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HOW LIABILITY LAW AFFECTS MEDICAL PRODUCTIVITY

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ABSTRACT

Previous research suggests that "direct" reforms to the liability system -- reforms designed to reduce the level of compensation to potential claimants -- reduce medical expenditures without important consequences for patient health outcomes. We extend this research by identifying the mechanisms through which reforms affect the behavior of health care providers. Although we find that direct reforms improve medical productivity primarily by reducing malpractice claims rates and compensation conditional on a claim, our results suggest that other policies that reduce the time spent and the amount of conflict involved in defending against a claim can also reduce defensive practices substantially. In addition, we find that "malpractice pressure" has a larger impact on diagnostic rather than therapeutic treatment decisions. Our results provide an empirical foundation for simulating the effects of untried malpractice reforms on health care costs and outcomes, based on their predicted effects on the malpractice pressure facing medical providers.

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Introduction

Medical malpractice liability law has two principal objectives: compensating patients who are injured through the negligence of health care providers, and deterring providers from practicing negligently. Considerable evidence suggests that the current liability system in the United States achieves neither. The tort system does not provide compensation rapidly, predictably, or equitably to patients injured negligently. Awards for medical malpractice claimants are subject to lengthy delays: on average, it takes almost four and a half years to resolve a malpractice suit. In addition, while adverse outcomes in the course of medical care are common, only one in fifteen patients who suffer an injury due to medical negligence receives compensation, and five-sixths of the cases that receive compensation have no evidence of negligence (Harvard Medical Practice Study 1990; Weiler et al. 1993). Rather, the primary determinant of whether an injury will receive compensation is the extent of the injury, not the extent of fault (Brennan et al. 1996).

The unpredictability of malpractice compensation suggests that the system may not achieve its second objective: providing incentives for physicians to take optimal precaution against patient injury. Kessler and McClellan (1996) show that elderly heart disease patients from states adopting liability-reducing tort reforms experience lower growth in medical expenditures, but do not experience significantly worse health outcomes. Put another way, the current system induces doctors to practice "defensive medicine": marginal reductions in the level of liability improve productivity.

Though the current malpractice system has been widely criticized, evidence to guide malpractice reform more generally has been limited. The Kessler-McClellan study suggests that state law reforms that reduce liability directly — such as caps on damages — reduce the use of costly treatments that have no measurable effects on important health outcomes. Even if they improve productivity, however, direct liability reforms only address the problem of excessive physician precaution. Other reforms have sought to improve the sensitivity and specificity of malpractice compensation, as well as to reduce the prevalence of defensive medicine. By enabling fairer and more efficient adjudication of plaintiffs' claims, these reforms have aimed to benefit both physicians and patients by making claim resolution faster and more predictable. One class of reforms proposes to retain the current fault-based system of awarding damages while encouraging resolution of a greater number of claims outside of formal litigation (e.g., Bovbjerg 1989). Pretrial screening panels, for example, offer either a mandatory or voluntary process for hearing a case informally prior to its coming to trial; mandatory nonbinding and voluntary binding arbitration accomplish a similar objective.

More fundamental changes in the liability system have also been proposed (e.g., Kinney 1995), although these reforms have not been broadly implemented. For example, some researchers have suggested that tort liability for medical malpractice should vest statutorily in hospitals (e.g., Abraham 1988; Weiler 1991) or health plans (e.g., Sage et al. 1994) rather than physicians, a reform termed "enterprise liability." Enterprise liability seeks to allocate responsibility for injuries and for maintaining adequate liability insurance to large organizations in order to reduce the financial burden on physicians of high malpractice premiums and to reduce administrative complexity by eliminating multidefendant claims. Other researchers have argued that the fault-based tort system should be replaced with an administrative no-fault system that would compensate certain individuals with medical injuries, whether or not the injury were due to medical negligence (Weiler 1991; Tancredi 1986; O'Connell 1986; Havighurst 1975). Medical practice guidelines can also serve as the basis for a reform that reduces physician incentives for defensive practices, if accompanied by legislation that makes compliance with guidelines an affirmative defense to a claim of negligence (Kinney 1995).

Predicting which if any of these untried reforms will improve the performance of the current liability system in terms of both compensation and deterrence requires an understanding the mechanisms through which malpractice laws affect physician behavior. Despite the implications for these proposed reforms of understanding how malpractice laws influence the "malpractice pressure" facing medical providers, little research has examined the mechanisms through which laws affect medical treatment decisions, and thereby medical costs and health outcomes.

Similar limitations apply to much of the work to date on program evaluations in many other contexts. Many analyses of the consequences of laws, regulations, and other mandates are reduced-form studies of the effects of laws on outcomes of interest; the mechanisms through which the effects are achieved are treated as a black box. This approach is simple, in that it avoids explicit empirical modeling of the key behavioral responses that actually lead to the outcomes of interest. But without explicit models of policy effects on incentives, and in turn of the effects of incentives on behavior, moving beyond the details of a particular reform to consider the likely consequences of other types of policy changes is highly speculative. Moreover, an explicit analysis of mechanisms could provide important validating information. Economic studies of policy effects are generally based on observational data, raising concerns that unmeasured factors rather than the policy changes themselves could account for the empirical results. Finally, explicit analysis of mechanisms provides a much richer context for modeling economic behavior; especially in the health care industry, provider behavior is not well understood.

In this paper, we develop a comprehensive empirical model of the mechanisms by which malpractice reforms influence physician behavior, and thereby medical costs and health outcomes. We integrate four unique data sources to illuminate how existing liability law and liability reforms affect the outcomes of the liability system, and how reform-induced changes in the incentives provided by the liability system affect treatment decisions, medical costs, and health outcomes. First, we use longitudinal data on all elderly Medicare recipients hospitalized for treatment of a new heart attack (AMI) or of new ischemic heart disease (IHD) in any of the years 1984-1994 analogous to that used in Kessler and McClellan (1996). We match this by state and year with two datasets that measure the pressures provided by the malpractice liability system: physician-level data on the frequency of malpractice claims, and malpractice claim-level data on claim costs and outcomes. Finally, we use data on existing state liability reforms from Kessler and McClellan (1997).

We model the complete process by which malpractice reforms affect health care productivity. First, we study the impact of liability reforms on a range of measures of the pressures on providers generated by the malpractice system: the frequency of malpractice claims; the likelihood of a prolonged duration of claims resolution; administrative and legal expenses incurred in defending against a claim; and the amount of any settlement or award to the plaintiff. We then analyze the extent to which changes in malpractice pressure affect the major categories of medical treatment decisions for elderly heart disease patients, and in turn the consequences of these changes in practices for medical expenditures and patient health outcomes. We thus remove the "black box" by identifying the actual incentives that policy reforms alter to influence the production of medical services, and how these changes in medical production affect health and cost outcomes.

Section I discusses the relationships between liability law, liability system outcomes, malpractice pressure, medical costs, and patient health outcomes. The Section begins with an outline of the mechanisms through which the liability system might change medical treatment decision-making, and then introduces our approach for identifying the effects of changes in malpractice pressure. Section II discusses all of our data sources and analytic variables in detail, as a foundation for the presentation of our econometric models in Section III. Section III presents models of the effects of law reforms on the processes of the liability system, of the effects of changes in the incentives resulting from these tort liability processes on physicians' treatment decisions, and of the consequences of these changes in treatment decisions for medical costs and health outcomes. Section IV presents our empirical results, and Section V concludes.

I. The Liability System and Incentives for Defensive Medicine

Figure 1 outlines the relationships between medical liability laws, liability claims and their resolution, malpractice pressure, medical treatment decisions, and patient health and medical costs. Our analysis traces the effects of changes in the rules of the tort system through this framework.

Reforms in tort law are designed to influence patient decisions about bringing and resolving liability claims. Claims are generally filed initially with the physician's malpractice insurance carrier, and often but not always are followed by the filing of a formal lawsuit against the physicians involved and possibly the institution in which the physician practices. Prior to the formal filing of a lawsuit, confidentiality of the physician-patient relationship prohibits insurers from discussing the suit with the defendant physician without the patient's permission. At this stage, the patient can obtain a copy of his or her medical records and talk with the physician, if the physician is willing. But the physician cannot be compelled to discuss the case until a formal suit is filed, when state laws governing discovery of evidence specify how each side must respond to the other's inquiries regarding the case.

Once discovery begins, the physician and other medical providers involved in the lawsuit begin to incur litigation costs. These costs may be both financial and nonfinancial. Because malpractice insurance is community rated, physicians are generally fully insured against claims that are closed with payment or that are litigated to a verdict for the plaintiff, and are also insured against most attorneys' fees and other litigation expenses. In contrast, no insurance is possible against the unpleasant experiences and considerable time commitment over months or years (e.g., Lawthers et al. 1992). For example, in discovery, a physician may be required to answer both written and oral questions about her competence and judgment and to respond to questions and other requests from lawyers for the patient, for the malpractice insurer, and for the hospital and its malpractice insurer. Moreover, even though most financial costs are not borne by physicians, they may still affect physician behavior through their effects on malpractice insurers and health care organizations. In cases with high financial stakes, the physician's insurer, hospital, or health care organization may impose additional time and effort costs to avoid an adverse liability judgment. For example, insurers may require more discussions of the details of the case, and hospitals may require extra documentation or additional tests for "high-risk" patients after an adverse event has occurred. Both physicians and health care organizations may also suffer from the adverse publicity that accompanies a publicized litigation process, financial settlement, or loss at trial.[1]

Because doctors may change their behavior to avoid these malpractice costs, the liability system creates *malpractice pressure* that may influence physicians' treatment decisions. We define malpractice pressure as the expected intensity of liability costs facing a physician, given a set of treatment choices for the population of patients she faces. As the foregoing discussion suggests, malpractice pressure is multidimensional, including both financial and nonfinancial costs.

Whether the malpractice pressure induced by a system of tort laws is optimal is an empirical question (Farber and White 1991). There are many potential market failures in health care that could lead medical providers to provide an inefficiently low level of patient care, that is, to fail to undertake treatment decisions with marginal social cost (in terms of physician effort and resource use of other health care services) less than the expected marginal social benefit in terms of improved patient health. In these circumstances, the additional costs of malpractice claims that follow injuries could deter providers from putting patients at excessive risk of adverse health outcomes. On the other hand, the level of malpractice pressure may be too high or misdirected, leading doctors to take socially excessive precautions, such that the marginal social benefit of the

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[1]Indeed, a national databank with disclosable information on settlements and judgments against physicians now exists.

additional treatments provided would be greater than their marginal social cost. In this case, malpractice pressure would induce doctors to practice *defensive medicine*.

Previous empirical evidence suggests that states with the most expansive malpractice liability laws experience more defensive medical practice (Rock 1988; Harvard Medical Practice Study 1990; Localio et al. 1993; Dubay et al. 1999; but see Baldwin et al. 1995). Most of these these studies have an important weakness: the source of variation in malpractice pressure was the individual liability experiences of doctors, hospitals, or areas within a single state over a limited time period. This is problematic because the claims frequency or insurance premiums of a particular provider or small area may be relatively high because the provider is relatively low quality, because the patients are particularly sick (and hence prone to adverse outcomes), because the patients have more "taste" for medical interventions (and may be more likely to disagree with their provider about management decisions), or because of many other unmeasured reasons. All of these factors are extremely difficult to capture in observational datasets, and therefore could lead to an apparent but noncausal association between measured malpractice pressure and treatment decisions.

Kessler and McClellan (1996) use a different approach to determine whether doctors practiced defensive medicine: a difference-in-differences (DD) framework to examine the consequences of reforms in malpractice laws for the health outcomes and medical expenditures of elderly patients with cardiovascular illness. As described in detail in that paper, these methods avoid many of the confounding factors that may influence both malpractice claims and medical outcomes. Kessler and McClellan (1996) find that patients in states enacting reforms that directly capped awards to plaintiffs had significantly smaller increases in hospital expenditures but no changes in mortality or serious complications of heart disease, compared to patients in states without such reforms. However, neither this study nor previous work explicitly evaluates *how* such outcome differences arose.

This omission is important for several reasons. First, understanding how malpractice laws affect health outcomes would provide better insights into the likely effects of untried malpractice reforms that differ from those previously implemented. Such untried reforms will also affect medical decisionmaking through their impact on malpractice pressure, and it is likely to be much easier to predict their effects on claims behavior (e.g., likelihood of bringing suit and time and expense associated with a given suit) than it is to predict their ultimate effects on health care productivity. An understanding of how changes in malpractice pressure influence behavior would allow better predictions of the effects of untried reforms. For example, untried reforms such as limited no-fault systems (Weiler 1993) are expected to reduce malpractice pressure by reducing the financial liability of physicians and the time required for claims resolution. Estimates of the elasticity of treatment decisions with respect to these dimensions of malpractice pressure would help predict the consequences of a limited no-fault system for medical costs and patient outcomes. Similarly, understanding which aspects of treatment behavior are most affected by changes in malpractice pressure can even guide the design of reforms. For example, to the extent that defensive medicine involves socially excessive diagnostic testing, reforms that allow physician compliance with medical practice guidelines for diagnostic testing as an affirmative defense against charges of negligence might improve productivity; but if malpractice pressure primarily affects therapeutic decisions, practice guidelines for diagnostic testing would be less effective.

While understanding how malpractice pressure affects treatment decisions and medical productivity is our principal goal, there are at least two other benefits of a detailed analysis of malpractice mechanisms. First, such a study would provide an important validation and critique of DD studies of law effects. Although law changes, lawsuit changes, physician practice changes, and medical costs may all move in a manner that is consistent with a simple economic model of behavior, the demonstration of such a coherent sequence of causal relationships would seem to provide much more convincing evidence of a causal relationship between legal reforms and medical productivity. Second, economic models that go beyond analyzing reform as a "black box" are of considerable interest in themselves. Few studies of the medical sector or other sectors of the economy have examined *both* how policy reforms affect production incentives *and* how these incentives influence behavior and productivity outcomes in the industry. This explicit framework provides a much richer foundation for micro-level economic studies, but also presents a number of challenges in terms of such issues as integrating data from multiple sources and modeling complex financial and nonfinancial incentives.

II. Data

We measure the processes of the liability system using two data sources. First, we use data on malpractice liability insurance claims maintained by the Physician Insurance Association of America (PIAA) to provide information on malpractice claims for approximately 95,000 physicians in 19 states with total annual malpractice premiums around $1.1 billion (as of 1992).[2]

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[2]California, Colorado, Georgia, Iowa, Maine, Michigan, Minnesota, Mississippi, Missouri, Montana, Nevada, New York, North Carolina, North Dakota, Pennsylvania, Texas, Utah, Washington, and Wisconsin.

The data include all claims by patients for compensation of injuries and financial losses arising out of medical care, even if no formal lawsuit was filed. The data consist of detailed medical causation data for more than 85,000 medical malpractice claims based on alleged injuries occurring from 1984 to 1994. For claims closed during the sample period, the PIAA data base reports the settlement or verdict amount (if any), the length of time required to resolve the claim, and the total allocated loss adjustment expenses (ALAE). Because ALAE includes most litigation costs incurred by the liability insurer in defending against the claim, such as expert witness and defense attorney expenditures, we use it as a proxy for the amount of conflict involved in defending against a claim.

Table 1 reports descriptive statistics on the PIAA data. Analysis of settlement amount and ALAE is based on closed claims only, because final information on settlement amount and ALAE is not available until a claim is resolved. Table 1 shows that this restriction is unlikely to affect our results: most of the claims filed (approximately 88 percent) were closed in our sample period, and the observable characteristics of the sample of closed claims are very similar to the observable characteristics of the full sample.[3]

Table 1 also shows that malpractice claims impose both financial and nonfinancial costs on physicians and malpractice insurers. Physicians pay to settle approximately one-third of all claims, and the average payment for those claims was $148,533 in 1994 dollars. Physicians and their insurers also incur substantial expenses defending against the malpractice claims.

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[3]Moreover, even if reforms reduce time to claim closure, and time to closure is positively related to other correlates of malpractice pressure such as settlement amount, restricting our analysis to closed claims will bias downward the estimated effect of reforms on claims outcomes. That is, relative to nonreform states, closed claims in reform states would reflect an excessive number of claims for high settlement amounts.

Approximately 86 percent of claims result in ALAE, with an average constant-dollar ALAE on claims incurring ALAE of $15,787. In addition, the system imposes other nonfinancial costs, in the form of physician time and effort devoted to a case between filing and resolution, as well as the unpleasantness of the claim itself; over 3.5 years elapse on average to between filing and closure of a claim. Finally, Table 1 shows that a substantial share of the claims in our sample were resolved in states that adopted reforms in our 1984-1994 sample period: 23.8 percent of closed claims were resolved in states adopting direct reforms, and 41 percent of closed claims were resolved in states adopting indirect reforms.

The PIAA claims data provide measures of claim severity, conditional on a claim occurring. To study the frequency of malpractice claims, we obtained data from the AMA Socioeconomic Monitoring System (SMS) surveys of physicians from 1987 through 1997. Questions from each year's survey relate to claims in the previous year, so these surveys provide measures of claim filing rates for 1986 through 1992. In general, the law in effect at the date of an individual's injury governs that individual's claim, regardless of when the claim or formal lawsuit is filed. For this reason, we matched the AMA data with law reforms (and our other datasets) based on the approximate date of the occurrence of the injuries underlying the claims reported in the survey. To account for the average delay of 1.6 years from time from injury to time of filing with the physician's insurer, we matched claims rates from year t with laws effective as of and with claims arising out of injuries occurring in year t-2.[4] The average physician in the entire survey sample had a 7.25 percent chance of defending against a

[4]Kessler and McClellan (1997) show that law reforms do not affect physician reported claims rates immediately, but rather take 1-3 years to reach their full effect.

malpractice claim in any year; physicians in the 19 states covered by the PIAA data had a 7.35 percent chance of a claim.[5]

To assess the impact of malpractice pressure on medical treatment, expenditures, and health outcomes, we use comprehensive longitudinal Medicare claims data for the vast majority of elderly Medicare beneficiaries who were admitted to a hospital with a new primary diagnosis of either AMI or IHD in 1984-1994. Patients with admissions in the prior 12 months were excluded. The sample is analogous to that used in Kessler and McClellan (1996), except that it covers all of the years 1984-1994 and only individuals residing in the 19 states for which we have malpractice claims data, and therefore measures of malpractice pressure. Data on patient demographic characteristics were obtained from the Health Care Financing Administration's HISKEW enrollment files, with death dates based on death reports validated by the Social Security Administration. Measures of total one-year hospital expenditures were obtained by adding up all inpatient reimbursements (including copayments and deductibles not paid by Medicare) from insurance claims for all hospitalizations in the year following each patient's initial admission for AMI or IHD. Measures of the occurrence of cardiac complications were obtained by abstracting data on the principal diagnosis for all subsequent admissions (not counting transfers and readmissions within 30 days of the initial admission) in the year following the patient's initial admission. Cardiac complications included rehospitalizations within one year of the initial event with a primary diagnosis (principal cause of hospitalization) of either subsequent AMI or heart failure. Treatment of IHD and AMI patients is intended to prevent

[5] AMA SMS descriptive statistics not reported in Table 1. Our calculated shares of physicians with claims are similar to those reported by Gonzalez (1995).

subsequent AMIs if possible, and the occurrence of heart failure requiring hospitalization is evidence that the damage to the patient's heart from ischemic disease has serious functional consequences.

Hospitals are not reimbursed separately for each test and procedure performed on Medicare patients. We approximate resource use for particular types of treatments by decomposing total expenditures into three major categories of services provided to patients: diagnostic, therapeutic, and other services. We use patient-level reported charges for each of these categories of service, weighted by hospital- and service-specific cost-to-charge ratios, to construct patient-level measures of each type of expenditure.[6]

Tables 2A and 2B present descriptive statistics for the AMI and IHD populations in our study. For comparison, the leftmost three columns of each Table show descriptive statistics for the entire U.S. population of elderly AMI and IHD patients; the rightmost three columns of each Table show descriptive statistics for patients from the 19 states covered by the PIAA data on

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[6]We construct these measures of service-specific expenditures as follows. Hospitals are required to report charges (list prices) for individual patients at the level of particular types of services provided (e.g., operating room charges, laboratory charges, pharmaceutical charges). They are also required to file annual financial statements describing the accounting costs and charges for caring for Medicare beneficiaries, from which service-specific cost-to-charge ratios can be constructed for each hospital in each year of the study. These ratios are used to convert reported charges to reported costs. Diagnostic services include laboratory and radiology services. Therapeutic services include anesthesia, blood administration, pharmacy, occupational therapy, operating room, physical therapy, inhalation therapy, speech pathology, and other incidental supplies. A third category of other services, which cannot easily be characterized as predominantly diagnostic or therapeutic, consist mainly of hospital perdiem costs (room and board, and nursing costs). To provide an approximate measure of the expenditures attributable to each type of cost, we assume that diagnostic, therapeutic, and other expenditures are proportional to the share of that cost type in total costs. For example, the diagnostic cost share for a patient is defined as the patient's reported diagnostic costs divided by the patients reported total costs (diagnostic, therapeutic, and other). Then the patient's diagnostic expenditures are estimated as the patient's diagnostic cost share times the patient's total expenditures.

malpractice claims. As the sample sizes indicate, the 19 state sample used in analysis covers approximately half of the U.S. elderly population of heart disease patients. Tables 2A and 2B show that the characteristics and health outcomes of the 19-state sample of patients that we use in this paper are largely similar to the characteristics health outcomes of the U.S. population of elderly AMI and IHD patients. Patients in the 19-state sample had somewhat higher levels and higher growth rates of expenditures than did the U.S. population overall, with real 1-year hospital expenditures for an AMI growing by 52.5 percent between 1984 and 1994 (compared to 49.7 percent for the entire U.S. population). Hospital expenditures for an IHD patient also grew substantially in real terms, by 47.7 percent over the period (compared to 44.8 percent for the entire population).

A disproportionate share of this expenditure growth occurred in therapeutic expenditures, reflecting the dramatic growth in therapeutic intensity for cardiac illness over this period (see, e.g., Cutler and McClellan 1997). Real expenditures on therapeutic treatment grew by 60.2 percent for AMI patients and by 55.4 percent for IHD patients. Real diagnostic treatment intensity also grew substantially: diagnostic expenditures increased by 32.1 percent for AMI patients and by 14.4 percent for IHD patients. Other expenditures, consisting mainly of daily support and staffing costs for hospital rooms, grew the least rapidly, with growth rates for both types of patients only one-sixth to one-tenth as high as growth rates for therapeutic expenditures.

We define state tort laws in effect in each year based on whether each state had adopted one or more liability-reducing divergences from a maximum-liability regime. Consistent with previous research on the impact of liability reform (Barker 1992; Campbell, Kessler, and Shepherd 1998; Danzon 1982, 1986; Kessler and McClellan 1996, 1997, 1999; Sloan, Mergenhagen, and Bovbjerg 1989; Zuckerman, Bovbjerg, and Sloan 1990), we group these reforms into two major categories: direct and indirect reforms. Direct reforms are statutory limits on malpractice awards: caps on total or noneconomic damages, collateral source rule reforms (which require damages to be reduced by all or part of the dollar value of collateral source payments to the plaintiff), abolition of punitive damages, and abolition of mandatory prejudgment interest. Indirect reforms are statutory changes that affect awards only indirectly, such as impositions of mandatory periodic payments (which require damages in certain cases to be disbursed in the form of an annuity that pays out over time), caps on attorneys' contingency fees, and abolition of joint-and-several liability for total or noneconomic damages, either for all claims or for claims in which defendants did not act jointly. Classification of states is identical to that in Kessler and McClellan (1997).

III. Models

III.1. Models of the Consequences of Reforms for Malpractice Pressure

To begin our analysis of the mechanisms through which legal reforms achieve their effects, we estimate models of the effects of liability reforms on malpractice claim rates and claim intensity. We denote the probability that physician i in state s faces a lawsuit arising out of alleged injuries in year t as a binary variable C_{ist}, with $C_{ist} = 1$ if i from s at t defended against at least one malpractice claim. The AMA SMS provides information on physician specialty, which we denote by a fourteen-dimensional vector of binary variables X_{ist}^{MD};[7] though the mix of

[7]Physicians are divided into 15 specialty categories: general practice/family practice, internal medicine, general surgery, otolaryngology, orthopaedic surgery, ophthalmology, urological surgery, other surgery, pediatrics, obstetrics and gynecology, psychiatry, radiology,

physician specialties in a geographic area is unlikely to change in the short run in response to changes in laws, such effects have been postulated over several or more years. We also control for state political characteristics W_{st}[8] (to proxy for time-varying differences in attitudes toward the tort system across states (e.g., Galanter 1996)), state- and time-fixed effects, and the presence of malpractice law reforms L_{st}. We denote the existence of reforms in state s at time t through a vector description of reform status: $L_{1st}=1$ if state s has adopted a direct reform at time t, $L_{2st}=1$ if state s has adopted an indirect reform at time t. Because all regressors in the model of claims determination are dichotomous, we estimate linear probability models in order to provide parameter estimates that are interpretable as differences in conditional means (although estimates from probit models give similar results). Thus our model of the probability of experiencing a malpractice claim is

$$C_{ist} = \theta_t + \alpha_s + X_{ist}^{MD}\beta + W_{st}\gamma + L_{st}\varphi + v_{ist} , \qquad (1)$$

where θ_t is a time fixed-effect, α_s is a state fixed-effect, β is a vector of the average effects of physician characteristics, φ is the two-dimensional average effect of malpractice reforms on the growth in claims rates, and v_{ist} is a mean-zero independently-distributed error term (our estimates correct for heteroscedasticity in v_{ist}). Because legal reforms may affect both the level and the growth rate of expenditures, we estimate different baseline time trends θ_t for states adopting

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anesthesiology, pathology, and all other (omitted category in regressions).

[8]These characteristics include contemporaneous and once-lagged political party of each state's governor and the majority political party of each house of each state's legislature.

reforms before 1985 (which were generally adopted before 1980) and nonadopting states, as in Kessler and McClellan (1996).

We use data on the characteristics of claims filed to model the impact of reforms on alternative measures of claim intensity conditional on filing. We consider five measurable dimensions ($j = 1, ..., 5$) of the intensity of malpractice claims i in state s arising out of injuries in year t, Y_{ist}^{j}. We include all resolved claims, whether the claims were litigated to a verdict, settled with payment from defendants to plaintiffs, or dropped by plaintiffs.[9] The first two dimensions use claim-related payments to plaintiffs to measure claim intensity: $Y_{ist}^{1}=1$ if the physician or her insurer paid a nonzero settlement or jury award to claim i, and Y_{ist}^{2} is the natural logarithm of the dollar value of the settlement or jury award in claim i, in constant 1994 dollars. The latter variable includes the bulk of the financial costs incurred in malpractice litigation: plaintiff attorney fees are largely contained in awards and, as Table 1 showed, ALAE averages only around one-tenth of the size of awards. Payments to claimants are also likely to be correlated strongly with the nonfinancial costs to physicians of defending against a claim. The remaining three malpractice claim outcome variables provide measures of malpractice pressure that focus on the physician time and disutility involved in claim resolution. Y_{ist}^{3} is a binary variable equal to 1 if the claim involved nonzero ALAE, and Y_{ist}^{4} is the natural logarithm of the amount of ALAE, conditional on ALAE > 0. Finally, Y_{ist}^{5} is a binary variable denoting a prolonged claim: $Y_{ist}^{5}=1$ if the number of days between injury and closure exceeded the sample median of 1,339 days.

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[9]We model the claims outcomes for litigated and settled claims together, because there is no exogenous factor that affects the decision to settle, litigate, or drop but not the outcome of the claims.

The claim intensity models specify claims outcomes as a function of state-fixed-effects, time-fixed-effects (allowed to vary in states with and without preexisting reforms), the specialty of the physician involved in the claim X_{ist}^{MD}, characteristics of the patient and of the alleged injury X_{ist}^{inj}, state political and regulatory characteristics W_{st}, and liability reforms:

$$Y_{ist}^{j} = \theta_t + \alpha_s + X_{ist}^{MD}\beta^{MD} + X_{ist}^{inj}\beta^{inj} + W_{st}\gamma + L_{st}\varphi + v_{ist} \ . \tag{2}$$

where X_{ist}^{MD} and X_{ist}^{inj} are vectors of binary variables.[10]

These models of the effects of malpractice reforms on the components of claim intensity are "reduced-form" in that they describe the *total* effect of reforms on claim intensity. That is, claim behavior may change as a result of malpractice reforms for two reasons: changes in incentives to bring or pursue a claim *given* the occurrence of a set of medical treatment decisions and an adverse outcome, and changes in the occurrence of treatment decisions and adverse outcomes. If reductions in malpractice pressure resulting from reforms lead to more serious adverse outcomes, they may appear to result in a smaller reduction in claim intensity than would be the case if they did not affect the occurrence of adverse events. Such responses would tend to reduce the apparent variation in malpractice pressure between reform and nonreform states, and

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[10]Physician specialty X_{ist}^{MD} includes three indicator variables for surgical and emergency specialists and general practitioners (omitted group in regression is general practitioner); claimant and injury characteristics X_{ist}^{inj} includes 15 indicator variables, three for type of negligence alleged (misdiagnosis error, no medical misadventure, omitted group in regression is all other errors), four for claimant age (child, elderly adult, age missing, omitted group in regression is adult), three for type of injury (minor permanent injury, major/significant permanent injury, omitted group in regression is temporary injury), and five for diagnosis (infections, endocrine/metabolic disorders, cancer, blood diseases; mental illness and substance abuse; nervous system, heart, cerebrovascular, respiratory diseases; digestive and genitourinary diseases; omitted group is muscular/skeletal and all other disorders).

hence would tend to bias upward the apparent effects of changes in malpractice pressure on medical treatments and outcomes. For this reason, we estimate instrumental-variables models of the impact of malpractice pressure that use malpractice law changes to examine the effects of changes in malpractice pressure, holding the distribution of patients and injuries constant.

III.2. Models of the Effects of Malpractice Pressure on Medical Productivity

Our measures of malpractice pressure seek to capture the idea that differences in expectations about the likelihood and intensity of a lawsuit may influence treatment decisions for a particular patient. As malpractice pressure increases, some treatment choices (such as less intensive treatment of heart disease) will have a greater liability threat; other treatment choices (such as tests to document the precise extent of heart disease, or possibly more intensive therapeutic treatment for heart disease) may have less liability threat. Because doctors treat a broad range of patients, a natural approach to defining a malpractice pressure index involves measuring claim intensity for a reference population of patients and treatment decisions.

We construct such malpractice pressure indices $\tilde{M}_{st}$ for each state and time period by constructing measures of the malpractice claim intensity that would be observed for a reference distribution of physicians, patients, and injuries. We denote this state-time malpractice pressure index as

$$\tilde{M}_{st} = \tilde{C}_{st} \cdot \tilde{Y}_{st}$$

where C_{st} denotes the adjusted average probability of defending against a malpractice claim in a state-time cell, and Y_{st} denotes the adjusted average intensity, conditional on a claim. To construct Y_{st}, we assume that, if the population of patients, physicians, treatment decisions, and injuries were held constant, then claim intensity will only vary as a result of intrinsic differences in malpractice pressure. We approximate these intrinsic differences in Υ_{st} by controlling for differences in injuries and providers across state-time cells as follows. First, we estimate a model of claim intensity analogous to equation (2) *without* controlling for the law reform variables L_{st}. Let v'_{ist} denote the residual claim intensity estimated from this first-step equation. Second, we calculate the adjusted intensity for each claim as $\Upsilon_{ist} = \Upsilon + v'_{ist}$, where Υ is the overall average claim intensity. Third, we calculate the weighted average adjusted intensity, conditional on a claim, as $\Upsilon_{st} = \sum_i \omega_{ist} \cdot \Upsilon_{ist}$, where ω_{ist} normalizes the patient, physician, and injury mix in each state-time cell to an overall representative population of malpractice claims. Specifically,

$$\omega_{ist} = \prod_{k=1}^{5} \sum_{p=1}^{p_k} X_{ist}^{p} \cdot \frac{\overline{X^{p}}}{X_{st}^{p}} \quad ,$$

where $X_{ist} = [X_{ist}^{MD}\ X_{ist}^{inj}] = [X_{ist}^{1}\ X_{ist}^{2} \ldots X_{ist}^{P}]$, and there are k=1,..., 5 characteristics describing a claim (physician specialty, type of negligence, claimant age, type of injury, and type of diagnosis) and p_k categories for each of these 5 characteristics. Note that the weights in our index implicitly assume that physician and injured patient characteristics are distributed independently across claims. Because our goal is only to produce a reasonable estimate of the differences in malpractice pressure for a given population of patients and physicians, this assumption is innocuous, provided our results are not sensitive to alternative "reasonable" specifications of the index population. We return to this issue below.

We estimate an index for malpractice claims C_{st} analogously. That is, we calculate weighted state-time residuals from a specification similar to equation (1), again omitting law reform effects, with overall population shares of physician characteristics used as weights. Because this data is collected on physicians, not on claims or injuries, it can not include any detailed information on patient or injury characteristics, so our index specification of malpractice pressure, $C_{st}*Y_{st}$, assumes that shifts in claims rates have uniform effects on malpractice pressure. We also describe below our tests of the sensitivity of our results to alternative specifications of intrinsic malpractice pressure.

We use the resulting measures of intrinsic malpractice pressure M_{st} to estimate linear models of medical expenditures and outcomes as a function of state fixed effects, time fixed effects (allowed to vary as above), patient characteristics, state political characteristics, and malpractice pressure:

$$\ln(R_{ist}) = \theta_t + \alpha_s + Z_{ist}\beta + W_{st}\gamma + \Phi\tilde{M}_{st} + u_{ist} . \qquad (3)$$

In these models, each patient i hospitalized with new occurrences of cardiac disease has observable demographic characteristics Z_{ist} -- which we describe as a fully-interacted set of binary variables describing his or her age, gender, race, and rural/urban residence status – inpatient hospital expenditures R_{ist}, and binary health outcomes O_{ist} (higher values of O denote worse outcomes). We decompose hospital expenditures R_{ist} into three components: R_{ist}^D, expenditures on diagnostic treatments; R_{ist}^T, expenditures on therapeutic treatments; and R_{ist}^O, expenditures on other treatments, not clearly classifiable as diagnostic or therapeutic. We also estimate analogous models of health outcomes O_{ist} which may be affected by the changes in malpractice pressure. Because in general $E(u_{ist} \mid M_{st}) \neq 0$ — malpractice pressure may be correlated with many other state- and time-specific factors that influence treatment decisions and outcomes — least-squares estimates of Φ may be inconsistent. We use malpractice law reforms L_{st} as instrumental variables for malpractice pressure.[11] Our estimation method amounts to a two-sample instrumental variables technique (see Angrist and Krueger (1992) for details).

We explore the sensitivity of our results to our specification of malpractice pressure facing physicians in several ways. We consider alternative dimensions of malpractice intensity, including measures based on claims and on intensity given claim, as well as measures of the overall intensity of malpractice pressure. Because all of these measures tend to vary together, both in terms of their overall variances and in terms of their variances associated with legal reforms, we explore whether our results are sensitive to alternative reasonable specifications of the malpractice pressure index. We construct five indices that differ in their measure of intensity per claim Y_{st}: the likelihood of substantial delay in claim resolution, C_{st}*Pr(lengthy delay in resolution | claim); the likelihood of a nonzero settlement amount, C_{st}*Pr(nonzero settlement | claim); the 1994 constant-dollar magnitude of settlement amount, C_{st}* E(settlement amount | claim); the likelihood of nonzero ALAE, C_{st}*Pr(nonzero ALAE | claim); and the 1994 constant-dollar magnitude of ALAE, C_{st}*E(ALAE | claim). We also model the effects of variations in claims per physician C_{st} alone. We also explore the extent to which our results differ from instrumental-variables models using measures of *actual* claims intensity $\tilde{M}_{st} = \tilde{C}_{st} * \tilde{Y}_{st}$, that is, measures that do not control for possible effects of shifts in injuries and treatments on claims

[11]Kessler and McClellan (1996) and Dubay et al. (1999) evaluate the validity of state malpractice law reforms as instrumental variables in some detail.

filed when states reform their tort laws. The estimated effects in the two specifications will be similar if reforms do not affect the distribution of physicians, patients, and injuries in the population.

IV. Results

Table 3 presents estimates of the "reduced-form" models of the impact of law reforms on outcomes of the liability system. As in all of the models we present, these DD models compare *time trends* in states that *changed* their liability system to trends in states that did not, controlling for state and time effects. The leftmost two columns of the Table present estimates of the impact of law reforms on trends in malpractice claims rates φ from equation (1), based on individual physician data from the AMA SMS. Physicians from states adopting both direct and indirect reforms show lower trend growth in malpractice claims rates than do physicians from states not adopting reforms (e.g., Kessler and McClellan 1997). Although this difference is not statistically significant among physicians from the 19 states for which we have malpractice claims data, it is significant for the U.S. as a whole. Physicians from states adopting direct reforms show a 1.4 percentage point decrease in claims rates; physicians from states adopting indirect reforms show a 1.1 percentage point decrease. Relative to the population average claims rate of around 7.4 percent per year, this is a substantial reduction.

The remaining five columns of Table 3 present estimates of equation (2), the impact of law reforms on trends in alternative measures of closed malpractice claims intensity from the 19-state PIAA data. Direct liability reforms consistently reduce the outcomes of the liability system that generate malpractice pressure. Direct reforms reduce significantly the share of claims resolved with some compensation to plaintiffs (receiving nonzero settlement), the share of claims with nonzero ALAE, and the share of claims with lengthy times-to-resolution, another measure of the nonfinancial costs of malpractice claims to defendants. For example, claims from states adopting direct reforms are 2.9 percentage points less likely to take longer to resolve than the median length of time-to-closure. In contrast, indirect reforms have no systematic impact on malpractice-pressure-generating outcomes of the legal system. For some outcomes, indirect reforms lead to substantial measured increases in malpractice pressure; for other outcomes, indirect reforms lead to negligible increases; and for some outcomes, indirect reforms lead to decreases in malpractice pressure.

Table 4 presents the instrumental-variables estimates of the effect of changes in malpractice pressure on patient health outcomes and expenditures, based on equation (3). Each table entry represents a separate IV regression model of the impact of a particular dimension of malpractice pressure. The models use the adoption of malpractice reforms as instruments for the malpractice pressure that medical providers face. We present results for six different specifications of the malpractice pressure index.

In all of these specifications, greater malpractice pressure leads to highly significant increases in hospital expenditures for both AMI and IHD patients, but not to important changes in health outcomes. The first row of Table 4 uses the malpractice claims rate as our index of malpractice pressure. A one percentage point increase in a physician's probability of defending against a malpractice claim in a given year results in approximately a 3 percent increase in real expenditures on hospital treatment for AMI, and a 2.1 percent increase in real expenditures for IHD. As Table 3 showed, this variation in claims rates is well within the range of variation in claims rates induced by direct malpractice reforms. For our second index, the probability of defending against a claim with a long time to resolution, a one percentage point increase results in approximately a 2.8 percent increase in AMI hospital expenditures, and a 2.1 percent increase in IHD expenditures.

The next two malpractice pressure indices in Table 4 are based on payments to claimants. A 1 percentage point increase in a physician's unconditional probability of making a nonzero payment to a claimant in any given year results in approximately a 4.3 percent increase in real expenditures on AMI treatment, and a 2.9 percent increase in real expenditures on IHD treatment. The elasticity of hospital expenditures with respect to the magnitude of a physician's expected real payments to claimants is 0.39 for AMI and 0.27 for IHD.

The final two specifications of malpractice pressure, which are based on ALAE in malpractice cases, are probably most closely related to the amount of conflict or "hassle" experienced by a physician in connection with defending against a claim. A one percentage-point increase in the probability of claim with nonzero defense expenses results in approximately a 2.4 percent increase in one-year hospital expenditures for an AMI, and a 1.6 percent increase in one-year hospital expenditures for an IHD admission. Similarly, the estimated elasticities of hospital expenditures with respect to the magnitude of ALAE are 0.25 for AMI and 0.16 for IHD.

These changes in medical practice induced by changes in malpractice pressure do not have systematic or substantial effects on patient health outcomes. For AMI patients, increases in malpractice pressure generally lead to *increased* rates of adverse health outcomes, significant increases in the case of the effect of compensation on AMI readmission rates. For IHD patients, increases in malpractice pressure (and accompanying increases in treatment intensity) lead to statistically significant improvements in some health outcomes, but these improvements in outcomes are extremely small. For example, a one percentage point decrease in a physician's unconditional probability of making a nonzero payment to a claimant would lead to a 2.9 percent decrease in hospital expenditures, but less than one-tenth of a percentage point (.097) increase in mortality. Taken together, these estimates imply that that the marginal expenditure/benefit ratio of a unit increase in malpractice-pressure-induced hospital treatment is approximately $540,000 per additional IHD survivor in 1994 dollars.[12] Even using the lower 95-percent confidence limit on the expenditure effect and the upper 95-percent confidence limit on the mortality effect leads to a marginal expenditure/benefit ratio of malpractice-pressure-induced treatment of over $290,000 per additional one-year IHD survivor.[13]

Direct reforms improve medical productivity primarily by reducing claims rates, and secondarily by reducing compensation to claimants, conditional on a claim. Through their effect on claims rates, direct reforms lead to approximately a 4.2 percent reduction in hospital expenditures (but no significant effect on health outcomes) for AMI patients: direct reforms reduce claims rates by 1.4 percentage points (Table 3), which in turn leads to a 4.2 percent reduction in expenditures (= 2.990 * 1.4). Similarly, through their effect on payments to claimants, direct reforms lead to approximately a 3.1 percent reduction in hospital expenditures

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[12]Using the average expenditure level of $17,866, (.0293*17,886)/.00097 = $540,268.

[13]That is, (17,866*(.0293 - (1.96*.00108))) / (.00097 + (1.96*.00035))) = $293,270.

for AMI patients.[14] These estimated effects of reforms are similar in magnitude to those reported in Kessler and McClellan (1996). By comparison, through their effect on ALAE, direct reforms lead to approximately a .4 percent reduction in hospital expenditures; through their effect on the rapidity of claim resolution, direct reforms lead to approximately a .6 percent reduction in expenditures.[15]

Other costs of the malpractice system to physicians, such as the time spent and the amount of conflict involved in claim defense, are nonetheless important determinants of treatment behavior. For example, even a modest reduction in the hassle of resolving a claim (as measured by ALAE) would lead to a large change in the intensity of treatment for heart disease, even though it might not be feasible to obtain such a reduction in ALAE with a direct reform. A 10 percent reduction in ALAE per physician per year – about $100, or equivalently a reduction in ALAE of about $1,580 per claim with ALAE – would lead to a reduction in hospital expenditures on AMI patients of approximately 2.5 percent (1.6 percent for IHD patients), without important effects on health outcomes. Put another way, a $1 reduction in ALAE per physician per year would lead to a $4.76 reduction in hospital expenditures for AMI patients,

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[14]Direct reforms reduce expected payments per physician by approximately 7.78 percent (dE(ln(Payments))=Pr(Claim)*[dE(ln(Payments) | Claim, Payments >0)*Pr(Payments > 0 | Claim) + E(ln(Payments) | Claim, Payments > 0)*dPr(Payments > 0 | Claim)], or .0778 = .0735*[.124*.309 + 10.515*.097]). In turn, a 7.78 percent reduction in payments per physician leads to a 3.06 percent reduction in hospital expenditures for AMI patients (=.393*.0778).

[15]By the formula in the previous footnote, direct reforms lead to a 1.7 percent reduction in expected ALAE per physician per year, because .017 = .0735*[.063*.857 + 8.085*.022], which in turn leads to a .42 percent reduction in hospital expenditures for AMI patients (=.249*.017); direct reforms lead to a .213 percentage point reduction in the probability per year of defending against a lengthy claim, because .00213=.0735*.029, which in turn leads to a .59 percent reduction in hospital expenditures for AMI patients (2.750*.00213).

without important outcomes effects; by comparison, a $1 reduction in compensation to claimants would lead to a $2.21 reduction in hospital expenditures.[16] Along these lines, a 10 percentage point reduction in the probability of defending against a malpractice claim that requires more than the median time of 3.7 years to resolve would lead to reduction of hospital expenditures on AMI patients of approximately 2.8 percent (2.1 percent for IHD patients). Given the distribution of claim closure times in the PIAA data, a 10 percentage point reduction in the probability of defending against a claim with greater-than-median closure time could be achieved with an across-the-board reduction in time-to-resolution of 183 days (6 months). Even though a speeding-up of claims resolution of this magnitude might not be achievable with a direct reform, it could well be achievable through other means. In other work, Kessler (1996) shows that reduction of court backlogs leads to significant reductions in delay in the settlement of automobile bodily injury claims.

Results from our analysis of the impact of malpractice pressure on different modes of treatment — diagnostic, therapeutic, and other, primarily per diem, hospital expenditures — appear in Table 5. For both AMI and IHD, increases in every dimension of malpractice pressure lead to increases in diagnostic expenditures and in other expenditures. Malpractice pressure consistently has a greater effect on diagnostic than on therapeutic expenditures, despite the fact that therapeutic treatments comprise the fastest-growing component of hospital expenditures in

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[16]A 10 percent reduction in ALAE per physician ≅ $100 (ALAE per physician per year = $994 = .0735*.8568*$15,787). In turn, a 10 percent reduction in ALAE would lead to a $473 reduction in hospital expenditures for AMI patients (based on average expenditures on AMI patients in 1994 of $18,992, $473 = 18,992*.0249). A 10 percent reduction in compensation to claimants per physician per year would be $337 (compensation to claimants per physician per year = $3,371 = .0735*.3088*$148,533). In turn, a 10 percent reduction in compensation to claimants would lead to a $746 (= 18,992*.0393) reduction in hospital expenditures.

aggregate for cardiac patients. In fact, for IHD patients, malpractice pressure actually leads to slight decreases in therapeutic intensity, which would be consistent with physicians reducing therapeutic treatment in marginal, riskier cases in response to the threat of malpractice.

As we noted above, defining the "index population" for construction of our malpractice indices involved some arguably arbitrary decisions. To assess the sensitivity of our results to our method for constructing summary measures of malpractice pressure, we also estimated instrumental-variables models of malpractice pressure effects based on measures of *actual* claims intensity $\check{M}_{st} = \bar{C}_{st} * \bar{Y}_{st}$, that is, measures that do not control for possible effects of shifts in injuries and treatments on claims filed when states reform their tort laws. The estimated effects in the two specifications will be similar if reforms do not affect the distribution of physicians, patients, and injuries in the population. These estimates were very similar to, although slightly larger in magnitude than, those obtained using adjusted malpractice pressure indices $\tilde{M}_{st}$. The similarity of estimates confirms that legal reforms (our source of identifying variation in malpractice pressure) did not result in substantial changes in the nature of injuries in the patient populations in the reforming states.

Medicare patients with IHD and AMI probably account for at most 5% to 10% of expenditures for care provided by physicians in our sample. While extending the results of our analysis to the treatment of other conditions is speculative, the results are consistent with incentive effects of the nonfinancial dimensions of malpractice pressure that are many times greater than the financial costs of liability to medical providers. This result is not surprising, because physicians generally bear the time and effort cost of liability defense, but neither most of the financial costs of litigation nor the financial costs of the medical care they produce (because of health insurance and the features of contracts with managed care plans). Indeed, if more intensive medical treatment at the margin is generally nonharmful to patients but potentially useful in defending against a malpractice claim, very small increases in the expected "hassle" from a malpractice claim or lawsuit should result in large increases in intensity.

V. Conclusion

There is widespread agreement that the medical malpractice liability system accomplishes neither its compensation nor its deterrence objective. Despite the fact that most physicians are fully insured against the financial costs of malpractice, previous research suggests that "direct" reforms -- designed to reduce the level of compensation to potential claimants -- improve productivity in health care by reducing the prevalence of defensive treatment practices. The current paper validates this potentially counterintuitive finding by identifying the mechanisms through which direct reforms affect behavior. Direct reforms affect treatment intensity primarily through their effect on claims rates, and secondarily through their effect on compensation conditional on a claim. Because defending against any claim imposes nonfinancial as well as financial costs on physicians, and because the nonfinancial costs of claim defense are correlated with compensation, direct reforms reduce treatment intensity by reducing both the (insured) financial and the (uninsured) nonfinancial dimensions of malpractice pressure. However, these reform-induced reductions in treatment intensity have negligible effects on health outcomes. This implies that doctors practice defensive medicine, and that reform-induced reductions in the level of liability improve medical productivity.

Our results suggest that alternative policies that reduce other costs of the liability system to physicians can also reduce defensive practices substantially. The likelihood of a claim that takes many years to resolve or that involves a large amount of conflict or hassle has a substantial effect on defensive treatment behavior. For example, our estimates suggest a savings of $4.76 in hospital expenditures on elderly patients with cardiac illness for each $1 reduction in ALAE (e.g., litigation costs incurred by the malpractice insurer in connection with claim defense) per physician per year. In contrast, we found no consistent evidence of any substantial effects on health outcomes of reducing such measures of malpractice pressure.

Our estimates can be used to simulate the effects on productivity of untried reforms to the liability system. This is important because even if direct reforms improve medical productivity, there is considerable disagreement over their effects on the equity and efficiency of the compensation process. A wide range of untried reforms, some advocating radical changes to the allocation of responsibility for iatrogenic injuries, seek to address both compensation and deterrence issues, but virtually no evidence exists on their potential effectiveness.

Our estimates assess the impact on medical productivity of exogenous variation in specific incentives facing doctors and hospitals to engage in inefficient treatment behavior. To the extent that untried reforms can be quantified in terms of their impact on these incentives, our estimates provide parameters for use in simulations. For example, at least for elderly heart disease patients, an untried reform that reduced the legal-defense burden on physicians and hospitals by one-quarter -- which is within the range of policy possibilities -- could be expected to reduce medical treatment intensity by approximately 6.2 percent, but not to increase the incidence of adverse health outcomes. In the same population, a policy that expedited claim resolution by six months across-the-board could be expected to reduce hospital treatment costs by 2.8 percent, without greater adverse outcomes. Furthermore, to the extent that untried reforms affect other incentives beyond the scope of this study, their impact on medical decision-making could be even larger. Future work might focus more explicitly on simulating these effects, and on investigating their applicability to a broader range of patients and illnesses.

Figure 1: The Impact of the Liability System on Medical Productivity

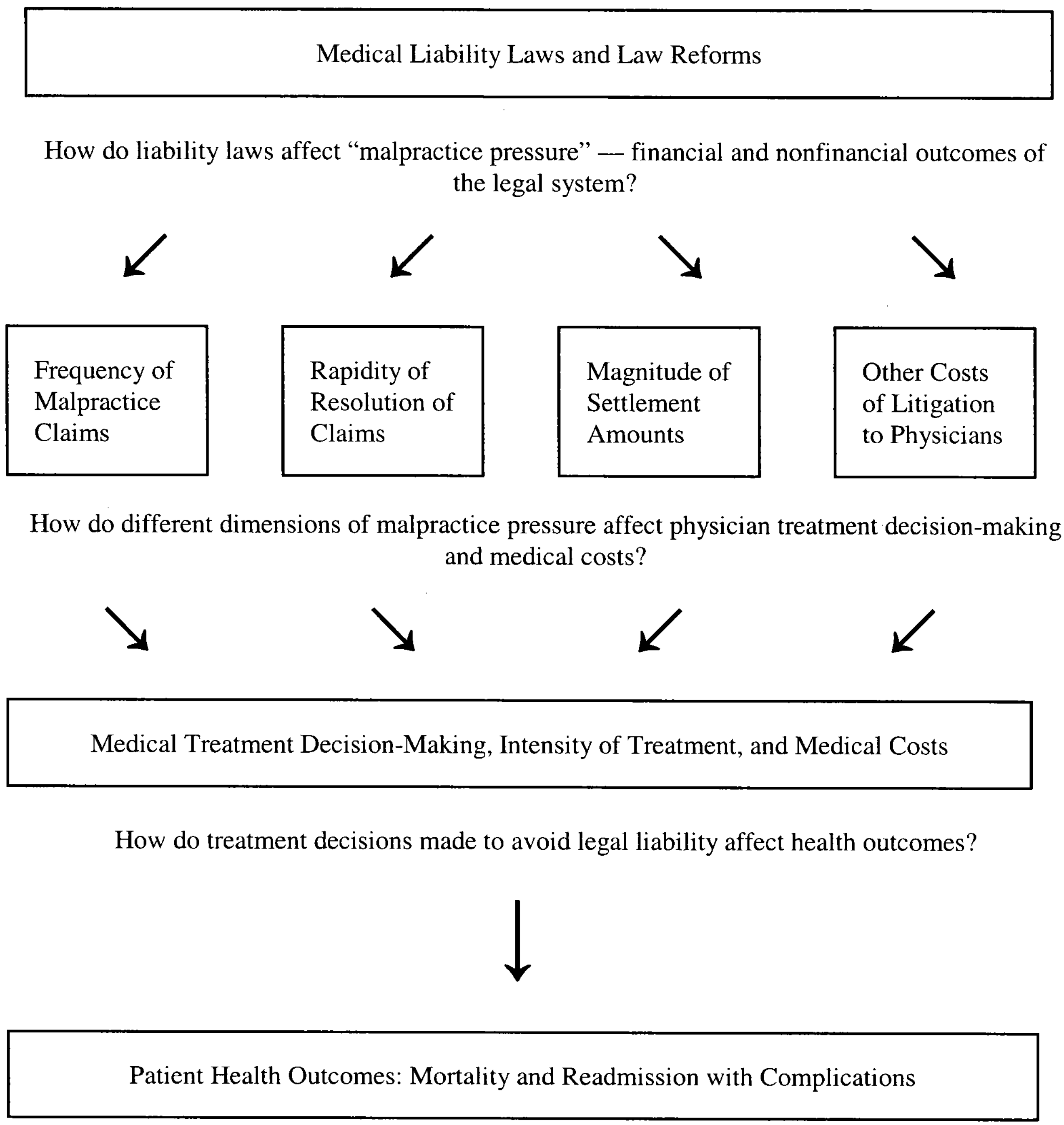

Table 1: Descriptive Statistics, Malpractice Claims Database

	All Claims	Closed Claims
Settlement amount (1994 $)		148,533 (234,550)
Nonzero settlement		0.3088
Total allocated loss adjustment expenses (ALAE) (1994 $)		15,787 (25,644)
Nonzero expenses		0.8568
Days from injury to claim closure		1366.82 (768.94)
Claim closed	0.8790	1.0000
Patient age > 64	0.1314	0.1343
Patient age < 2	0.0665	0.0656
Collateral source	0.9618	0.9623
Female patient	0.4969	0.4920
Surgical MD	0.4887	0.4827
Emergency MD	0.1936	0.1856
Misdiagnosis error	0.2132	0.2159
No medical error	0.1792	0.1686
Direct reform	0.2378	0.2555
Indirect reform	0.4102	0.3803
Sample size	86,967	76,446

Notes: Standard deviations in parentheses. Indicators for four diagnosis groups, missing plaintiff age, missing plaintiff gender, one house of state legislature democratic, governor+ one house democratic, and governor+both houses democratic included in analysis but not in table. Means and standard deviations for settlement amount and total expenses calculated for nonzero observations only, so N for those variables is equal to the fraction nonzero * N for the column.

Table 2A: Health Care Costs, Outcomes, and Demographic Characteristics for Acute Myocardial Infarction Populations

Variable	Full Sample 1984	Full Sample 1994	Full Sample %chg, 84-94	19-State Sample Used in Analysis 1984	19-State Sample Used in Analysis 1994	19-State Sample Used in Analysis %chg, 84-94
1-Year mortality	40.2	32.8	-7.4	40.1	33.0	-7.1
1-Year AMI readmit	6.2	5.3	-0.9	6.3	5.2	-1.1
1-Year HF readmit	7.8	8.4	0.6	7.7	8.4	0.7
1-Year Total Expenditures	$12,370 (12,672)	$18,520 (18,609)	49.7	$12,457 (13,196)	$18,992 (19,367)	52.5
Diagnostic	$1,759 (2,036)	$2,259 (2,701)	28.4	$1,772 (2,069)	$2,341 (2,848)	32.1
Therapeutic	$3,336 (5,256)	$5,365 (7,567)	60.8	$3,355 (5,787)	$5,375 (7,539)	60.2
Other	$7,330 (7,422)	$8,840 (9,812)	20.6	$7,400 (7,577)	$9,210 (10,716)	24.5
Age	75.5	76.4	0.9	75.5	76.5	1.0
Female	48.2	48.7	0.5	48.1	48.8	0.7
Black	5.2	5.8	0.6	5.0	5.8	0.8
Rural	28.7	30.8	2.1	27.9	30.8	2.9
Sample Size	245,378	230,613		125,441	111,386	

Notes: Sample size of full panel of AMI patients in the 19-state sample is 1,202,650. Standard deviations in parentheses. Hospital Expenditures in 1994 dollars. Outcome measures and demographic characteristics except age in percentage points. Growth rates for hospital expenditures are percentage changes; all other growth rates are percentage point changes. Diagnostic+therapeutic+other expenditures do not add to total because some hospitals did not report information necessary to apportion expenditures among categories; diagnostic, therapeutic, and other expenditures for nonresponding hospitals were reported as missing.

Table 2B: Average Health Care Costs, Outcomes, and Demographic Characteristics for Ischemic Heart Disease Populations

	Full Sample			19-State Sample Used in Analysis		
Variable	1984	1994	%chg, 84-94	1984	1994	%chg, 84-94
1-Year mortality	13.5	9.5	-4.0	13.5	9.5	-4.0
1-Year AMI readmit	3.7	2.6	-1.1	3.8	2.6	-1.2
1-Year HF readmit	6.2	5.6	-0.6	6.1	5.5	-0.6
1-Year Total Expenditures	$11,967 (12,628)	$17,333 (17,688)	44.8	$12,099 (12,893)	$17,866 (18,384)	47.7
Diagnostic	$1,814 (2,154)	$2,018 (2,573)	11.2	$1,842 (2,205)	$2,107 (2,746)	14.4
Therapeutic	$3,782 (5,604)	$5,835 (7,839)	54.3	$3,844 (5,717)	$5,976 (8,049)	55.4
Other	$6,683 (7,086)	$7,174 (8,616)	7.3	$6,737 (7,405)	$7,460 (9,232)	7.3
Age	74.5	74.5	0.0	74.5	74.6	0.1
Female	55.5	49.1	-6.4	55.3	49.2	-6.1
Black	5.9	6.0	0.1	5.7	6.0	0.3
Rural	30.2	30.1	-0.1	28.8	29.7	0.9
Sample Size	359,166	355,063		179,212	169,217	

Notes: Sample size of full panel of IHD patients in the 19-state sample is 1,825,745. Standard deviations in parentheses. Hospital Expenditures in 1994 dollars. Outcome measures and demographic characteristics except age in percentage points. Growth rates for hospital expenditures are percentage changes; all other growth rates are percentage point changes. Diagnostic+therapeutic+other expenditures do not add to total because some hospitals did not report information necessary to apportion expenditures among categories; diagnostic, therapeutic, and other expenditures for nonresponding hospitals were reported as missing.

Table 3: Estimates of the Effects of Direct and Indirect Reforms on Outcomes of the Liability System

	probability of a malpractice claim		conditional on a malpractice claim (19-State sample)				
	full sample	19-state sample	nonzero payment to claimant	ln(payment to claimant (1994 $))	nonzero total ALAE[1]	ln(total ALAE (1994 $))[1]	lengthy time-to-resolution
Direct Reforms	-0.014** (0.006)	-0.014 (0.010)	-0.097** (0.018)	-0.124 (0.102)	-0.022* (0.013)	-0.063 (0.070)	-0.029** (0.013)
Indirect Reforms	-0.011* (0.007)	-0.012 (0.010)	0.095** (0.037)	-0.065 (0.145)	0.076** (0.015)	0.347** (0.121)	-0.008 (0.022)
R^2	0.029	0.030	0.115	0.145	0.081	0.134	0.228
Data Set	AMA SMS[1]	AMA SMS[1]	PIAA[2]	PIAA[2]	PIAA[2]	PIAA[2]	PIAA[2]
Sample Size	42,266	22,436	76,446	23,610	76,446	65,501	86,967

Notes: Heteroscedasticity-consistent standard errors in parentheses. * - significantly different from zero at the 10 percent level. ** - significantly different from zero at the 5 percent level.

1. Estimates calculated controlling for time-fixed-effects, state-fixed-effects, fourteen categories of physician specialties, and contemporaneous and once-lagged political/regulatory environment controls (political party of state's legislature and governor and number of lawyers per capita). Estimates calculated using AMA sampling weights.

2. Estimates calculated controlling for time-fixed-effects, state-fixed-effects, six categories of patient illness, whether defendant is a surgical specialist, claimant age, presence of a claimant collateral source, claimant gender, whether claim arose out of an emergency, whether claim arose out of a misdiagnosis, and contemporaneous and once-lagged political/regulatory environment controls (political party of state's legislature and governor). Estimates calculated using sampling weights equal to observed claims frequency in each state/year cell divided by elderly population.

Table 4: Effects of Malpractice Pressure on Expenditures and Outcomes of Acute Myocardial Infarction and Ischemic Heart Disease

	AMI				IHD			
Variable	ln(1-Year Hospital Expenditures)	1-Year Mortality	1-Year AMI Readmit	1-Year HF Readmit	ln(1-Year Hospital Expenditures)	1-Year Mortality	1-Year AMI Readmit	1-Year HF Readmit
Probability of a claim occurring	2.990** (0.071)	0.052 (0.041)	0.033 (0.020)	0.035 (0.024)	2.136** (0.068)	-0.034 (0.022)	0.012 (0.012)	-0.054** (0.016)
Lengthy time-to-resolution	2.750** (0.085)	0.081 (0.052)	0.014 (0.025)	0.060 (0.030)	2.053** (0.085)	-0.033 (0.028)	0.027* (0.016)	-0.025 (0.020)
Nonzero payment to claimant	4.257** (0.112)	0.024 (0.066)	0.059* (0.033)	0.043 (0.039)	2.932** (0.108)	-0.097** (0.035)	0.004 (0.019)	-0.093** (0.026)
ln(payment to claimant 1994$)	0.393** (0.010)	0.002 (0.006)	0.006* (0.003)	0.004 (0.004)	0.270** (0.010)	-0.009** (0.003)	0.0004 (0.002)	-0.009** (0.002)
Nonzero total ALAE	2.403** (0.068)	0.042 (0.040)	0.029 (0.019)	0.013 (0.023)	1.634** (0.065)	-0.046** (0.021)	0.003 (0.012)	-0.061** (0.015)
ln(total ALAE 1994$)	0.249** (0.007)	0.005 (0.004)	0.003 (0.002)	0.001 (0.002)	0.163** (0.007)	-0.006** (0.002)	0.0002 (0.001)	-0.007** (0.002)

Notes: Sample size for AMI models is 1,202,651; sample size for IHD models is 1,825,745. Each table entry represents a separate IV regression model. Heteroscedasticity-consistent standard errors in parentheses. * - significantly different from zero at the 10 percent level. ** - significantly different from zero at the 5 percent level. Hospital Expenditures in 1994 dollars. Coefficients on binary malpractice pressure indices measure the percentage (percentage point) change in hospital expenditures (outcomes) in response to a one percentage point change in the malpractice pressure index. Coefficients on continuous malpractice pressure indices measure the percentage (percentage point) change in hospital expenditures (outcomes) in response to a one percent change in the malpractice pressure index. All models include controls for the regulatory/legal environment and patient demographic characteristics.

Table 5: Effects of Malpractice Pressure on Diagnostic, Therapeutic, and Other Hospital Expenditures, Acute Myocardial Infarction and Ischemic Heart Disease

	AMI			IHD		
Variable	ln(Diagnostic Expenditures)	ln(Therapeutic Expenditures)	ln(Other Expenditures)	ln(Diagnostic Expenditures)	ln(Therapeutic Expenditures)	ln(Other Expenditures)
Probability of a claim occurring	2.433** (0.082)	1.429** (0.108)	3.319** (0.081)	1.707** (0.079)	0.141 (0.122)	2.450** (0.075)
Lengthy time-to-resolution	2.337** (0.100)	1.287** (0.131)	3.053** (0.098)	1.636** (0.101)	0.185 (0.155)	2.289** (0.095)
Nonzero payment to claimant	3.604** (0.130)	1.874** (0.172)	4.745** (0.127)	2.421** (0.125)	-0.530** (0.192)	3.375** (0.118)
ln(payment to claimant 1994$)	0.332** (0.012)	0.174** (0.016)	0.440** (0.012)	0.222** (0.012)	-0.049** (0.018)	0.312** (0.011)
Nonzero total ALAE	2.023** (0.078)	0.898** (0.104)	2.695** (0.076)	1.388** (0.075)	-0.415** (0.115)	1.945** (0.070)
ln(total ALAE 1994 $)	0.214** (0.008)	0.083** (0.011)	0.281** (0.008)	0.142** (0.008)	-0.068** (0.012)	0.198** (0.007)

Notes: Sample size for AMI models is 1,075,226; sample size for IHD models is 1,454,775. Sample sizes are smaller than those in previous tables because of patients with missing service-specific data on charges (see footnote 6 for explanation). Each table entry represents a separate IV regression model. Heteroscedasticity-consistent standard errors in parentheses. * - significantly different from zero at the 10 percent level. ** - significantly different from zero at the 5 percent level. Hospital Expenditures in 1994 dollars. Coefficients on binary malpractice pressure indices measure the percentage change in hospital expenditures in response to a one percentage point change in the malpractice pressure index. Coefficients on continuous malpractice pressure indices measure the percentage change in hospital expenditures in response to a one percent change in the malpractice pressure index. All models include controls for the regulatory/legal environment and patient demographic characteristics.

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