Malpractice Liability Costs And The Practice Of Medicine In The Medicare Program

This analysis suggests that an important association exists between malpractice costs and the use of imaging services in particular.

by Katherine Baicker, Elliott S. Fisher, and Amitabh Chandra

ABSTRACT: Mounting malpractice liability costs might affect physician practice patterns in many ways, such as increasing the use of diagnostic procedures while reducing major surgeries. This paper quantifies the association between malpractice liability costs and the use of physician services in Medicare. We find that higher malpractice awards and premiums are associated with higher Medicare spending, especially for imaging services that are often believed to be driven by physicians' fears of malpractice. The 60 percent increase in malpractice premiums between 2000 and 2003 is associated with an increase in total Medicare spending of more than $15 billion. [*Health Affairs* 26, no. 3 (2007): 841–852; 10.1377/hlthaff.26.3.841]

RECENT INCREASES IN PHYSICIAN MALPRACTICE PREMIUMS and rapid growth in the number and size of awards to plaintiffs have raised widespread concerns about the medical malpractice liability system.[1] Although some argue that the current system plays an important role in maintaining the quality of care, others point out that it fails to compensate most patients who suffer avoidable injuries and punishes many physicians for adverse events that were not caused by negligence.[2] Perhaps even greater concerns have been raised about how rising malpractice premiums and payments affect the way that medicine is practiced.[3]

We focus on state-level variation in malpractice costs and health care use and spending patterns in the Medicare population from 1993 to 2001. We hypothesize that the practice of medicine—and the use of physician services in particular—

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"We hypothesize that the effect of increasing liability will be most pronounced for common, discretionary physician services."

will be different in states in which physician malpractice liability costs are higher (as measured by higher premiums or malpractice payments).[4]

Previous research on the effect of malpractice costs on the practice of medicine has focused on the use of a relatively small set of specific procedures, physician surveys of "consciously defensive" medicine, or comparisons of hospital spending on heart attack patients in states with and without tort-reform initiatives.[5] These analyses do not quantify the aggregate effect of an increase in malpractice liability on clinical practice, total spending, or spending on physician services. Furthermore, many of these studies were conducted prior to the mid-1990s. Since then, there have been major changes in medical technology, including the increased use of diagnostic imaging tests, medical management, and minimally invasive surgery.[6]

We hypothesize that the effect of increasing liability will be most pronounced for common, discretionary physician services (such as visits, consultations, diagnostic tests, imaging services, and minor procedures, where errors of omission are perceived to carry greater malpractice risks than errors of commission) or for discretionary procedures where physicians may decline treatment for risky patients altogether. The effect on total use is ambiguous. On the one hand, increased testing might lead to some additional downstream treatment as a result of the additional medical services required to treat conditions not identified in areas with lower testing rates.[7] On the other hand, concerns about malpractice could lead to lower rates of elective surgery if physicians leave areas with unfavorable malpractice climates or seek to avoid some higher-risk procedures or patients.[8] We therefore hypothesize that any effect on total spending will be smaller than the effect on low-risk discretionary physician services.

Health care spending that is induced by malpractice costs and that costs more than it benefits patients (through improvements in mortality, morbidity, and patient satisfaction) is often labeled "defensive medicine."[9] Our analysis speaks primarily to the changes in use that are associated with changes in malpractice costs, but we also provide some evidence on whether additional spending is associated with improvements in mortality.

Study Data And Methods

■ **Analysis.** We report regression-adjusted estimates of the association between the growth of state-level malpractice payments per physician (or malpractice premiums) and the growth of use of and spending on several different types of procedures between 1993 and 2001. We performed our analysis at the state level because many aspects of the medical liability and medical practice environment (such as tort reforms) are set at that level.[10] We focused on changes in malpractice costs and

changes in health care spending within states, to account for any confounders that are time-invariant within each state. For example, if a certain state was more urban or had a more heavily regulated health care sector (which might influence both practice patterns and malpractice liability exposure) than others, the effect of that factor would be netted out of our longitudinal analysis. This longitudinal analysis also accounted for tort reforms that were implemented before 1993 or remained unchanged through 2001 (as the vast majority of reforms were).[11] Our choice of study periods was further motivated by data availability and by the fact that the long window reduces the effect of measurement error.[12]

To control for factors that vary over time at the state level and might be correlated with malpractice liability and medical care use rates, we included covariates for per capita income, unemployment rate, education levels, racial composition, hospital beds per capita, and health maintenance organization (HMO) penetration.[13] To validate these results, we examined whether our measures of malpractice liability were associated with outcomes that were unlikely to be uninfluenced by that liability, such as hospitalizations for hip fracture and acute myocardial infarction. It is unlikely that the incidence of or hospitalizations for these diseases were driven by the malpractice environment, although they were likely affected by potential confounders such as the underlying health of the population, so estimating the effect of malpractice liability costs on these outcomes can help test our methodological design.

■ **Defining "malpractice liability."** We constructed two independent measures of malpractice liability costs. Our primary measure was the mean dollar value of malpractice payments (arising from both judgments and settlements) per physician in each state. Our choice of this measure was motivated by research finding that physicians respond to the number of claims as well as to the average size of malpractice awards: Being sued imposes costs on physicians, including lost time at work and psychic costs.[14]

We constructed this measure using data from the National Practitioner Data Bank (NPDB).[15] We examined payments that resulted from either a court judgment or a settlement made outside of the courts. We averaged data for each of two periods, 1991–1993 and 1999–2001. Although the number of claims per physician would provide an additional measure of the burden of malpractice liability on practicing physicians, no national data on claims were available, and studies suggest that payments per physician are highly correlated with claims per physician.[16] Despite limitations (such as the "corporate shield" loophole and potential underreporting), researchers report that the NPDB is the most representative national database on medical malpractice payments and that the size of these potential biases is limited.[17]

Nevertheless, to address concerns that some payments might be missed by the NPDB and that payments reported to the NPDB reflect claims filed a few years ago, we constructed a second measure of malpractice liability costs based on phy-

sician malpractice insurance premiums. A further advantage of using malpractice premiums as a measure of malpractice liability is that they reflect insurers' estimates of open and future claims—a factor that will be missed by the NPDB. Our measure was constructed from premiums reported in the *Medical Liability Monitor* (MLM), whose annual national survey of insurers provides premium data for internal medicine, general surgery, and obstetrics-gynecology by state. We calculated average premiums faced by a typical physician in a state by weighting premium data across specialties by the physician mix in each state and averaging three years of data to minimize idiosyncrasies. Our final data consist of average premiums by state for 1991–1993 and 2000–2002, adjusted for inflation.[18]

■ **Use of medical care.** Our measures of use and spending were both based on the Medicare population, chosen because of the unusually rich data available. Our primary dependent variables were (1) total Medicare spending per beneficiary, (2) spending per beneficiary on each major component of total professional and laboratory services (evaluation and management, diagnostic tests, imaging, minor procedures, major procedures) based on the Berenson-Eggers Type of Service (BETOS) classification system, and (3) rates of use of the specific physician services (screening tests, diagnostic and imaging procedures) and major elective surgical procedures that are available in the *Dartmouth Atlas of Health Care.*[19] We combined data from the fee-for-service (Part B) claims and the Medicare Provider Analysis and Review (MEDPAR) files.[20] Data for these analyses were all adjusted for the age, race, and sex composition of the population, and all spending measures were adjusted for inflation and differences in prices across states.[21]
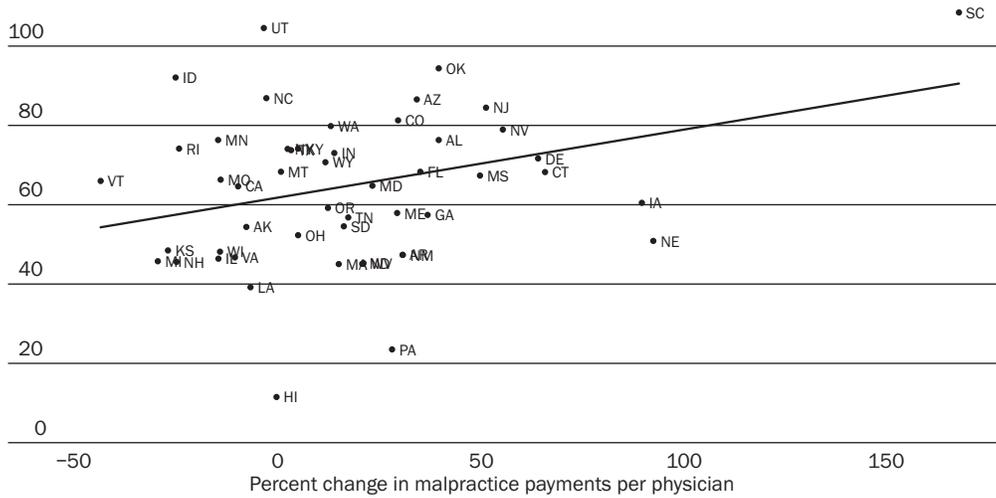
Study Results

Exhibit 1 reports summary statistics for our primary analysis. Between 1993 and 2001, total Medicare spending per beneficiary grew 35 percent and averaged $6,500 in 2001 (all dollar figures are reported in 2001 dollars). Over the same time period, there was a 31 percent increase in spending on total physician services; the subcomponent of reimbursement for evaluation and management and imaging claims grew the most quickly. Between 1993 and 2001, mean malpractice payments per physician grew 12 percent, whereas malpractice premiums grew 8 percent. These national numbers mask considerable heterogeneity in growth rates across states.

■ **Malpractice payments and Medicare spending.** We first examined the simple association between malpractice payments per physician and two categories of Medicare spending of particular interest: Medicare spending on total physician services (Exhibit 2), and Medicare spending on the imaging subcomponent of physician services (Exhibit 3). These regressions suggest that increases in malpractice payments were associated with significant increases in Medicare spending on physicians in general and in spending on imaging in particular. These univariate regression results are quite consistent with the main multivariate regression results pre-

EXHIBIT 1
Growth In Medicare Spending And Malpractice Liability, 1993–2001

	1993 ($)	2001 ($)	Percent growth, 1993–2001
Measure of malpractice liability per physician			
Malpractice payments per physician	4,756	5,221	11.7
Malpractice premiums per physician	25,762	26,608	7.8
Measure of Medicare spending per beneficiary			
Total spending	4,858	6,534	34.7
Total physician (Medicare Part B) services	1,669	2,169	30.8
Evaluation and management	547	854	57.6
Diagnostic tests	158	141	−9.8
Imaging	159	261	64.2
Minor procedures	466	573	23.6
Major procedures	77	67	−12.1

SOURCE: Authors' calculations, based on data below.

NOTES: Medicare spending data are from the *Dartmouth Atlas of Health Care* project, adjusted for age, race, and sex composition and inflation. Physician charges are classified using Berenson-Eggers Type of Service (BETOS) codes. Malpractice payments per physician were obtained from the National Practitioner Data Bank. Malpractice premiums per physician were obtained from the *Medical Liability Monitor*. "Percent growth" column reports the average percentage growth across all states. Dollar amounts are reported in 2001 dollars.

sented below; the scatterplots show that the results are not driven by outlier states, larger states, or idiosyncratic functional form.

Having documented a strong correlation in the raw data, we next turn to our

EXHIBIT 2
Longitudinal Association Between Growth In Malpractice Payments Per Physician And Medicare Spending On Total Physician Services, 1993–2001

Percent growth in Medicare spending on physician services

SOURCE: Authors' calculations.

NOTES: Univariate regression implies that a 10 percent increase in malpractice payments per physician is associated with a 0.88 percent (standard error = 0.43 percent) increase in spending. Regression line is population weighted. In 2001, average malpractice payments per physician were $5,221.

EXHIBIT 3

Longitudinal Association Between Growth In Malpractice Payments Per Physician And Medicare Spending On Imaging Services, 1993–2001

Percent growth in Medicare spending on imaging services

SOURCE: Authors' calculations.
NOTES: Univariate regression implies that a 10 percent increase in malpractice payments per physician is associated with a 1.73 percent (standard error = 0.74 percent) increase in spending. Regression line is population weighted. In 2001, average malpractice payments per physician were $5,221.

main specification: a multivariate analysis controlling for both fixed state-specific factors and state characteristics that might change over time, such as population demographics and the economic climate. Exhibit 4 reports the regression-adjusted association between 10 percent growth within a state over time in our two liability measures and the growth of various Medicare spending components. These associations controlled both for any state-level characteristics of the malpractice environment or population and for the covariates noted above. Increases in payments per physician were statistically significant for spending on total physician services, the evaluation and management subcomponent, reimbursement for imaging services, and payments for minor surgical procedures. There was no statistically significant effect on the use of diagnostic procedures and major procedures. Thus, for example, a state with 10 percent higher growth in malpractice payments than its neighbor saw a little more than 1 percent higher growth in total spending on physician services, holding constant each state's idiosyncrasies as well as changes in the economic and demographic covariates. The second panel of Exhibit 4 reports results using premiums as an alternative measure of malpractice liability. These results are quite similar. Both measures of malpractice liability have a positive but statistically insignificant association with total Medicare spending. Specification tests using alternative models yielded strikingly similar

EXHIBIT 4
Longitudinal Association Between Malpractice Liability And Medicare Spending, 1993–2001

Measure of Medicare spending per beneficiary	Effect of 10 percent growth in malpractice payments per physician (N = 50 states)		Effect of 10 percent growth in malpractice premiums per physician (N = 50 states)	
	Percent increase	*p* value	Percent increase	*p* value
Total spending	0.6	0.18	1.0	0.17
Total physician (Medicare Part B) services	1.0	0.00	1.3	0.01
Evaluation and management	0.9	0.00	2.7	0.01
Diagnostic tests	0.0	0.95	0.2	0.77
Imaging	2.2	0.00	2.1	0.03
Minor procedures	1.0	0.01	0.9	0.03
Major procedures	−0.3	0.24	−0.1	0.90

SOURCE: Authors' calculations, based on data below.
NOTES: Medicare spending data are from the *Dartmouth Atlas of Health Care* project, adjusted for age, race, and sex composition and inflation. Physician charges are classified using Berenson-Eggers Type of Service (BETOS) codes. Malpractice payments per physician were obtained from the National Practitioner Data Bank. Malpractice premiums per physician were obtained from the *Medical Liability Monitor*. "Percent increase" column reports the average percentage growth across all states. Dollar amounts are reported in 2001 dollars. Regressions are at the state level, weighted by state population, with heteroskedasticity-consistent standard errors. Covariates include per capita income, unemployment rate, percentage black, health maintenance organization (HMO) penetration, and percentage with high school degree. All variables were measured as the percentage growth within each state between 1993 and 2001.

results.[22]

■ **Specific services and malpractice costs.** To identify the specific services that increase with higher malpractice costs, we studied the effect on procedure-specific utilization rates (Exhibits 5 and 6). A 10 percent increase in malpractice payments increases use of carotid duplex, echocardiography, electrocardiogram

EXHIBIT 5
Association Between A 10 Percent Increase In Malpractice Payments Per Physician And The Use Of Diagnostic And Imaging Procedures
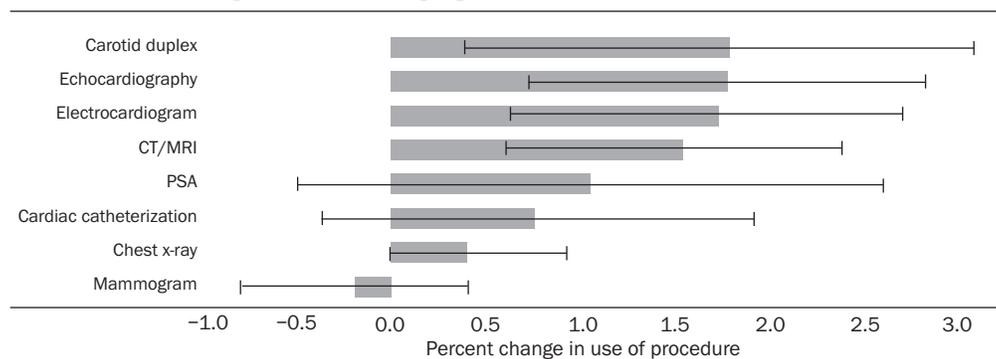
SOURCE: Authors' calculations.
NOTES: Bars represent regression-adjusted coefficients from regression of log of procedure use on log of number of malpractice judgments or settlements per physician, with 95 percent confidence intervals indicated by the horizontal ruling lines. CT is computed tomography. MRI is magnetic resonance imaging. PSA is prostate-specific antigen.

EXHIBIT 6
Association Between A 10 Percent Increase In Malpractice Payments Per Physician And The Use Of Major Surgical Procedures
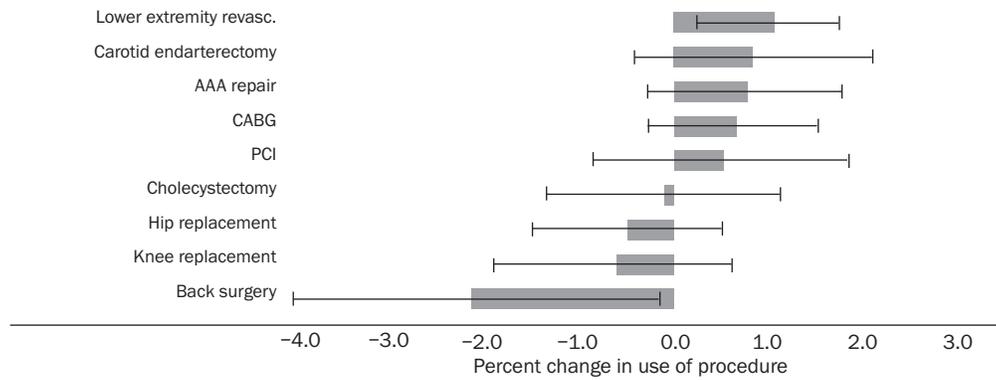
SOURCE: Authors' calculations.
NOTES: Bars represent regression-adjusted coefficients from regression of log of procedure use on log of number of malpractice judgments or settlements per physician, with 95 percent confidence intervals indicated by the horizontal ruling lines. AAA is abdominal aortic aneurysm. CABG is coronary artery bypass graft. PCI is percutaneous coronary intervention.

(EKG), and computed tomography (CT)/magnetic resonance imaging (MRI) scanning by 1.5–1.8 percent ($p < 0.05$). Increases in the use of prostate-specific antigen (PSA) testing, cardiac catheterization, and chest x-rays were not significant at conventional levels. We did not find an increase in the use of mammograms (Exhibit 5). In contrast to the increased use of diagnostic and imaging procedures, we did not find that increases in malpractice costs were associated with increases in the use of major surgical procedures (Exhibit 6). The only exception to this finding is the use of lower extremity bypass—here, a 10 percent increase in malpractice payments was associated with a 1.0 percent increase ($p < 0.01$) in procedure use. In fact, there was a significant decrease in the use of back surgery, potentially the type of procedure that physicians might avoid when malpractice costs are higher. We found, however, only a statistically insignificant negative association between increased malpractice liability costs and overall spending on major procedures. This might be because the set of patients and conditions in which surgeons avoid surgery is relatively small.

There is always the possibility that confounders affected our analysis, so we performed several analyses to test the robustness of our findings. In particular, we were concerned about confounding variables that are positively correlated with premiums and payments and with diagnostic intensity but not with use of medical procedures. We studied the association between our measures of medical malpractice and the incidence of heart attacks, hip fractures, and mortality from cardiovascular disease and malignant neoplasms.[23] If there were a positive association between these variables, we would be concerned that an omitted variable such as population health could be driving both the increase in malpractice liability and the use of imaging services. The prevalence of neither heart attack nor hip fracture was affected by either of our measures of malpractice liability exposure.

"We did not find that higher malpractice liability costs were associated with reductions in total or disease-specific mortality."

. . . .

■ **Mortality and malpractice costs.** We also examined the association between mortality from various causes and our measures of malpractice costs.[24] Here, too, there was no significant association. This lack of correlation suggests not only that unmeasured changes in patient illness did not drive our results but also that the increased Medicare spending associated with rising malpractice costs did not measurably reduce mortality, although it certainly might have affected patient well-being in other ways.

Another possibility is that patients in some areas are becoming more "certainty oriented," thereby explaining the use of diagnostic testing as well as an increase in litigation arising from allegations of failure to diagnose. To explore this hypothesis, we used data from a recent study and were unable to find evidence of geographic variation between census regions in patients' preferences for routine cancer screening, free total-body CT scans, and the choice between receiving $1,000 or a free body scan.[25] This result, although not definitive, is reassuring.

Finally, the NPDB specifies whether a malpractice payment was made for alleged malpractice in the areas of diagnosis, surgery, obstetrics, medication, equipment, anesthesia, or treatment. If the "certainty orientation" hypothesis were correct, we might expect an increase in payments associated with "failure to diagnose" and "delay in diagnosis" in states where malpractice liability increased. We found no evidence of such a relationship: The correlation between the percentage increase in malpractice payments per physician and the percentage increase in the number of diagnostic payments was 0.17 ($p < 0.24$). The correlation between the percentage increase in malpractice payments per physician and the percentage increase in the number of diagnostic payments in the narrower categories of "failure to diagnose" and "delay in diagnosis" was −0.03 ($p < 0.83$). Although neither of these tests irrefutably rejects the certainty-orientation hypothesis, they suggest that it was not a first-order source of bias.

Discussion

Our study used fairly recent data to estimate the association between increases in malpractice liability costs and changes in medical spending and practice patterns. We found that a 10 percent increase in average malpractice payments per physician within a state was associated with a 1.0 percent increase in Medicare payment for total physician services and a 2.2 percent increase in the imaging component of these services. We obtained similar results using malpractice premiums as an alternative measure of liability costs.

In addition to the increase in the use of imaging services, we saw a somewhat weaker increase in the use of other discretionary, generally low-risk services such

as physician visits and consultations, diagnostic tests, and minor procedures. A recent survey of physicians found that more than 93 percent ordered additional tests and performed additional diagnostic procedures in response to growing malpractice costs.[26] This survey also reported a substantial increase in the use of imaging technologies and a reduction in major surgeries among certain patient populations. Our results are consistent with these self-reports.

Our estimates shed some light on the magnitude of the relationship between malpractice liability and the use of medical services. States in the top quartile of malpractice payments per physician have 70 percent more payments per physician than states in the bottom quartile. Our estimates suggest that relative to states in the bottom quartile, all else equal, these states with high malpractice liability will have total Medicare spending that is 4.2 percent higher and spending on physicians that is 7.0 percent higher.

To put these estimates into perspective, consider the 60 percent increase in average malpractice premiums between 2000 and 2003. Our results suggest that this increase was associated with an increase Medicare spending of about $16.5 billion total and $7.1 billion on physician services (since Medicare outlays in 2003 were $275 billion).[27]

Although our analysis suggests an important association between malpractice costs and the use of imaging services, this link might have been missed in previous studies that focused on an earlier era, when the use of imaging procedures and outpatient services was less prevalent. Our estimates do not imply that any change in spending was necessarily "defensive medicine." To the extent that additional malpractice costs mean greater precautionary testing with some medical value, any additional procedures might be protective of patient health or valued regardless of their therapeutic properties. We did not find that higher malpractice liability costs were associated with reductions in total or disease-specific mortality. This evidence is clearly not sufficient to rule out a potential benefit from malpractice liability–induced medical spending, but there is also some evidence from other studies that the increases in use associated with malpractice liability costs could actually lead to harm.[28]

Our study is not without limitations. First, our sample was limited to the Medicare population; although this population accounts for a sizable share of overall health spending, our results might not generalize to other parts of the health care system. Second, although our longitudinal analysis was designed to account for all fixed unobservable confounders that operate at the state level and all national trends, unobserved confounders that vary within states over time might have affected our analysis. The specification tests we reported suggest that this was not the case, ruling out many of the most likely potential sources of bias, but outside of an experimental setting, it is difficult to prove causality conclusively.

NOTES

1. M.M. Mello, D.M. Studdert, and T.A. Brennan, "The New Medical Malpractice Crisis," *New England Journal of Medicine* 348, no. 23 (2003): 2281–2284; and D.M. Studdert, M.M. Mello, and T.A. Brennan, "Medical Malpractice," *New England Journal of Medicine* 350, no. 3 (2004): 283–292.

2. T.A. Brennan et al., "Incidence of Adverse Events and Negligence in Hospitalized Patients: Results of the Harvard Medical Practice Study I," *New England Journal of Medicine* 324, no. 6 (1991): 370–376; and A.R. Localio et al., "Relation between Malpractice Claims and Adverse Events Due to Negligence: Results of the Harvard Medical Practice Study III," *New England Journal of Medicine* 325, no. 4 (1991): 245–251.

3. D.M. Studdert et al., "Defensive Medicine among High-Risk Specialist Physicians in a Volatile Malpractice Environment," *Journal of the American Medical Association* 293, no. 21 (2005): 2609–2617.

4. We used the term "malpractice liability costs" to refer to both malpractice insurance premiums and the size and number of malpractice judgments and settlements. As discussed below, the term is not intended to imply any specific causal relationship between these components of the malpractice liability environment and physician behavior or the value of services performed.

5. Studdert et al., "Defensive Medicine among High-Risk Specialist Physicians"; L.M. Baldwin et al., "Defensive Medicine and Obstetrics," *Journal of the American Medical Association* 274, no. 20 (1995): 1606–1610; A.R. Localio et al., "Relationship between Malpractice Claims and Cesarean Delivery," *Journal of the American Medical Association* 269, no. 3 (1993): 366–373; L. Dubay, R. Kaestner, and T. Waidmann, "The Impact of Malpractice Fears on Cesarean Section Rates," *Journal of Health Economics* 18, no. 4 (1999): 491–522; U.S. Congress Office of Technology Assessment, *Defensive Medicine and Medical Malpractice*, Report no. OTA-H-602 (Washington: OTA, 1994); and D.P. Kessler and M.B. McClellan, "Do Doctors Practice Defensive Medicine?" *Quarterly Journal of Economics* 111, no. 2 (1996): 353–390.

6. Medicare Payment Advisory Commission, *Healthcare Spending and the Medicare Program* (Washington: MedPAC, 2005); and J.K. Iglehart, "The New Era of Medical Imaging—Progress and Pitfalls," *New England Journal of Medicine* 354, no. 26 (2006): 2822–2828.

7. D. Verrilli and H.G. Welch, "The Impact of Diagnostic Testing on Therapeutic Interventions," *Journal of the American Medical Association* 275, no. 15 (1996): 1189–1191.

8. D.P. Kessler, W.M. Sage, and D.J. Becker, "Impact of Malpractice Reforms on the Supply of Physician Services," *Journal of the American Medical Association* 293, no. 21 (2005): 2618–2625; and K. Baicker and A. Chandra, "The Effect of Malpractice Liability on the Delivery of Health Care," in *Frontiers of Health Policy Research*, ed. D. Cutler and A.M. Garber (Cambridge, Mass.: MIT Press, 2005), 16–18.

9. Kessler and McClellan, "Do Doctors Practice Defensive Medicine?"

10. We weighted each state according to its population in the 2000 census (so that results can be interpreted as applying to the average person).

11. Kessler and McClellan, "Do Doctors Practice Defensive Medicine?"; and D.P. Kessler and M.B. McClellan, "How Liability Law Affects Medical Productivity," *Journal of Health Economics* 21, no. 6 (2002): 931–955.

12. Z. Griliches and J.A. Hausman, "Errors in Variables in Panel Data: A Note with an Example," *Journal of Econometrics* 31, no. 1 (1985): 93–118.

13. National Center for Health Workforce Analysis, Area Resource File (Rockville, Md.: Health Resources and Services Administration, 2003). Sensitivity to these choices, discussion of other potentially omitted factors, and estimates with additional controls are included in an online appendix, available at http://content.healthaffairs.org/cgi/content/full/26/3/841/DC1.

14. Kessler and McClellan, "How Liability Law Affects Medical Productivity."

15. A. Chandra, S. Nundy, and S.A. Seabury, "The Growth of Physician Malpractice Payments: Evidence from the National Practitioner Data Bank," *Health Affairs* 24 (2005): w240–w249 (published online 31 May 2005; 10.1377/hlthaff.w5.240).

16. B. Black et al., "Stability, Not Crisis: Medical Malpractice Claim Outcomes in Texas, 1988–2002," *Journal of Empirical Legal Studies* 2, no. 2 (2005): 207.

17. Baicker and Chandra, "The Effect of Malpractice Liability"; and Chandra et al., "The Growth of Physician Malpractice Payments."

18. Federal Reserve Bank of St. Louis, "Gross Domestic Product: Implicit Price Deflator," 2004, http://research.stlouisfed.org/fred2/data/GDPDEF.txt (accessed 14 February 2007).

19. Berenson-Eggers Type of Service (BETOS) Codes, 2005, http://www.cms.hhs.gov/HCPCSReleaseCodeSets/20_BETOS.asp (accessed 12 March 2007); and J. Wennberg and M. Cooper, *The Dartmouth Atlas of Health Care* (Chicago: American Hospital Association Press, 1999). This study, and its underlying protocol guaranteeing the confidentiality of the Medicare claims data, was approved by the Institutional Review Board (IRB) at Dartmouth College.

20. A 5 percent sample of Medicare fee-for-service physician (Part B) claims was used to calculate age-, race-, and sex-adjusted rates of spending on total physician services and for each of the major BETOS categories. Total Medicare spending per beneficiary was also ascertained from the same 5 percent sample, using records from the Continuous Medical History Sample File. Rates of major elective inpatient surgical procedures were based upon a 100 percent sample drawn from the Medicare Provider Analysis and Review (MEDPAR) file, and rates of specific physician services were calculated from a 20 percent sample of Part B physician claims in later years and a 5 percent sample in earlier years. The population denominator for all rates was the midyear population of fee-for-service Medicare beneficiaries, age sixty-five and older, who were eligible for both Parts A and B.

21. We used a state-level cost-of-living adjustment to adjust all premium, payment, and spending dollar values for state-level variation in prices, although as shown in the appendix, this does not affect subsequent regression results. See Note 13.

22. In the appendix exhibits we report a number of specification tests, including results from models using two alternative sets of weights (state population from the 1990 census and the number of physicians in each state) as well as including other covariates. See Note 13.

23. See Appendix Exhibit 3; ibid.

24. Ibid.

25. L.M. Schwartz et al., "Enthusiasm for Cancer Screening in the United States," *Journal of the American Medical Association* 291, no. 1 (2004): 71–78. Geographic identifiers in this study were limited to the four major census regions. We performed a chi-square test to examine if there were geographic differences in preferences for screening.

26. Studdert et al., "Defensive Medicine among High-Risk Specialist Physicians."

27. Congressional Budget Office, *The Budget and Economic Outlook: Fiscal Years 2005 to 2014*, January 2004, http://www.cbo.gov/showdoc.cfm?index=4985&sequence=0&from=0#anchor (accessed 14 February 2007). We focused on the responsiveness of health care spending to malpractice liability in the Medicare population. There is evidence that elderly beneficiaries are much less likely than others to litigate, which suggests that our analysis might understate the response in the general population. However, most beneficiaries are enrolled in fee-for-service, where, unlike capitated plans, there are few restrictions on a physician's ability to order additional tests—a possibility that suggests that results from Medicare might be larger than the economywide responsiveness of physicians to malpractice costs. If these effects roughly offset each other, extrapolating these estimates to the general population would suggest that the 60 percent increase in malpractice premiums between 2000 and 2003 would be associated with a 6 percent, or $95 billion, increase in national health spending. Given that our data drew only from the Medicare population, however, the true effect on national health spending might be quite different.

28. E.S. Fisher and H.G. Welch, "Avoiding the Unintended Consequences of Growth in Medical Care: How Might More Be Worse?" *Journal of the American Medical Association* 281, no. 5 (1999): 446–453.