the rate of physician migration has increased.

Dranove and Gron (2005) present summary data on actual physician activity levels and patient travel times in Florida through 2003. They find minimal evidence of malpractice effects. However, their paper has several limitations. First, their time frame may have been too short to observe physician exit. Second, they fail to perform multivariate analyses or report statistical tests. Finally, they cannot say whether trends in Florida differ from trends in non-crisis states. We address these shortcomings by carrying the data through 2004, performing multivariate statistical analysis, and comparing Florida with California. In addition, we provide several case studies that illustrate in more detail how local markets respond to physician exit.

3. Data and Methods

3.1. Data

We use hospital inpatient utilization data from Florida and California for the years 1996, 2000, and 2004. In some analyses, we also use Florida data from 1998 and 2002. The data contain details about every admission to every hospital in each state, including the diagnoses, treatment, patient demographics, and residence zip code. Florida data also include a surgeon identifier that can be linked across years.

We use diagnostic and procedure codes to identify inpatient procedures that would normally be performed by obstetricians or neurosurgeons. We divide these into "high risk" and "normal risk" procedures aimed at identifying those most likely to result in lawsuits based upon simple rules of thumb. In particular, for neurosurgery, we selected the diagnosis-related groups with the highest mortality rates; these are the DRGs associated with craniotomies.[6] For high risk deliveries (HRDs), we selected patients with complications.[7]

We use the Mapquest travel time calculator to compute travel times from each patient's zip code centroid to the centroid of each hospital's zip code.[8] We eliminated from the analysis patients whose zip codes were not in the same state as the hospital. Of the remaining patients, approximately 9 percent of neurology patients and 5 percent of obstetrics patients could not be assigned a travel time, due to missing or invalid patient or hospital zip codes.

3.2. Methods

This section describes our methods for examining patient access to care. We use travel time as a proxy for access. Our basic approach is to compare travel times for high risk procedures in 2004 (well into the crisis) with travel times in 2000 (a period when, by all accounts, the crisis had not yet begun or was just beginning.) To determine whether any observed change was more than what might have been expected due to factors unrelated to the crisis, we compare the simple difference in travel times for high risk procedures with other travel time differences, including:

· The difference in travel time for low risk procedures over the same time period

· The difference in travel time for high risk procedures between 1996 and 2000

· The difference in travel time for high risk procedures in California

· The relative difference between 2004/2000 trend and 2000/1996 trend for high risk versus low risk procedures (i.e., a "triple difference" analysis.) The triple difference tells us if any departure from past trends for high risk travel times is more than we would expect given departures from past trends for low risk travel times.

Under some circumstances, it could be possible for an apparent effect to show up in all of the above models, but to be due to something other than the malpractice crisis. This would require the following to be the case:

· Factors unrelated to malpractice caused an increase in travel time trends during the 2000-2004 period

· Factors unrelated to malpractice caused a bigger jump in trends in the later period for high-risk patients relative to low-risk patients in Florida

· Factors unrelated to malpractice caused a bigger jump in trends in the later period for high-risk patients in Florida relative to high-risk patients in California.

Thus, if an effect shows up in all models, that would be reasonably strong evidence that the effect is due to the malpractice crisis.

Our unit of observation for this analysis is the individual patient. We estimate the following equation for both neurosurgeries and deliveries in Florida:[9]

(1) $M_{idzt} = \alpha_0 + \alpha_x X_i + \alpha_Z D_Z + \alpha_{DRG} D_{DRG} + \alpha_1 T + \alpha_2 D_{2004} + \alpha_3(HighRisk*T) + \alpha_4(HighRisk*D_{2004}) + \varepsilon_{idzt}$, where

M_{idzt} is the travel time for patient i with DRG d in time t in zip code z,

X_i is a vector of individual characteristics,

D_Z is a vector of zip code dummies,

D_{DRG} is a vector of DRG dummies,

D_{2000} and D_{2004} are year dummies for 2000 and 2004,

T is a discrete variable for a time trend (T=0 if year = 1996, T=1 if year = 2000; T = 2 if year = 2004),

HighRisk is a dummy variable for the risk level (HighRisk = 1 if high risk), and

ε_{idzt} is a normally distributed error term.

This specification allows us to assess whether the time trend for craniotomies for 2000/2004 differed from the 2000/2004 trend for low risk diagnoses ($\alpha_3 + \alpha_4$) or whether it differed from the

1996/2000 trend for craniotomies ($\alpha_2 + \alpha_4$). We can also assess whether the change in time trend for craniotomies differed from that for low risk diagnoses (the triple difference α_4.). In the case of neurology, the DRG dummies are replaced by an indicator for craniotomies due to the addition of several new craniotomy DRGs in 2004. The equation used to compare California with Florida is similar to equation (1). The difference is that the *HighRisk* variable will be replaced by a dummy variable indicating that the patient resides in Florida.

In unreported regressions, we restricted the sample to rural populations. Our results were similar; if anything, there is even less evidence that the crisis caused travel times to increase.

3.3. Sample Overview

Table 1 reports summary statistics for travel times. Average annual travel times for craniotomy patients in Florida increase substantially between 1996 and 2000 but then level out. Travel times for craniotomies in California declined between 1996 and 2000, then increased somewhat between 2000 and 2004. Travel times for HRDs increase over the entire period but the increases are small.

4. Regression Results: Travel Times

We now present our difference-in-difference results comparing high risk and low risk procedures and comparing the period from 1996-2000 with the period from 2000-2004, as well as triple difference results that combine both of these comparisons, and results that compare Florida with California.

4.1. Travel Times: Neurosurgeries

In the interest of brevity, we do not present the full regression results, which are available upon request. We instead report regression-adjusted travel times for various comparison groups. Table 2 summarizes the main results. The travel time for a Florida craniotomy patient with

average values for all control variables was about 37 minutes in 2000 and about 42 minutes in 2004. This increase of 5 minutes is the "simple difference." The simple difference for the comparison low risk neurosurgery patients in 2000-2004 was about 0.4 minutes. The difference in differences of nearly 4.7 minutes is statistically significant at $p<.001$. The simple difference for the comparison high risk neurosurgery patients in 1996-2000 was 3.4 minutes; the difference in differences of 1.6 minutes is significant at $p=.042$. Finally, the triple difference (the "diff in diff" for craniotomies minus the "diff in diff" for other neurosurgery) is about 3 minutes and is significant at $p=.002$. In other words, the increase in travel times relative to trend for craniotomy was about 3 minutes more than the increase relative to trend for other neurosurgeries. Moreover, the big increase for craniotomies occurred during the crisis period, whereas travel times for other neurosurgeries during this time were essentially flat. All of these findings point to an adverse effect of the crisis on access.[10]

The comparisons with California reveal similar patterns. Florida craniotomy patients experienced a significantly larger increase in travel times between 2000 and 2004 than did California craniotomy patients. Additionally, high risk patients in Florida appear to have experienced a larger increase in trends between 2000 and 2004 relative to the earlier period than California patients did during the same time period.

We can assess the economic importance of the increase in travel time by noting that a typical craniotomy costs about $15,000. If we assume that the additional 5+ minute round trip is made 40 times by the patient, family members, and friends, this would still amount to no more than 4 hours of total additional travel.[11] The transportation literature gives a range of values for the cost of travel of $7.00 to $20.00 per hour.[12] Valuing travel time at $20 per hour, we put the

cost associated with additional travel for a craniotomy at no more than $80 per craniotomy, or about 0.53 percent of the cost of the procedure.

4.2. Travel Times: Deliveries

Table 2 shows that HRD travel times increased between 2000 and 2004 by about 0.2 minutes more than did travel times for low-risk patients; the effect is weakly significant. The HRD trend between 2000 and 2004 was not significantly different from the trend between 1996 and 2000. The triple difference estimate is also insignificant.

The comparisons between Florida and California show that, as with craniotomies, travel times for high-risk patients were trending upwards in Florida and downwards in California prior to 2000. HRDs in Florida showed a slightly faster gain in travel time relative to California between 2000 and 2004, but the effect is weak. Florida patients experienced no increase in trend between 2000 and 2004, relative to 1996-2000. The triple difference is negative and significant.

5. Physician Activity Levels

We next consider whether the malpractice crisis has caused some doctors to sharply curtail their level of high risk procedures or exit altogether. Because of changes in how physicians were identified prior to 1997, we were not able to use the 1996 data. For this analysis, we look at the years 1998, 2000, 2002, and 2004. We define various degrees of "exit" according to the physician's base year level of activity:

- *Very low volume exit*: The physician performed 1-3 procedures in the base year and 0 procedures 2 years later
- *Low volume exit*: 4-10 procedures in the base year and 0-1 subsequently
- *Medium volume exit*: 11-24 procedures in the base year and at least a 67 percent reduction subsequently

- *High volume exit*: 25 or more procedures in the base year and at least a 50 percent reduction subsequently

We obtain similar findings when we try different definitions.

Table 3 presents the distribution of physicians across the categories of initial volume (e.g., very low volume, etc.). Chi-square tests reject the null hypotheses of equal distributions in all years for both craniotomies and HRDs, although the test is only significant at 10% for craniotomies. One noticeable trend is the reduction between 2000 and 2004 of the percentage of physicians performing very low volumes of both types of procedures. In the case of craniotomies, however, this reduction follows an initial jump between 1998 and 2000.

Table 4 presents the exit rates. The rate of exit of very low volume craniotomy providers is very high and increasing between 1998 and 2004. This increase is statistically significant. There is also a steady and statistically significant increase in exit rates of doctors who had performed high volumes of craniotomies (though not for those performing very high volumes.) Taken together, these results are consistent with the observed increase in travel times for craniotomies. Exit rates for physicians performing low and very low volumes of HRDs also increase by significant amounts over time, but there is no increase in exit rates of high and very high volume providers. Combined with the absence of an increase in travel times for HRDs, these findings suggest that the crisis is having a minimal effect on access to care.

6. Local Effects of Physician Exit on Travel Times: Case Studies

Because aggregate data can sometimes mask the kinds of anecdotal events that have fueled the malpractice debate, we elected to perform "mini-case studies" of markets that might have been disproportionately affected by physician exit. While physician exit can disrupt established patient relationships in any market, the most talked about disruptions seem to be

those that occur when physicians exit rural markets, as the local patients may have to travel great distances to find alternative providers. Thus, we restrict attention to rural zip codes, where at least 30 percent of the population is defined as rural according to the U.S. census. We then used the following criteria to identify "rural" zip codes that might be disproportionately affected by exit:

- There were at least 5 high risk procedures performed on residents in 2002
- Physicians who exited between 2002 and 2004 accounted for at least 40 percent of the procedures performed in 2002.[13]

Using these criteria, we identified 6 zip codes that might have been adversely affected by exit of neurosurgeons. All 6 zip codes had exactly 5 craniotomy patients in 2002 (representing a total of 0.5 percent of the total craniotomy population) and in each case, exiting doctors performed 2 procedures. Due to the small numbers of patients affected, we elected not to perform an extensive analysis of these zip codes.

We identified 14 zip codes that might have been adversely affected by the exit of obstetricians. There were a total of 119 HRDs in these zip codes, or about 0.4 percent of the total HRD population. We performed more in depth analyses of these zip codes to determine how patients were affected. Our findings for the following three zip codes were representative of the complete set of affected zips.[14]

Case Study 1: There were 18 HRDs in 2002, performed by 11 doctors. Exiting doctors accounted for 8 of the HRDs, with one doctor performing 6. All 18 patients traveled less than 40 minutes to their hospital. In 2004, there were 29 HRDs performed by 16 different doctors. One new doctor performed 7 HRDs. The distribution of travel times became skewed; 5 of the 29 patients had to travel more than 50 minutes to their hospital.

Case Study 2: There were 12 HRDs in 2002, performed by 8 doctors. One doctor who performed 5 HRDs exited the market. All the patients traveled 85 minutes or further to get to a hospital. The 14 HRDs in 2004 were performed by 8 doctors, one of whom was new to the zip code and performed 6 HRDs. A hospital in the same zip code began performing HRDs, reducing travel times considerably for the 6 local patients who were treated there.

Case Study 3: There were 10 HRDs in 2002, performed by 6 doctors. One exiting doctor performed 5 of them; another exiter performed one. None of the patients traveled more than 50 minutes for care. The 10 HRDs in 2004 were also performed by 6 doctors; one doctor expanded from performing 1 in 2002 to performing 6 in 2004. One patient traveled more than 50 minutes.

The case studies show that when a doctor leaves a rural market, another doctor usually picks up the slack. Few if any of the patients residing in the affected markets travel considerably further distances to access a hospital. We are unable to determine if travel times to see the physicians have changed.

7. Discussion

In this paper we provide a detailed look at changes in patient access and physician activity levels for the high risk procedures in two high malpractice premium specialties, neurosurgery and obstetrics. We examine the changes in the state of Florida, providing a 'before' period (1996-2000) to compare with the period of rapidly rising malpractice rates (2000-2004) in a state that has been highly affected by the current malpractice premium increases. We also compare these changes to changes in the state of California, which has been largely unaffected by the malpractice crisis. We find evidence of significantly increased travel times for craniotomies relative to other neurosurgery procedures. We do not find similar evidence of increases in travel times in our examination of HRDs.

Our exit rate estimates suggest that low-volume physicians are leaving the market for HRDs. To the extent that there is a positive relationship between volume and outcomes, this may be good news for patients. The literature has documented correlations between volume and outcome for these procedures, but causality has not been resolved.[15] The results for craniotomies are not as consistent: very low volume providers exited the market in greater numbers between 2002 and 2004, and the overall distribution of volume across physicians did significantly change between 1998 and 2004, but the change in distribution does not show a consistent pattern. Low-volume providers maintained a significant presence in the market in 2004.

Overall, our findings give a mixed account of the effects of the malpractice crisis in Florida on physician activity and patient access to care. While we find evidence of decreased access to care for craniotomy patients statewide, we do not find the same when we focus on high risk deliveries.

It remains to be seen whether there will be larger effects in the coming years. Since it is very costly for a physician to build a practice anew, physicians might wait a while before pulling up stakes. However, after four years of rising premiums, it seems somewhat unlikely that a substantial effect would show up in the future when the evidence suggests little effect up to this point.

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References

Agency for Healthcare Research and Quality, 2002. *AHRQ Quality Indicators—Guide to Inpatient Quality Indicators: Quality of Care in Hospitals—Volume, Mortality, and Utilization*. Rockville, MD:. AHRQ Pub. No. 02-RO204.. Revision 2 (September 4, 2003)

American Medical Association 2003, Dying for Help: Are patients needlessly suffering due to the high cost of medical liability insurance? statement of the MAM to the Subcommittee on Wellness and Human rights committee on Government reform US house of representatives, presented by John C. Nelson. October 1, 2003.

American Medical Association 2005, America's liability crisis: A national view. http://www.ama-assn.org/ama/noindex/category/11871.html accessed 1/11/05

Blue Cross Blue Shield Association 2003. The malpractice insurance crisis: The impact on healthcare cost and access. BlueCross BlueShield Association.

Boorstein, M. 2005. Peninsula Isolated From Health Care. Washington Post, 8/28/2005. Metro page C08.

Brooks, R., Menachemi, N., Clawson, A., Beitsch, L., 2005. Availability of physician services in Florida, revisited: The effect of the professional liability insurance market on access to care. Archives of Internal Medicine. 165: 2136-2141.

Dranove, D., Gron, A., 2005. Has the malpractice crisis in Florida affected access to care? Health Affairs. 24(3): 802-810.

Greene, L. 2004. Florida Doctors Cut Services Over Malpractice Rates. St. Petersburg Times, 11/9/2004, page 1A.

Hartwig, R.P., Wilkinson, C., 2003. Medical Malpractice Insurance. Insurance Information Institute, Insurance Issues Series. Vol. 1. number 1.

Insurance Information Institute, 2003. Hot Topics and Insurance Issues: Medical Malpractice. September 2003.

Medical Liability Monitor, Various Years, Chicago, IL.

Small, K., Winston, C., and Yan, J., 2003. Uncovering the distribution of motorists' preferences for travel time and reliability: Implications for road pricing. Manuscript, University of California at Irvine.

United States General Accounting Office, 2003. Medical Malpractice: Implications of Rising Premiums on Access to Health Care. GAO – 03-836.

Table 1: Travel Time Summary Statistics

	FLORIDA			CALIFORNIA		
NEUROSURGERY SAMPLE						
	Number of patients	Mean	Median	Number of patients	Mean	Median
1996						
Craniotomy	5990	30.3	19	12076	42.2	19
Other	14546	22.9	17	16363	26.7	15
2000						
Craniotomy	7658	35.8	21	12660	34.5	21
Other	16490	25.9	18	17604	27.3	16
2004						
Craniotomy	6501	36.6	23	11300	36.3	22
Other	3393	27.7	18	16111	28.5	17
OBSTETRICS SAMPLE						
1996						
HRD	27633	20.8	18	61083	17.2	14
Non-HRD	146347	20.2	18	433385	16.4	13
2000						
HRD	32087	21.4	18	58275	17.4	14
Non-HRD	161629	21	17	433860	16.4	13
2004						
HRD	32498	21.8	18	62588	17.9	14
Non-HRD	171517	21.2	18	435424	17.1	14

Table 2
Estimated Trends in Travel Times

	Florida only		Florida versus California	
Neurosurgery				
Year	High-risk Travel Times (Treatment)	Other Procedure Travel Times (Comparison)	Florida Travel Times (Treatment)	California Travel Times (Comparison)
1996	33.46	22.96	31.11	33.35
2000	36.88 P=.000	24.67 P=.000	33.85 P=.000	36.5 P=.000
2004	41.93 P=.000	25.06 P=.000	39.08 P=.000	39.40 P=.000
Diff in Diff$_{04-00}$: [2004-2000]$_{Treatment}$ -- [2004-2000]$_{Comparison}$	4.661 P=.000		2.333 P=.001	
Diff in Diff$_{High\ risk}$: [2004-2000]$_{High\ risk}$ – [2000-1996]$_{High\ risk}$	1.630 P=.042		2.490 P=.010	
Diff in Diff$_{Treatment}$ – Diff in Diff$_{Comparison}$	2.945 P=.002		2.741 P=.027	
Obstetrics				
1996	20.66	19.96	18.24	19.67
2000	21.48 P=.00	21.03 P=.00	18.57 P=.000	18.20 P=.000
2004	22.45 P=.00	21.92 P=.00	19.14 P=.000	18.55 P=.000
Diff in Diff$_{04-00}$: [2004-2000]$_{Treatment}$ – [2004-2000]$_{Comparison}$	0.197 P=.052		0.224 P=.067	
Diff in Diff$_{HRD}$: [2004-2000]$_{HRD}$ – [2000-1996]$_{HRD}$	0.245 P=.133		0.254 P=.143	
Diff in Diff$_{Treatment}$ – Diff in Diff$_{Comparison}$	0.153 P=.391		-1.571 P=.000	

Table 3: Distribution of Physicians by Category

(% in parentheses)

	1998	2000	2002	2004	Chi^2 Prob
CRANIOTOMY					
Very low volume	215	266	234	211	0.078
	(49.88)	(53.41)	(51.43)	(48.73)	
Low volume	36	44	29	52	
	(8.35)	(8.84)	(6.37)	(12.01)	
Medium volume	56	55	55	66	
	(12.99)	(11.04)	(12.09)	(15.24)	
High volume	87	90	83	71	
	(20.19)	(18.07)	(18.24)	(16.40)	
Very high volume	37	43	54	33	
	(8.58)	(8.63)	(11.87)	(7.62)	
HRD					
Very low volume	333	337	272	257	0.002
	(20.58)	(20.82)	(17.61)	(17.69)	
Low volume	330	302	310	252	
	(20.40)	(18.65)	(20.06)	(17.34)	
Medium volume	479	489	534	469	
	(29.60)	(30.20)	(34.56)	(32.28)	
High volume	366	373	316	339	
	(22.62)	(23.04)	(20.45)	(23.33)	
Very high volume	110	118	113	136	
	(6.80)	(7.29)	(7.31)	(9.36)	

Table 4: Exit Rates

(% in parentheses)

	1998-2000	2000-02	2002-04	Chi2 prob
NEUROSURGERY				
Very low volume exit	155	213	199	0.003
	(72.09)	(80.08)	(85.04)	
Low volume exit	5	12	9	0.215
	(13.89)	(27.27)	(31.03)	
Medium volume exit	8	9	6	0.705
	(14.29)	(16.36)	(10.91)	
High volume exit	2	4	10	0.021
	(2.30)	(4.44)	(12.05)	
Very high volume exit	3	1	4	0.468
	(8.11)	(2.33)	(7.41)	
HRDs				
Very low volume exit	202	222	195	0.018
	(60.66)	(65.88)	(71.69)	
Low volume exit	80	89	121	0.000
	(24.24)	(29.47)	(39.03)	
Medium volume exit	44	53	75	0.046
	(9.19)	(10.84)	(14.04)	
High volume exit	37	29	26	0.496
	(10.11)	(7.77)	(8.23)	
Very high volume exit	8	9	9	0.981
	(7.27)	(7.63)	(7.96)	

[1] See Dranove and Gron (2005) for further rationale for using these specialties and focusing on Florida.

[2] For example, National Association of Insurance Commissioners' data show that the national medical malpractice premium volume (total medical malpractice revenue) increased by 18.3 percent and 26.7 percent from 2000-2001 and 2001-2002 respectively whereas the average annual increase in premium volume for the prior 6 years (1995-2000) was 0.8 percent.Data are from the National Association of Insurance Commissioners (NAIC): Historical Direct Premiums written (available at www.naic.org/research/Research_Division/Stats/2002_pc_stat_compHISTORY.pdf).

[3] Source: *Medical Liability Monitor*, various years. National data are approximated from *MLM* reports.

[4]The St. Paul Companies announced their withdrawal from the market in December 2001, as did Frontier, Clarendon, and Washington Casualty. Legion was placed in 'rehabilitation' and PHICO was placed in run-off (where no additional policies are written) by the Pennsylvania Insurance Department. Other companies reported to be reducing the number of policies written include CNA and MIIX [Medical Liability Monitor, October 2002.]

[5] For example, see Greene (2004) and Boorstein (2005).

[6] We designated patients in diagnosis related groups (DRGs) 1-2 as "high risk", and patients with DRGs 4-9 as normal risk. Beginning in the fourth quarter of 2004, some patients previously classified into DRGs 1 or 2 were reclassified into new DRGs 528, 529, 530, and 543. We exclude procedures on children (DRG 3).

[7] We selected patients with DRGs 370 and 372, which are caesarian deliveries with complications and vaginal deliveries with complications. We originally selected deliveries with *preexisting* complications based on International Classification of Disease codes 64000-64999. However, we observed a sharp increase in the number of patients reported to have these diagnostic codes, creating concerns of "diagnosis creep." The DRG coding does not display the same "creep," though it necessarily includes some patients whose complications arose during the delivery. We replicated our analyses using alternative definitions of high risk deliveries, with similar results.

[8] For patients who receive care in their own zip code, we set travel time equal to 1 minute. To limit the role of outliers, we set the maximum travel time to 200 minutes. These assumptions improve the precision of our estimates without changing the qualitative conclusions. In the California data, the patient's zip code was masked for some observations. These records were thus incomplete, and had to be omitted from the analysis.

[9] Because we have repeated observations for each zip code, we cluster standard errors by zip code to account for possible lack of independence.

[10] In some models, we added interactions with the Medicaid dummy to account for the possibility that Medicaid patients were disproportionately affected by the change in travel times. However, these interactions were not significant.

[11] The average length of stay is about 15-20 days.

[12] For example, see Small, Winston, and Yan [2002]

[13] We consider all those physicians who we previously classified as "low exit" to "very high exit." Thus, we exclude "very low exit" physicians.

[14] We do not report the zip code numbers so as maintain anonymity.

[15] For example, see *AHRQ Quality Indicators—Guide to Inpatient Quality Indicators: Quality of Care in Hospitals—Volume, Mortality, and Utilization*. Rockville, MD: Agency for Healthcare Research and Quality, 2002. AHRQ Pub. No. 02-RO204.. Revision 2 (September 4, 2003)