HAS TORT REFORM BEEN EFFECTIVE IN ABATING THE MEDICAL MALPRACTICE CRISIS? AN EMPIRICAL ANALYSIS FROM 1991-2012

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Abstract

This paper evaluates the impact of malpractice reforms on average malpractice payment awards, frequency of malpractice claims, and malpractice premiums for internists, surgeons, and OB/GYNS. We also empirically test the physician-induced demand (PID) hypothesis in the context of the medical malpractice environment. Our results suggest that caps on noneconomic damages and total damages as well as patient compensation funds are successful in reducing average payments, while damage caps and collateral source rule reform were found to lower malpractice claim incidence. When grouping claims by severity level, we find that noneconomic damage caps and patient compensation funds are more effective at reducing average payment with increasing severity level, while total damage caps induce the greatest reductions in payments for cases of medium severity. Also, noneconomic damage caps were found to only significantly decrease the incidence of medium severity claims. With regards to malpractice premiums, we found that implementation of total damage caps as well as modification of joint-and-several liability were associated with lower premiums for all specialists. Finally, we evaluate the notion of 'defensive medicine' by studying whether higher malpractice premiums result in greater Medicare payments. Based on our model, increases of $10,000 in OB/GYN premiums are estimated to result in a 0.81% rise in total spending. Of the reforms studied, modification of joint-and-several liability had the most significant and consistent effects in reducing Medicare reimbursements for all categories of spending analyzed, and total damage caps were also estimated to effectively slow the growth of spending in specifications without premiums.

JEL classification: I1; I18; I19

Keywords: Medical Malpractice; Tort Reform; Defensive Medicine

Introduction

Practicing physicians in the United States treat an endless stream of ailing patients day to day and must deal with a labyrinth of bureaucratic procedures and administrative hassles. Another source of stress that physicians also deal with are the pressures of malpractice liabilities. In a medical context, malpractice is defined as an improper or negligent professional activity or treatment performed by a medical practitioner. Medical malpractice certainly plays an important role, as it both compensates victims accordingly for the damages of the tort committed as well as deter practitioners from negligent behavior. The magnitude of the malpractice award as well as the number of claims are meant to send a signal to physicians that helps them determine how much effort should be made to avoid such mistakes. However, some argue that in relation to the benefits mentioned above that the malpractice system disproportionately contributes to the rising costs of the healthcare system in the US. This is especially relevant given the rapid growth of healthcare spending; notably, in 2012, the healthcare industry accounted for roughly 18% of the US GDP, and the increase in healthcare costs (3.6% in 2011) continues to outpace inflation.[28]

The trends over the past few years provide evidence that this idea merits further study. During the last two decades the number of malpractice awards across most physician specialties has steadily increased along with the average damage totals awarded. From 1991 to 2001, the number of payments for malpractice claims increased over 20% from 13,711 cases to 16,676 cases, and the median payment for such cases rose during the same period from $63,750 to $135,941 (in 1991 dollars).[14] Similarly, the amount of costs incurred for the defendants involved have also been steadily increasing; for example, in Indiana from 1999 to 2001 the average expense per defendant increased over 30%. As such, premiums for malpractice insurance have been on the rise as the costs associated with insuring physicians have increased. Malpractice

premiums rose nationally by an average of 15 percent from 2000 to 2002 according to Congressional Budget Office estimates. In medical specialties associated with riskier procedures, the growth in premiums have been even greater. For example, during the same period in Florida OB/GYN premiums grew by 75 percent to a staggering $175,000 per year.[22]

Some argue that the increase in the associated costs of medical malpractice may contribute to the failure of the malpractice insurance market, as increasing loss ratios could compel insurers to leave the market. From 1998-2001, studies have found that the growth in insurance premiums can be attributed to the growth of both direct losses as well as the uncertainty of such losses, and consequently during the period of the largest increases in losses the number of insurers nationally fell from 276 in 1997 to 248 in 2001.[21]

These figures in tandem suggest the existence of a medical malpractice crisis, which results in an increasing misallocation of resources to tort cases rather than services in the healthcare sector. Policymakers at the state level have recognized the issues outlined above and long sought to reform the tort system to address the inefficiencies of the malpractice insurance market. "Tort" is formally defined as the civil wrong causing someone to suffer loss or harm resulting in a legal liability for the one committing the tortious act.[8] Across state lines, there has been a large amount of heterogeneity with regards to the malpractice system; for example, claim rates and average payouts were found to be nearly 20 times higher in states known for their malpractice environment, such as California, as compared to low-activity states such as Maine.[13] As such, different states across the United States have attempted a variety of policy responses to address this crisis. These include caps on non-economic and total damages, limits on attorney fees, altering joint-and-several liability, implementation of collateral source rules, the establishment of screening panels, and a variety of other reforms with the goal of decreasing the

number of claims, slowing the increase in payments for such claims, and stabilizing malpractice insurance premiums.

Over half of U.S. states implement some degree of tort reform, though not all states have enacted any policy prescriptions to address this issue. From the perspective of physicians, a volatile malpractice environment leads to fear of litigation and may cause practitioners to be 'defensive' in their practice of medicine to insure against the risk of having a claim made against them. Where optimal care can be viewed as the amount of healthcare services that maximizes consumer welfare, defensive medicine is defined as services for which the cost exceeds the benefit. Estimates for the amount that the medical malpractice system and defensive medicine contribute to national health expenditures range anywhere from 2.4% ($55.6 billion in 2008)[11] to 9% ($50.6 billion in 2002)[14], though such figures are difficult to determine given that judgments must be made on what services constitute defensive medicine. Similarly, 'negative' defensive medicine may also occur as a result of an aggressive malpractice environment, as physicians may shy away from high-risk specialties or specific procedures due to fear of litigation. As such, tort reform is needed not only to address a flawed and broken malpractice insurance market but may be also a necessary key to keeping health care inflation in check.

The goal of the analysis here is threefold: first, we plan to evaluate whether the reforms put in place do in fact achieve their intended goals: namely, whether they succeed in lowering the number of malpractice claims and slowing the rate of growth in average payment amounts. We plan on examining the malpractice environment in all 50 states that have put different combinations of policies in place and comparing the relative success of each state in achieving the three goals outlined above. The policies that are evaluated are caps on non-economic damages, regulation of contingency fees, modification of collateral source rules, elimination or

modification of joint-and-several liability, periodic payment plans, patient compensation funds, and the establishment of screening panels. In observing different combinations of reform initiatives, we aim to determine whether certain policies better achieve the goals outlined above when other reforms are simultaneously in place.

A second and related question is whether tort reforms are successful in lowering malpractice premiums for physicians in states with higher malpractice awards and frequency of claims (both of which are likely to drive up premiums). As before, we are interested to see whether certain initiatives are more suited to slowing the growth of premiums as opposed to addressing total malpractice awards or lowering the incidence of malpractice claims.

Finally, we are interested in examining whether malpractice pressures contribute to variations in medical practices across the country. Given the background outlined above, physicians in states with higher malpractice premiums are expected to practice positive defensive medicine, or the provision of treatments with small expected benefits relative to their associated costs. To study this issue, we plan to examine total Medicare spending per enrollee, as well as diagnostic, surgical, and laboratory spending, to see if certain categories of services are more susceptible to the effects of defensive medicine than others. If the latter two hypotheses hold true, then this implies that tort reform has important implications in influencing physician behavior by mitigating the pressures of the malpractice system.

Literature Review

The Impact of Tort Reforms on Malpractice Award Totals and Frequency of Claims

Prior to the implementation of medical malpractice tort reforms, egregiously exorbitant malpractice payments were often sought after and eventually awarded to plaintiffs pursuing the charge. As the established regulations neglected this problem, it continued to grow insidiously, burdening nearly every agent of medical practice - including direct practitioners, hospital staff & administration, and other medical professionals. Recent tort reform laws were enacted with the purpose of containing malpractice payment award totals and claim frequencies to more reasonable levels.

In 2007, Ronen Avraham et al. analyzed medical malpractice cases between 1991 and 1998. Studying over 100,000 cases, they examined the effects of six tort reforms. In particular, caps on pain and suffering damages and limitations on joint and several liability were found to significantly reduce the number of annual payments while caps on pain/suffering damage and periodic-payment reform were found to reduce average malpractice payment awards.[43] A joint effect of implementing all six reforms was also statistically significant for reducing the number of malpractice lawsuits.[43]

A study by Ronald M. Stewart et al. examined impacts of tort reform laws recently implemented in Texas. Similar to Avraham's findings, comprehensive tort reform was associated with significant decreases in both the prevalence and cost of surgical malpractice lawsuits. Litigation costs associated with surgical malpractice lawsuits were also reduced by approximately two-thirds. Unsurprisingly, reforms were believed to help diminish the incentive for physicians to practice defensive medicine.[44]

Furthermore, Teresa Waters et al.'s research reveals that the size and number of medical malpractice payments are affected by only some tort reforms.[45] States with lower malpractice payment levels were repeatedly found to have caps on damages, more restrictive statutes of limitations, and more restrictive expert-witness requirements. In contrast to the other papers discussed, other tort law reforms were said to have had only limited consequences for the number and value of paid malpractice claims.[45]

As the views on how medical malpractice reforms affect both the average award amounts and claim frequency are diverging, it will be necessary for us to perform this examination. Using average payment award amounts from the National Practitioner Data Bank, we will be able to analyze the individual effects of implemented reforms on average payment amounts and the number of malpractice claims.

The Effects of Malpractice Liability on Physician Supply

A common fear prevalent among practitioners is the prospect of facing a medical malpractice lawsuit. The pressure of malpractice liability is believed to have an impact on the behaviors of physicians. As the landscapes for malpractice laws vary among different states, it is logical to surmise that physicians would actively avoid practicing in states with relatively more stringent malpractice laws.

Katherine Baicker and Amitabh Chandra's article aims to determine if increased malpractice awards result in increased malpractice insurance premiums and also whether increases in malpractice liability cause physicians to close their practices or move to areas with lower payments. Baicker and Chandra's research involves the use of annual state-level data on premiums, payments, physicians, and treatments to examine long run effects of changes in physician malpractice liability on the physician workforce and practice of medicine. The authors

hypothesize that recently observed rises in malpractice insurance premiums are explained by rising malpractice claims and associated awards for plaintiffs. Baicker et al.'s results find that there is a fairly weak relationship between malpractice award payments and the premiums charged by malpractice insurance providers. [1] Similarly, malpractice payouts do not seem to be the primary driving force behind increased malpractice insurance premiums. Also, the size of the physician workforce in each state generally responds insignificantly to the increases in premiums; however, specifically in rural areas, a significant response is observable between malpractice insurance premiums and physician workforce.

Mello et al (2007) study changes in physician supply both before and after dramatic increases in malpractice premiums in Pennsylvania. The authors focused their attention on ten specialties associated with high medical liability due to the services typically rendered (anesthesia, cardiology, emergency medicine, general internal medicine, neurosurgery, obstetrics/gynecology, orthopedics, radiology, surgery) and compared these findings to those in those specialties typically associated with lower risk (allergy, dermatology, geriatrics, infectious disease, neurology, pediatrics, and psychiatry). After further study, the authors observed an insignificant correlation between malpractice insurance premiums and physician workforce in high-risk categories. In fact, the number of high-risk specialists and from 1999-2002 (a period of rapidly increasing malpractice premiums) increased both in absolute and per capita terms, challenging the assertion of negative defensive medicine induced by malpractice liability. Furthermore, though the number of OB/GYNs decreased by 8 percent in Pennsylvania from 1999-2002 during a period of increasing premiums, the overall supply of physicians performing deliveries (which can include family/general practitioners) increased.[17]

These results suggest that malpractice premium increases may be more relevant in specific cases, notably in rural areas facing doctor shortages as well as high-risk specialties where malpractice liability is more of a concern. In our study of defensive medicine and expenditures, we narrow our analysis to internists, general surgeons, and OB/GYNs to see whether increases in malpractice premiums for specific practitioners are more correlated with greater utilization of services.

The Impact of Malpractice Pressures on Physician Psychology and Behavior

Prior studies have found that physicians' personal experiences with the malpractice system are said to be a major determinant of the perceived importance of defensive medicine.[3] Thus, studying the effects of physician attitudes towards their respective malpractice environment merit further study, as well as determining whether tort reform is effective in mitigating physician malpractice fears should these be found to result in defensive medicine. One notable study (1998) was done by Kessler and McClellan (were interested in studying whether physicians in states with some degree of tort reform had a lower perceived impact of malpractice pressure on practice patterns compared to counterparts from states lacking such reforms. The authors utilized a survey by taken by the American Medical Association called the Socioeconomic Monitoring System survey, which reports on physicians' experiences regarding medical malpractice. This is examined alongside data on state liability reforms to explore the relationship between liability reforms, malpractice pressure, and physician perceptions of malpractice pressure.

Approximately 17% of physicians reported an increase in referrals for consultation and time spent with patients in response to malpractice pressure; 20% reported increased malpractice pressure induced diagnostic tests, while over 30% reported increased record keeping due to

pressure from malpractice. Interestingly, within one year after the passage of direct reforms, the trend in malpractice claims rates in reform states is substantially smaller than the trend in non-reform states by over 2 percentage points (a statistically significant measure at the 5% level). Indirect reforms did not produce a statistically significant effect on claiming behaviors. Within three years after adoption, physicians from states adopting direct reforms show statistically significantly lower trend growth in their malpractice insurance premiums, of about 8.4%. Kessler and McClellan conclude that tort law reforms affect the attitudes of physicians, as they reduce the probability of an encounter with the liability system. [3] Their personal experiences with the malpractice system can play a key role in determining their perceived importance of defensive medicine.

The previously cited study of Mello et al. (2007) also focused their attention on the impact of malpractice pressures on physicians' scope of practice in Pennsylvania, which during the time period studied was hit with very large increases in malpractice premiums. Specifically, the study addresses whether physicians stopped performing high-risk procedures before the dramatic rises in malpractice premiums. The authors found that the difference in the proportions of high-risk specialists who restricted their scope of practice before and after the rise in premiums in Pennsylvania was not statistically significant, suggesting that the malpractice environment may not contribute to variations in the physicians' determination of their scope of practice.[17]

Katz et al. (2005) instead studies how physicians who identify as having more concerns about possible malpractice suits evaluated patients with possible acute cardiac ischemias (ACIs) as compared to those who did not place the same weight on the malpractice environment. Surveying 33 emergency physicians at 2 university hospitals who treated 1,134 patients, the

authors found that physicians who are in the upper tertile with regards to malpractice fear are less likely to discharge low-risk patients as compared to their counterparts in the lower tertile, and the most malpractice-cognizant physician were more likely to admit low-risk patients into either an ICU or telemetry bed.[19] This suggests that malpractice pressure may in fact be a large factor in contributing to variations in the practice of medicine for emergency physicians, specifically in triage situations.

Similarly, Carrier et al. (2013) studies whether physicians concerns about malpractice liabilities may predict higher fee-for-service Medicare payments for patients that reported either chest pain, headache, or lower back pain. The authors hypothesized that more malpractice-sensitive practitioners would use more imaging services , be more likely to recommend their patients to emergency rooms, or be more inclined to admit patients to the hospital (all of which were measures of defensive medicine) than those less concerned about the malpractice environment. In office settings, physicians with higher malpractice concerns were more likely to order conventional and advanced imaging for patients with back pain or headaches than their less wary counterparts.[18]

As malpractice reforms impact the incentives and behaviors of physicians, they serve as a key determinant in altering the treatment approaches and associated patient health outcomes. It will be difficult to assess these psychological effects without any survey data; however, a meaningful analysis can be produced using malpractice premiums as proxy for the psychological pressures stemming from the malpractice environment.

The Contribution of Medical Malpractice to Health Care Expenditures and Utilization

In studying medical malpractice, it is important to put this in the context of the larger healthcare landscape and its possible relation to health care inflation. As detailed in the

Introduction, this is believed to increased utilization of health care services (defensive medicine) induced by malpractice pressures of physicians. As such, it is important to see study how malpractice litigation payments and claims contribute to variations in spending and whether reforms are effective in mitigating the effects of the malpractice environment in driving up health care costs.

One such work addressing this topic was by Roberts and Hoch (2006), who both evaluate whether differing levels of malpractice activity may explain part of the variation in area medical costs in Mississippi to reduce sources of heterogeneity that exist across state lines. Using Medicare Part B claims in 82 counties from 1998-2002 as a proxy for total area medical costs and the number of medical malpractice lawsuits filed in a county relative to the county population for the level of malpractice litigation, the authors find that an additional lawsuit per 100,000 residents adds $1.40/enrollee to Medicare expenditures. After multiplying this coefficient by the average number of claims (16.05), the authors estimate the indirect costs of medical malpractice (ie. defensive medicine) to be $22.47, or roughly one percent of average expenditures ($2431/enrollee). When assuming that dummies in the county fixed effects model also capture the effects of malpractice litigation, this estimate rises to 3%, suggesting that the malpractice environment, while not a driving force of small area variations, certainly does contribute.[46]

Another study done by Kessler and McClellan was focused on direct reforms that aim to reduce provider liability were successful in lowering expenditures on health care without adversely affecting the health of patients. The authors obtained data on total hospital spending payments for Medicare beneficiaries that were treated for acute myocardial infarctions (AMIs) and ischemic heart diseases (IHDs) in 1984, 1987, and 1990, and they proceeded to combine

reforms into two subcategories: direct reforms (including caps on damages, collateral source rule modification, elimination of mandatory prejudgment interest, and abolition of punitive damages) and indirect reforms (which included joint-and-several liability reform, regulation of contingency fees, mandatory periodic payments, and patient compensation funds). It was found that direct reforms reduced expenditures from 5 to 9 percent without resulting in increases in medical errors or significantly affecting mortality, though the same effects were not observed for indirect reforms.[20] The success of these reforms in lowering utilization of services was markedly larger for heart attacks (AMIs) than for the less severe IHDs. Based on these findings and that 40 percent of the patients being treated for cardiac disease were affected by these reforms, Kessler and McClellan estimate that these reforms would have ranged from $400 to $600 million each year following implementation of malpractice reform policies.

Following this study, Sloan and Shadle (2008) proceed to reassess the findings of Kessler and McClellan using total Medicare payments rather than those made solely to hospitals and broaden the scope of the study to also include primary diagnoses of AMIs, strokes, cancer, and diabetes from 1985-2000 utilizing data from the National Long-Term Care Survey (NLTCS) as well as Medicare claims data to identify diagnoses. As in the prior study, while controlling for health, functional status, and demographics, the authors also examine whether the reforms have any observable effects on the probability of survival. Though Sloan and Shadle find that direct reforms reduce 1-year Medicare payments by 3.6% and spending specifically on AMIs by 17.6%, neither of these findings were statistically significant. Interestingly, contrary to the results of Kessler and McClellan, the authors' models suggest that implementation of indirect reforms has a roughly 9% implied reduction in total payments. Also, neither the direct nor indirect reforms studied were found to have any significant effects on mortality.

Another topic which arises in the discussion on the effects of malpractice liability on health care utilization is the dilemma faced by obstetricians. More so than most other physicians, obstetricians face an exorbitant load of pressure from malpractice liabilities. Practicing obstetricians often focus heavily on the use of cesarean sections and antenatal testing to avoid malpractice claims and limit their exposure to malpractice risks. Additionally, obstetricians can be found legally responsible from the time the patient is born up until he or she is eighteen years of age.

For obstetricians, a reduction in riskier services results in reduced revenues and adverse health consequences. The obvious benefit of limiting exposure to risk is the associated reduction in expected malpractice liability costs. If an obstetrician chooses not to provide obstetrical services in response to increased malpractice pressure, the supply of services decreases, forcibly reducing the equilibrium quantity of services used. Obstetricians can respond by providing additional services of little value (defensive medicine practices) for the purpose of limiting their exposure to risk.

In the context of OB/GYNs, Yang et al. (2009) study the impacts of malpractice liability on the rates of cesarean sections as well as vaginal births. They also evaluate whether direct malpractice reforms are successful in lowering the total number of cesarean sections and consequently total delivery costs. OB/GYNs have the choice of either recommending cesarean sections or vaginal births after cesareans (VBACs). Though C-sections do contribute to higher costs, many argue that physicians have substituted towards this procedure given the perceived lower probability of being named in a malpractice claim. Yang et al. find that C-section rates and malpractice premiums are positively correlated. More precisely, a $10,000 decline in premiums is estimated by the authors to result in 1600 more VBACs and 6000 fewer C-sections

nationwide. Additionally, with regards to reforms, only caps on noneconomic damages as well as malpractice screening panels are found to lower c-section rates, though by very modest amounts (0.48 percent in the case of noneconomic damage caps) [2].

Given the incongruent findings between the two studies focusing on general health care expenditures, this suggests that tort reforms are likely to have heterogeneous effects dependent upon the condition or type of service in question. Thus, it will be important to include in our study an analysis of the effects of malpractice reform policies on health care expenditures for a variety of different procedures. For the purposes of this manuscript, we focus our attention on Medicare spending per enrollee for all services, diagnostics, labs, and medical or surgical services. We will be interested to see whether the policies studied have differential effects on expenditures dependent upon the service in question.

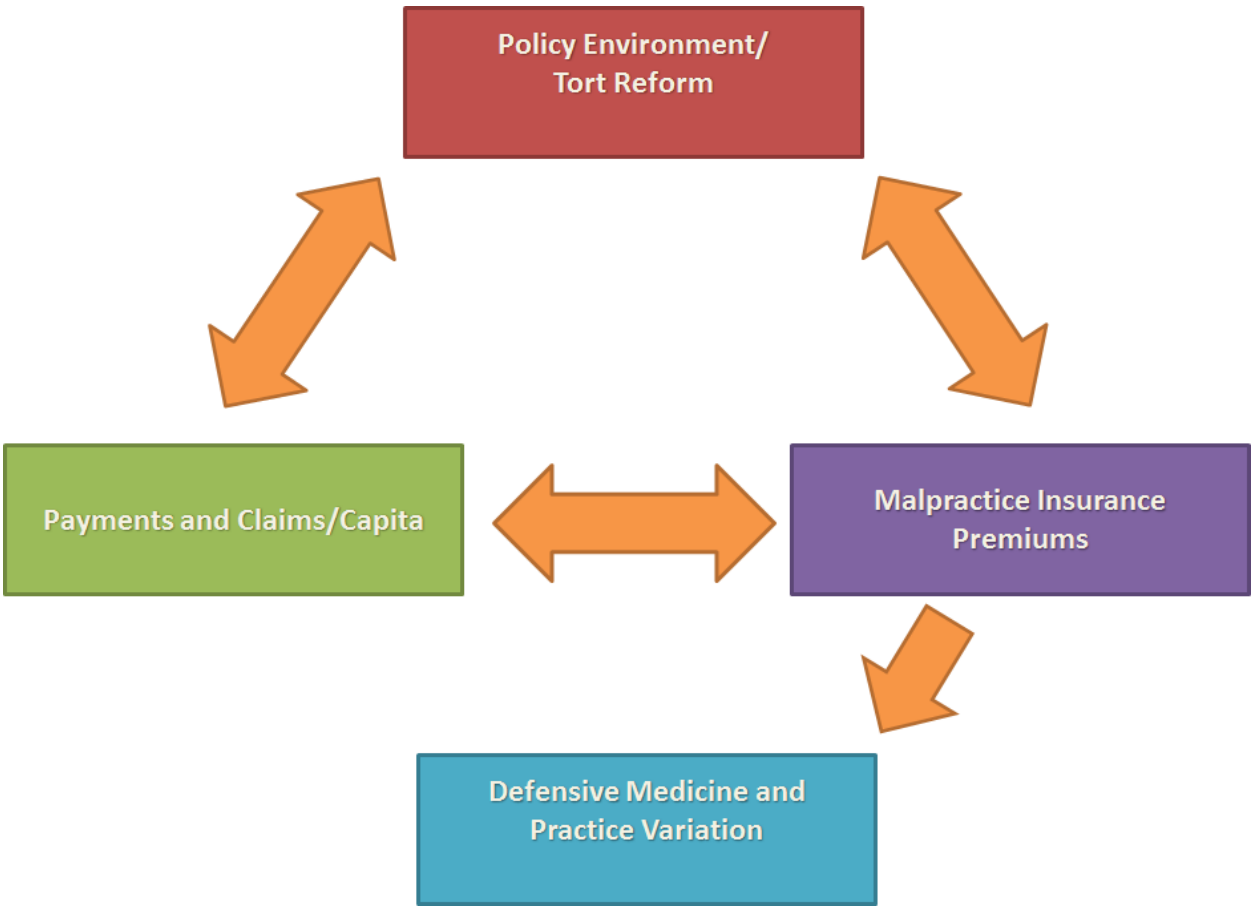
Theoretical Framework

As stated in the Introduction, we are interested in dissecting how different aspects of the medical malpractice environment influence one another. Each of the links that we hope to analyze can be found in **Figure 1** on the following page. The first aim of our analysis is to test whether various tort reforms have met any success in either decreasing payment awards or decreasing the frequency of malpractice claims. In this study, we specifically focus our attention on caps on non-economic damages, caps on total damages, regulation of contingency fees, modification or elimination of joint-and-several liability, modification of the collateral source rule, malpractice screening panels, periodic payments, and patient compensation funds. An explanation and intuition behind each policy is more fully explored in the Empirical Framework.

Next, we wanted to see if the average malpractice payment award as well as the frequency of claims within each state was related to the premiums for malpractice insurance policies purchased by physicians. Intuitively, it makes sense that insurance providers would be likely to charge higher premiums in states where the magnitude of the payment award as well as the number of awards are elevated to stay profitable. We also evaluate whether the tort reforms had any significant effect on decreasing premiums, as advocates argue that reform is needed to mitigate the effects that malpractice premiums have in inducing defensive medicine and additional costs for the healthcare system.

Finally, we wanted to study whether the general assertion of defensive medicine being induced by higher malpractice premiums held true, using Medicare Spending as a proxy for utilization and practice variation. We are interested in examining whether the malpractice environment has any noticeable effect on the practice of medicine across state lines.

Figure 1



Small area variations in the utilization of physician services exist across various geographic regions. To explain this, many have turned to the physician practice hypothesis, or the notion that per capita variations in health services utilization can be attributed to differences in clinical practice. Physicians likely have different opinions about the amount and type of services that constitute the optimal amount of care dependent upon both their training in medical school and residency programs as well as their colleagues' methods close to their place of work. Generally, treatment strategies and practice styles are believed to be confined to an area as physicians have no incentive to promote the diffusion of such ideas to other regions.[47] Because measuring practice styles are difficult, it has been difficult to determine the extent to which different

opinions on clinical care contribute to small area variations.

In our framework, we stipulate that the malpractice environment may contribute to small area variations of healthcare utilization based on the theory of the physician-induced demand hypothesis (PID), which stipulates that physicians may shift the demand curve of patients to lead to the provision of more or less health care services that are not in the best interest of the patient.[27] The PID hypothesis can be described in the context of asymmetric information as well as the principal-agent problem. The asymmetry of information that exists between the physician and patient leads to consumers turning to the expertise of the physician to determine what procedures and treatments are needed to address the health concerns of the patient. As such, physicians are not only responsible for the supply of medical services but also heavily contribute to the determination of patient demand for office visits, tests, procedures, etc. Thus, physicians may be able to alter the demand for medical services for reasons unrelated to the health of the patient. For example, an increase in the number of practicing physicians in an area may shift the supply curve to the right, thus leading to a decrease in the price of services. In response to increased competition as well as a fall in income, physicians may take advantage of the asymmetry of information between themselves and the patient to induce the demand curve to also shift right to raise the price of services either back to the original equilibrium price or even higher. For example, one of the seminal works done by Gruber and Owings in 1996 found that a fall in fertility rates (and subsequently, the amount of services provided) induced OB/GYNs to substitute from normal childbirths to cesarean delivery (for which physicians receive a higher reimbursement).[30]

Similarly, the issue of the principal-agent problem and its relevance to the PID hypothesis has been studied for many years since first being noted by Arrow.[29] In the context of the

physician-patient relationship, the physician acts as an agent for the patient by ordering (demanding) medical services for the patient. As described earlier, due to the problem of asymmetric information, some economists argue that physicians are able to take advantage of the principal-agent situation and to induce more services when it is in their financial interest. While a perfect agent would recommend the optimal amount of services (which the patient would choose to consume if they had the same knowledge as the physician), physicians are believed to deviate from this ideal. This is especially relevant given the different payment models that may be in place (ie. fee-for-service vs. managed care contract). In fee-for-service contracts, physicians may be inclined to order more tests than necessary as it is in their financial interest given they are paid for the service regardless of the medical benefit of the past. Given that the majority of patients are insured and are only responsible for a fraction of the cost of the service, they are expected to accept the additional medical services recommended by the practitioner. Conversely, in HMOs and similar managed care organizations, it is in the physician's interest to lower the amount of services provided as they must share part of the costs involved in such procedures.

With regards to asymmetric information, some economists have posited an increasing monopoly model, or the notion that as the physicians per capita within a certain market increase so will their market power. As the number of physicians within a region increase, the information that a consumer will have about each individual practitioner will subsequently fall. This represents an increase in the search costs for consumers, who as a result are less sensitive to price changes (resulting in a more inelastic demand curve). As a result, based on the theory of monopolistic competition, such a scenario will lead to arise in the equilibrium price of physician services.[41] To test this theory, past empirical studies have studied and demonstrated that regions with high physician density demonstrate market failure as evidenced by elevated levels of

utilization and fees, all else held equal.[42]

As outlined above, many factors can contribute to either overutilization or underutilization of healthcare services. Similarly, we believe that this may also have relevance to the medical malpractice landscape. Higher malpractice premiums lead to a fall in the income of physicians. To compensate for this loss, physicians may induce an increase in the demand for services to raise the equilibrium price and stabilize their income stream. In this case, one would expect there to be overutilization of services.

The level of demand inducement depends on the magnitude of the loss in income that the physician would be reacting to (ie. the size of the premium). To try and better understand this phenomena, it is a useful exercise to see how physicians would react to a decrease in the price of services (ie. such as a cut in reimbursement rates). Physicians' income is dependent upon the profit rate (T) of each service, the quantity of services (Q), and the magnitude of demand inducement (D). As such, the income possibilities (Y) of a physician are denoted by the linear equation below:

$$Y = T * Q + T * D$$

The physician aims to reach the highest indifference curve possible (with utility increasing as one moves northwest in **Figure 2**). If a physician was to face increased competition in his region, then this could lead to a decrease in the average profit rate (T decreases to T^1), thus decreasing both the slope and intercept of the income possibility line. Note that in this case the income effect will lead to greater inducement of demand while the competing substitution effect will favor less demand inducement. This new slope of the income line leads to a higher level of demand inducement (D increases to D^1) and equilibrium quantity of services (Q_0 increases to Q^1) due to the negative income effect (past literature has empirically demonstrated that this will

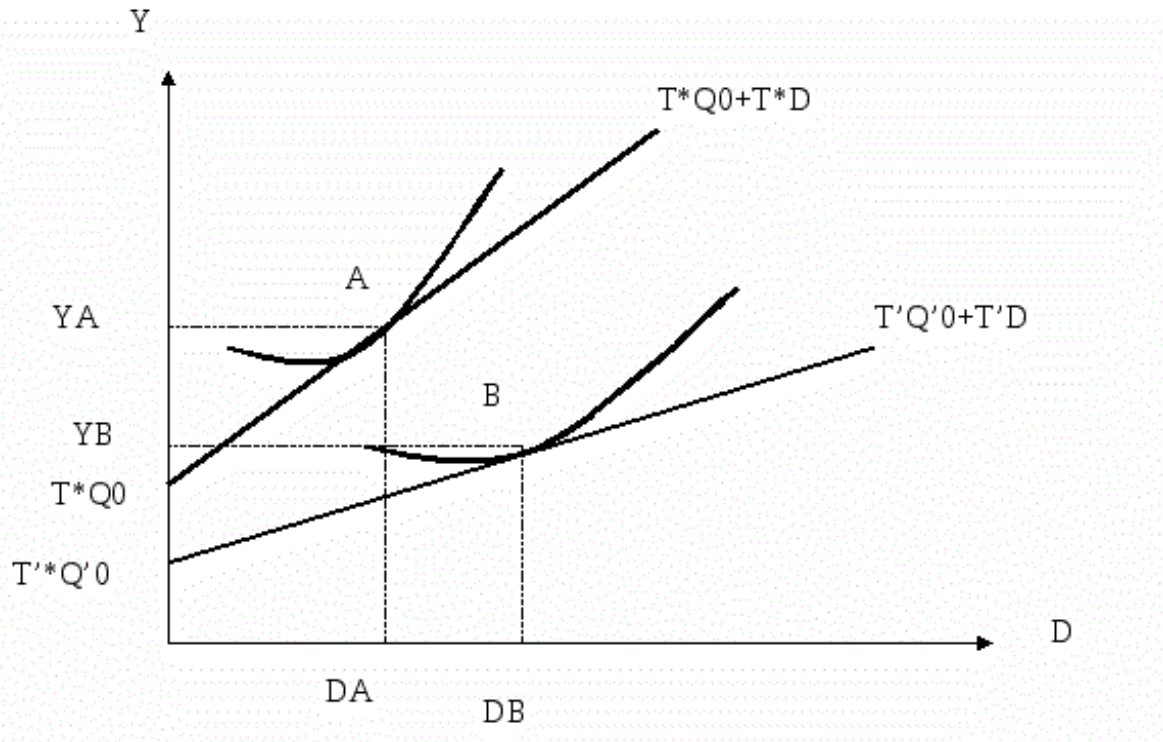
generally be greater than the substitution effect as decreases in reimbursement fees from Medicare have been found to lead to higher volume of services)[37, 38, 39].

To put the PID hypothesis in the context of the medical malpractice market, we now include the premium (P) in the income possibility equation:

$$Y = (T * Q) + (T * D) - P$$

An increase in P would decrease the intercept of the income equation, representing a pure income effect that would similarly increase the magnitude of demand inducement on the part of the physician.

Figure 2



Also, as noted in our Literature Review, it is important to consider the psychological aspects of the malpractice environment. Higher premiums may contribute to 'malpractice pressure', or the extent to which the malpractice environment may alter a physician's choice of

the quantity of services to provide. In states with higher malpractice claims and average payments, physicians' perceptions of best practices may change in light of wishing to minimize their susceptibility to being held liable and subsequently lead to different treatment recommendations than would otherwise have occurred regardless of whether these tests and procedures provide additional marginal benefit for the patient's health. It is this intuition that gives 'defensive medicine' its well-known name and attributes overutilization of services not to the loss of income but rather the minimization of risk for the physician. This line of thinking is still in line with the PID hypothesis as it assumes that the provider alters the demand for services to meet his or her own needs rather than those of the physician.

Thus, given the intuition developed above, tort reform theoretically may decrease defensive medicine, health care utilization, and slow the growth of healthcare inflation if it is able to decrease premiums. By mitigating the growth of average malpractice payments, the number of claims, and malpractice premiums, this would address both the negative income effect induced by rising premiums as well as the concerns about liability that are believed to contribute to defensive medicine. However, as noted earlier, the PID hypothesis depends on how one models a physician's choices; though we are interested in the relation of malpractice premiums to physician income and minimization of liability, it is important to keep in mind that physician-rich areas may also have higher utilization due to the problem of asymmetric information. As such, the PID hypothesis may explain practice variation across states, but this may be due to variations in physician density across the US rather than the heterogeneity of the malpractice environment. Thus, we also include in our analysis the physicians per 100,000 residents in our analysis to control for other characteristics that may contribute to physician-inducement of demand.

Data

Data related to malpractice cases was obtained from the National Practitioner Data Bank (NPDB), which was created by the United States Congress with the goals of improving healthcare quality, protecting the public, and reducing health care fraud and abuse. Agents reporting to the National Practitioner Data Bank include medical malpractice payers, state health care practitioner licensing and certification authorities, hospitals, federal and state government agencies, and health plans.

The NPDB is rather comprehensive, offering statistics with 54 variables for approximately 999,212 cases between 1990 and 2012. For the purposes of our analysis, we dropped observations that did not have award figures, that did not involve a practicing physician (either an MD or DO), as well as cases from 1990 (as the NPDB began reporting statistics in this year and the claims during this year are quite limited in comparison to those filed in 1991, suggesting there was limited data during the first year).

As noted earlier, malpractice payment averages in the United States throughout the last 20 years have gradually increased. **Figure 3** below illustrates this trend. These dollar figures were adjusted for inflation using 2013 as the base year and were calculated using the Consumer Price Index (CPI). In 1990, the average payout was approximately $210,000 and has steadily increased over time, reaching its peak of 2003 of an average award value of nearly $360,000 and hovering around $320,000 for the past 10 years. Also, the number of malpractice claims nationally per year remained constant throughout the 1990's and reached a peak in 2001 of 16,134 claims involving a physician. Since that time, malpractice payments have steadily declined to 9,194 cases in 2012 **(Figure 4)**. Given these trends, we are interested to see whether tort reform has played a role in slowing the growth of both payments and claims over time.

Starting in 2004, the NPDB also began to include injury severity for each observation, which will help to serve as a major control. Severity is coded from 0-9, with 1 being an 'Emotional Injury' and 9 being 'Death' (a full description of the scale can be found in the **Variables** section immediately following this section). We denoted claims with an injury severity falling between 0-5 to be 'low severity', 6-7 to be 'medium severity', and 8-9 to be 'high severity'. For our study, we plan to observe whether tort reforms are more or less effective dependent upon the severity of the injury in question. In **Figure 5**, we plot the reported average payments across the US for each of these subgroups, and in **Figure 6** we include the frequency of claims for each severity category.

For the purposes of our analysis of tort reforms by state, we tabulated the average award payments, the average severity of all claims, and the number of claims in each year in a particular state. Additionally, we also tabulated the above figures for each severity subgroup to allow us to study whether reforms differentially affect malpractice claims of certain characteristics more so than others.

As stated earlier, one of the aims of this paper is to evaluate the effectiveness of tort reforms in slowing the growth of the number of malpractice claims, payment totals, and malpractice insurance premiums. Information regarding each state's policy environment was obtained from the American Tort Reform Association (ATRA), the Database of State Tort Law Reforms, and the National Conference of State Legislatures. Dummy variables were created for each policy and a state was assigned '1' for a particular year if it had the reform in place at the time. For our analysis, we coded the dummy variable for screening panels to be a '1' if the state required that malpractice cases be heard by a panel before going to court. With regards to joint-and-several liability reform, we noted that the state had implemented a reform if it had either

eliminated joint-and-several liability for malpractice claims or defendants that shared 50% or less of the responsibility of the tort could not be held liable for the entire payment (in some states with reform, physicians can be held liable for the entire payment if they carry more than ¼ of the fault. . If collateral source payments were admissible at court and were allowed to be deducted from payment totals, then the state was cited as having enacted collateral source rule reform. Descriptions of the specific reforms can be found on the following page, and maps showing what policies were in place in which state from 1990-2010 in 5 year intervals can be found in the **Appendix** section.

We also obtained time-series malpractice premium data from the Annual Rate Surveys conducted from 1991-2012 by the Medical Liability Monitor (MLM). This source provides premium rates for various regions of states across the country and provides individual premiums for internists, general surgeons, and OB/GYNs. Also, in states with patient compensation funds, the Annual Rate Surveys also provide the additional premium physicians in states with this reform have to pay to the fund. We tabulated averages by state and year for each of the three specialties. The trends in malpractice premiums in the US over time can be found in **Figure 7**. In 2007, average OB/GYN and general surgeon premiums reached peaks of roughly $80,000 and $57,000, respectively, while internist premiums have remained relatively stable since 2004 after nearly doubling in value from 2000-2004.

Also, to determine whether premiums may contribute to practice variation across states, we turned to the Dartmouth Atlas of Health Care (DAHC). Prior to 2003, this source relied on the Continuous Medicare History Sample (CMHS), which comprised 5% of the fee-for-service population, for its estimates. For data from 2003-2007, the estimates reflect 20% of Medicare beneficiaries and draw on actual Medicare claims files. The Dartmouth Atlas of Health Care

provides the magnitude of total Medicare reimbursements for Part A and Part B by state and year and also breaks the total into a variety of services covered. Medicare reimbursements are adjusted to control for regional differences in prices across the US. For our analysis, we focus our attention on spending for overall utilization, medical and surgical services, diagnostic services, and professional and laboratory testing. All of the figures provided were tabulated per Medicare enrollee.

Information on various controls of interest were obtained from the Behavioral Risk Factor Surveillance System (BRFSS) run by the Center for Disease Control (CDC) from 1995-2009. The BRFSS was piloted in 1983 as a telephone survey with the goal of collecting data on behaviors of the general population to better address public health issues in a variety of states. Since that time, it has grown to be the largest telephone survey in the world in 2011 with 500,000 interviews conducted. We turned to the BRFSS to control for characteristics of state populations that may contribute to different healthcare landscapes. Specifically, the data obtained from the survey includes the proportion of the population that smokes, that is obese, that is over 65 years of age, that describes themselves as having 'poor health', and that had a college degree at the time of the survey. Additional controls, including state populations, state uninsurance rates, and state per capita income figures were obtained from the United States Census Bureau.

Summary statistics of each of the variables outlined above can be found in the **Appendix**.

Figure 3

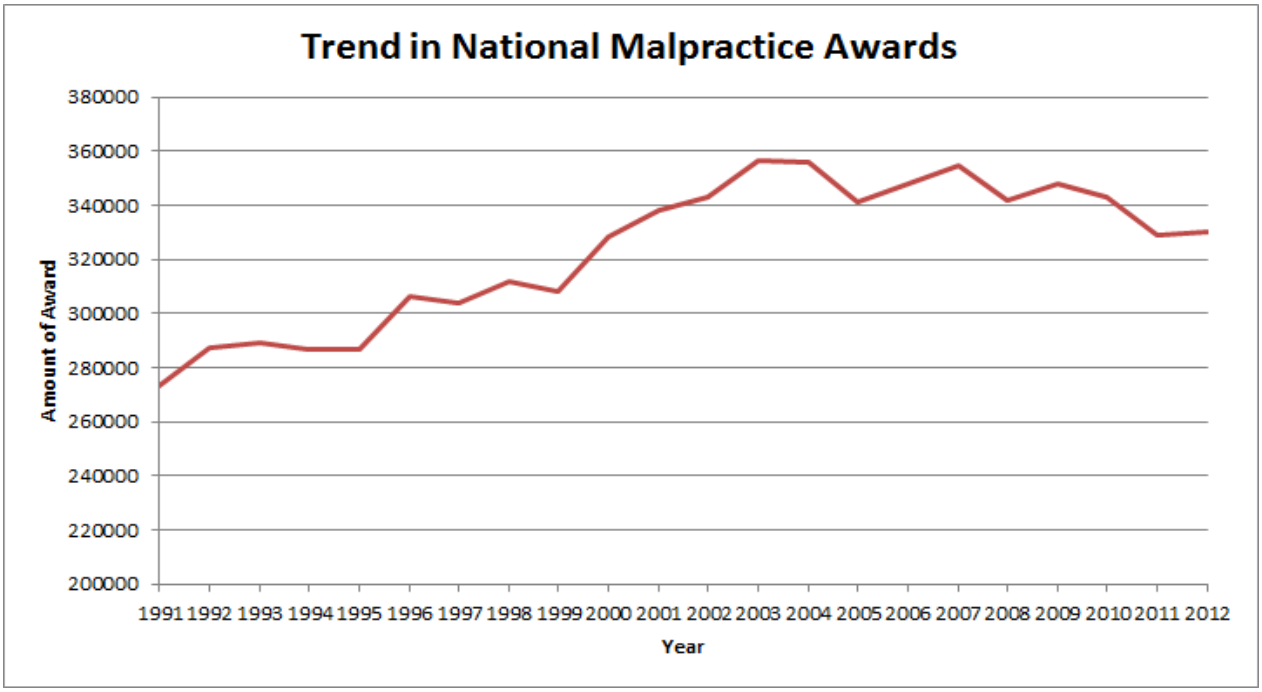


Figure 4

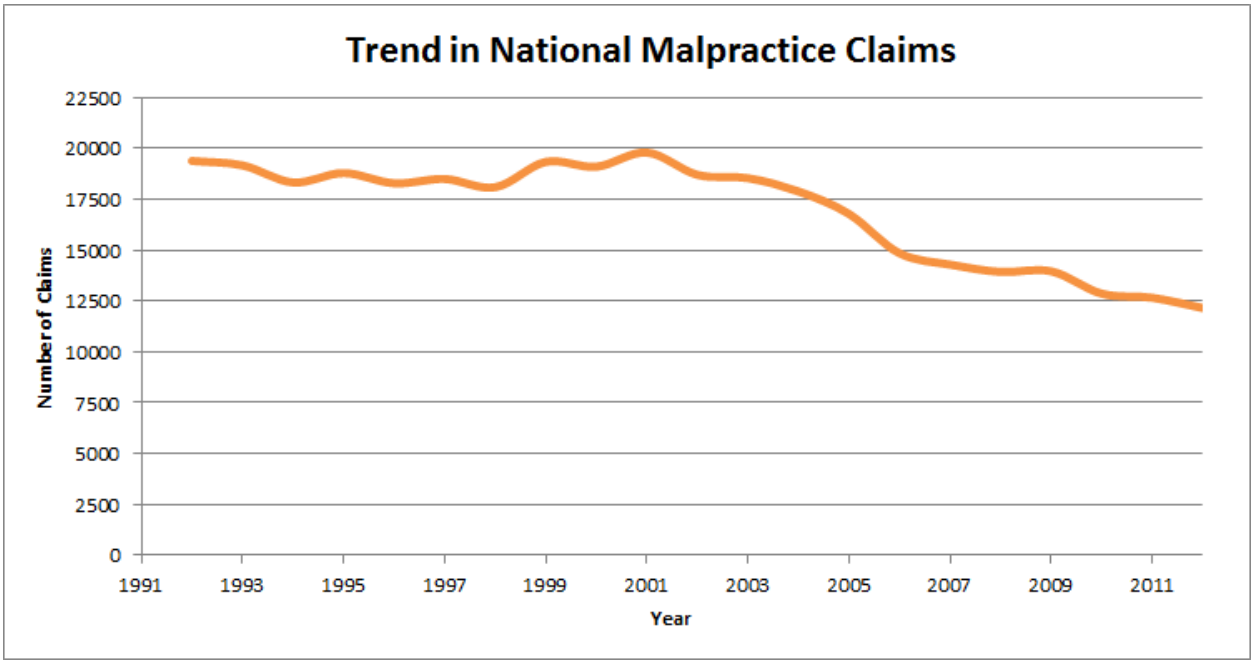


Figure 5

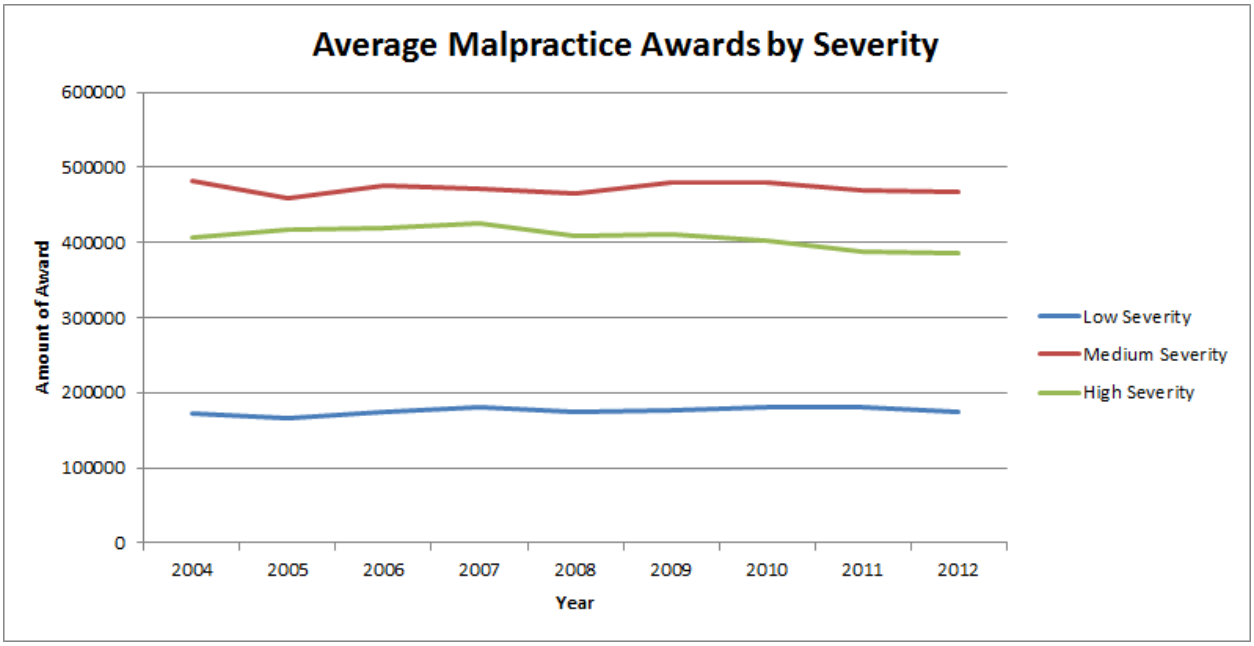


Figure 6

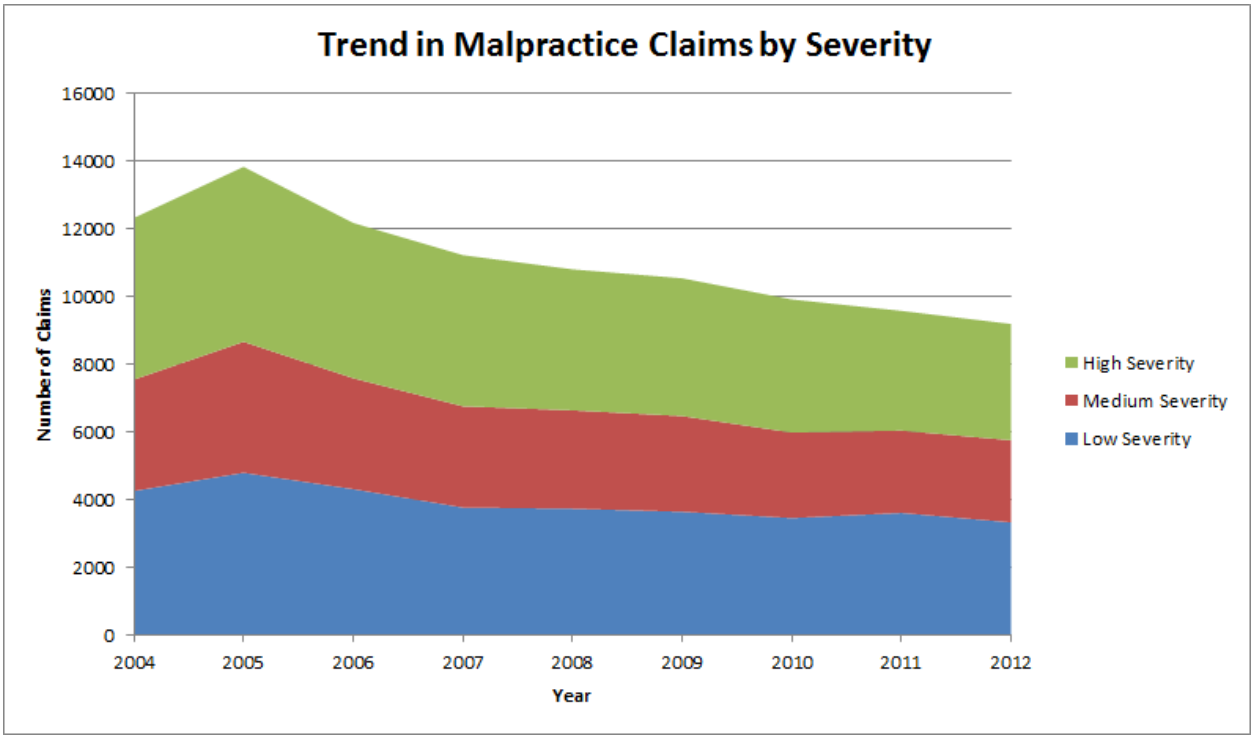
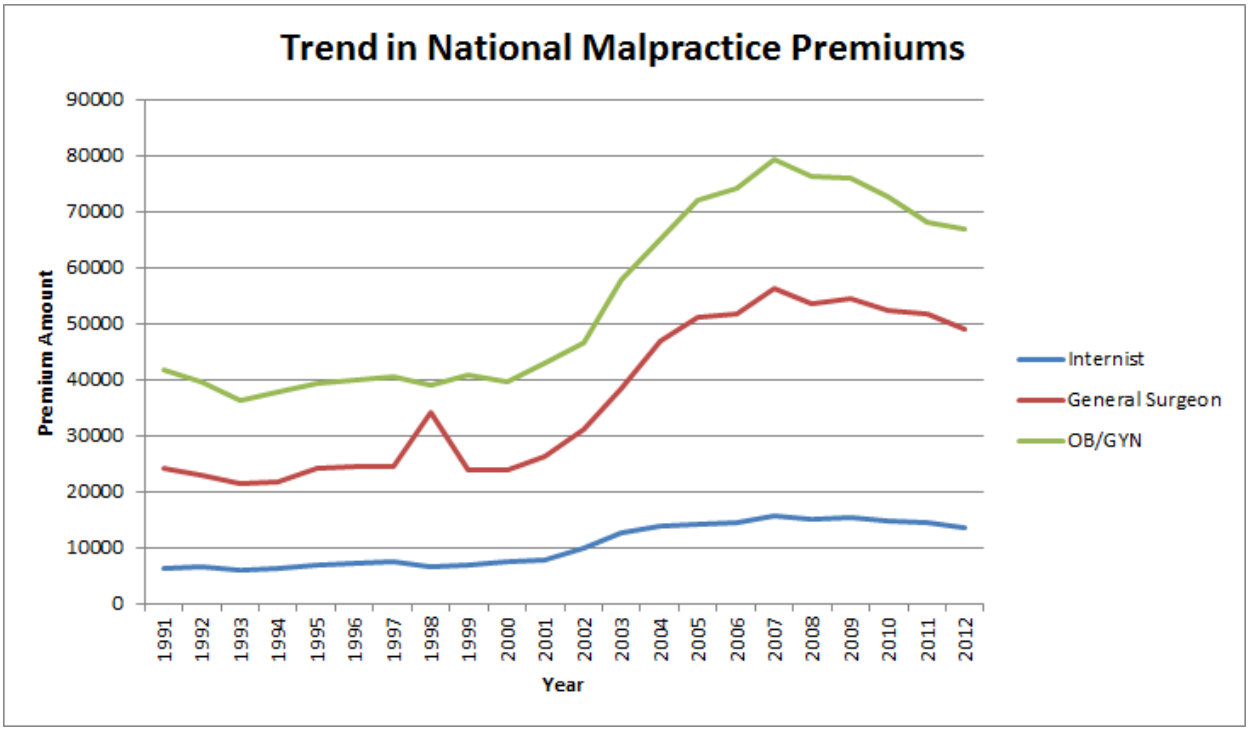


Figure 7


Trend in National Malpractice Premiums
Premium Amount
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Year
Internist
General Surgeon
OB/GYN

Variable Definitions

Injury Severity ***(severity)***	A recorded measure of the severity of an injury. The levels of severity are as follows: 1. Emotional Injury 2. Insignificant Injury 3. Minor Temporary Injury 4. Major Temporary Injury 5. Minor Permanent Injury 6. Significant Permanent Injury 7. Major Permanent Injury 8. Quadriplegic, Brain Damage, Lifelong Care 9. Death
Average Payment ***(avgpayment)*** ***(avgpaymentlow/med/high)***	Indicates the average malpractice award of all claims filed in a state in a particular year (also tabulated for each severity subgroup; ie. **avgpaymentlow** denotes the average payment of low severity claims)
Claims per 100,000 residents ***(claimsper100k)*** ***(claimslow/med/highper100k)***	Denotes the number of claims filed in a particular state and year for every 100,000 residents (also tabulated for each severity subgroup; ie. **claimsper100klow** denotes the number of low severity claims for every 100,000 residents)
Total Spending ***(totalspending)***	Indicates the total amount of Medicare reimbursements per enrollee for all services
Diagnostic Spending ***(diagnosticpspending)***	Indicates the amount of Medicare reimbursements per enrollee for diagnostic services
Lab Spending ***(labspending)***	Indicates the amount of Medicare reimbursements per enrollee for lab services
Medical and Surgical Spending ***(medsurgspending)***	Indicates the amount of Medicare reimbursements per enrollee for medical and surgical services

Per Capita Income per 1000 residents ***(percapitaincomeper1000)***	Denotes the per capita income of each state, adjusted for inflation with 2013 as the base year.
Uninsured ***(uninsured)***	Denotes the proportion of the state population that does not have health insurance
Tobacco Use ***(smoking)***	Indicates the proportion of a state's population that regularly uses tobacco
Proportion obese ***(obesity)***	Indicates the proportion of a state's population that is obese (ie. BMI > 30)
Low Income Population ***(below15k)***	Indicates the proportion of a state's population whose income falls below $15,000
Population in Poor Health ***(poorhealth)***	Denotes the proportion of a state's population that describes themselves as having poor health
Population over 65 ***(percentover65)***	Denotes the proportion of a state's population whose age falls above 65 years
Bachelor ***(bachelor)***	Denotes the proportion of a state's population that obtained a degree from a 4-year college
Internal Medicine Premium ***(impremium)***	Indicates the average premium for an internist in a particular state and year
General Surgeon Premium ***(gspremium)***	Indicates the average premium for a general surgeon in a particular state and year
OB/GYN Premium ***(obgynpremium)***	Indicates the average premium for an obstetrician and gynecologist in a particular state and year
Physicians per capita ***(physiciansper100k)***	Denotes the number of physicians per 100,000 residents in a particular state and year
State ***(state)***	Indicates the state the observation/average was reported for
Year ***(year)***	Indicates the year that the observation/average was reported for

Description of Tort Reforms

Cap on Noneconomic and Total Damages *(necap, totalcap)*	Places a limit on the amount of noneconomic or total damages that the defendant can be held liable for
Regulation of Attorney (contingent) Fees *(attorneycap)*	Places a limit that the plaintiff's attorney may receive on a sliding scale based on payment award
Collateral Source Rule Reform *(csrule)*	Collateral source rules do not allow evidence that shows that the plaintiff's losses have been paid by other sources; reform allows collateral source payments to be admissible at court and be deducted from the total award
Elimination or modification of Joint and Several Liability *(jsl)*	Without reform, defendants that share a small portion of the responsibility may be held liable for the entire award if the other named defendants are insolvent; with reform, the plaintiff may seek out damages from the defendants only in proportion to the defendants' respective contributions; modification entails that defendants that are less than 50% responsible for the damages can not be held liable for the total payment award.
Screening Panels *(screenpanel, screenevidence)*	Establishes bodies of physician reviewers that examine evidence from a malpractice claim and estimate the liability of the defendant; *may* suggest appropriate damages; these opinions *may be* admissible at trials
Periodic Payments *(periodic)*	Award is paid out over many years rather than in a lump-sum; attempts to prevent physician practices that may go under if faced with one year lump-sum payment
Patient Compensation Funds *(pcf)*	Aim to offer hospitals and physicians affordable coverage if faced with insurance premium volatility while providing fair compensation for patients

Empirical Framework and Results

Aim 1: Evaluating the effectiveness of reforms in lowering average malpractice awards and frequency of malpractice claims across different policy landscapes

Many of the policies evaluated are thought to be good tools through which to decrease the number of claims as well as lower malpractice payments. Generally, each of these reforms aim at lowering the return on litigation for both the plaintiff and attorney involved. The cap on non-economic damages and total damages lowers the aggregate payment that the plaintiff can win from the case, which concurrently lowers the return for the attorney and plaintiff as generally they receive a portion of the aggregate award payment. Similarly, regulating the contingency fees lowers the expected return that an attorney might have otherwise made by pursuing litigation for a plaintiff if the fee that would have been charged is greater than what policy allows. Modification of collateral source rules allow the defendants' lawyers to argue that part of the award payment can be obtained from other entities (such as health insurance or workers' compensation) and subsequently that collateral source payments should be deducted from the award total. Also, joint-and-several liability is thought to contribute to higher payment totals, as this implies that each defendant involved in the case may be liable for the entire award payment, regardless of the proportion of the fault that lies with them. Thus, abolishment of joint-and-several liability (or modification of the rule that allows it to only be applicable for defendants who are more than 50% at fault) may also lower payment totals and decrease the propensity to pursue litigation.

Screening panels aim to provide medical knowledge in cases where the jury might not be as informed to determine what the appropriate award is for the tort in question. Payments that are determined in court tend to be higher than those that stem from arbitration, and so screening

panels may have utility in bridging the gap between these disparities. Also, they are thought to be useful as they can drop suits that have very little stake to the payment in question. Given that they are likely to decrease the likelihood of petty claims or cases that would likely result in low payment awards, we hypothesized that screening panels would decrease the number of claims while raising the average payments in each state (as smaller cases would likely be screened out of the process). Also, it's important to note that in only 11 of the 16 states that have instituted screening panel allow findings from the panel to be discussed at court cases.[24.26] As this allows recommendations regarding the amount of the award, we expected that states that allowed findings of the panel to be admissible would have lower average payment awards.

Finally, patient compensation funds and periodic payments aim at stabilizing malpractice insurance markets and lowering the likelihood of physician bankruptcies from malpractice cases, respectively. Thus, we did not expect either to have a significant effect on average payments or claims.

Our two models can be found below. It includes the reforms discussed above as well as a variety of behavioral controls. Note that each observation recorded is an average of the malpractice award totals or number of claims filed in a particular state *s* at some time *t*.

$$\text{Log}(\text{Payment}_{st}) = \beta_0 + \beta_1(\text{Cap on NE Damages}_{st}) + \beta_2(\text{Cap on Total Damages}_{st}) + \beta_3(\text{Collateral Source Reform}_{st}) + \beta_4(\text{Liability Reform}_{st}) + \beta_5(\text{AttorneyCap}_{st}) + \beta_6(\text{Screening Panels}_{st}) + \beta_7(\text{ScreeningEvidence}_{st}) + \beta_8\text{Periodic}_{st} + \beta_9\text{PCF}_{st} + \beta_{10}\text{PerCapitaIncome}_{st} + \beta_{11}\text{Uninsured}_{st} + \beta_{12}\text{Smoking}_{st} + \beta_{13}\text{Obesity}_{st} + \beta_{14}\text{PoorHealth}_{st} + \beta_{15}\text{Above65yrs}_{st} + \beta_{16}\text{Below15,000}_{st} + \beta_{17}\text{BachelorDegree}_{st} + \beta_{18}\text{InjurySeverity}_{st} + \alpha_s + \varepsilon_t + u_{st}$$

$$\text{Claimsper100k}_{st} = \beta_0 + \beta_1 (\text{Cap on NE Damages}_{st}) + \beta_2 (\text{Cap on Total Damages}_{st}) + \beta_3 (\text{Collateral Source Reform}_{st}) + \beta_4 (\text{Liability Reform}_{st}) + \beta_5 (\text{AttorneyCap}_{st}) + \beta_6 (\text{Screening Panels}_{st}) + \beta_7 (\text{ScreeningEvidence}_{st}) + \beta_8 \text{Periodic}_{st} + \beta_9 \text{PCF}_{st} + \beta_{10} \text{PerCapitaIncome}_{st} + \beta_{11} \text{Uninsured}_{st} + \beta_{12} \text{Smoking}_{st} + \beta_{13} \text{Obesity}_{st} + \beta_{14} \text{PoorHealth}_{st} + \beta_{15} \text{Above65yrs}_{st} + \beta_{16} \text{Below15,000}_{st} + \beta_{17} \text{BachelorDegree}_{st} + \alpha_s + \varepsilon_t + u_{st}$$

These models were tested using Ordinary Least Squares (OLS) regressions first without state or fixed effects, which we proceeded to include in later specifications of the two models above to reduce the chance that any findings were driven by omitted variable bias. However, it is important to note that for state fixed effects we expected the estimators to be inconsistent. Given that tort reform policies are 'sticky' (ie. once they are in effect and found to be constitutional in courts, they are quite likely to stay in place for a long period of time), there is not much heterogeneity *within* states with regards to malpractice reform. We did expect time fixed effects to be a better estimator given that there is more heterogeneity between states *within* years than in the former case (refer to maps of reforms in **Appendix**). Therefore, we will focus our attention on findings controlling for fixed time effects but not for fixed state effects specifications. The results regarding award payments and frequency of claims can be found in **Table 1 and 2** below, respectively.

With regards to average malpractice awards, caps on non-economic damages were found to be significant at the 1% level for all specifications of the model and ranged from a 15.8% (2) to an 18% (3) reduction in average payments. The results for caps on total damages were also

consistent; when controlling for average injury severity and time fixed effects, the reform was found to reduce average payments by 20%. In all specifications of the model, the introduction of patient compensation funds resulted in lower payment totals, ranging from a 5.65% to 12% decrease significant at the 1% level (disregarding state fixed effects specifications). Interestingly, modification of the collateral source rule was observed to raise malpractice award averages by 16.8 % (4) (significant at the 1% level). Also inconsistent with our hypothesis was the finding that states that allowed findings from screening panels to be admissible at courts in fact had average awards rise by 11.1% (4). It may be that, contrary to our deductions, that juries often under-estimate the additional costs to be incurred by the plaintiff after the injury that physicians may be more familiar with. Also, we were surprised to find states with screening panels (but that do not allow findings from the panel to be admissible) had their average payments decrease by 7.98% (4). Regulation of contingency fees were found to be statistically insignificant in all specifications not including state fixed effects. Similarly, after controlling for severity of claims as well as time fixed effects, periodic payments and modification of joint and several liability were also insignificant.

In studying the effects of reforms on the number of claims per 100,000 residents, the state fixed effects model once again seemed to be less reliable than the time fixed effects model. Thus, we focused our analysis on specification (2). For context, note that the average number of claims across the US during the time period studied was roughly 5.5 malpractice claims per 100,000 residents. Caps on non-economic damages were found to reduce the number of claims per 100,000 people by 0.380, and caps on total damages resulted in an ever greater reduction of 0.898 (both significant at the 1% level). Again, the results of screening panels were not consistent with our predictions; in all specifications the reform had positive coefficients.

However, states that allowed findings of the panel to be admissible were found to have 0.25 lower claims per 100,000, though the absolute value of this coefficient is smaller than that of the screening panel dummy, suggesting that on the whole the policy is associated with higher claims per capita. Similarly, both periodic payments as well as patient compensation funds resulted in very high positive coefficients (0.948 and 1.895, respectively) that both had p-values less than .01. Modification of the collateral source rule proved to be effective in achieving the goals of tort reform, as its passage was associated with a 0.673 reduction in claims per 100,000 residents. Finally, modification or elimination of joint and several liability was associated with increasing the frequency of claims in each specification.

Table 1

VARIABLES	(1) Avg Payment	(2) Avg Payment	(3) Avg Payment	(4) Avg Payment
Reforms				
Noneconomic Damage Caps	-0.176***	-0.158***	-0.180***	-0.166***
	(0.0249)	(0.0310)	(0.0245)	(0.0302)
Total Damages Cap	-0.235***	-0.130***	-0.275***	-0.200***
	(0.0337)	(0.0440)	(0.0343)	(0.0443)
Collateral Source Rule Reform	0.123***	0.141***	0.129***	0.168***
	(0.0239)	(0.0359)	(0.0240)	(0.0360)
Joint-and-Several Liability Reform	0.00871	0.0326	0.00195	0.0493
	(0.0223)	(0.0341)	(0.0222)	(0.0350)
Regulation of Attorney Fees	-0.0472*	0.0180	-0.0319	0.0246
	(0.0271)	(0.0392)	(0.0264)	(0.0383)
Screening Panels	0.0272	-0.0341	-0.00660	-0.0798
	(0.0338)	(0.0497)	(0.0344)	(0.0507)
Panels' Findings Admissible	-0.0229	0.0684	0.0116	0.110*
	(0.0399)	(0.0650)	(0.0407)	(0.0656)
Periodic Payments	-0.0732***	-0.0169	-0.0701***	-0.0129
	(0.0227)	(0.0316)	(0.0223)	(0.0309)
Patient Compensation Funds	-0.0881***	-0.183***	-0.0565**	-0.120***
	(0.0273)	(0.0421)	(0.0275)	(0.0424)
Controls				
Per Capita Income	0.0163***	0.0153***	0.00759**	0.00312
	(0.00279)	(0.00316)	(0.00357)	(0.00427)
Proportion Uninsured	-0.00230	-0.00952*	-0.00598*	-0.0138***
	(0.00331)	(0.00490)	(0.00343)	(0.00489)
Proportion Tobacco Users	0.0142***	0.00827	0.0245***	0.0245***
	(0.00423)	(0.00607)	(0.00470)	(0.00610)
Proportion Obese	-0.00374	-0.0189***	-0.0231***	-0.0338***
	(0.00279)	(0.00620)	(0.00573)	(0.00831)
Proportion in 'Poor Health'	0.0114**	0.0133	0.0188***	0.0239**
	(0.00545)	(0.00941)	(0.00586)	(0.00962)
Proportion over 65 years of age	0.000923	0.00275	-0.00735	-0.0147*
	(0.00536)	(0.00844)	(0.00569)	(0.00828)
Proportion with Income Below $15,000	-0.00223	-0.00626	-0.00292	-0.0123
	(0.00483)	(0.00809)	(0.00502)	(0.00803)
Proportion with Bachelor's Degree	0.0161***	0.00860*	0.0232***	0.0257***
	(0.00354)	(0.00462)	(0.00495)	(0.00702)
Injury Severity		0.183***		0.200***
		(0.0313)		(0.0321)
Time Fixed Effects?	No	No	Yes	Yes
Constant	11.27***	10.91***	11.83***	11.31***
	(0.214)	(0.324)	(0.290)	(0.360)
Observations	897	449	897	449
R-squared	0.348	0.430	0.373	0.470

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2

VARIABLES	(1) Claims Per Capita	(2) Claims Per Capita
Reforms		
Noneconomic Damages Cap	-0.456***	-0.380***
	(0.136)	(0.135)
Total Damages Cap	-1.183***	-0.898***
	(0.202)	(0.205)
Collateral Source Rule Reform	-0.687***	-0.673***
	(0.172)	(0.172)
Joint-and-Several Liability	0.252	0.322**
	(0.157)	(0.157)
Regulation of Contingency Fees	-0.145	-0.234
	(0.171)	(0.164)
Malpractice Screening Panels	0.428**	0.595***
	(0.214)	(0.223)
Panels' Finding Admissible	-0.0975	-0.250
	(0.245)	(0.249)
Periodic Payments	0.954***	0.948***
	(0.152)	(0.150)
Patient Compensation Funds	2.073***	1.895***
	(0.233)	(0.235)
Controls		
Per Capita Income	0.0604***	0.116***
	(0.0176)	(0.0222)
Proportion Uninsured	-0.0203	0.0151
	(0.0248)	(0.0252)
Proportion Tobacco Users	0.141***	0.0100
	(0.0290)	(0.0307)
Proportion Obesity	-0.197***	-0.0305
	(0.0171)	(0.0340)
Proportion in 'Poor Health'	0.142***	0.149***
	(0.0387)	(0.0418)
Proportion over 65 years old	0.0915**	0.156***
	(0.0439)	(0.0438)
Proportion with Income below $15,000	0.0791**	0.0538
	(0.0335)	(0.0341)
Proportion with Bachelor's Degree	0.107***	0.0712**
	(0.0218)	(0.0322)
Time Fixed Effects?	No	Yes
Constant	-3.692**	-9.040***
	(1.705)	(2.057)
Observations	897	897
R-squared	0.341	0.394
Robust standard errors in parenthese		
*** p<0.01, ** p<0.05, * p<0.1		

As discussed earlier, we were also interested in examining whether the effectiveness of reform policies are dependent on the injury severity of the claim. Thus, we proceeded to examine the effects of these reforms on average payments and frequency of claims for low, medium, and high severity cases. The results for payments and number of claims can be found in **Table 3** and **Table 4**, respectively.

We narrowed our analysis to specifications (4), (5), and (6), which control for time fixed effects as well as average severity of claims within each subgroup. We predicted that caps on non-economic and total damages would reduce payments for higher severity claims by a larger amount than those of low severity (given that the cap was more likely to apply in more severe cases). Consistent with this hypothesis, caps on non-economic damages reduced average payments for low, medium, and high severity cases by 4.6%, 13.6%, and 17.7%, respectively (all being significant at the 1% level). Interestingly, though, caps on total damages were found to be more effective in lowering award amounts for medium severity cases (21.9%), while the results for the low (10.6%) and high (12%) were quite similar. However, upon observing average payments categorized by injury severity, this in fact makes sense given that average payments for medium severity cases are higher than high severity cases (refer back to **Figure 4**). Patient compensation funds had the same differential effect as caps on noneconomic damages as it lower payments for low, medium, and high severity cases in an increasing manner (2%, 12%, and 15%, respectively). After breaking down claims by severity, we find that modification of the collateral source rule is associated with dramatic increases of nearly 20% in average payments for medium and high severity cases. Coefficients for modification of joint and several liability, regulation of contingency fees, screening panels and the admissibility of their findings, and periodic payments were all found to be insignificant at the 5% level.

With regards to the frequency of claims broken down by severity, we again turn our attention to the time fixed effects regressions (specifications (4), (5), and (6)). Note that the national averages of malpractice claims for low, medium, and high severity cases are 1.08, .81, and 1.07 cases per 100,000 residents (this does not add up to the total average of 5.5 previously cited given that not all cases in the NPDB were assigned an injury severity classification). Non-economic damage caps did not significantly affect the frequency of low or high severity claims, though the reform was found to decrease claims of medium severity by 0.155 per 100,000 residents (a statistically significant measure at the 1% level). Though total damage caps were found to reduce the frequency of low severity malpractice cases per capita by 0.255, this result was not significant. Collateral source rule reform did not have a significant effect on the number of low or medium severity cases, but the policy did decrease high severity claims per capita by .113 (with a p-value of less than .01). As was the case earlier, we once again found that screening panels had significant effects in raising rather than lowering the frequency of medium and high severity claims by .245 and .235 per 100,000 residents, respectively (significant at 1% level). As was predicted, states that allowed the screening panel's findings to be admissible at trial had the frequency of claims per 100,000 residents decrease by .117 and .178 for claims involving medium and high severity injuries. However, this suggests that malpractice screening panels are ineffective in reducing claims given that the positive coefficients for panels are larger in value than the states that allow such findings to be admissible. Interestingly, periodic payments were found to significantly raise the number of claims per capita for all severity subgroups, while modification or elimination of the joint-and-several liability rule also had positive coefficients for claims involving a 'low' or 'medium' severity injury. As before, regulation of contingency fees did not have significant effects on the frequency of any subgroup of claims.

Table 3

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	avgpaymentlow	avgpaymentmed	avgpaymenthigh	avgpaymentlow	avgpaymentmed	avgpaymenthigh
Reforms						
Noneconomic Damages Cap	-0.0381	-0.132***	-0.169***	-0.0460	-0.136***	-0.177***
	(0.0416)	(0.0393)	(0.0356)	(0.0415)	(0.0386)	(0.0357)
Total Damages Cap	-0.0476	-0.154***	-0.0638	-0.106*	-0.219***	-0.120**
	(0.0578)	(0.0566)	(0.0530)	(0.0614)	(0.0577)	(0.0540)
Collateral Source Rule Reform	-0.00397	0.183***	0.164***	0.0285	0.198***	0.188***
	(0.0565)	(0.0577)	(0.0425)	(0.0578)	(0.0590)	(0.0436)
Joint-and-Several Liablity Reform	-0.0393	0.0790	-0.0345	-0.0115	0.0855*	-0.0183
	(0.0410)	(0.0491)	(0.0359)	(0.0428)	(0.0503)	(0.0370)
Regulation of Contingency Fees	0.0400	0.0314	-0.0377	0.0554	0.0383	-0.0296
	(0.0564)	(0.0509)	(0.0464)	(0.0566)	(0.0500)	(0.0463)
Malpractice Screening Panels	0.0407	-0.0540	0.0564	-0.00256	-0.0959*	0.0213
	(0.0554)	(0.0556)	(0.0516)	(0.0573)	(0.0567)	(0.0528)
Panels' Findings Admissible	-0.0216	0.0709	-0.106	0.0120	0.112	-0.0785
	(0.0769)	(0.0839)	(0.0706)	(0.0788)	(0.0829)	(0.0725)
Periodic Payments	0.0346	-0.0547	-0.0381	0.0394	-0.0499	-0.0355
	(0.0394)	(0.0422)	(0.0368)	(0.0390)	(0.0423)	(0.0370)
Patient Compensation Funds	-0.0783	-0.178***	-0.204***	-0.0206	-0.120**	-0.150***
	(0.0557)	(0.0471)	(0.0473)	(0.0566)	(0.0503)	(0.0479)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	avgpaymentlow	avgpaymentmed	avgpaymenthigh	avgpaymentlow	avgpaymentmed	avgpaymenthigh
ntrols						
Per Capita Income	0.0153***	0.0160***	0.0151***	0.00236	0.00517	0.00434
	(0.00442)	(0.00418)	(0.00390)	(0.00582)	(0.00562)	(0.00514)
Proportion Uninsured	-0.00772	-0.00268	-0.0179***	-0.00844	-0.00756	-0.0204***
	(0.00753)	(0.00722)	(0.00561)	(0.00740)	(0.00760)	(0.00574)
Proportion Tobacco Users	0.0111	0.0131	-0.00131	0.0212**	0.0306***	0.0106
	(0.00863)	(0.00877)	(0.00788)	(0.00978)	(0.00881)	(0.00863)
Proportion Obese	-0.0114	-0.0131	-0.0158**	-0.0151	-0.0311**	-0.0237**
	(0.00778)	(0.00847)	(0.00744)	(0.0116)	(0.0123)	(0.0104)
Proportion in 'Poor Health'	0.0476***	0.00329	0.0419***	0.0597***	0.0123	0.0510***
	(0.0158)	(0.0143)	(0.0124)	(0.0164)	(0.0147)	(0.0126)
Proportion over 65 years of age	0.0271**	-0.0149	0.00116	0.0159	-0.0317***	-0.0115
	(0.0121)	(0.0117)	(0.0118)	(0.0123)	(0.0121)	(0.0126)
Proportion with Income Below $15,000	-0.0143	0.00268	-0.0169*	-0.0250**	-0.00154	-0.0226**
	(0.0111)	(0.0111)	(0.00946)	(0.0110)	(0.0119)	(0.00955)
Proportion with Bachelor's Degree	0.0187**	0.0124*	0.0102*	0.0400***	0.0259***	0.0268***
	(0.00725)	(0.00650)	(0.00531)	(0.0101)	(0.00902)	(0.00792)
Average Severity (Low Severity Claims)	0.301***			0.302***		
	(0.0852)			(0.0840)		
Average Severity (Medium Severity Claims)		0.779***			0.776***	
		(0.180)			(0.180)	
Average Severity (High Severity Claims)			-1.233***			-1.235***
			(0.236)			(0.254)
Time Fixed Effects?	No	No	No	Yes	Yes	Yes
Constant	8.667***	7.236***	23.11***	8.433***	7.849***	23.38***
	(0.604)	(1.320)	(2.144)	(0.690)	(1.406)	(2.362)
Observations	448	449	447	448	449	447
R-squared	0.251	0.330	0.427	0.283	0.359	0.446
Robust standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

Table 4

VARIABLES	(1) Low Severity Claims	(2) Medium Severity Claims	(3) High Severity Claims	(4) Low Severity Claims	(5) Medium Severity Claims	(6) High Severity Claims
Reform						
Noneconomic Damages Cap	-0.0437	-0.158***	-0.0653	-0.0450	-0.155***	-0.0567
	(0.0734)	(0.0390)	(0.0543)	(0.0703)	(0.0367)	(0.0515)
Total Damages Cap	-0.269	-0.0511	-0.170**	-0.255	0.0382	-0.0391
	(0.198)	(0.0697)	(0.0816)	(0.285)	(0.0698)	(0.0823)
Collateral Source Rule Reform	0.0640	-0.0440	-0.101*	0.0749	-0.0461	-0.113**
	(0.0729)	(0.0481)	(0.0582)	(0.0871)	(0.0459)	(0.0556)
Joint-and-Several Liability Reform	0.172**	0.128**	0.0218	0.197***	0.138***	0.0309
	(0.0795)	(0.0495)	(0.0631)	(0.0761)	(0.0496)	(0.0630)
Regulation of Attorney Fees	0.180	-0.0339	-0.107	0.190	-0.0388	-0.114
	(0.170)	(0.0610)	(0.0713)	(0.189)	(0.0582)	(0.0693)
Malpractice Screening Panels	0.105	0.193***	0.161**	0.0899	0.245***	0.235***
	(0.173)	(0.0727)	(0.0788)	(0.122)	(0.0700)	(0.0770)
Panels' Findings Admissible	0.166	-0.0519	-0.0925	0.173	-0.117	-0.178**
	(0.128)	(0.0804)	(0.0898)	(0.128)	(0.0768)	(0.0873)
Periodic Payments	0.165**	0.205***	0.152**	0.176**	0.204***	0.152**
	(0.0718)	(0.0426)	(0.0611)	(0.0758)	(0.0418)	(0.0602)
Patient Compensation Funds	0.600***	0.416***	0.602***	0.600***	0.345***	0.496***
	(0.144)	(0.0681)	(0.0965)	(0.212)	(0.0692)	(0.0997)
Per Capita Income	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	(0.00620)	(0.00423)	(0.00523)	(0.0190)	(0.00562)	(0.00635)
Proportion Uninsured	0.0129	-0.0158**	-0.00504	0.0147	-0.00736	0.00592
	(0.0350)	(0.00773)	(0.0107)	(0.0309)	(0.00723)	(0.0103)
Proportion Tobacco Users	0.0134	0.0305***	0.0449***	0.000743	0.000765	0.00396
	(0.0117)	(0.00847)	(0.0103)	(0.0285)	(0.00958)	(0.0108)
Proportion Obese	-0.0824**	-0.0409***	-0.0373***	-0.0684	-0.00197	0.0136
	(0.0346)	(0.00806)	(0.00990)	(0.0553)	(0.0100)	(0.0117)
Proportion in 'Poor Health'	0.109**	0.0379***	0.0883***	0.120**	0.0316**	0.0786***
	(0.0427)	(0.0141)	(0.0174)	(0.0585)	(0.0142)	(0.0172)
Proportion over 65 years old	0.0141	0.0220*	0.0342**	0.0230	0.0464***	0.0691***
	(0.0177)	(0.0116)	(0.0136)	(0.0233)	(0.0129)	(0.0138)
Proportion with Income Below $15,000	-0.0198	0.0282**	0.00581	-0.0345	0.0245*	0.00217
	(0.0517)	(0.0119)	(0.0141)	(0.0621)	(0.0129)	(0.0145)
Proportion with Bachelor's Degree	0.0120	0.0407***	0.0545***	0.0202	0.0310***	0.0368***
	(0.0241)	(0.00554)	(0.00706)	(0.0155)	(0.00809)	(0.00926)
Time Fixed Effects?	No	No	No	Yes	Yes	Yes
Constant	0.0715	-1.387***	-2.622***	-0.668	-2.673***	-4.310***
	(0.974)	(0.507)	(0.634)	(1.381)	(0.544)	(0.685)
Observations	449	449	449	449	449	449
R-squared	0.122	0.356	0.369	0.145	0.427	0.437
Robust standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

Aim 2: Determining whether tort reform, average malpractice awards, and frequency of claims affect state malpractice insurance premiums

For the next step in our analysis, we proceeded to determine whether states with higher malpractice activity (ie. higher average malpractice payments and number of claims per 100,000 residents) had higher malpractice premiums for internists, general surgeons, or OB/GYNs. We were also interested in evaluating whether tort reform policies have had a significant effect on lowering premiums (as higher premiums are generally thought to lead to more deviations from an ideal amount of care under the PID hypothesis). We consider the following regression below for the three premium categories:

$$\text{Log(Premium)}_{st} = \beta_0 + \beta_1 (\text{Cap on NE Damages}_{st}) + \beta_2 (\text{Cap on Total Damages}_{st}) + \beta_3 (\text{Collateral Source Reform}_{st}) + \beta_4 (\text{Liability Reform}_{st}) + \beta_5 (\text{AttorneyCap}_{st}) + \beta_6 (\text{Screening Panels}_{st}) + \beta_7 (\text{ScreeningEvidence}_{st}) + \beta_8 \text{Periodic}_{st} + \beta_9 \text{PCF}_{st} + \beta_{10} \text{PerCapitaIncome}_{st} + \beta_{11} \text{Uninsured}_{st} + \beta_{12} \text{Smoking}_{st} + \beta_{13} \text{Obesity}_{st} + \beta_{14} \text{PoorHealth}_{st} + \beta_{15} \text{Above65yrs}_{st} + \beta_{16} \text{Below15,000}_{st} + \beta_{17} \text{BachelorDegree}_{st} + \alpha_s + \varepsilon_t + u_{st}$$

As before, this was done using OLS regressions and proceeding in later specifications to include both time and state fixed effects. As before, we do not have much confidence in the findings of the state fixed effects specification given the stickiness of the policies as described earlier, and thus will not be addressing them in our interpretations of our model. Our findings

regarding the evaluations of tort reforms found in **Table 5**, and specifications also involving average payments and frequency of claims are displayed in **Table 6**.

When first studying the effects of reforms on malpractice premiums, we were surprised to find that caps on total damages and caps on non-economic damages had drastically different effects in time fixed effects models (specifications (4) - (6)). Though total damage caps were found to reduce premiums by 38%, 35%, and 45% (all significant at the 1% level) for internists, surgeons, and OB/GYNs, respectively, institution of caps on noneconomic damages resulted in rises in premiums by 20%, 11%, and 9% for the three specialties listed before. We hypothesized that total damage caps were likely to reduce premiums by a greater amount that caps on non-economic damages given that non-economic damages only comprise one part of the final award, but we do not have an adequate explanation for why caps on noneconomic damages were associated with higher malpractice premiums. In addition to total damage caps, modification or elimination of joint-and-several-liability was found to significantly lower internist premiums by roughly 18% for internists and 16% for both surgeons and OB/GYNs. As this reform keeps physicians from being held liable for the actions of other insolvent defendants, it makes sense this would lower the risk involved for insuring physicians. Given that patient compensation funds have surcharges on top of the malpractice insurance premium purchased by physicians, we were not surprised to find that patient compensation funds raised premiums ranging from 12 to 15% dependent on specialty. Reform of the collateral source rule was observed to significantly raise internist premiums by 7.7%, though similar effects were not noted surgeons' or OB/GYNs' premiums. States that enacted malpractice screening panels had 16.6% and 17.4% higher premiums for surgeons and OB/GYNs, though in states that allowed such findings to be admissible at court, this increase is washed out for surgeons but not for OB/GYNs. Finally,

implementation of contingency fee regulations did not have any significant effects on premiums.

Next, we proceeded to include malpractice payment totals as well as the number of claims per 100,000 residents in the model. As expected, average malpractice award and frequency of claims were positively correlated with insurance premiums for all three specialties. For every $10,000 increase in average malpractice payments, our model predicts increases of 0.37%, 0.43%, and 0.42% in premiums for internist, general surgeons, and OB/GYNs, respectively. Similarly, if the frequency of claims per 100,000 was to increase by 1 case, then this would result an 8.9% in premiums for internists and roughly 10% for both surgeons as well as OB/GYNs. Of all the reform variables, caps on total damages were found to have the most significant effect in slowing the growth of premiums for all specialties, leading to a 28%, 23%, and 33.6% decline in premiums for internists, surgeons, and OB/GYNs, respectively. Similarly, modification or elimination of joint-and-several liability also stymied rising premiums with a roughly 20% reduction for all three specialties. After including average payments and the frequency of claims, patient compensation funds were found to lower rather than increase premiums as in the last specification by roughly 3 to 5 percent across the board, though none of the coefficients were found to be significant. Once again, caps on noneconomic damages were found to have quite dissimilar results to total damage caps; the reform was associated with a 25.3% increase in internist premiums and roughly 15% for surgeons and OB/GYNs (all significant at the 1% level). Again, the authors are unable to provide a reason for why this would be the case. Also unexpected was the finding that screening panels led to a 10% jump in both surgeon and OB/GYN premiums, though given the results in the past aim this is likely due to the reform not achieving its goal of reducing the frequency of malpractice claims. However, states that allowed the panel's findings to be presented to juries did significantly reduce general

surgeon premiums by 15%. Though reform of the collateral source rule did have statistically significant effects on average malpractice awards as well as claim frequency, we were surprised to find that it had no significant effect on surgeon or obstetrician premiums and that its implementation increased premiums for internists by nearly 12%. Also, though periodic payments were insignificant for both internist and OB/GYN premiums, passage of this reform was associated with rise of surgeon premiums of roughly 11%. As before, regulation of contingency fees did not significantly affect premiums for any specialty.

Table 5

VARIABLES	(1) IM Premiums	(2) GS Premiums	(3) OB/GYN Premiums	(4) IM Premiums	(5) GS Premiums	(6) OB/GYN Premiums
Reforms						
Noneconomic Damages Cap	0.197***	0.110***	0.0960***	0.200***	0.108***	0.0923***
	(0.0362)	(0.0359)	(0.0349)	(0.0351)	(0.0344)	(0.0335)
Total Damages Cap	-0.367***	-0.319***	-0.429***	-0.381***	-0.346***	-0.450***
	(0.0564)	(0.0574)	(0.0531)	(0.0575)	(0.0590)	(0.0539)
Collateral Source Rule Reform	0.100***	0.0212	0.0152	0.0767**	-0.00586	-0.00468
	(0.0365)	(0.0394)	(0.0367)	(0.0355)	(0.0373)	(0.0356)
Joint-and-Several Liability Reform	-0.141***	-0.117***	-0.121***	-0.176***	-0.161***	-0.160***
	(0.0389)	(0.0400)	(0.0385)	(0.0383)	(0.0399)	(0.0381)
Regulation of Attorney Fees	0.0231	-0.0552	-0.0398	0.0382	-0.0394	-0.0343
	(0.0389)	(0.0406)	(0.0367)	(0.0390)	(0.0400)	(0.0373)
Malpractice Screening Panels	0.0766	0.197***	0.195***	0.0508	0.166***	0.174***
	(0.0503)	(0.0498)	(0.0534)	(0.0506)	(0.0492)	(0.0540)
Panels' Findings Admissible	-0.145***	-0.233***	-0.128**	-0.0978*	-0.177***	-0.0844
	(0.0544)	(0.0542)	(0.0536)	(0.0561)	(0.0551)	(0.0550)
Periodic Payments	0.0969***	0.195***	0.141***	0.0958**	0.196***	0.144***
	(0.0375)	(0.0404)	(0.0371)	(0.0373)	(0.0401)	(0.0368)
Patient Compensation Funds	0.117**	0.139***	0.112**	0.119**	0.152***	0.125**
	(0.0516)	(0.0530)	(0.0535)	(0.0544)	(0.0568)	(0.0573)
Controls						
Per Capita Income	0.0398***	0.0363***	0.0361***	0.0365***	0.0314***	0.0338***
	(0.00404)	(0.00421)	(0.00488)	(0.00522)	(0.00517)	(0.00617)
Proportion Uninsured	0.0526***	0.0419***	0.0347***	0.0481***	0.0339***	0.0265***
	(0.00530)	(0.00583)	(0.00538)	(0.00560)	(0.00572)	(0.00565)
Proportion Tobacco Users	0.0192***	0.00578	0.00861	0.0309***	0.0231***	0.0225***
	(0.00638)	(0.00699)	(0.00676)	(0.00698)	(0.00769)	(0.00749)
Proportion Obese	0.0272***	0.0241***	0.0123***	-0.00929	-0.0236***	-0.0287***
	(0.00444)	(0.00458)	(0.00414)	(0.00845)	(0.00833)	(0.00811)
Proportion in 'Poor Health'	0.0545***	0.0722***	0.0708***	0.0554***	0.0742***	0.0743***
	(0.00829)	(0.00832)	(0.00820)	(0.00962)	(0.00962)	(0.00941)
Proportion over 65 years old	0.00502	-0.00851	-0.00417	0.000707	-0.0178	-0.0147
	(0.00981)	(0.0102)	(0.00993)	(0.0107)	(0.0109)	(0.0111)
Proportion with Income below $15,000	-0.0152**	-0.0154**	-0.0119	-0.0122	-0.00978	-0.00551
	(0.00722)	(0.00733)	(0.00733)	(0.00751)	(0.00731)	(0.00747)
Proportion with Bachelor's Degree	0.0302***	0.0244***	0.0271***	0.0218***	0.0148*	0.0171**
	(0.00500)	(0.00513)	(0.00518)	(0.00751)	(0.00798)	(0.00744)
Time Fixed Effects?	No	No	No	Yes	Yes	Yes
Constant	4.066***	6.125***	6.701***	4.724***	6.992***	7.439***
	(0.408)	(0.438)	(0.453)	(0.422)	(0.457)	(0.469)
Observations	888	888	888	888	888	888
R-squared	0.506	0.478	0.451	0.536	0.520	0.483
Robust standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

Table 6

VARIABLES	(1) IM Premium	(2) GS Premium	(3) OB/GYN Premium	(4) IM Premium	(5) GS Premium	(6) OB/GYN Premium
Malpractice Environment						
Average Payments by $10,000	0.00471***	0.00549***	0.00525***	0.00368**	0.00431***	0.00422***
	(0.00165)	(0.00161)	(0.00143)	(0.00164)	(0.00154)	(0.00142)
Claims per 100,000 residents	0.0750***	0.0810***	0.0834***	0.0889***	0.0996***	0.0997***
	(0.0103)	(0.0113)	(0.0109)	(0.0106)	(0.0115)	(0.0112)
Reforms						
Noneconomic Damages Cap	0.256***	0.175***	0.161***	0.253***	0.168***	0.152***
	(0.0357)	(0.0347)	(0.0334)	(0.0343)	(0.0325)	(0.0316)
Total Damages Cap	-0.253***	-0.193***	-0.301***	-0.279***	-0.231***	-0.336***
	(0.0590)	(0.0568)	(0.0539)	(0.0590)	(0.0557)	(0.0523)
Collateral Source Rule Reform	0.131***	0.0527	0.0493	0.119***	0.0403	0.0420
	(0.0370)	(0.0399)	(0.0369)	(0.0357)	(0.0375)	(0.0352)
Joint-and-Several Liability Reform	-0.159***	-0.137***	-0.142***	-0.204***	-0.192***	-0.191***
	(0.0365)	(0.0376)	(0.0359)	(0.0352)	(0.0362)	(0.0343)
Regulation of Attorney Fees	0.0359	-0.0411	-0.0256	0.0608*	-0.0141	-0.00892
	(0.0379)	(0.0392)	(0.0353)	(0.0369)	(0.0375)	(0.0348)
Malpractice Screening Panels	0.0344	0.151***	0.148***	-0.00743	0.101**	0.109**
	(0.0479)	(0.0478)	(0.0508)	(0.0457)	(0.0452)	(0.0494)
Panels' Findings Admissible	-0.133**	-0.218***	-0.113**	-0.0731	-0.149***	-0.0566
	(0.0532)	(0.0534)	(0.0521)	(0.0529)	(0.0528)	(0.0520)
Periodic Payments	0.0381	0.132***	0.0760**	0.0216	0.113***	0.0611*
	(0.0346)	(0.0365)	(0.0337)	(0.0344)	(0.0354)	(0.0328)
Patient Compensation Funds	-0.0247	-0.0125	-0.0457	-0.0420	-0.0282	-0.0550
	(0.0549)	(0.0530)	(0.0544)	(0.0563)	(0.0526)	(0.0548)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	IM Premium	GS Premium	OB/GYN Premium	IM Premium	GS Premium	OB/GYN Premium
Controls						
Per Capita Income	0.0325***	0.0281***	0.0279***	0.0247***	0.0181***	0.0205***
	(0.00390)	(0.00398)	(0.00456)	(0.00478)	(0.00484)	(0.00563)
Uninsured	0.0549***	0.0445***	0.0373***	0.0479***	0.0337***	0.0263***
	(0.00505)	(0.00543)	(0.00500)	(0.00547)	(0.00544)	(0.00536)
Proportion Tobacco Users	0.00704	-0.00757	-0.00496	0.0278***	0.0195***	0.0190***
	(0.00590)	(0.00626)	(0.00617)	(0.00630)	(0.00671)	(0.00663)
Proportion Obese	0.0426***	0.0408***	0.0294***	-0.00426	-0.0179**	-0.0230***
	(0.00488)	(0.00483)	(0.00448)	(0.00773)	(0.00751)	(0.00734)
Proportion in 'Poor Health'	0.0421***	0.0587***	0.0571***	0.0401***	0.0570***	0.0571***
	(0.00820)	(0.00812)	(0.00802)	(0.00963)	(0.00909)	(0.00895)
Proportion over 65 years old	-0.00257	-0.0167*	-0.0126	-0.0129	-0.0331***	-0.0300***
	(0.00931)	(0.00978)	(0.00935)	(0.0102)	(0.0105)	(0.0106)
Proportion with Income below $15,000	-0.0217***	-0.0225***	-0.0191***	-0.0174**	-0.0157**	-0.0114*
	(0.00696)	(0.00704)	(0.00700)	(0.00711)	(0.00681)	(0.00689)
Proportion with Bachelor's Degree	0.0201***	0.0132***	0.0158***	0.0132*	0.00505	0.00739
	(0.00499)	(0.00501)	(0.00500)	(0.00748)	(0.00729)	(0.00690)
Time Fixed Effects?	No	No	No	Yes	Yes	Yes
Constant	4.409***	6.502***	7.083***	5.314***	7.655***	8.102***
	(0.365)	(0.380)	(0.398)	(0.384)	(0.390)	(0.412)
Observations	888	888	888	888	888	888
R-squared	0.555	0.536	0.520	0.599	0.599	0.574
Robust standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

Aim 3: Assessing whether malpractice insurance premium rates influence practice variation and induce defensive medicine under the PID hypothesis

For our third goal of this paper, we are interested in evaluating whether premiums induce defensive medicine among physicians. Given the intuition developed in our Theoretical Framework, we deduced that higher malpractice premiums would lead to greater inducement of demand for health services and subsequently a higher amount of equilibrium services being provided. Using spending as a proxy for health care utilization, we hypothesized that higher premiums may be associated with higher Medicare reimbursements for a variety of services. In addition to behavioral controls included in prior models, we also include physicians per 100,000 residents as this may also contribute to PID as alluded to in the Theoretical Framework. This is to ensure that the coefficients for the premiums are not susceptible to omitted variable bias and subsequently overestimated.

We proceeded to run the following regression for the four categories of spending and exclude premiums that suffered from endogeneity with the service in question.

$$\text{Log(Spending)}_{st} = \beta_0 + \beta_1 (\text{IMPremium}_{st}) + \beta_2 (\text{GSPremium}_{st}) + \beta_3 (\text{OB/GYNPremium}_{st}) + \beta_4 (\text{Physiciansper100k}_{st}) + \beta_5 (\text{Cap on NE Damages}_{st}) + \beta_6 (\text{Cap on Total Damages}_{st}) + \beta_7 (\text{Collateral Source Reform}_{st}) + \beta_8 (\text{Liability Reform}_{st}) + \beta_9 (\text{AttorneyCap}_{st}) + \beta_{10} (\text{Screening Panels}_{st}) + \beta_{11} (\text{ScreenEvidence}_{st}) + \beta_{12} \text{Periodic}_{st} + \beta_{13} \text{PCF}_{st} + \beta_{14} \text{PerCapitaIncome}_{st} + \beta_{15} \text{Uninsured}_{st} + \beta_{16} \text{Smoking}_{st} + \beta_{17} \text{Obesity}_{st} + \beta_{18} \text{PoorHealth}_{st} + \beta_{19} \text{Above65yrs}_{st} + \beta_{20} \text{Below15,000}_{st} + \beta_{21} \text{BachelorDegree}_{st} + \alpha_s + \varepsilon_t + u_{st}$$

Again, this was done using OLS regressions later including time and state fixed effects. As discussed earlier the state fixed effects specification is not given much weight due to stickiness of tort reform policies and consequent inconsistent estimators. The results of our model can be found in **Table 7** and **Table 8**.

We first examine the effects that tort reforms as well as malpractice premiums have on spending. Our attention is directed to specifications (5) - (8). First, of the three specialties, only increases in OB/GYN premiums were associated with increased levels of spending for all services studied. Given that the regression was run with premiums being adjusted to account for increases of $1,000, we can interpret the coefficient in (5) for OB/GYN premiums to mean that a $10,000 increase in such premiums results in a .82% increase in total spending for all healthcare services covered under Medicare. Similarly, lab and medical/surgical spending were found to rise by 1.2% and 0.93% for every $10,000 upswing in OB/GYN premiums (all coefficients were statistically significant at the 1% level). Malpractice premiums for internists or general surgeons did not seem to have a significant effect on either total or medical/surgical spending figures. Also, as predicted by the PID hypothesis and increasing monopoly model, an increase in 10 physicians per 100,000 residents in a state would lead to rises of 1.2% in total spending, 0.57% for lab services, 0.62% in diagnostic services, and 0.65% in medical/surgical services (all of these findings are significant at the 5% level).

Of all the malpractice reforms studied, modification or elimination of joint-and-several liability had the most significant effect on all four types of spending analyzed. Implementation of the reform led to a 4.4%, 5.7%, 6.7%, and 5.1% decline in total, lab, diagnostic, and medical/surgical spending, respectively (all significant at the 1% level). Similarly, coefficients for total damage caps were negative for each spending category spending, though it was found to

only significantly reduce diagnostic spending by 4.9%. However, caps on noneconomic damages had positive coefficients for all categories of spending studied, having been estimated to raise spending on all services by 2.53% (other findings were statistically insignificant). Implementation of collateral source rule reform has an implied 2.78% decline in total spending (significant at the 5% level), though it did not have similar effects on the other services studied. Also of interest was the finding that regulation of contingency fees was associated with a 3.9% bump in total spending (significant at 1% level). However, the reform was not observed to similarly alter spending levels of more specific services. Patient compensation funds led to increases in each spending category, leading to jumps of 1.9%, 5.7%, 9.6%, and 4.0% for total, lab, diagnostic, and medical/surgical spending, respectively (the effect on total spending was significant at the 10% level and all others at the 1% level). Also, periodic payments of malpractice awards were observed to lead to increases of 2.1%, 3.2%, 5.5% and 2.6% rise in total, lab, diagnostic, and medical/surgical spending, respectively (the effect on total and medical/surgical spending was significant at the 5% level and all others significant at the 1% level). Finally, the introduction of screening panels were found to have no significant effects on any spending measures studied.

However, we were concerned about the possibility of reverse causality, as higher spending levels and consequently more services were likely to raise malpractice premiums (given that medical errors would be more likely to occur with more services being provided). Given the possibility of endogeneity, it could be likely that OLS estimators would subsequently be biased. To address this issue, we proceeded to run a Durbin-Wu-Hausman test for each combination of malpractice premium and spending figure (refer to **Appendix** for results).

Since the results of the test suggest endogeneity between premiums and spending, we

omit premiums in the following specifications and utilize tort reforms as instruments for premiums. As before, both total damage caps as well as modification of joint-and-several liability seem to be most effective in lowering health care spending. After omission of premiums, total damage caps are estimated to lower total, lab, diagnostic, and medical/surgical spending by 4.6%, 5.8%, 8.9%, and 3.9%, respectively (all findings are significant at the 1% level, which was not the case in the last specification). Similarly, implementation of joint-and-several liability modification has an implied decline of 5.3%, 7.6%, 8%, and 7% for total, lab, diagnostic, and medical/surgical spending. Reform of the collateral source rule was associated with a 2.55% decline in total spending (significant at 5% level), though similar results were not observed for other services. However, noneconomic damage caps still had positive coefficients in this specification, as did periodic payments and patient compensation funds. As in the last specification, screening panels had an insignificant effect on Medicare spending.

Table 7

VARIABLES	(1) total	(2) lab	(3) diagnostic	(4) medsurg	(5) total	(6) lab	(7) diagnostic	(8) medsurg
Physician Density	0.00104***	0.000458***	0.000558	0.000434***	0.00115***	0.000570***	0.000623**	0.000543***
	(0.000134)	(0.000176)	(0.000360)	(0.000162)	(0.000115)	(0.000162)	(0.000270)	(0.000140)
Premiums								
Internist Premiums per $1000	-0.000473	0.00196	0.00510*	0.00234*	0.000282	0.00127	0.000993	0.00157
	(0.000945)	(0.00134)	(0.00271)	(0.00121)	(0.000830)	(0.00120)	(0.00197)	(0.00106)
General Surgeon Premiums per $1000	4.40e-06	0.000129	5.03e-05	0.000173	-0.000125**	4.66e-05	4.55e-05	8.28e-05
	(8.79e-05)	(0.000119)	(0.000226)	(0.000134)	(5.78e-05)	(9.70e-05)	(0.000161)	(0.000110)
OB/GYN Premiums per $1000	0.00118***	0.00104***	-3.37e-05	0.000846**	0.000817***	0.00118***	0.000933	0.00104***
	(0.000269)	(0.000375)	(0.000859)	(0.000358)	(0.000228)	(0.000334)	(0.000568)	(0.000309)
Reforms								
Noneconomic Damages Cap	0.0210**	0.00415	-0.0106	0.00494	0.0253***	0.0215	0.0287	0.0233*
	(0.0102)	(0.0141)	(0.0302)	(0.0131)	(0.00912)	(0.0131)	(0.0208)	(0.0119)
Total Damages Cap	-0.00160	-0.00706	-0.0651*	0.0114	-0.0238*	-0.0168	-0.0487*	0.000196
	(0.0162)	(0.0180)	(0.0353)	(0.0170)	(0.0140)	(0.0165)	(0.0277)	(0.0148)
Collateral Source Rule Reform	-0.0269**	0.0109	0.0255	0.00282	-0.0278***	0.00494	0.0162	-0.00230
	(0.0109)	(0.0162)	(0.0296)	(0.0149)	(0.0106)	(0.0161)	(0.0230)	(0.0145)
Joint-and-Several Liability Reform	-0.0251***	-0.0377***	-0.0507*	-0.0319***	-0.0438***	-0.0568***	-0.0671***	-0.0514***
	(0.00965)	(0.0130)	(0.0264)	(0.0122)	(0.00932)	(0.0124)	(0.0189)	(0.0113)
Regulation of Attorney Fees	0.0287***	-0.0251	-0.0614**	-0.0159	0.0389***	-0.00475	-0.0358	0.00604
	(0.0105)	(0.0157)	(0.0306)	(0.0148)	(0.00938)	(0.0146)	(0.0221)	(0.0134)
Malpractice Screening Panels	0.0161	-0.00211	-0.00177	0.00421	0.00203	-0.0263	-0.0329	-0.0226
	(0.0132)	(0.0192)	(0.0371)	(0.0181)	(0.0118)	(0.0175)	(0.0285)	(0.0158)
Panels' Findings Admissible	-0.0144	0.00232	0.0168	-0.00902	0.00922	0.0371*	0.0535*	0.0285
	(0.0145)	(0.0212)	(0.0440)	(0.0199)	(0.0134)	(0.0202)	(0.0323)	(0.0181)
Periodic Payments	0.0166*	0.0327**	0.0632**	0.0262**	0.0211**	0.0323***	0.0547***	0.0256**
	(0.00968)	(0.0137)	(0.0269)	(0.0127)	(0.00850)	(0.0123)	(0.0188)	(0.0110)
Patient Compensation Funds	0.00407	0.0545***	0.116***	0.0349**	0.0192*	0.0571***	0.0960***	0.0395***
	(0.0118)	(0.0163)	(0.0321)	(0.0155)	(0.0107)	(0.0148)	(0.0233)	(0.0138)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	total	lab	diagnostic	medsurg	total	lab	diagnostic	medsurg
Controls								
Per Capita Income	0.0150***	0.0253***	0.0303***	0.0231***	0.0126***	0.0227***	0.0310***	0.0200***
	(0.00156)	(0.00271)	(0.00484)	(0.00254)	(0.00146)	(0.00249)	(0.00356)	(0.00225)
Proportion Uninsured	0.0179***	0.0162***	0.0181***	0.0136***	0.0159***	0.0174***	0.0276***	0.0146***
	(0.00160)	(0.00234)	(0.00422)	(0.00218)	(0.00152)	(0.00208)	(0.00324)	(0.00186)
Proportion Tobacco Users	2.91e-05	-0.00809***	-0.00357	-0.00734***	0.00544***	-0.00513**	-0.00839**	-0.00435*
	(0.00176)	(0.00287)	(0.00500)	(0.00274)	(0.00157)	(0.00247)	(0.00409)	(0.00228)
Proportion Obese	0.0299***	0.0297***	0.0164***	0.0300***	0.0100***	0.0108***	0.0130**	0.00983***
	(0.00130)	(0.00175)	(0.00331)	(0.00167)	(0.00231)	(0.00314)	(0.00526)	(0.00278)
Proportion in 'Poor Health'	0.000524	0.0200***	0.0346***	0.0156***	0.00480*	0.0218***	0.0313***	0.0182***
	(0.00241)	(0.00327)	(0.00550)	(0.00314)	(0.00249)	(0.00306)	(0.00467)	(0.00278)
Percent over 65 years old	0.00204	0.00943***	0.00245	0.00928***	-0.00389*	0.00739**	0.0102**	0.00676**
	(0.00209)	(0.00321)	(0.00624)	(0.00305)	(0.00205)	(0.00293)	(0.00469)	(0.00274)
Percent with income below $15,000	-0.000124	-0.00682**	-0.00944*	-0.00515*	0.00281	-0.00565**	-0.0139***	-0.00379
	(0.00195)	(0.00289)	(0.00518)	(0.00275)	(0.00184)	(0.00278)	(0.00410)	(0.00256)
Proportion with Bachelor's Degree	-0.00255	0.000305	-0.00436	0.000386	-0.00580***	-0.00456	-0.0102**	-0.00426
	(0.00208)	(0.00346)	(0.00554)	(0.00322)	(0.00200)	(0.00328)	(0.00474)	(0.00292)
Time Fixed Effects?	No	No	No	No	Yes	Yes	Yes	Yes
Constant	6.997***	4.930***	3.432***	4.821***	7.287***	5.235***	3.459***	5.139***
	(0.101)	(0.148)	(0.267)	(0.142)	(0.0976)	(0.146)	(0.238)	(0.133)
Observations	638	638	638	638	638	638	638	638
R-squared	0.798	0.787	0.466	0.787	0.841	0.823	0.716	0.834
Robust standard errors in parentheses								
*** p<0.01, ** p<0.05, * p<0.1								

Table 8

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	total	lab	diagnostic	medsurg	total	lab	diagnostic	medsurg
Reforms								
Non-Economic Damages Cap	0.0360***	0.0298**	0.0147	0.0303**	0.0363***	0.0428***	0.0470**	0.0444***
	(0.00954)	(0.0138)	(0.0306)	(0.0128)	(0.00880)	(0.0129)	(0.0203)	(0.0118)
Total Damages Cap	-0.0293**	-0.0569***	-0.123***	-0.0355**	-0.0461***	-0.0583***	-0.0893***	-0.0398***
	(0.0145)	(0.0168)	(0.0328)	(0.0159)	(0.0133)	(0.0156)	(0.0263)	(0.0141)
Collateral Source Rule Reform	-0.0306***	0.0134	0.0376	0.00513	-0.0255**	0.0118	0.0245	0.00437
	(0.0112)	(0.0169)	(0.0295)	(0.0155)	(0.0106)	(0.0160)	(0.0229)	(0.0143)
Joint-and-Several Liability Reform	-0.0445***	-0.0679***	-0.0746***	-0.0609***	-0.0528***	-0.0755***	-0.0804***	-0.0701***
	(0.00933)	(0.0135)	(0.0277)	(0.0126)	(0.00929)	(0.0130)	(0.0196)	(0.0119)
Regulation of Attorney Fees	0.0231**	-0.0129	-0.0221	-0.00495	0.0355***	-0.00293	-0.0275	0.00835
	(0.0100)	(0.0160)	(0.0318)	(0.0150)	(0.00951)	(0.0147)	(0.0221)	(0.0136)
Malpractice Screening Panel	0.0184	-0.0166	-0.0398	-0.00985	0.00274	-0.0309*	-0.0424	-0.0279*
	(0.0128)	(0.0192)	(0.0387)	(0.0179)	(0.0120)	(0.0185)	(0.0300)	(0.0167)
Panels' Evidence Admissible	-0.0164	0.0129	0.0360	-0.000220	0.00252	0.0359	0.0552	0.0276
	(0.0151)	(0.0225)	(0.0449)	(0.0208)	(0.0140)	(0.0219)	(0.0337)	(0.0197)
Periodic Payments	0.0263***	0.0492***	0.0787***	0.0412***	0.0288***	0.0487***	0.0712***	0.0410***
	(0.00941)	(0.0134)	(0.0270)	(0.0126)	(0.00861)	(0.0124)	(0.0186)	(0.0113)
Patient Compensation Funds	0.0126	0.0731***	0.138***	0.0532***	0.0267**	0.0736***	0.109***	0.0562***
	(0.0114)	(0.0165)	(0.0330)	(0.0157)	(0.0107)	(0.0148)	(0.0234)	(0.0139)
Controls								
Physicians per 100,000 residents	0.00131***	0.000883***	0.00103***	0.000818***	0.00133***	0.000868***	0.000954***	0.000817***
	(0.000121)	(0.000164)	(0.000333)	(0.000150)	(0.000112)	(0.000156)	(0.000257)	(0.000136)
Per Capita Income	2.26e-05***	3.08e-05***	2.45e-05***	2.86e-05***	1.67e-05***	3.00e-05***	3.68e-05***	2.65e-05***
	(1.80e-06)	(3.13e-06)	(5.96e-06)	(2.90e-06)	(1.85e-06)	(3.20e-06)	(4.88e-06)	(2.84e-06)
Proportion Uninsured	0.0201***	0.0205***	0.0227***	0.0179***	0.0180***	0.0220***	0.0318***	0.0192***
	(0.00150)	(0.00219)	(0.00401)	(0.00205)	(0.00152)	(0.00204)	(0.00306)	(0.00184)
Proportion Tobacco Users	0.00344*	-0.00118	0.00588	-0.000913	0.00678***	-0.00229	-0.00475	-0.00162
	(0.00177)	(0.00275)	(0.00472)	(0.00265)	(0.00166)	(0.00255)	(0.00413)	(0.00237)
Proportion Obese	0.0209***	0.0176***	0.00739*	0.0190***	0.00979***	0.0106***	0.0130**	0.00969***
	(0.00147)	(0.00228)	(0.00443)	(0.00212)	(0.00237)	(0.00329)	(0.00531)	(0.00292)
Proportion in 'Poor Health'	0.00152	0.0219***	0.0361***	0.0172***	0.00673***	0.0256***	0.0346***	0.0216***
	(0.00220)	(0.00302)	(0.00529)	(0.00291)	(0.00251)	(0.00316)	(0.00473)	(0.00288)
Proportion over 65 years of age	-9.80e-05	0.00668*	-0.000237	0.00685**	-0.00451**	0.00692**	0.00917*	0.00641**
	(0.00224)	(0.00346)	(0.00646)	(0.00327)	(0.00226)	(0.00326)	(0.00495)	(0.00305)
Proportion with income below $15,000	0.000890	-0.00761**	-0.0137**	-0.00580**	0.00131	-0.00884***	-0.0179***	-0.00678**
	(0.00190)	(0.00295)	(0.00550)	(0.00278)	(0.00187)	(0.00289)	(0.00425)	(0.00265)
Proportion with Bachelor's Degree	-0.00761***	-0.00238	0.00131	-0.00226	-0.00570***	-0.00388	-0.00779	-0.00354
	(0.00216)	(0.00364)	(0.00613)	(0.00337)	(0.00206)	(0.00334)	(0.00485)	(0.00296)
Time Fixed Effects?	No	No	No	No	Yes	Yes	Yes	Yes
Constant	7.138***	5.109***	3.625***	4.972***	7.263***	5.158***	3.463***	5.050***
	(0.0983)	(0.148)	(0.254)	(0.143)	(0.0991)	(0.152)	(0.240)	(0.141)
Observations	647	647	647	647	647	647	647	647
R-squared	0.806	0.777	0.442	0.778	0.835	0.809	0.704	0.820
Robust standard errors in parentheses								
*** p<0.01, ** p<0.05, * p<0.1								

Limitations

One limitation of our study is we are unable to address the expansive heterogeneity that exists between different reforms. Noneconomic damages were coded as '1' regardless of their magnitude. The same limitation and approach also applies to the caps on total damages. With regards to attorney caps, we coded the attorney cap as '1' if such regulations were in place, regardless of the specific sliding scale put in place. Similarly, there was no distinction coded between mandatory or discretionary applications of modification of the collateral source rule. Fourth, there was no distinction between the various types of restrictions on the joint and several liability rule or between the exact higher evidentiary requirements in the punitive evidence reform. Finally, we do not attempt to study whether reforms have differential effects based on whether they were put in place by the courts system or state legislatures.

Also, as discussed in the Theoretical Framework, the direction that physicians will shift demand under the PID hypothesis is dependent upon whether the practitioner is working under a fee-for-service arrangement or in an HMO. Thus, it would be wise to control for HMO penetration rates across the country when studying the effects of defensive medicine and practice variation. However, we were unable to obtain data for more than one year.

Another fallback of our analysis is our inability to focus our attention on regions rather than states. This would no doubt allow for a greater study of practice variation (given that within states the norms governing the practice of medicine will likely differ in rural vs. urban areas). While malpractice premium data obtained would have allowed us to attempt to pursue this, the Medicare reimbursement data obtained only had figures for each state rather than specific regions. Though a few observations were available from the Dartmouth Atlas of Health Care for specific hospitals across the country, this likely would not have a large enough sample size to be

robust enough for this study.

Additionally, with regards to our study of physician-induced demand, we stipulate that the malpractice environment may contribute both to higher general malpractice pressures as well as a negative income effect that in turn may result in defensive medicine. However, in our study, we use malpractice premiums as a proxy for the magnitude of both malpractice pressures as well as the magnitude of this income effect. As such, we are unable to differentiate between possible negative income effect of premiums or whether would increase services due to attempting to minimize liability.

Finally, as discussed in the **Results** section, there is the possibility of reverse causality between malpractice premiums and Medicare spending, which was confirmed by use of the Durbin-Wu-Hausman test. Though this would ideally be addressed through use of instrumental variable and 2SLS approach, due to time constraints the authors instead elected to omit the endogenous premiums from spending and use reforms as an instrument in the second stage regression.

Conclusion

Our results also indicate that caps on noneconomic damages, total damage caps, and patient compensation funds are effective in tools in lowing average malpractice awards. Caps on noneconomic damages resulted in reductions in average malpractice payments ranging from a 15.8% to 18% reduction in average payments, while caps on total damages were also successful in reducing average payments by 20%. With regards to the incidence of malpractice claims, both damage caps and collateral source rule reform were estimated to decrease the frequency of malpractice cases. Given the relative success of these reforms, it would be advisable for legislators to ensure that noneconomic and total damage caps are enacted in some capacity. Additionally, when grouping claims by severity level, we find that noneconomic damage caps and patient compensation funds are more effective at reducing average payment with increasing severity level, while total damage caps induce the greatest reductions in payments for cases of medium severity. Also, noneconomic damage caps were found to only significantly decrease the incidence of medium severity claims.

As many are concerned with the malpractice environment's relation to defensive medicine, we proceeded to see whether the reforms analyzed were successful in slowing the growth of malpractice premiums (which are believed to contribute to the overutilization of services). We find that implementation of total damage caps as well as modification of joint-and-several liability were associated with lower malpractice premiums for all specialists, suggesting that both reforms may be worth further study to mitigate the effects of possible demand inducement by physicians.

The final section of our analysis validates the physician-induced demand (PID) hypothesis in the context of the medical malpractice environment. Notably, increases of $10,000

in OB/GYN premiums are estimated to result in a 0.81% rise in total spending, implying that OB/GYNs are most susceptible to malpractice pressures and negative income effects that may induce the provision of additional services (given that this specialty faces the highest premiums). Similar results were not noted for either internists or general surgeons. These findings suggest that it may be necessary for policymakers to target malpractice insurance agents' coverage of OB/GYNs to reduce health care expenditures, as a statistically significant association is certainly present. However, as previously discussed, this should be taken with a grain of salt given the endogeneity issues alluded to earlier. With regards to possible reforms, implementation of joint-and-several liability was consistently found to lower spending across all types of services, and as such it would seem a wise choice to institute this policy to attempt to mitigate the growth of health care spending.

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Appendix

Summary Statistics

Variable Name	Mean	Standard Deviation
Payment	$323,615	$117,216
Claims per 100,000 residents	5.323427	2.444549
Payment (Low Severity)	$159,950	$72543.41
Payment (Medium Severity)	$497,809.9	$283,062.2
Payment (High Severity)	$427,374.3	$189,218.1
Claims per 100,000 residents (Low Severity)	1.08156	1.141984
Claims per 100,000 residents (Medium Severity)	.8049782	.4995313
Claims per 100,000 residents (High Severity)	1.066726	.6203502
Severity	6.394558	.4735659
Internal Medicine Premiums	$10,532.97	$7,855.05
General Surgeon Premiums	$ 37,264.54	$30,496.23
OB/GYN Premiums	$54,803.15	$33,450.02
Total Medicare Spending	$5,757.95	$1,614.86
Lab Spending	$1,232.04	$438.33
Diagnostic Spending	$284.48	$116.96
Medical/Surgical Spending	$932.54	$317.51
Proportion Uninsured	13.73638	4.024007
Per Capita Income per 1,000 residents	38.41372	6.497932
Proportion of Tobacco Users	21.57781	3.624733
Proportion Obese	22.69041	4.996566

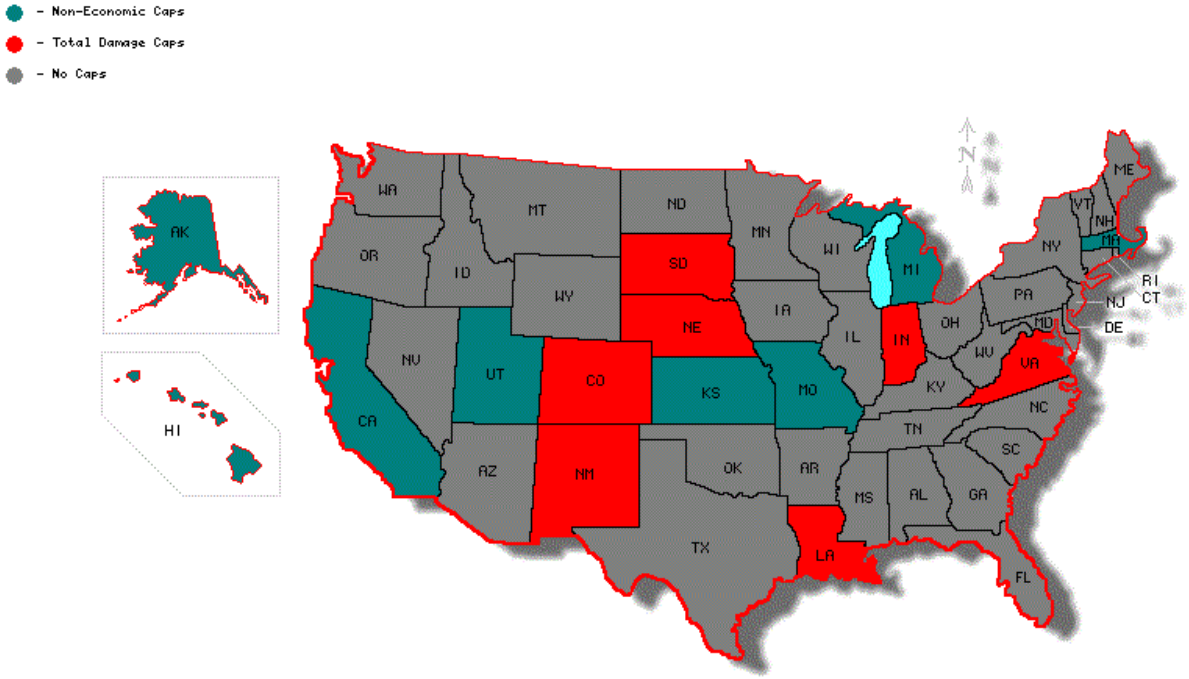
Proportion over 65 years old	17.40234	2.287862
Proportion with Income less than $15,000	10.58183	3.511113
Proportion with Bachelor's Degree	29.01583	6.009052
Proportion in 'Poor Health'	15.27648	3.438953

Durbin-Wu-Hausman Results

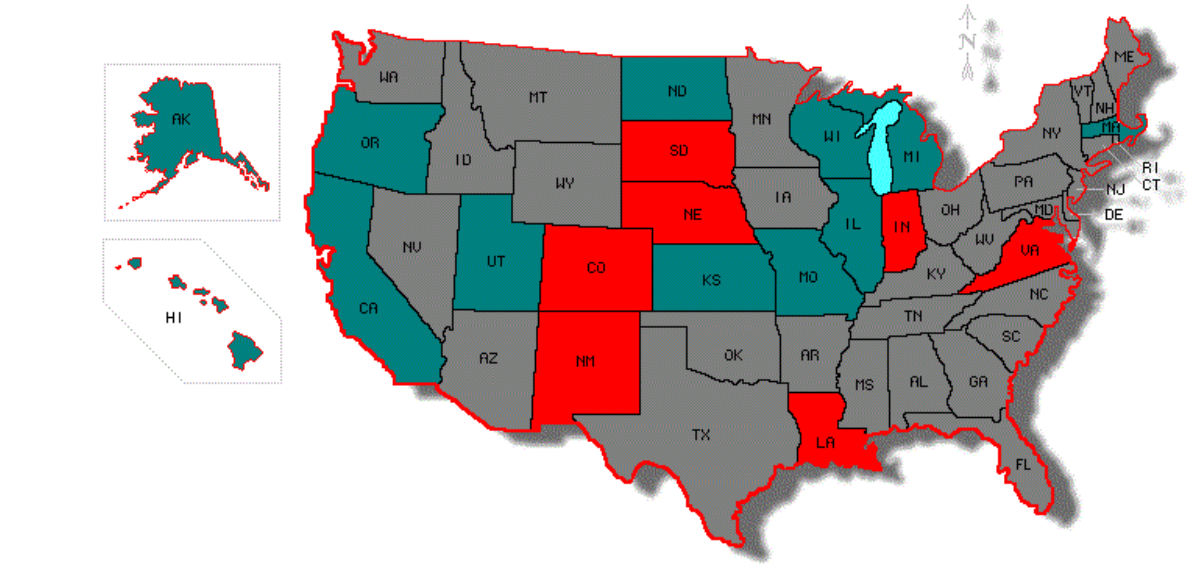
	Total Spending	Lab Spending	Diagnostic Spending	Medical/Surgical Spending
IM Premium	F(1, 626) = 8.50	F(1, 626) = 4.04	F(1, 626) = 2.85	F(1, 626) = 3.37
	Prob > F = 0.0037	Prob > F = 0.0449	Prob > F = 0.0918	Prob > F = 0.0670
GS Premium	F(1, 626) = 3.31	F(1, 626) = 3.95	F(1, 626) = 6.69	F(1, 626) = 3.09
	Prob > F = 0.0693	Prob > F = 0.0473	Prob > F = 0.0099	Prob > F = 0.0794
OB/GYN Premium	F(1, 626) = 2.78	F(1, 626) = 0.00	F(1, 626) = 2.09	F(1, 626) = 6.60
	Prob > F = 0.0958	Prob > F = 0.9697	Prob > F = 0.1492	Prob > F = 0.0104

Maps of Reforms over Time

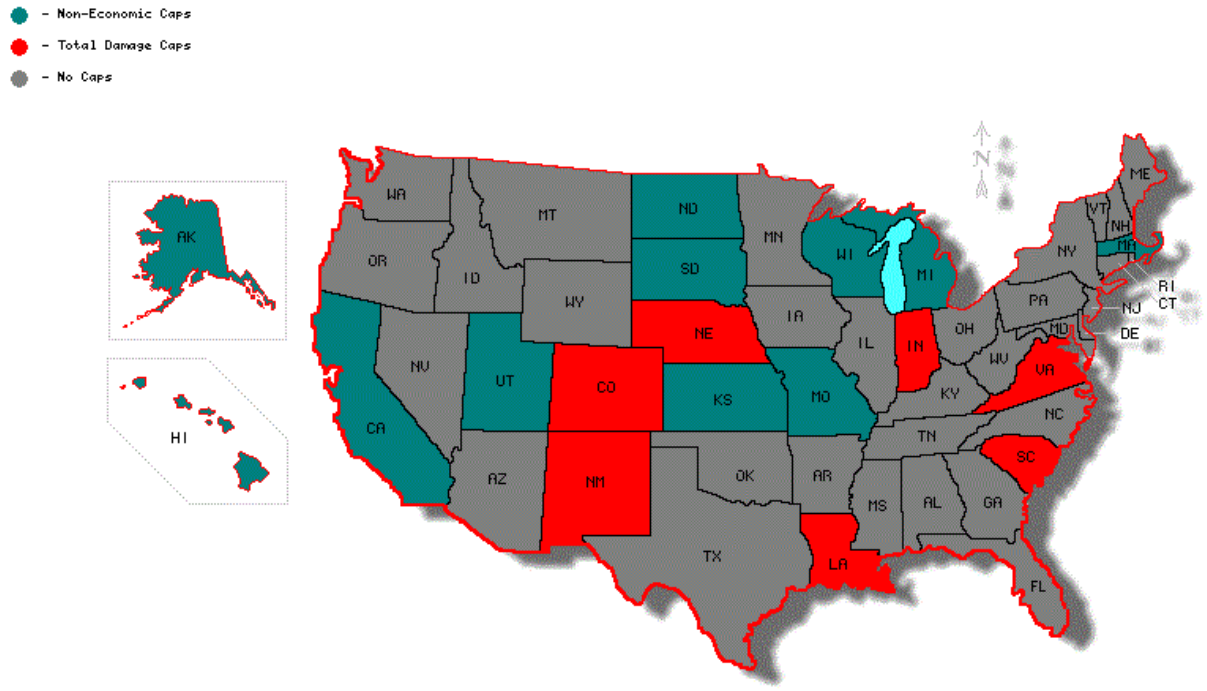
Caps on Non-Economic or Total Damages (1990)



Caps on Non-Economic or Total Damages (1995)



Caps on Non-Economic or Total Damages (2000)



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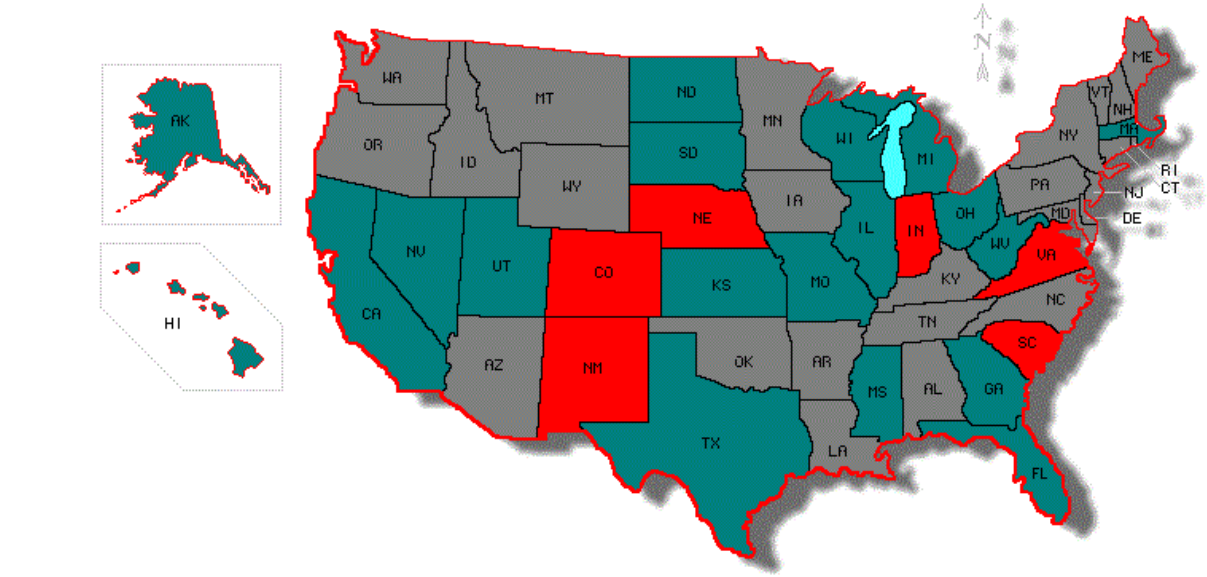
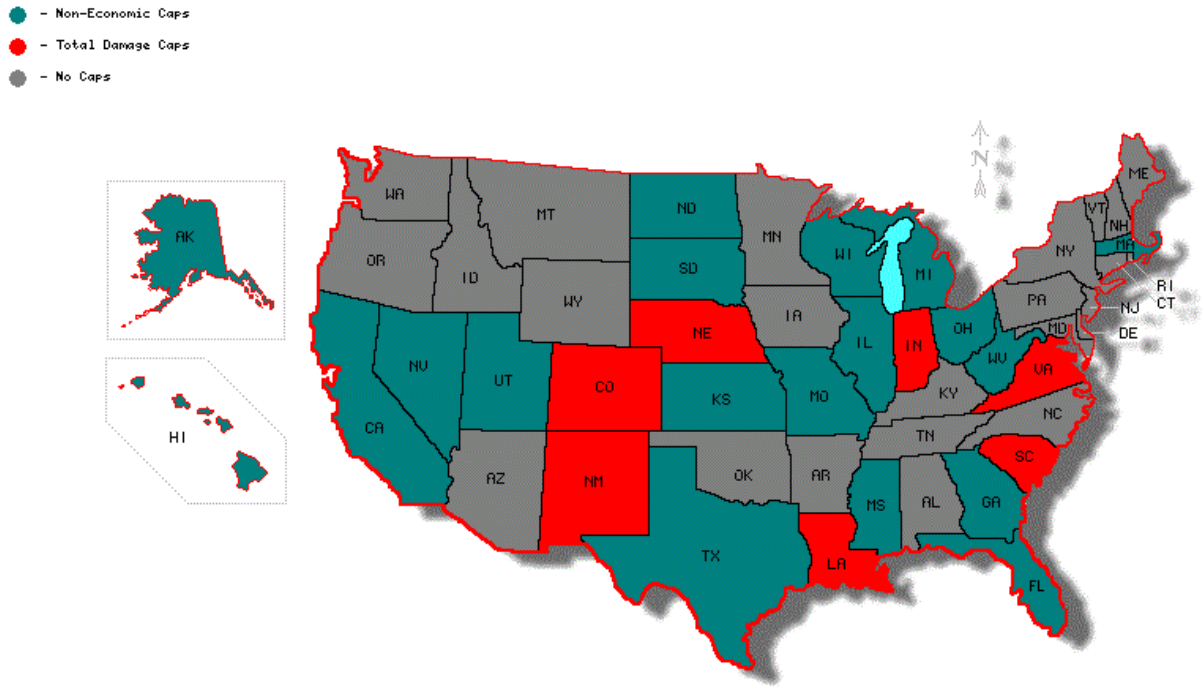
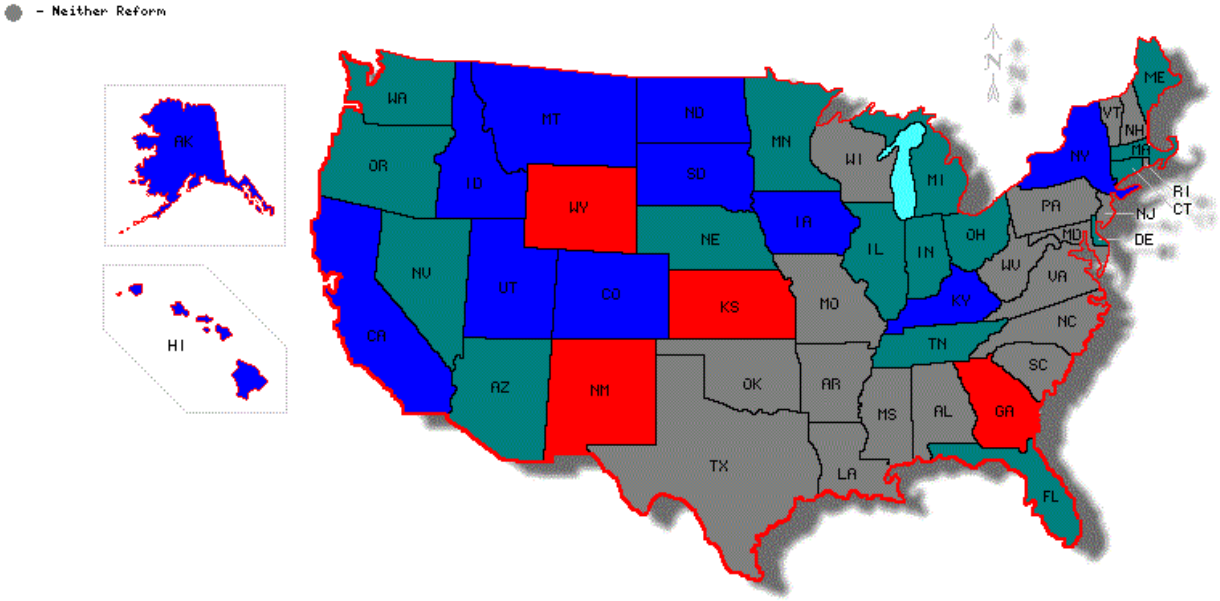


Caps on Non-Economic or Total Damages (2010)



Joint-and-Several Liability and Collateral Source Rule Reform (1990)



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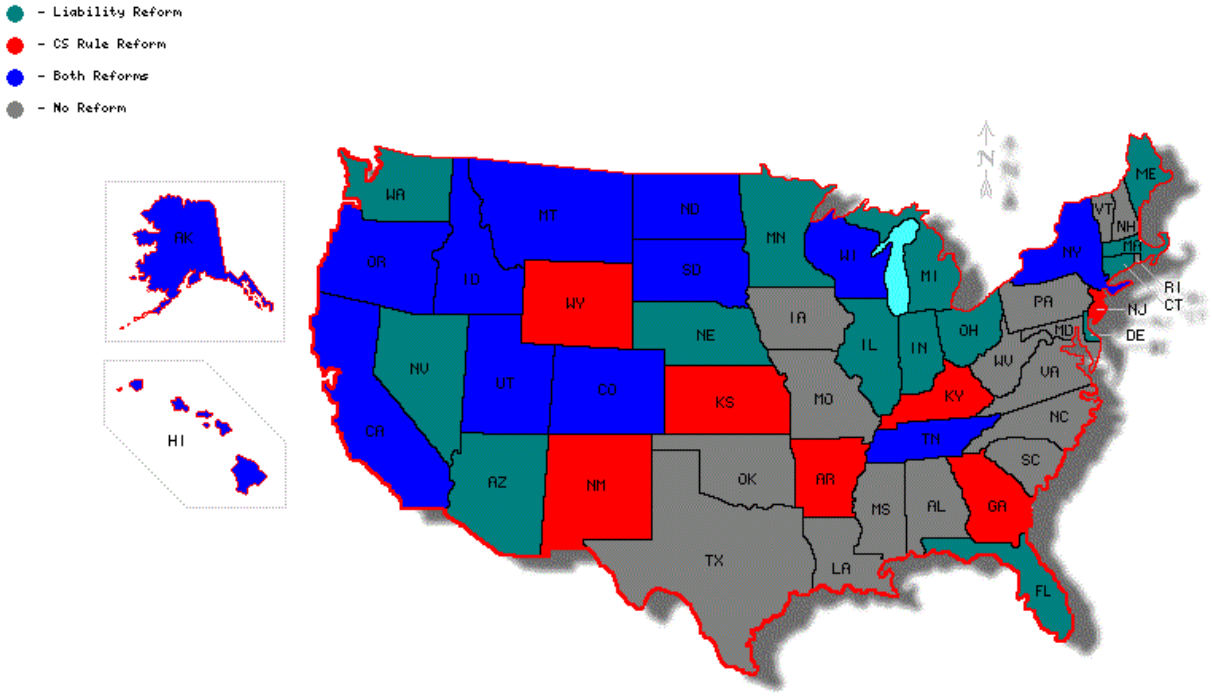

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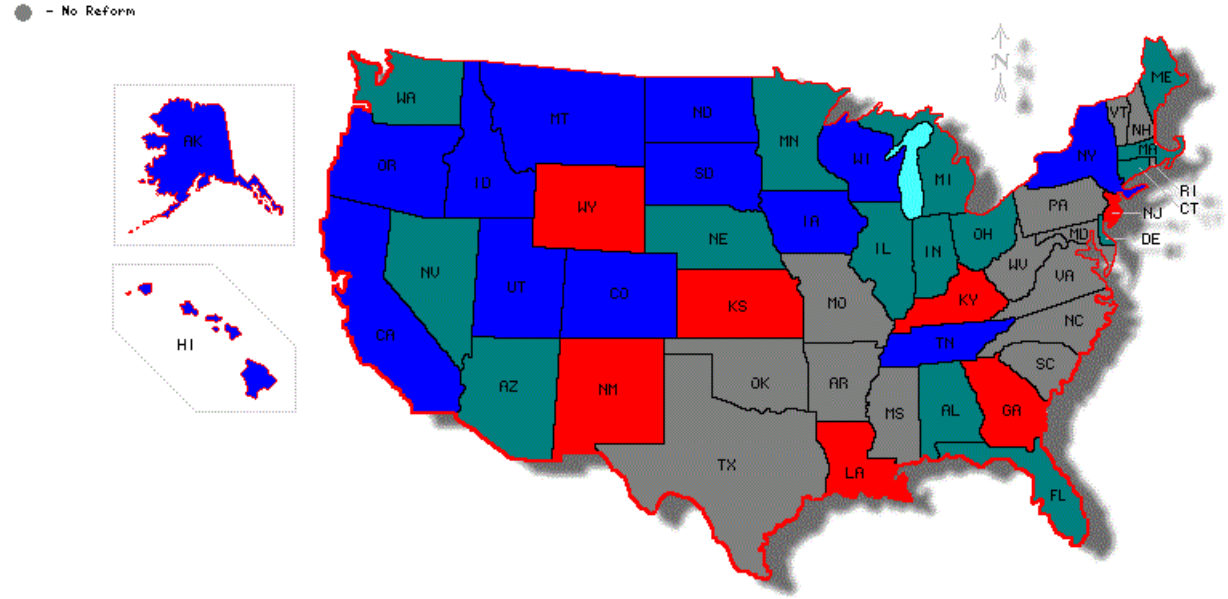

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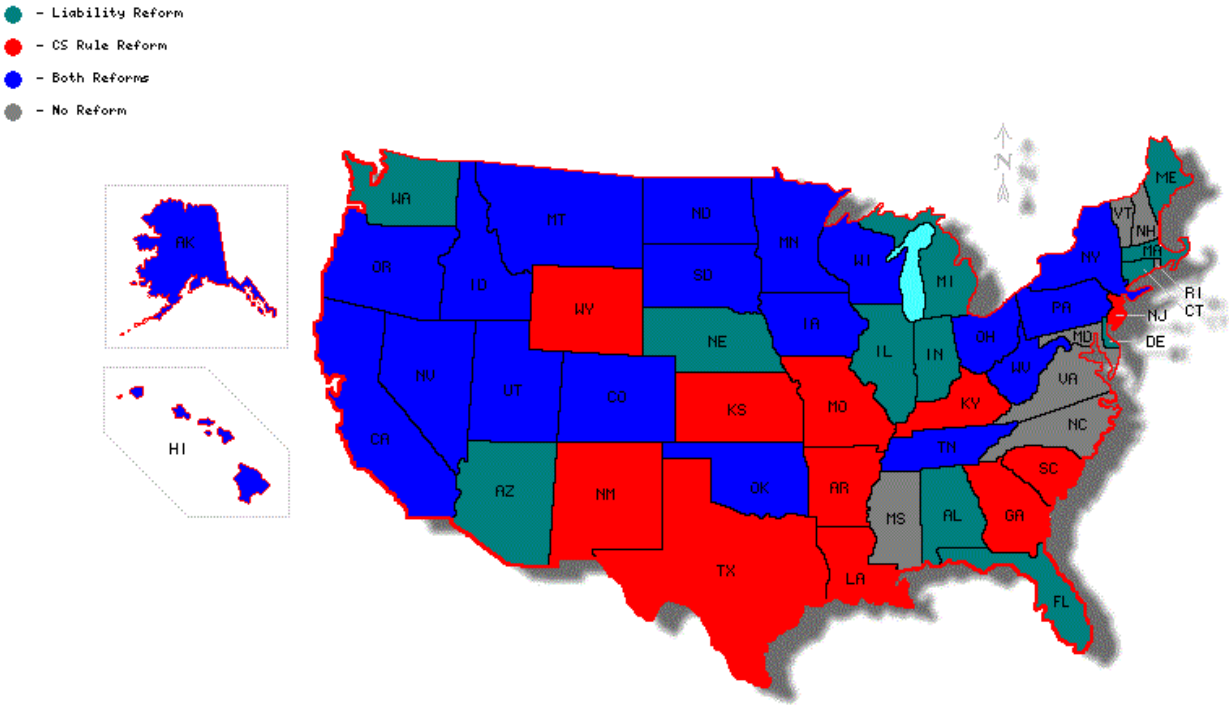

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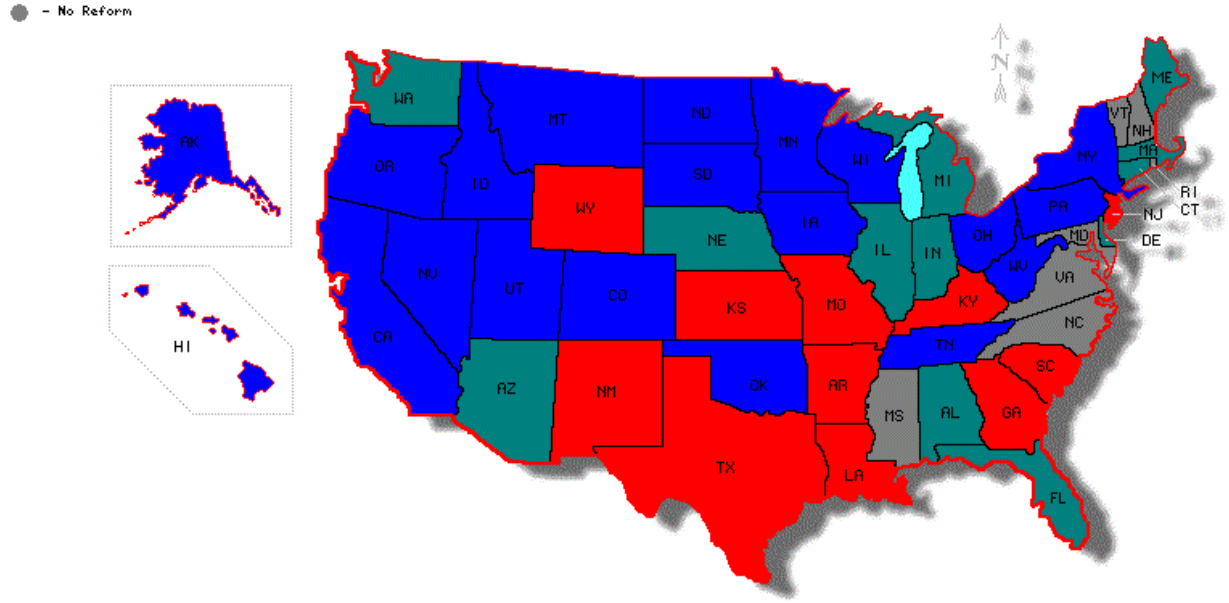
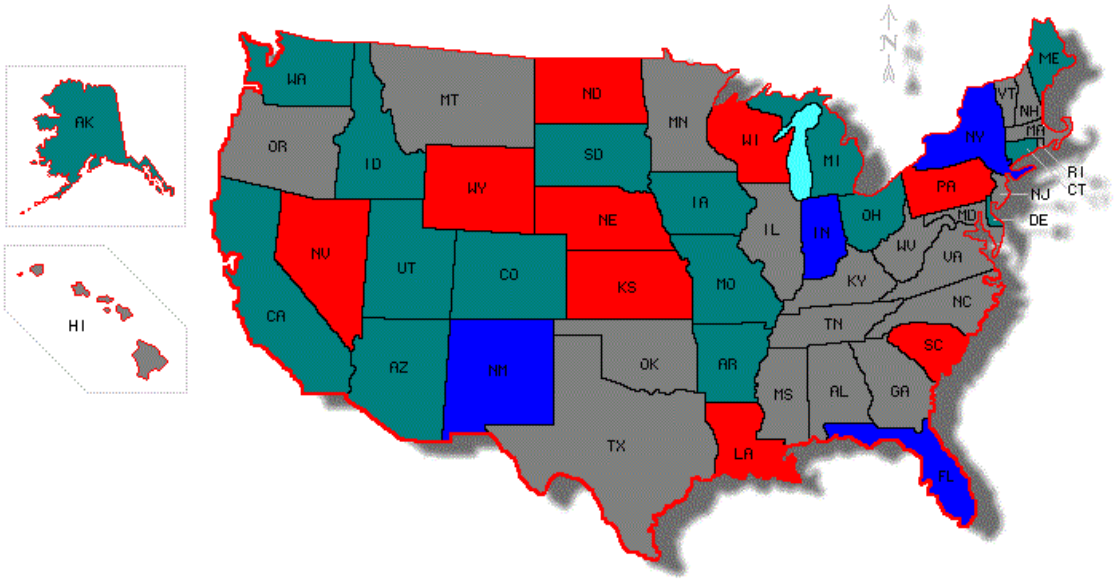


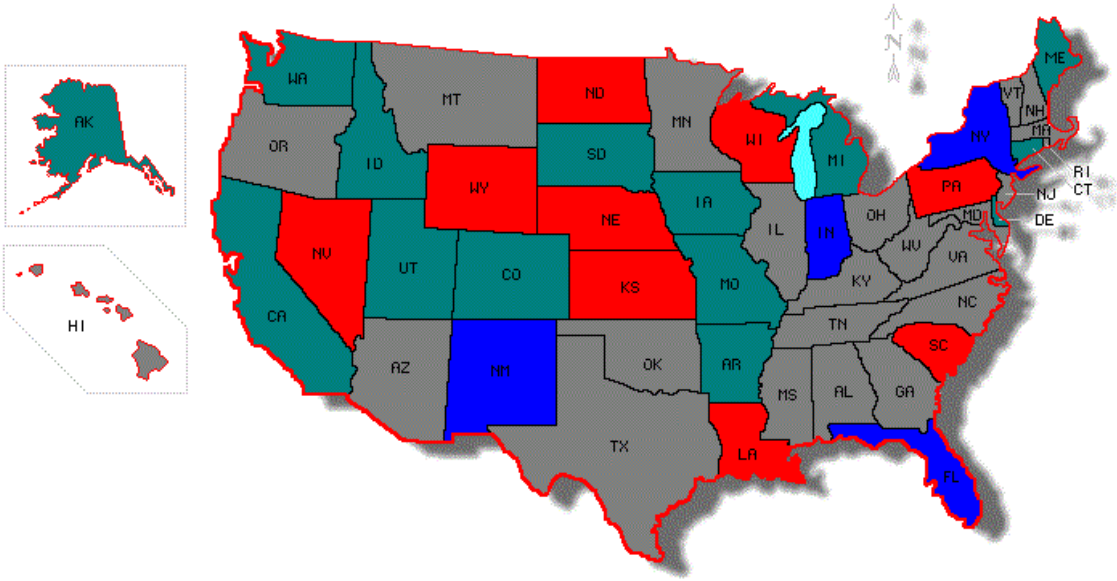
Periodic Payments and Patient Compensation Funds (1990)

- Periodic Payments
- Compensation Funds
- Both Reforms
- Neither Reform



Periodic Payments and Patient Compensation Funds (1995)

- Periodic Payments
- Compensation Funds
- Both Reforms
- Neither Reform



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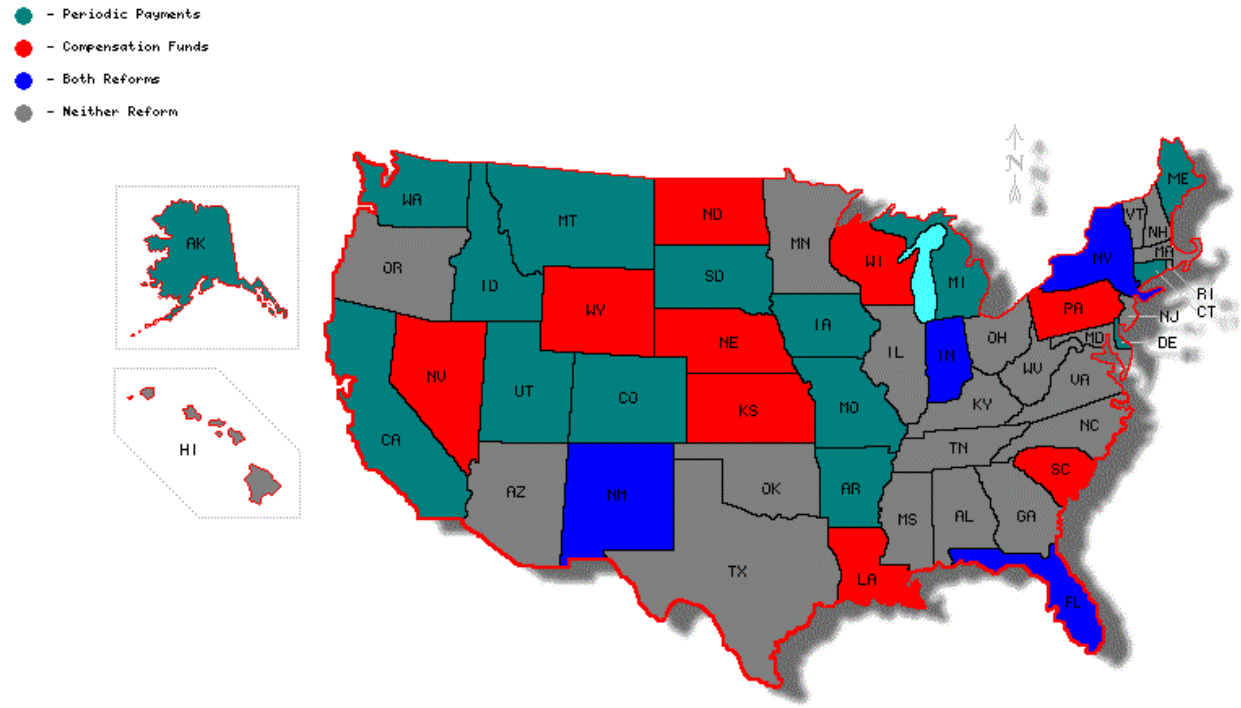

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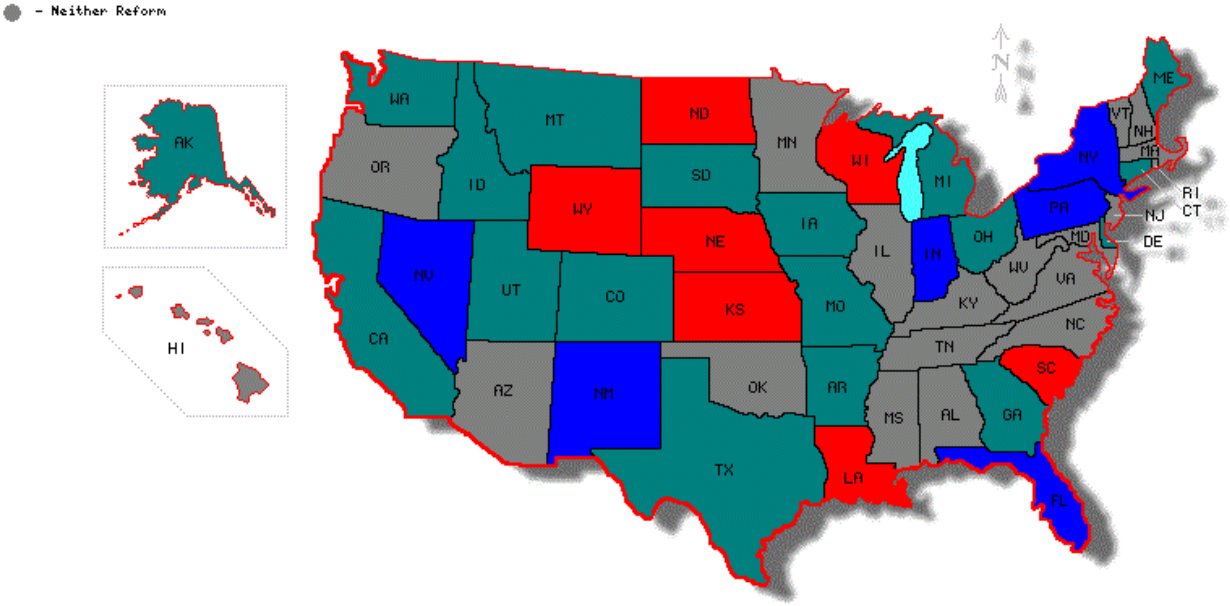
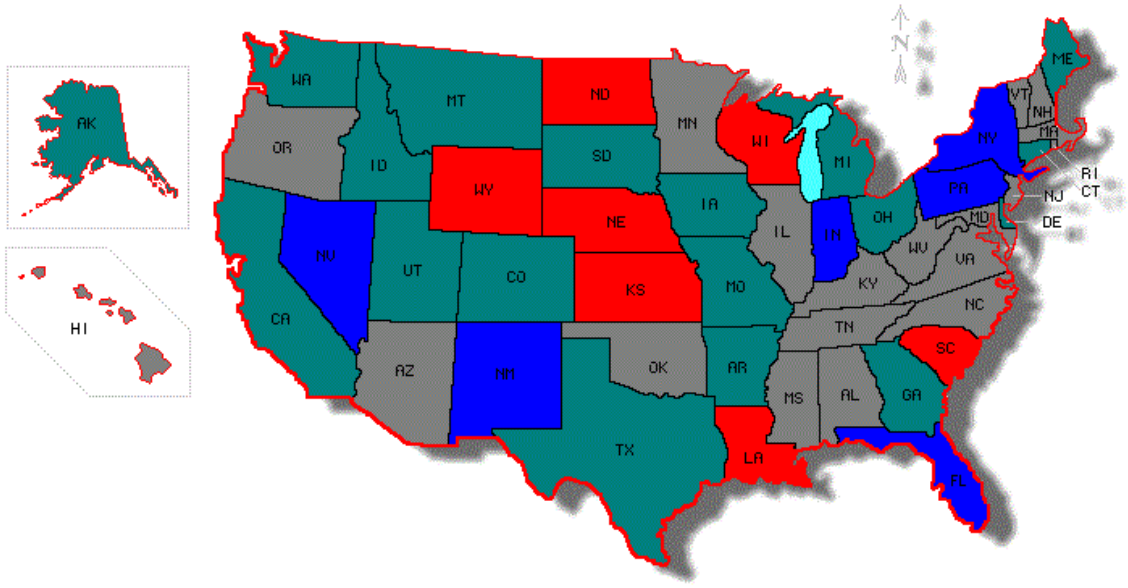


Periodic Payments and Patient Compensation Funds (2010)

- Periodic Payments
- Compensation Funds
- Both Reforms
- Neither Reform



Malpractice Screening Panels (1990-2013)

- Screening Panels
- Evidence Admissible
- No Panels