THE EFFECTS OF MALPRACTICE TORT REFORM ON DEFENSIVE MEDICINE

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ABSTRACT

Positive defensive medicine occurs when physicians order additional tests or procedures primarily to avoid malpractice liability. This paper shows the degree of defensive medicine occurring across states is related to the malpractice environment in the states. As the environment changes due to malpractice tort reform, defensive medicine practices also change. This paper shows the existence of positive defensive medicine and how it adds to total health care expenditures for head trauma victims in 23 states in 2000. Moreover, given different malpractice environments across states, we witness variations in defensive medicine practices leading to differences in health care expenditures.

INTRODUCTION

Doctors march on state capitols to bring attention to the rising cost of malpractice insurance premiums. Although declining reimbursements by private health insurers and the federal government have hurt physicians' incomes, the chief culprit in the doctors' dissatisfaction is rising malpractice insurance premiums. While malpractice tort reform is debated in state capitols and reforms are undertaken, another implication needs to be addressed. How does the malpractice environment affect doctors' decisions in treating patients and do these decisions contribute to higher health care costs?

The behavioral response of doctors to liability concerns is called defensive medicine. Positive defensive medicine occurs when physicians order additional tests or procedures primarily to avoid malpractice liability. Negative defensive medicine occurs when doctors avoid seeing risky patients. Since the early 1970's economists, lawyers, and those within the medical community have debated the existence of defensive medicine. While recent economic analyses support the idea that physicians practice defensive medicine, complexities surrounding the topic have prevented economists from discerning its pervasiveness and direct contribution to health care costs. Given the role defensive medicine plays in health care and the scarcity of studies that link it to the malpractice environment, this study examines positive defensive medicine across states in light of differences in the states' malpractice environments.

MALPRACTICE THEORY AND PRACTICE

According to Danzon (1994), professional liability systems are necessary in situations where asymmetric information exists. Physician's extensive use of medical jargon and patients' inabilities to understand such terminology is just one example of the information gap that exists in medicine. Thus, the purpose of a liability system like the medical malpractice system is twofold; it is meant to both to deter negligence and compensate patients injured as a result of negligent care. A person is deemed injured if and only if the injury was preventable and it was reasonable to undertake preventive activities. Thus, adverse outcomes resulting from normal risks of medical procedures should not be considered under the medical malpractice negligence rule.

Regarding liability insurance, economic theory states that premiums should reflect the expected cost of claims based on individual physician's standards of care. Theory predicts that experience rating malpractice premia ensure that the physicians sued most often pay the highest malpractice premia, not unlike the automobile driver who pays the highest insurance rates because of multiple accidents. However, this is not the standard practice. Malpractice premia are experience rated across specialties, but not across doctors within a region within a specialty. A community rating is used within a specialty across regions. For example, the Philadelphia Inquirer (2003) reports an obstetrician in Philadelphia paid on average $140,000 per year for malpractice insurance, compared to $67,000 in Los Angeles, indicating different community ratings across states. These state variations in premia are the result of the malpractice tort law itself, since these laws are created by state legislatures. For instance, statute of

limitations, capped damages, etc. vary across the country.

Experience ratings differ across specialties with riskier practices, say obstetrics, paying more. An orthopedic surgeon in Philadelphia only paid $115,000 on average in 2003 compared to the above obstetrician, according to the Philadelphia Inquirer (2003). Experience rating within a specialty could have the effect of retarding new technological procedures, which is why it is not used. It would effectively punish the doctors utilizing new, perhaps initially riskier techniques, causing doctors to shy away from newly emerging procedures. Such incentives could retard the forward movement of technological medical procedures. In addition to specialty rating, malpractice premia are also experience rated by location. Physicians from locales with above average suit awards will have higher premia due to higher insurer payouts. Frequency and severity variations within a state result in regional specialty specific premia variations. As such, Philadelphia orthopedic surgeons paid $7,000 more on average than doctors in adjacent Montgomery County due to Philadelphia's high jury payouts, according to the Philadelphia Inquirer (2003).

Unfortunately, the community rated system has its own disadvantages. Because physicians are grouped by specialty, they may experience premium increases if claim volume or claim awards grow within their specialty, regardless of their personal malpractice claims history. At this point, insurance companies are not offering hybrid pricing systems combining the advantages of both community and experience rating; community rating is the standard pricing technique.

Malpractice laws reside within state civil codes, either tort or contract, although there has been some discussion of instituting federal laws. The litigation process involves three steps, each of which increases litigation expenses. In the first step plaintiffs file suit. Lawyers screen potential cases due to the US tradition of contingency-based legal fees. If expected costs of litigation are less than the expected payout, a suit is filed. In pretrial discovery, the second step of litigation, defendants and plaintiffs exchange information by releasing medical records and naming expert witnesses, and the plaintiff officially names medical personnel involved in the incident. The third step of litigation, trial or settlement, is preceded in some states by voluntary or mandatory arbitration, which offer incentives to settle out of court by eliminating costs associated with trial.

PREVIOUS STUDIES OF DEFENSIVE MEDICINE

There are three methods to determine the existence and magnitude of defensive medicine: direct physician surveys; hypothetical clinical scenarios; and healthcare utilization studies. An OTA (1994) review of direct physician surveys shows physicians do practice both positive and negative defensive medicine. Sixteen studies reviewed by OTA found anywhere from 21 to 81 percent of physicians ordered additional tests out of fear of litigation. It is difficult to determine from these surveys, however, how often and to what extent it is practiced.

A second branch of literature uses physician surveys to assess actions given specific clinical situations. An advantage of this type of survey is the ability to focus on physician specialties and clinical scenarios in which defensive medicine is a concern. In an OTA (1994) study, the percentage of respondents who chose "malpractice concerns" as the primary reason for administering a clinical action ranged from 4.9 (back pain scenario) to 29.0 percent (head trauma scenario). It was estimated the aggregate cost of defensive Cesarean deliveries to be $8.7 million in 1991 compared to the aggregate cost of defensive diagnostic radiology of the head for Americans ages 5 to 24 to be $45 million.

While these studies provide an additional verification of the existence of defensive medicine, their hypothetical basis limits their predictive power and creates bias. Thus, a third branch of defensive medicine statistically analyzes the impact of liability risk on health care utilization. For example, Localio et. Al. (1993) examine the relationship between malpractice liability risk and the rates of Cesarean deliveries in a sample of New York state hospitals in 1984. The authors found that a patient in a hospital with high frequency obstetric malpractice claims was 32 percent more likely to undergo a Cesarean delivery than a patient in a hospital with low claim frequency.

PAST NATIONAL MEDICAL MALPRACTICE CRISES AND TORT REFORM

Literature on malpractice has identified two previous times during which the system was in crisis: one in the 1970's and one in the 1980's. Danzon (1984) cites stock market volatility and long claims tails as major contributors to the depletion in insurance capital in the 1970s. Both encouraged insurers to seek large premium increases to shore up depleted capital reserves in 1974-75. These premium increases led to crises in which physicians had difficulty paying for malpractice premiums.

Harrington and Danzon (1984) contend the 1980s crisis was the result of price undercutting and inadequate risk information. They believe the largest insurers deliberately underreported claims and used reinsurance to hide losses. Additionally, Danzon (1983) also finds the rising cost of malpractice claims due to pro-plaintiff trends in laws, erosion of traditional malpractice defenses (like the locality rule and charitable immunity), growth in the number and complexity of medical treatments, an increase in the number of lawyers per capita, and erosion of the patient-physician relationship leading to higher insurance rates.

In response to the malpractice crises occurring in the 1970's and 1980's, states enacted various tort reforms. Some are termed "indirect" reforms in that they indirectly reduce malpractice awards. Barker (1992) notes several indirect reforms following the first two crises. He indicates 34 states reduced their statute of limitations to two to three years and many decreased the length of time permitted for injury discovery. Several reforms that "directly" reduced awards also followed the crises. After 1975, nine states enacted reforms capping malpractice awards values; seven states capped total damage awards while two states capped only noneconomic damages of pain and suffering. Several states created Patient Compensation Funds (PCF), in which physicians were responsible for awards up to a certain dollar amount, after which the PCF paid the rest of the award due. Modification of the collateral source rule was also enacted. Originally, this rule prohibited evidence of collateral award sources to be introduced to the jury. Reform allowed juries to consider, and sometimes mandated, that they lower awards when plaintiffs had collateral award sources. These collateral sources could include other physicians, hospitals, or insurance companies. By enacting such reforms, plaintiffs could no longer receive duplicate malpractice awards from multiple sources; it eliminated double dipping.

To reduce costs associated with litigation, three major reforms were enacted. First, some states mandated pretrial screening. This reform required potential cases be screened by a panel before proceeding to trial; cases deemed unworthy did not reach trial, thus eliminating unnecessary trial expenses. Barker (1992) shows thirteen states created provisions for arbitration, either voluntary or mandatory, between pretrial discovery and trial, in order to eliminate expenses associated with trial. Under the process of arbitration, plaintiffs and defendants submit their claim to a third party who makes a decision regarding the case outcome. Under mandatory arbitration third party decisions are binding and cannot be appealed. A third reform, capped contingency fees for attorneys, limits the percentage of the award collected by lawyers following successful trials.

California can be viewed as a case study in tort reform. California was one of the first states to pursue tort reform aggressively, according to the Philadelphia Inquirer (2003). In 1975, California passed state passed the Medical Injury Compensation Reform Act, MICRA, which: capped pain and suffering awards to $250,000; enforced a collateral source rule; limited lawyers contingency fees to 40% for the first $50,000 awarded, 33% for awards between $50,000-$100,000; 25% for the next half million; and 15% for amounts in excess of $600,000; reduced the statue of limitations to three years; and allowed periodic payments non-mandatory arbitration. Then in 1991, Proposition 103 passed to mitigate rising insurance fees by requiring regulatory approval. Today, states such as Pennsylvania and New Jersey look to the California system as a model, according to the Philadelphia Inquirer (2003).

Kessler and McClellan's (1996) study examines how tort reform and malpractice environments impact defensive medicine. They are interested in the effects of indirect and direct reforms on positive defensive medicine. This study focuses on cardiac patients. The authors used a difference-in-difference analysis of longitudinal data on Medicare patients from 1984, 1987, and 1990 who treated for acute myocardial infarction (AMI) and new ischemic heart disease (IHD). They compared outcomes among states with reforms and without reforms. Tort law reforms were divided into two categories: direct, which directly reduce expected malpractice awards such as damage caps and mandatory collateral-source offsets and indirect ones such as mandatory periodic payments, statute of limitations reductions, or modification of the joint and several liability rule, which have a less discernable impact on malpractice pressures. Joint and several liability rules allocate payments according to degree of fault. Kessler and McClellan examine the occurrence of adverse outcomes one year after cardiac illness, including subsequent AMI, heart failure requiring hospitalization, and mortality. The magnitude of defensive medicine was estimated by the cost of an additional year of life to treatment intensity used.

Results from their study indicate reform states and non-reform states had similar baseline expenditures and outcomes. However, expenditure growth was 2-6% lower in reform states than in non-reform states for AMI. Trends for IHD showed slightly greater differences. Expenditures in states adopting direct reforms declined 5.3% relative to non-reforming states and expenditures in states with indirect reforms increased 1.8% relative to non-reforming states. The

adoption of malpractice reforms lead to reductions in hospital expenditures of 5% for AMI and 9% for IHD by five years after reform adoption. Overall, the results of the study show direct reforms reduce expenditure growth without increasing mortality, while indirect reforms have no substantial effects on expenditure or mortality.

HEALTHCARE UTILIZATION MODEL OF DEFENSIVE MEDICINE

We build a healthcare utilization model to estimate the individual impacts of twelve tort reform measures. The purpose of the analysis is to discover how state malpractice environments influence the practice of positive defensive medicine. The scope of the study is limited to patients with skull fractures. Since these patients are associated with a high level of risk and uncertainty, it is likely that physicians practice defensive medicine on them. Thus, reductions in state malpractice pressures could diminish the level of defensive medicine associated with these patients, and result in substantial cost savings. The healthcare utilization model of defensive medicine is as follows:

$$\text{CHARGES} = b_0 + b_P\text{Patient Demographics} + b_H\text{Hospital Demographics} + b_T\text{Tort Reform} + \mu \quad (1)$$

The dependent variable, total in-patient hospital expenditures (*CHARGES*), is used to assess the level of defensive medicine practiced in each state. To construct a model distinguishing the effect of state malpractice environmental factors from other factors contributing to variations in patients' total expenditures, independent variable vectors accounting for patient, b_P, and hospital demographics, b_H , have been included. Dummy variables for various tort reforms serve as identifiable measures of differences in state malpractice environments. Chart 1 gives the matrix describing tort reforms in each of the 23 states included in this analysis. Table 1 lists the 12 dummy variables for the malpractice tort laws created for each state.

Several variables within the patient demographic vector account for differences in patient's hospital experiences and skull fracture injuries. Ultimately each can be held constant to examine the role of tort reform on total charges, though each variable will have its own individual impact on charges. A patient's length of stay, number of diagnoses, and number of medical procedures, all indicators of the patient's hospital experience, are expected to positively impact charges. Since hospitals charge a minimum daily fee for inpatient visits on top of charges associated with tests and procedures, increasing a patient's length of stay or increasing the number of procedures performed will increase a patient's total charges. It is also reasonable to expect that a patient with more severe injuries will have more diagnoses recorded on his or her hospital encounter than a patient with less severe injuries; thus, the number of diagnoses on a patient's hospital encounter serves as a proxy for the patient's extent of injury. All three variables are expected to have positive coefficients.

Other general patient demographics are also included in the patient demographic vector, as evident in Tables 2 and 3. The hospital demographic vector is made up of several variables, including variables describing hospital control, size, location, and teaching status. If government and non-profit facilities are less cost-conscious than for-profit facilities, they may have higher patient expenditures for patients with the same set of diagnoses, leading to an expected positive sign on the government and non-profit facilities coefficients. Since the other patient and hospital demographic variables are used as control variables to be held constant to discern the impact of individual tort variables, a full discussion of the remaining coefficients' expected signs is excluded.

To consider differences in state malpractice environments, dummy variables for 12 various tort reforms are included in the model. These reforms are: arbitration, pre-judgment measures, contingency fee caps, collateral source rules, damage caps, joint and several liability rules, periodic payments, physician compensation funds, and state's statutes of limitations. Within these reforms, the effects of voluntary arbitration versus mandatory arbitration, and the option to elect periodic payments versus mandatory periodic payments are considered. Periodic payments imply the award is paid over time, not in a lump sum, and they cease if the patient dies. We also separate damage cap reforms into two groups: those that limit noneconomic or total awards and those that only limit punitive damage awards. We hypothesize physicians working in states that have enacted malpractice tort reforms will feel less malpractice pressure than physicians working in states without malpractice reforms. In turn, these physicians will practice less defensive medicine than their counterparts in non-reform states; they will not order as many additional tests and procedures out of fear of litigation. Based on this, the above mentioned tort dummy variables are expected to have negative coefficients.

DATA

The data come from two major sources. Information on total expenditures, patient demographics, and hospital

demographics for patients who had primary, secondary, or tertiary diagnoses of skull fractures were derived from the 2000 Nationwide Inpatient Sample, part of the Healthcare Cost and Utilization Project sponsored by the Agency for Healthcare Research and Quality. The diagnoses codes for skull fractures are based on the ICD-9CM codes valid for the patient's discharge date and include: 800.00-800.99 (fracture of skull vault), 801.00-801.99 (fracture of skull base), and 803.00-803.99 (other and unqualified skull fractures). Information on ICD-9-CM codes was obtained from a topsSearch ICD-9 Trial on e-mds.com and UMEA University's online directory of ICD-9-CM International Coding Standard. The data set contains 7,450,992 inpatient hospital stays from 994 hospitals in 28 states. Concentrating on a significant number of skull fractures the data were limited to 23 states: Arizona, California, Colorado, Connecticut, Florida, Georgia, Illinois, Kansas, Kentucky, Maryland, Massachusetts, Missouri, New Jersey, New York, North Carolina, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, Washington, and Wisconsin.

We understand significant differences in hospital charges can be due to extreme differences in patients. We attempt to make patients as similar as possible by using several restrictions on the patients considered in this study so that expenditure differences are more likely to be due to differences in state environments. Age is restricted to patients 18 to 65 old for two reasons. First, minors are eliminated because they are subject to different malpractice statutes of limitations in many states. Second, the elderly are eliminated because literature on malpractice suits has shown that successful elderly claimants are awarded low dollar amounts due to their advanced age. Thus, theory holds that physicians are less likely to practice defensive on this demographic group. Also, due to deteriorating health and health complications, the elderly are likely to be outliers with respect to length of stay, number of diagnoses, total charges, etc. To further reduce outliers patients considered in this study are restricted to those whose length of stay was ten days or less and who had ten or fewer diagnoses on their hospital encounter. Table 2 describes the means and standard deviations of the variables used in regression analysis.

The total charges obtained from the NIS are altered to consider state and regional variations in the price of medical care services. This is accomplished by dividing regional or city CPI data for a given state by a base state's CPI, thereby setting patient charges from all states on equal footing. CPI data for the year 2000 were obtained from the Urban Consumer Series "All Items" CPI index available on Bureau of Labor Statistics' website. If data for a metropolitan area within a given state were available or the state was cited as having a CPI value corresponding to a metropolitan area in a nearby state, this CPI value was used. If data for several metropolitan areas within a state or corresponding to a state were available, the average of these values were used. For states in which there were no corresponding metropolitan areas associated, the regional (Northeast, Midwest, South, or West) "All Items" Urban CPI value was used. Kansas was selected as the base state in this analysis because of its baseline number of malpractice tort reforms. This method of CPI base lining is the best approximation that can be made, given the limited amount of CPI information available for locations around the nation.

The second major source of data, from which information on state tort laws is compiled, come from the American Medical Association Advocacy Resource Center's state law charts on liability reform. The dummy variables are listed in Table 2 for each state. Since the patient and hospital data are for 2000, we use the tort law in place in 1998 to allow for a two year, albeit arbitrary, lag for doctors to respond to incentives.

RESULTS

Regression results are reported in Table 3. Using ordinary least squares, the adjusted R-squared value is 48.62, implying 48.6% of the variation in total charges can be explained by the variation in the independent variables. The mean total charge for patients with skull fractures is $21,127. The condition index of 35.91 suggests multicollinearity exists, but it is inconsequential in that numerous statistically coefficients with the expected sign are found. Based on the results of White's test, the null hypothesis of homoscedasticity was rejected. The T-values are found using White's consistent estimators of the variance and are indicated in parentheses in below the coefficients in Table 3.

Table 3 shows each additional day in the hospital is expected to increase total charges by $3,191, ceteris paribus, whereas an additional procedure raises them by $3,716. Similar interpretations of coefficients of the many statistically significant patient and hospital demographic variables are easily obtainable, but the thrust of this paper is on the reform coefficients.

All but one tort reform, voluntary arbitration, is statistically significant. The tort reform with the largest coefficient, indicating the most important reform in terms of savings from reduced defensive medicine, is mandatory arbitration. Having a provision for mandatory arbitration reduces total skull fracture

charges by $12,177, a significant amount compared to the dependent mean of $21,127. This result supports the theory that physicians fear malpractice suits going to court and practice less defensive medicine when suits must first be assessed outside of court. Interestingly, having a voluntary arbitration policy has no impact on charges, thus on defensive medicine, implying the policy needs to have teeth, i.e., be mandated. Similar to mandatory arbitration, pre-judgment measures reduce charges by $5,174.99. Physicians will practice less defensive medicine if states screen claims before they can proceed to court because physicians are confident an objective board will eliminate frivolous suits.

Enacting contingency fee caps reduce charges by $4,534.50 or 20% of the average charges. A possible explanation for this reduction is that caps force attorneys to more closely scrutinize potential cases, resulting in fewer malpractice cases going to court. In turn, physicians may feel less pressure to practice defensive medicine due to the reduced frequency, and therefore probability, of malpractice court cases being filed.

Physicians may order fewer extraneous tests or procedures when they have a decreased risk of having their assets wiped out in a malpractice suit. The fear of litigation rises with the size of the expected payout. Doctors are not only concerned with the immediate payouts they may incur, but the impact on their insurance premium. Policies reducing the expected payout, such as periodic payments and joint and several liability rules, are expected to reduce defensive medicine. Making physicians responsible for the same proportion of damages as their actions though the joint and several liability rule reduces charges by $2,474.77. Mandatory periodic payments reduce charges by $7,842.91. Additionally, the existence of state physician compensation funds reduces defensive medical care by $1,856.49. Here, states pick up the portion of the payout above what the insurer will pay on behalf of the doctor. Interestingly, permitting periodic payment actually increases total charges by $2,775.17, in contrast with expectations.

Some results are contrary to expectations. The coefficient on the statute of limitations variable indicates that for each additional year a patient is able to take medical liability action, there is a $1,504.69 decrease in total charges for skull fracture patients. Theory predicts allowing patients an additional year to take action will increase the volume of malpractice claims filed, thus causing physicians to practice more defensive medicine; if a physician knows that a patient has more years in which he or she can file a malpractice suit, then perhaps the physician orders more tests for protection from a suit claiming that the proper standard of care was not met. More research on the relationship between defensive medicine and statute of limitations reductions is needed before firm conclusions can be drawn.

In contrast to theory, the collateral source rule and damage cap reforms significantly increase total charges. Having a collateral source reform, which eliminates double dipping for awards, increases charges by $3,866.88. Caps on noneconomic or total awards increase charges by $2,584.30, while caps on punitive damages only increase charges by $2,226.01. A possible explanation for these unexpected results is they result from an endogenous relationship between tort reforms and state malpractice environments. Tort reforms are generally enacted in states after some sort of malpractice crisis exists. These crises resulting from long claim tails, high numbers of malpractice suits, and severe damage awards, are often manifested through large annual physician malpractice premium increases; reforms on the collateral source rule and damage caps are generally enacted when a state is in crisis. Thus, the significantly positive coefficients on collateral source rule reforms, noneconomic/total award damage caps, and punitive damage caps most likely reflect this endogenous relationship between states in malpractice crises and the reforms they enact. The positive coefficients may reflect lingering crises effects originating before the reforms were enacted.

CONCLUSIONS

The regression results provide strong evidence that variations in state malpractice environments significantly influence the level of defensive medicine practiced by physicians on skull fracture patients. On the upper end, states enacting mandatory arbitration could reduce charges by $12,177, over half the mean hospital charge for skull fracture patients. Those enacting various pre-judgment measures could save $5,175, whereas capping attorney fees could save $4,534 per skull fracture patient. States mandating periodic payment of awards could also significantly reduce defensive medical charges by $7,843 per skull fracture patient. In contrast, damage caps and collateral-source rule reforms increase patient expenditures.

The results are consistent with some of Kessler and McClellan's (1996) findings, though contrary to others. Both studies find that joint and several liability rules and mandatory periodic payments reduce patient expenditures. Kessler and McClellan (1996), however, show damage caps reduce expenditures, contrary to findings here. Danzon (1986) finds damage caps decrease claims severity, but not their frequency. If this

is the case, then physicians do not perceive a reduced likelihood of being sued with damage caps in place and thus do not practice less defensive medicine, which would contradict Kessler and McClellan's findings. The positive coefficient on damage caps here is not inconsistent with Danzon, and as mentioned previously, the endogeniety between higher medical costs malpractice crises may best explain it.

The major weakness of this study is that health outcomes are not held constant due to lack of data availability. Kessler and McClellan (1996) found no evidence of differences in health outcomes, and we take the liberty of presuming that would be the case with skull fracture patients. Despite this limitation, the results suggest significant costs savings from reduced defensive medicine. Based on the national estimate by Kraus et AL. (1996) that approximately 2 million head injuries occur each year, enacting mandatory arbitration could save over $24 billion in skull fracture defensive medical practices. Considering this estimate represents savings from only one percent of the total patient population, policy makers should seriously consider the impact of state malpractice tort reforms on the practice of defensive medicine.

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Chart 1	**Malpractice Tort Laws Used in Analysis.**
Reform	**Description of reform**
Arbitration (Permitted)	Arbitration is permitted, but not mandated.
Arbitration (Mandatory)	Arbitration is mandated.
Pre-judgment	Claimants need to obtain a certificate of affidavit of merit within a certain amount of time in order to pursue medical liability action.
Contingency Fee Cap	The proportion of an award that an attorney can contractually charge is statutorily capped at a specific level.
Statute of Limitations	The maximum number of years (from incident occurrence, discovery, or the maximum time limit) during which a claimant can commence an action for medical liability
Collateral Source Rule Reform	Damages payable in a malpractice suit are statutorily reduced by all or part of the dollar value of collateral-source payments to the plaintiff.
Damage Caps (noneconomic or total damages)	Either noneconomic, total damages, or both types of damages are capped at a statutorily established dollar amount.
Damage Caps (punitive damages)	Punitive damages are capped at a statutorily established dollar amount.
Joint and Several Liability Rule Reform	The Joint and Several Liability rule is abolished either for noneconomic or total damages in all claims, such that damages payable in a malpractice suit are statutorily allocated in proportion to the tortfeasors' degree of fault.
Periodic Payment of Awards (Permitted)	Part or all of the damages are permitted to be disbursed in the form of an annuity that pays out over time.
Periodic Payment of Awards (Mandatory)	Part or all of the damages must to be disbursed in the form of an annuity that pays out over time.
Physician Compensation Fund	A state-administered excess malpractice liability insurance program exists for physicians.

Table 1 State Tort Coding Matrix

State	Arbit	PreJudge	ContFeeCap	StatLim	CollSoRef	DamCap	JntSevL	PeriodPay	PCF
AZ	0	0	0	2	1	0	1	0	0
CA	1	0	1	3	1	1	0	1	0
CO	1	1	0	3	1	1	1	2	0
CT	1	0	1	3	1	0	1	1	0
FL	1	1	0	4	0	0	1	1	1
IL	0	1	1	4	1	0	0	1	0
KS	1	1	0	4	0	1	1	1	0
KY	0	0	0	1	0	0	1	1	0
MA	0	0	1	7	1	1	0	0	0
MD	2	1	0	5	0	1	0	1	0
MO	0	1	0	10	0	1	0	1	0
NC	2	0	0	4	0	0	0	0	0
NJ	0	1	1	2	1	2	1	0	0
NY	1	1	1	2.5	1	0	1	2	0
OR	0	0	1	5	0	0	0	0	0
PA	1	0	0	7	0	2	0	1	1
SC	1	0	0	6	0	0	0	0	1
TN	1	0	0	3	1	0	1	0	0
TX	1	1	0	2	0	2	1	0	0
VA	2	0	0	2	0	1	0	1	0
WA	2	0	0	8	1	0	0	1	0
WI	1	0	1	5	1	1	1	1	1
GA	1	1	0	5	0	2	0	0	0

STATE TORT CODING KEY *

*All reforms took effect in prior to 1998 in order to allow for lag time between tort reform enactment and physician behavior change.

Arbitration:
Arbit= 0 if there are no provisions for arbitration.
Arbit= 1 if there arbitration is permitted (voluntary) .
(In regression analysis transformed to: ArbitVol= 1.)
Arbit= 2 if there arbitration is mandatory .
(In regression analysis transformed to: ArbitMand= 1.)
Pre-judgment measures:
PreJudge= 0 if claimants do not need to obtain a certificate/affidavit of merit within a certain amount of time in order to pursue a medical liability action .
PreJudge= 1 if claimants must (mandated) file a certificate/affidavit of merit within a certain amount of time in order to pursue a medical liability action .
Contingency Fee Caps:
ContFeeCap= 0 if contingency fees are not capped (This includes HI, IA, and WA where courts must approve/determine reasonable contingency fees.)
ContFeeCap= 1 if contingency fees are capped.

Statute of Limitations:
StatLim= #. This number is the maximum number of years (from incident occurrence or discovery) during which a claimant can commence an action for medical liability. In cases where there were different time limits for occurrence, discovery, or a maximum statute of limitations I have used the maximum time limit.
Collateral Source Rule:
CollSoRef= 0 if the collateral source rule is in effect (juries cannot consider claimants' external compensation sources).
CollSoRef= 1 if the collateral source rule has been reformed such that juries are permitted to consider claimants' external compensation sources.
Damage Caps:
DamCap= 0 if there are no caps on any type of damage award .
DamCap= 1 if there are caps on noneconomic/total damages.
(In regression analysis transformed to: DamCapNT= 1.)
DamCap= 2 if there are caps on punitive damages only
(In regression analysis transformed to: DamCapPun= 1.)
Joint and Several Liability Rule:
JntSevL= 0 if joint and several liability is in effect (joint tortfeasors are each responsible for the entire judgment)
JntSevL= 1 if joint and several liability has been reformed such that damages are allocated in proportion to tortfeasors' degree of fault)
Periodic Payment of damages:
PeriodPay= 0 if there are no provisions for periodic payments of damages
PeriodPay= 1 if periodic payment of damages is permitted, but mandated
(In regression analysis transformed to: PerPayPerm = 1.)
PeriodPay= 2 if periodic payment of damages is mandated
(In regression analysis transformed to: PerPayMand = 1.)
Physician Compensation Funds:
PCF= 0 if the state did not have a patient compensation fund in 2000.
PCF= 1 if the state had a patient compensation fund in 2000.

Table 2. Means and standard deviations of variables used in regression analysis.

Variables	Mean	Standard Deviation
Patient Demographics		
(*AGE*): Age	35.190	12.499
(*FEMALE*): Gender	0.190	0.392
(*MEDICAID*): Medicaid Insurance	0.101	0.301
(*PRIVATE*): Private Insurance	0.476	0.499
(*TWENTYFIVE*): Income $25,000-34,999	0.277	0.448
(*THIRTYFIVE*): Income $35,000-44,999	0.256	0.438
(*FORTYFIVE*): Income $45,000 +	0.312	0.463
Patient Hospital Stay Demographics		
(*LOS*): Length of Stay	3.584	2.634
(*NDX*): Number of Diagnoses	5.854	2.438
(*NPR*): Number of Procedures	2.182	2.329
Hospital Demographics		
(*TEACH*): Teaching facility	0.572	0.499
(*URBAN*): Urban location	0.885	0.319
(*LARGE*): Large size	0.690	0.462
(*PUBLIC*): Public facility	0.087	0.282
(*VOLUNTARY*): Non-profit facility	0.149	0.356
Malpractice Tort Law Reforms		
(*ARBITVOL*): Arbitration- Voluntary	0.617	0.486
(*ARBITMAND*): Arbitration- Mandatory	0.098	0.298
(*PREJUDGE*): Pre-judgment	0.535	0.499
(*CONTFEECAP*): Contingency Fee Cap	0.466	0.497
(*STATLIM*): Statute of Limitations	3.950	2.009
(*COLLSOREF*): Collateral Source Rule	0.537	0.499
(*DAMCAPNT*): Damage Caps- Noneconomic/Total damages	0.404	0.491
(*DAMCAPPUN*): Damage Caps- Punitive	0.207	0.405
(*JNTSEVL*): Joint and Several Liability	0.622	0.485
(*PERPEYPERM*): Periodic Payment- Permitted	0.582	0.493
(*PERPAYMAND*): Periodic Payment- Mandatory	0.095	0.293
(*PCF*): Physician Compensation Fund	0.201	0.400

Table 3. Regression Results. (T values in parentheses.)[a]

Adjusted R^2 = 0.4862 Condition Index = 35.91244 Dependent Mean (Total Charges) = $21,127

Variables	Coefficient Estimates[b]	Variables	Coefficient Estimates[a]
Intercept	-$130.98 (-0.06)		
Patient Demographics		Malpractice Tort Law Reforms	
(*AGE*): Age	-$130.98 (-0.83)	(*ARBITVOL*): Arbitration- Voluntary	$686.81 (0.67)
(*FEMALE*): Gender	-$17.34** (-2.71)	(*ARBITMAND*): Arbitration-Mandatory	-$12,177.00*** (-10.40)
(*MEDICAID*): Medicaid Insurance	$3,596.63** (2.85)	(*PREJUDGE*): Pre-judgment	-$5,174.99*** (-6.18)
(*PRIVATE*): Private Insurance	$30.30 (0.06)	(*CONTFEECAP*): Contingency Fee Cap	-$4,534.50*** (-5.27)
(*TWENTYFIVE*): Income $25,000-34,999	-$1,535.95 (-1.54)	(*STATLIM*): Statute of Limitations	-$1,504.69*** (-8.98)
(*THIRTYFIVE*): Income $35,000-44,999	-$1,410.69 (-1.50)	(*COLLSOREF*): Collateral Source Rule	$3,866.88*** (4.73)
(*FORTYFIVE*): Income $45,000 +	$1,841.90 (1.90)*	(*DAMCAPNT*): Damage Caps-Noneconomic/Total	$2,584.30*** (3.97)
Patient Hospital Stay Demographics		(*DAMCAPPUN*): Damage Caps-Punitive	$2,226.01** (2.01)
(*LOS*): Length of Stay	$3,191.70*** (25.59)	(*JNTSEVL*): Joint and Several Liability	-$2,474.77** (-2.69)
(*NDX*): Number of Diagnoses	$191.68 (1.59)	(*PERPAYPERM*): Periodic Payment-Permitted	$2,775.17*** (3.48)
(*NPR*): Number of Procedures	$3,716.70*** (15.88)	(*PERPAYMAND*): Periodic Payment-Mandatory	-$7,842.91*** (-5.32)
Hospital Demographics		(*PCF*): Physician Compensation Fund	-$1,856.49** (-2.03)
(*TEACH*): Teaching facility	$654.39 (0.64)		
(*URBAN*): Urban location	$7,063.70*** (8.29)		
(*URBAN*): Large size	$3,954.61*** (7.22)		
(*PUBLIC*): Public facility	$2,686.13** (2.29)		
(*VOLUNTARY*): Non-profit facility	$2,714.92** (2.00)		

[a] T values produced using White's consistent estimators of the variance.

[b] All coefficient estimates have been deflated to 2000 dollars.

*Significant at the 10% confidence level.

**Significant at the 5% confidence level.

***Significant at the 1% confidence level.