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DOES MEDICAL MALPRACTICE LAW IMPROVE HEALTH CARE QUALITY?

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ABSTRACT

Despite the fundamental role of deterrence in justifying a system of medical malpractice law, surprisingly little evidence has been put forth to date bearing on the relationship between medical liability forces on the one hand and medical errors and health care quality on the other. In this paper, we estimate this relationship using clinically validated measures of health care treatment quality constructed with data from the 1979 to 2005 National Hospital Discharge Surveys and the 1987 to 2008 Behavioral Risk Factor Surveillance System records. Drawing upon traditional, remedy-centric tort reforms—e.g., damage caps—we estimate that the current liability system plays at most a modest role in inducing higher levels of health care quality. We contend that this limited independent role for medical liability may be a reflection upon the structural nature of the present system of liability rules, which largely hold physicians to standards determined according to industry customs. We find evidence suggesting, however, that physician practices may respond more significantly upon a substantive alteration of this system altogether—i.e., upon a change in the clinical standards to which physicians are held in the first instance. The literature to date has largely failed to appreciate the substantive nature of liability rules and may thus be drawing limited inferences based solely on our experiences to date with damage-caps and related reforms.

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I. INTRODUCTION

Among the key rationales typically invoked to support the medical malpractice liability system is the notion that medical liability forces can incentivize physicians to improve the quality of care that they provide to patients. Somewhat surprisingly, however, little direct evidence exists on whether malpractice law actually provides such a "deterrent" effect to physicians. Rather, the empirical malpractice literature has somewhat deemphasized considerations of medical quality and medical errors and has paid significantly more attention to the relationship between malpractice pressure and measures of treatment utilization and health care costs, i.e. "defensive medicine." Although studies of defensive medicine generally demonstrate that greater health care spending or utilization, prompted by greater malpractice pressure, is infrequently associated with significant improvements in broad measures of mortality, it is nearly universally recognized that such mortality measures themselves are poor surrogates for more direct measures of health care treatment quality. It is therefore essentially unknown whether the tort system is achieving one of its stated goals: to improve the quality of care provided by physicians through deterrent forces.

We approach this question in this paper using direct, clinically validated measures of health care treatment quality. In particular, using data from the National Hospital Discharge Surveys from 1979 to 2005 and the Behavioral Risk Factor Surveillance System from 1987 to 2008, we analyze the effect of medical malpractice liability on several comprehensive inpatient and outpatient health care quality metrics including: (1) risk-adjusted inpatient mortality rates for selected medical conditions (e.g., acute myocardial infarctions, hip fractures and strokes), which have been argued to specifically reflect the quality of inpatient care, (2) avoidable hospitalization rates and cancer screening rates, which reflect the quality of outpatient care provided by physicians, and (3) adverse-event rates to mothers during childbirth, which reflect an alternative, patient-safety-focused indicator of inpatient quality.

Collectively, these indicators account for four of the five domains of quality targeted by the OECD's Health Care Quality Indicator's project and for each of the three domains of quality promulgated by the Agency for Health Care Research and Quality (AHRQ). We note, of course, that particular quality measures may induce greater liability fears among physicians than others, given the frequency with which lawsuits arise in the associated medical contexts. For instance, cancer screening rates may be especially good measures to study the link between malpractice and health care quality given that missed cancer diagnoses constitute a frequent basis for malpractice lawsuits (Schiff et al. 2013).

We employ two approaches to identifying the influence of liability forces on health care quality. First, we take the more traditional route in the literature and estimate difference-in-difference specifications that draw upon the adoption of caps on non-economic damages awards and related reforms (i.e., 'traditional reforms' or "damage cap reforms"). These plausibly exogenous reforms primarily serve to decrease the expected consequences of liability and by doing so allow us to evaluate the impact of reforms that essentially maintain the basic structure of the tort system, but that simply blunt its severity. Second, in contrast to these traditional, remedy-focused reforms, we study the impact on quality of care of more substantive reforms which directly alter the standards of care against which physicians are judged in medical malpractice suits. In particular, we study changes in state-level laws which led to the retreat from rules which expected physicians to follow customary local practices and the contemporaneous adoption of rules that physicians be held to national standards of care (Frakes 2013).

The empirical malpractice literature to date has largely viewed medical liability forces in a rather abstract sense. It has spoken about liability "pressure," without necessarily asking: "pressure to do what?" We demonstrate that this failure to appreciate the substantive nature of liability rules and the clinical expectations such rules place on physicians may leave analysts relying solely upon our experiences to date with traditional reforms with incomplete information regarding the potential role of medical liability in shaping physician practices. We contend that, even if observed levels of health care quality happen to be relatively insensitive to the adoption of a damage cap or related remedy-focused reform, one would be premature to take such findings to conclude that physicians are, in fact, universally unresponsive to liability forces. Relative to such traditional reforms, substantive reforms that change the standards against which physicians are judged hold the potential to more directly and powerfully influence physician practice patterns. Such latter reforms thus merit separate attention.

To understand the intuition behind the insufficiency in merely relying upon the results of the damage-cap studies, one must first understand the substantive nature of our present liability rules. In determining the legal standards against which physicians should be judged, malpractice law generally defers to customary market practices. In other words, physicians determine their own standards. Liability forces in a system of this nature thus impose few independent expectations on physicians. Systematically, under such rules, physicians may only alter their practices in response to liability fears due to uncertainty in their beliefs as to how courts will assess customary practices—i.e., they may aim to deliver higher quality than otherwise customarily desired over fear that courts will misjudge customary practices to entail such higher practices. Damage caps may therefore only induce changes in physician practices to the extent that they reduce the cost of uncertainty to physicians about whether their practice patterns deviate negatively from customary market practices. Caps otherwise do not alter the clinical expectations being placed upon physicians.

One might not be surprised to find that the channel of influence inherent in a custom-focused liability system is limited in its ability to independently induce substantially higher levels of care. After all, as just suggested, liability forces in this system may only incentivize higher levels of care as a result of blind guesswork on the part of physicians. Consider, in contrast, an alteration of the structure of this system altogether—for example, by changing the way in which the clinical standards expected of physicians are determined in the first place. To the extent that these standards change in a way so as to explicitly expect higher levels of quality, one might be less surprised to find a substantial response in physician behavior. Following a reform of this nature, physicians will not deliver higher quality of care simply because they are guessing that this might be expected of them at court. Rather, they may deliver higher quality care as a result of explicit directions under the law to do so.

Generally consistent with expectations, our empirical analysis of the impact of remedy-centric traditional reforms on the quality of care provided by physicians casts doubt upon the independent deterrent effect of medical liability forces in the present custom-focused liability system. For each measure of health care treatment quality, the estimated effect of malpractice pressure within our current liability system, as identified by the adoption of non-economic damage caps and related tort reforms, is both statistically insignificant and small in magnitude, with a 95% confidence interval that is relatively tightly bound around zero. For instance, at one end of this interval, the lack of a non-economic damages cap — which is indicative of higher malpractice pressure — is associated with only a 2 percent decrease in inpatient mortality rates for selected medical conditions.

Importantly, however, while this remedy-centric-reform analysis implies at most a modest degree of deterrence stemming from the present system of liability rules, the results from the standard-of-care-reform analysis suggests that a substantive alteration of the malpractice system may lead to more meaningful changes in observed measures of quality. For example, for each measure of health care treatment quality, we find that when states modify their standard-of-care rules to expect physicians to provide a higher level of quality, observed levels of quality increase substantially in the direction of such new expectations. Moreover, when states modify their rules so as to condone lower provision of quality by physicians, physicians do not appear to respond by delivering lower quality care. Changing the legal standard of what is expected of physicians therefore has the potential to improve the quality of care provided by low-quality physicians without reducing the quality of care provided by already high-quality physicians. Our analysis suggests that medical liability forces—under the right structural framework—hold the potential to elevate the quality floor.

The paper proceeds as follows. In Section II, we discuss existing evidence on the deterrent impact of medical liability. Section III presents a simple model of physician decision-making under the threat of liability. Section IV discusses the data and empirical methodology. Section V presents the results of the empirical deterrence analysis. Finally, Section VI concludes.

II. MALPRACTICE LAW AND PHYSICIAN BEHAVIOR: BACKGROUND

Relatively limited evidence exists on the degree to which medical malpractice deters undesirable practices and improves health care quality.[1] Among those studies that do explore this link, most evaluate aggregate health outcome measures such as overall mortality, which by

[1] Whatever has been done has largely been conducted rather tangentially in connection with investigations into the physician supply-related impacts of malpractice law or into the relationship between malpractice forces and health care costs and treatment utilization rates.

itself poorly reflects the quality of the various clinical processes of care that physicians use to improve health. Moreover, the results of these studies paint a mixed picture. For example, Lakdawalla and Seabury (2009) find that higher county-level malpractice pressure leads to a modest decline in county-level mortality rates., whereas other studies of the impact of malpractice reforms on infant mortality rates generally find no relationship (Klick and Stratmann 2007). Similarly, Frakes (2012), Currie and MacLeod (2008), and Dubay, Kaestner, and Waidmann (1999) each estimate the impact of malpractice pressure on infant Apgar scores (recognized as valid predictors of neonatal health outcomes),[2] generally finding no evidence consistent with any such relationship.[3]

A major limitation of the above approaches to measuring health care quality is that such broad-based measures are likely to be driven by many factors other than the care actually delivered at particular outpatient and inpatient encounters (McClellan and Staiger 1999). These factors include health care access, socio-economic status, individual risky behaviors, living conditions, social support networks, etc. Although Apgar scores and infant mortality rates are arguably more connected to a particular encounter – i.e., the delivery itself – delivery outcomes are also influenced by environmental, physical and medical factors throughout the full term of the pregnancy and not simply the delivery. While outcomes such as general mortality rates and infant mortality rates are undeniably important, the possibility of a multitude of determinants of one's health status raises statistical concerns over the ability to reliably identify the link between variations in the malpractice environment and the indicated health outcomes.

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[2] See, for example, Casey et al. (2001).

[3] Various other studies similarly calculate health outcome measures based on mortality rates that are focused on more targeted populations. For instance, Kessler and McClellan (1996) estimate a trivial relationship between liability reforms and (1) survival rates during the one year period following treatment for a serious cardiac event (e.g., acute myocardial infarction), and (2) hospital readmission rates for repeated serious cardiac events over that period. Sloan and Shadle (2009) undertake a similar analysis.

A key advantage of focusing the malpractice inquiry on those quality measures developed by the medical literature and discussed further below is that the promoted measures are, by their very design, better reflective of the influence of the delivered health care itself. Moreover, while some of the indicators continue to emphasize mortality-related outcomes, other indicators, such as avoidable hospitalizations, adherence to cancer screening guidelines, and maternal traumas, bear on a broader range of morbidity- and non-mortality-related impacts. Very few malpractice studies have investigated the link between malpractice law and these types of quality metrics. One exception perhaps is Currie and MacLeod (2008). The authors find that damage cap adoptions increase preventable complications of labor and delivery, suggesting that higher liability pressure improves patient safety. Iizuka (2013) likewise finds that certain tort reforms—e.g., collateral source rule reforms and punitive damage caps—increase labor and delivery-related complications (using the ob-gyn-specific patient safety indicators promulgated by the Agency for Health Care Research and Quality). Interestingly, Iizuka finds no such relationship with non-economic damage-caps, despite the fact that such caps arguably amount to the most significant reduction in liability pressure out of the four traditional reforms that he explores (Paik et al, 2013).[4]

Our analysis builds upon the Currie and MacLeod (2008) and Iizuki (2013) studies in several important ways. First, we explore a broad range of both inpatient and outpatient measures of health care quality that goes beyond the obstetrics context. While obstetrics has formed the canonical example of research in empirical malpractice, obstetricians themselves account for less than 3 percent of U.S. physicians. The health care quality processes that we

[4] Another recent study by Zabinski and Black (2012) explores the impact of Texas' non-economic damage cap adoption in 2003 on a much broader range of patient safety indicators than that considered by Currie and MacLeod (2008) and Iizuka (2013), similarly documenting an increase in the incidence of adverse events upon the lightening of malpractice pressure associated with the damage-cap adoption. With only one treatment group, however, the point estimates from this analysis should be interpreted with caution.

study form the ‘bread-and-butter’ practices of generalist physicians which form the largest group of practicing physicians. Second, we analyze the quality of health care provided in outpatient settings, a setting which accounts for over 20% of the nation’s total health care dollars (CMS 2011) and has received no special attention by the malpractice deterrence literature. Third, as described below, our analysis also captures a richer degree of variation in relevant tort laws than that considered by both Currie and MacLeod (2008) and Iizuki (2013), resulting in arguably more reliable estimates. Finally, as an arguably more robust way to investigate the link between liability and quality, we also consider the impact of more structural liability reforms that alter the clinical standards expected of physicians.

III. MODEL OF PHYSICIAN BEHAVIOR UNDER MALPRACTICE

A. *The effect of traditional malpractice reforms*

This section develops an illustrative model of how physician behavior is affected by malpractice liability and both traditional vs. substantive malpractice reforms. Consider a physician faced with the decision of whether or not to undertake a quality-improving action / precaution, *A*, that comes at a cost of *C* to the physician. The patients a physician treats are each characterized by a unique disease severity *s*, where higher levels of *s* reflect greater disease complexity and whereby *s* follows a uniform distribution (0/1) across the population. For a patient with disease severity *s* who receives action A by the physician, the benefit to the patient is *B(s)*, where the benefit is increasing in *s*.

Physicians decide upon a cutoff point, *s’*, along the distribution of patient disease complexity at which they begin to take precaution *A*. For patients with disease complexity below this cutoff—i.e., for the healthiest patients—the physician might deem *A* unnecessary given its cost. For risk factor levels above the cutoff point, they will elect to perform the action. This behavior can be summarized by a quality improvement rate of $1 - s'$.

Now, first assume that the physician's desired cutoff point is influenced solely by their clinical beliefs regarding the appropriateness of *A* given *s*. She will avoid the quality-improving action as long as its cost, *C*, exceeds the benefits, *B(s)*, of taking the precaution. With levels of *s* beyond this point, the benefits will surpass such costs and she will undertake the quality improving treatment. An equilibrium will be reached whereby the physician will set her cutoff point at the intersection of the benefit and cost curves. As demonstrated by Figure 1, we signify this particular cutoff at $\hat{s}$.

Of course, other factors could also influence this cutoff decision. For instance, physicians may be compensated more for taking precaution *A* (i.e., paid "fee-for-service"), which may shift upwards their perceived benefits curve, leading to a lower cutoff point and an associated higher level of precaution-taking. On the other hand, as a result of limitations in their knowledge bases, the benefits that physicians perceive to follow from taking precaution *A* may fall short of the true benefits. As demonstrated by Figure 2, the benefits that a physician attaches to *A* may actually follow $B^*(s)$. Operating under such beliefs, physicians will set a cutoff point at s^*, which is higher than the fully-informed (i.e., optimal) point, $\hat{s}$. In this equilibrium in which physicians are imperfectly informed, physicians may not provide treatment *A* to a subset of patients—i.e., those with *s* between $\hat{s}$ and s^*—for whom the true benefits of treatment exceed the costs.

Continuing with the assumptions in Figure 2, next consider the marginal effect of malpractice liability. For now, assume that the liability system is free of uncertainty and error. The law consistently sets a particular standard of care that the physician is expected to follow and the physician is assumed to be able to determine with certainty what this standard is. Assume further that this standard of care is initially set according to local customs. Because the standard of care is based on customary practices and because physicians are assumed to underestimate the benefit of treatment (i.e., the perceived benefit is $B^*(s)$), the standard expected under the law will be set at s^*, the cutoff point (with an associated treatment rate of 1-s^*) actually implemented by physicians as a result of their non-liability influences. If a physician fails to provide the quality-improving action *A* to patients with disease complexities beyond cutoff s^*, she may subject herself to liability. If a physician fails to provide treatment in situations where treatment is normally not provided (i.e. $s < s^*$), even if the true benefits of the precaution surpass its cost in such instances, she will nonetheless avoid liability due to the customary standard for liability.

In this simple case, liability pressure only reinforces the pre-liability equilibrium of treatment provision and incentivizes physicians to continue setting their practices such that they follow a sub-optimal precaution rate of 1- s^* and a cutoff of s^*. Thus, as a first-order matter, liability forces under a customary standard of care do not push clinical behaviors in any particular direction. Consequently, in the presence of customary standards of care, diminishing the force of the liability system through the adoption of reforms that render the consequences of malpractice liability less severe—e.g., a damage cap—should not cause physicians to deviate from their customary practice positions.

Now allow for uncertainty to enter the liability determination process. Courts may misperceive what the customary norms of practice actually are. For instance, consider a patient with a disease complexity level just below s^*, in which case physicians would typically opt not to perform *A* on someone of this health status. If courts have imperfect information about what practice patterns are customary, they may make the incorrect assessment that physicians customarily perform *A* in such circumstances and thus attribute negligence to this physician. The threat to physicians of malpractice may cause them to reevaluate their customary positions and expand their level of precaution-taking to patients healthier than s*. This will be true if the expected damages from liability surpass the physician's perceived net costs of providing treatment *A* to this patient—i.e., $C\text{-}B^*(s)$. At some point, however, as s falls below s*, the probability of a negligence determination may become remote enough that the perceived net costs of taking the quality-improving action on such healthy patients outweighs any foregone liability costs and patient health benefits that could come from providing this action. Accordingly, physician uncertainty about the risk of malpractice liability may lead to an increase in treatment levels, though it will unlikely lead to a universal adoption of the treatment. Online Appendix A specifies in greater detail those conditions under which imperfect information among courts about customary standards of care may lead physicians to increase levels of treatment.

To the extent that physicians underestimate the benefits of treatment *A*, the imposition of a liability system which imperfectly measures customary standards of care may therefore compel them to increase rates of precaution-taking in the direction of the optimum, $\hat{s}$. In other words, the liability system may induce some amount of welfare-improving deterrence. Similarly, the adoption of reforms that reduce the expected cost to physicians of losing a malpractice suit—e.g., a damage cap—may undo these liability-related benefits and lead to declines in quality. In the empirical analysis below, we test for the extent of any such second-order, uncertainty-related changes in quality stemming from damage caps.

The effect of substantive malpractice reforms

Interestingly, liability-induced improvements in quality in the above framework may simply stem from imperfect information in courts about the customary practice patterns of physicians, as opposed to stemming from well-delineated legal standards that establish the optimal level of health care quality. In an environment in which a physician's liability is determined solely based on a physician's accordance to customary practices, the independent and marginal effect of liability in deterring medical errors and improving health care quality arises perhaps from happenstance (i.e., imperfect information in courts). This raises the obvious question of whether improvements in quality could arise more cleanly and directly by altering how physician behavior is evaluated by courts in the first place—e.g., by a retreat from using actual customary practices of physicians to determine standards, which may themselves be inherently sub-par, and by the imposition of standards that are based on better-informed science and that directly expect that physicians follow optimal clinical approaches. We stress that this inquiry is more than a mere hypothetical exercise. Many of the proposed "next generation" malpractice reforms under discussion by analysts and policymakers are of this nature—e.g., those in which liability standards are to be set according to compliance with clinical practice guidelines.

To explore this question within our model, consider again a situations in which physicians reach an equilibrium marked by an insufficient level of treatment and an associated cutoff point at s^*. Consider now an alternative standard of care imposed by courts whereby the law expects that physicians begin providing the quality-improving precaution at $\hat{s}$—i.e., at the efficient point where the true benefits of the precaution begin to surpass its costs. Will this induce physicians to increase their rate of precaution taking? Consider patients with disease complexity in the range between s^* and $\hat{s}$. In this range, physicians' own perceptions of the benefits of precaution *A* fall short of their costs. That is, if physicians provide the precaution, they perceive that they will lose an amount equal to the difference between *C* and *B*(s)*. However, should they fail to undertake *A*, they will now be liable under the new standard and will lose an even greater amount by being expected to compensate patients for the forgone benefits that they would have received with treatment, *B(s)*.[5] This induces them to provide the precaution to the set of patients with complexities between s^* and $\hat{s}$.

It is worth noting that physician behavior may also move in the direction of this new standard for reasons other than liability fears, e.g., through informational forces. By assumption, physicians may have initially provided sub-standard quality due to their failure to fully appreciate the benefits of undertaking the relevant precaution. By retreating from a liability system based on custom that only reinforced those informational deficiencies and by instead imposing a new liability system that sets liability standards optimally, physicians may update their priors regarding the benefits of precaution taking, given the saliency of information that may flow through liability channels. Such updating alone may cause an increase in delivered quality.

In the empirical analysis below, we test whether physicians respond to changes in liability standards that expect a higher (lower) standard of care by delivering higher (lower) levels of quality.

IV. DATA AND METHODOLOGY

A. Overview

We study the impact of malpractice reforms on the quality of health care provided by physicians, as measured by clinically validated quality metrics rather than aggregate outcomes

[5] By assumption, *B(s)* is greater than *C* in this range between s^* and $\hat{s}$ and thus is greater than *C-B*(s)*.

such as overall mortality. We use two data sources which reflect on the quality provided at both inpatient and outpatient settings. First, we collect data on several quality measures (described below) from the 1979 to 2005 National Hospital Discharge Surveys (NHDS), each of which provides a nationally-representative sample of inpatient discharge records. Second, we use data from the 1987 to 2008 Behavioral Risk Factor Surveillance System (BRFSS) to capture various rates of cancer screening, a measure of outpatient quality of care.[6] We then take two approaches in evaluating the impact of malpractice law on health care quality: (1) estimating the association between our observable quality metrics and the adoptions of traditional, remedy-centric tort reforms—primarily, non-economic damage caps and (2) exploring the relationship between health care quality and substantive liability reforms to the manner in which courts determine medical liability standards.

B. <u>**Damage Cap Analysis**</u>

The first part of our deterrence analysis explores the general relationship between health care quality and changes in malpractice pressure on the margin, as identified by the imposition of traditional tort reforms, the immediate effect of which is largely to reduce the expected levels of damages imposed in the event of liability, without necessarily altering the substantive nature of the liability-determination process itself. Reducing the expected damages awards, in turn, may leave plaintiffs and/or their attorneys less inclined to bring suit, thereby lessening the level of pressure placed upon physicians. Though generally fully insured against financial risks, physicians may welcome such reduced likelihoods of suit to the extent that they face non-insurable costs of liability—e.g., psychological or reputational harms (Jena et al. 2011). The

[6] Not all screening measures are available over this entire time period, however. While longer time periods are available for some measures—e.g., mammograms—others are only available over the 2000s—e.g., PSA testing.

reforms that we emphasize in this analysis, and that have received the most attention by the literature, are caps on non-economic damage (i.e., pain and suffering) awards.

Non-economic damages generally represent over half of the typical malpractice award (Hyman et al. 2009). Furthermore, caps on such damages represent the tort-reform measure that has been most commonly associated with an observed change in certain malpractice outcomes: claims severity, physician supply and malpractice premiums.[7] Nearly thirty states currently have non-economic damage cap provisions in place, most of which were adopted during the malpractice crisis of the 1980's (see Table I). In light of the timing of this variation, those studies relying largely on the 1990s and early 2000s to evaluate the impact of non-economic damage caps (e.g., Currie and MacLeod 2008) fail to draw on the most relevant sources of variation in malpractice law and consequently rely on few treatment groups, implicating concerns over the reliability of the estimated standard errors and over the consistency of the point estimates (Conley and Taber 2011). The NHDS data, supplemented with geographic identifier codes, provides inpatient discharge records over a long enough period of time to allow us to draw on an extensive set of legislative variations. In most specifications, we also explore the association between observed health care quality and certain additional types of tort reforms, including reforms of the collateral source rule, caps on punitive-damages awards and other "indirect" reforms. Further descriptions on all reforms are provided in Online Appendix B.

Ultimately, by rolling back the force of the liability system, without altering its substance, such reforms provide us with a mechanism to explore the marginal influence of the *present* structure of liability standards.

C. **<u>Liability-Standards Analysis</u>**

[7] See Mello and Kachalia (2011) for a comprehensive review of relevant studies. Paik et al. (2013) provides a recent example.

Unlike reforms focused on curbing remedies available to plaintiffs, states have done significantly less experimentation along the more substantive and structural dimension to malpractice law—i.e., the standards against which physician behavior is judged. One significant exception, however, is the broad-based shift largely beginning in the 1960s away from the so-called "locality rule."

Historically, state malpractice laws judged physicians against customary practices of physicians working in the same locality, essentially expecting physicians to follow the practices applied by those around them. Deviations in care from these customary standards that led to adverse medical events were judged as negligent. Over the latter half of the Twentieth Century, however, the majority of states amended their substantive malpractice laws to abandon locality rules in favor of rules requiring physicians to follow national standards of care, thereby geographically harmonizing clinical expectations under the law. In light of the rampant regional disparities in care that have persisted across regions for decades (Wennberg and Cooper 1999), one can view the move from a local to a national-standard rule as a meaningful alteration of the standards clinically expected of physicians (Frakes 2013).

State adoptions of the national-standard rule offer an alternative approach to exploring the relationship between malpractice law and health care quality. In terms of the model presented in Section III, if we conceptualize s^* as representing the customary practices of a particular locality initially operating under a locality rule and $\hat{s}$ as representing the average customary practices of the rest of the nation, then the abdication of the locality rule may allow us to test for the hypothesized shift from a legally expected cutoff of s^* to $\hat{s}$ in the precaution-taking and quality-improving decision of physicians.

In related work, Frakes (2013) tests the hypothesis that, upon the adoption of a national-standard rule, physician practices in the affected regions converge towards practices of the rest of the nation, focusing on utilization rates of various obstetric and cardiac treatments and diagnostic procedures. We follow Frakes (2013) and test for the impact of national-standard adoptions by estimating whether mean quality measures in a state that uses a local-standard rule converge towards relevant national rates when the state amends its malpractice laws to require that physicians comply with national standards of care. Online Appendix B provides further details on the evolution of malpractice-standard rules. Roughly 14 states abandoned the use of local standards in favor of national standards over the sample period (see Table II).

Importantly, this analysis affords us the opportunity to separately test how physicians respond to changes in malpractice standards which in some instances expect higher levels of quality and in other instances lower levels. For each of the quality metrics explored, a number of treatment states began the sample period with high quality levels while a number of others began with low quality levels, in which event the move towards a national standard represented a change in legal expectations in both directions depending on the pre-reform level of quality. In light of the possibility that physicians may respond differently to an elevation of what is expected of them relative to a slackening of what is expected of them, we test for asymmetrical responses to the adoption of national-standard rules.

D. **<u>Quality measures</u>**

Accompanying the medical community's renewed interests on health care quality in recent decades is the development of appropriate indicators of quality useful in assessing associated progress. Foremost among those organizations promulgating indicators is the Agency for Healthcare Research and Quality (AHRQ). AHRQ measures are particularly useful for the present study insofar as they are designed for use with administrative inpatient databases such as the NHDS. AHRQ measures generally cover three domains of quality—i.e., Prevention Quality Indicators (PQIs), Inpatient Quality Indicators (IQIs), and Patient Safety Indicators (PSIs). In constructing quality indicators, we largely build off those developed by the AHRQ, supplementing the AHRQ-related measures with those capturing cancer-screening practices. We provide a brief overview of each metric below, with additional details regarding the construction of the resulting quality metrics provided in Online Appendix B.

Inpatient mortality for selected conditions. Following the AHRQ's IQIs, we first construct a composite inpatient mortality rate for selected acute medical conditions using data from the National Hospital Discharge Surveys. Unlike overall mortality rates computed over the entire jurisdiction affected by a relevant legal regime, IQI-inspired mortality rates are designed to capture mortality events likely associated with a clinical encounter itself and the associated quality of care during that encounter, rather than unobserved socioeconomic characteristics that affect overall mortality within a population. To rule out selection concerns—i.e., concerns regarding the liability regime impacting the probability of patients appearing in the inpatient environment in the first place—this measure focuses on mortality among a subsample of discharges in which the primary diagnosis code indicates select medical conditions (e.g., acute myocardial infarction, stroke, etc.) that uniformly entail hospitalization upon their occurrence. We further risk adjust this composite rate for fluctuations in the incidence of the various conditions comprising the sub-sample.[8] Such risk adjustment addresses concerns that an

[8] In alternative specifications (not shown), we estimate the relationship between liability reforms and the rate of hospitalization for each such condition (e.g., hip fractures), where this rate is calculated relative to the total number of hospitalizations within this subsample of selected conditions. The results suggest very little relationship, if any, between liability pressure and the distribution of conditions comprising this subsample. For instance, at the upper end of the 95 confidence interval, the adoption of a non-economic damages cap is associated with only a 0.7 percent increase in the relative rate of hip fracture admissions among this subsample.

increase in the proportional incidence of one of the lesser-mortality conditions within the sample (e.g., hip fractures) could lead to a reduction in the observed mortality rate with no actual improvement in quality.

Avoidable hospitalizations as a measure of outpatient quality. The second quality measure that we employ captures the rate of avoidable hospitalizations (AH) within each state-year cell, a measure that is inspired by the AHRQ's PQIs. Though constructed using inpatient data, AH rates are widely argued by physicians to reflect the quality of care prevailing in the associated outpatient community. Such measures identify conditions (e.g., hospitalization for asthma exacerbation, uncontrolled diabetes, and uncontrolled hypertension, etc.) with respect to which proper outpatient care would have prevented the need for hospitalization.

One may be concerned that changes in AH rates are not simply picking up changes in associated outpatient quality but are also picking up fluctuations in inclinations of physicians over the decision to admit patients into inpatient care who present to the hospital with the indicated conditions. To alleviate such concerns, we also construct an alternative AH rate that focuses only on a subset of avoidable hospitalizations with little physician discretion over the decision to hospitalize—i.e., focusing on hospitalizations that both could be prevented through quality outpatient care and whose incidence are generally insensitive to the discretion of admitting physicians at hospitals (e.g., ruptured appendix).

Maternal Trauma and Complications. Patient-safety indicators (PSIs) capture complications and adverse events that take place in inpatient settings following surgeries, procedures and deliveries. Using NHDS data, we focus our analysis of PSIs on those related to delivery / childbirth. Many PSIs reflect the quality of care provided during surgeries, rates of which may be a function of the liability environment–e.g., rates of surgery may in theory be more or less common in environments with high malpractice pressure, creating issues of selection. Rates of childbirth, on the other hand, are unlikely to be impacted by malpractice pressures. For the sake of simplicity and to maximize the sample size for this analysis, we group together cesarean trauma events with vaginal delivery trauma events (with and without instruments) and thus construct a composite obstetric trauma indicator. To look at a broader, but related set of obstetric-related complications, we follow Currie and MacLeod (2008) and also consider the incidence of preventable delivery complications—e.g., fetal distress, excessive bleeding, precipitous labor, prolonged labor, dysfunctional labor, etc.

Cancer Screening as a measure of outpatient quality. To complete our measurement of the quality of outpatient care, we use patient self-reports from the Behavioral Risk Factor Surveillance System from 1987 to 2008 to compute incidences of mammography, physical breast exam, Prostate-Specific Antigen (PSA) testing, digital rectal exam, pap smear, and sigmoidoscopy / colonoscopy, used to screen for breast, prostate, cervical, and colon cancer, respectively. As explained in greater detail in Online Appendix B, we use national cancer screening guidelines to select the relevant age groups for the analysis and the window period of relevance for the exam—e.g., mammography within the previous two years for females and sigmoidscopy / colonscopy starting at age 50 and at least once every 5 years).

Descriptive statistics. On average, each NHDS state-year cell contains roughly 424 discharges associated with the selected conditions used in the composite inpatient mortality rate measure, our first quality indicator. The average inpatient mortality rate among this sub-sample is 8 percent, as presented in Table III. Likewise, each state-year cell contains an average of roughly 1017 avoidable hospitalizations. As explained in Online Appendix B, we form AH rates by normalizing AH counts by an index of hospitalizations for low-discretionary medical conditions—e.g., acute myocardial infarction, stroke, etc.—in which case this denominator captures the size of the relevant state-year cell without itself being sensitive to legal or financial incentives. With this normalization, the average AH rate across state-year cells equals 1.7. Furthermore, each state-year cell in the NHDS contains on average roughly 600 deliveries. Within this delivery subsample, maternal trauma (third or fourth degree lacerations) occurs nearly 4 percent of the time and preventable complications occur nearly 16 percent of the time. Finally, cancer screening rates among the relevant BRFSS participants ranges, on average, from 40 to 73 percent.

To describe the variation in quality of care across regions, Column 2 of Table III provides, for each quality indicator, a measure of the average gap over the sample period between the mean state level and the associated mean national level. More specifically, following Frakes (2013), we summarize this gap by calculating the mean absolute deviation between the state and national indicator levels (for each year) and normalizing this rate by the national level. For instance, on average over the sample period, the mean maternal trauma rate within a state differed from the national mean trauma rate by an amount equal to roughly 26 percent of the national level. Because this measure is computed over the entire sample period, this measure to some degree understates the regional disparity measure that is most relevant to our analysis. In particular, in early years of the sample and among states which began the sample under a locality-rule regime, the average gap between the state and the national rate, for each of the listed indicators, is substantially larger than the figures provided in Table III. In the empirical analysis below, we explore whether these gaps are narrowed through the adoption of national-standard rules (approaching the inquiry separately from each side of the regional quality distribution).

E. **Specifications**

We estimate the effect of damage caps on the quality of care provided by physicians through the following specification:

$$(1) \qquad Log(Q_{s,t}) = \alpha + \boldsymbol{\gamma_s} + \boldsymbol{\lambda_t} + \boldsymbol{\varphi_s} t + \beta_1 CAP_{s,t} + \boldsymbol{\beta_2 X_{s,t}} + \boldsymbol{\beta_3 Z_{s,t}} + \boldsymbol{\beta_4 O_{s,t}} + \varepsilon_{s,t}$$

where *s* indexes state and *t* indexes year. $CAP_{s,t}$ represents an indicator variable for the presence of a cap on non-economic damages in state *s* and year *t*. State fixed effects, $\boldsymbol{\gamma_s}$, and year fixed effects, $\boldsymbol{\lambda_t}$, control for fixed differences across states and across years, respectively. $Q_{s,t}$ represents the relevant healthcare quality measure – e.g., the composite inpatient mortality rate or the avoidable hospitalization rate. The coefficient of interest in each specification is captured by β_1, representing the relationship between the relevant quality measure and the adoption of non-economic damage caps.

To control for a range of additional state-year factors, $\mathbf{X_{s,t}}$ represents certain demographic characteristics of the patient population, along with certain mean characteristics of the represented hospitals. $\mathbf{Z_{s,t}}$ represents certain other state-year characteristics (HMO penetration rate, physician concentration rate, and median household income). $\mathbf{O_{s,t}}$ is a matrix representing a set of indicator variables for the incidence of additional tort reforms. In some specifications, we include state-specific linear time trends, $\boldsymbol{\varphi_s}$t, to control for slowly-moving correlations between the relevant quality measures in a state and the adoption of tort reforms by that state. For each of the relevant quality indicators, Online Appendix B provides additional details regarding the compositions of **X** and **Z**.

For the obstetrics-focused and cancer-screening measures, we estimate a specification identical to that indicated above except at the individual-year level (as opposed to the state-year level), using, as appropriate, the full sample of deliveries in the NHDS records or the relevant sample of individual respondents within the BRFSS. The dependent variables in these analogous specifications represent the individual incidence of the respective quality indicator.

To explore whether the quality of health care provided by physicians is affected by the clinical malpractice standards expected of physicians under the law, we next explore whether state mean rates for the relevant quality measures converge towards their respective national mean rates as states adopt national-standard rules. In this investigation, however, we allow for a differential convergent response from the top and the bottom of the regional quality distribution— that is, we allow for a different response when the law changes so as to expect a higher level of quality of physicians compared to when the law changes so as to condone a lower level of quality. Following Frakes (2013), we estimate the following:

$$(2) \qquad Log(Q_{s,t}) = \alpha + \boldsymbol{\gamma_s} + \boldsymbol{\lambda_t} + \boldsymbol{\varphi_{s,t}} + \boldsymbol{\beta_1 X_{s,t}} + \boldsymbol{\beta_2 Z_{s,t}} + \boldsymbol{\beta_3 O_{s,t}} +$$

$$\beta_4 BELOW_s + \beta_5 NS_{s,t} + \beta_6 BELOW_s * NS_{s,t} + \varepsilon_{s,t}$$

where $\mathbf{X_{s,t}}$, $\mathbf{Z_{s,t}}$, $\mathbf{O_{s,t}}$, $\boldsymbol{\gamma_s}$, $\boldsymbol{\lambda_t}$ and $\boldsymbol{\varphi_{s,t}}$ are defined as above. $NS_{s,t}$ represents an indicator for a national-standard law. *BELOW* is an indicator for a state that began the sample period with an initial rate below the national mean for the relevant quality indicator. The coefficient of β_5 in this interaction specification can effectively be interpreted as the association between national-standard laws and quality indicator levels for states with initially above-average indicator levels (i.e., when *BELOW* = 0). Note that for all indicators other than cancer screening rates, higher indicator levels represent lower levels of quality (and vice versa); therefore, states with *BELOW*

= 1 are those with initially low indicator levels (e.g. mortality) but actually higher than average quality. For states with initially below-average indicator levels (*BELOW* = 1), this same association is captured by the sum of β_5 and β_6.

V. RESULTS

A. Damage-Cap Analysis

Overview

Tables IV-VIII present estimation results from specifications that explore the relationship between non-economic damage caps (and related reforms) and health care quality. For each quality measure, we estimate an association between a non-economic damage-cap adoption and the relevant indicator that is statistically indistinguishable from zero, though relatively tightly bound around zero.[9] As such, while we cannot rule out that greater malpractice pressure within our existing system—as identified through the lack of a non-economic damages cap—induces higher quality health care, we can rule out that such forces induce substantially higher levels of quality. Similarly, we can rule out that damage cap adoptions which reduce malpractice pressure are associated with substantial reductions in health care quality.

AHRQ-Inspired Measures and Preventable Delivery Complications

We begin by describing the results for the AHRQ-inspired health care quality indicators and the preventable delivery complications measure (Tables IV – VII), considering that these measures all reflect lower levels of quality as the relevant indicator level rises (and vice versa), whereas the cancer screening measures, which we discuss in subsection A(2) below (and Table

[9] Reported standard errors in Table IV-VIII and in all subsequent tables are clustered at the state level to allow for arbitrary within-state correlations of the error structure.

VIII), reflect higher levels of quality as the screening levels rise. We separate the discussions with this difference in mind to ease confusion in exploring the relevant associations.

Upon the adoption of a non-economic damage cap, we estimate mean changes in the inpatient mortality rate for selected conditions, the AH rate, the low discretionary AH rate, the maternal trauma rate and the preventable delivery complication rate of only 0.8, 0.3, -0.5, -2.2, and -1.2 percent, respectively.[10] This pattern of point estimates does not change meaningfully upon the inclusion of state-year covariates, other tort laws and state-specific linear time trends, as demonstrated by Columns 2 and 3 in each of Tables IV-VII and by Columns 6 and 7 of Table V (-3.8, -1.0, -1.7, -0.0, and 4.2 percent, respectively).

These estimates are not significant at the p=0.05 level of significance. Accordingly, we cannot rule out that positive associations between damage caps and these various quality indicators exist—that is, we cannot rule out some decline in quality associated with reductions in liability pressure and thus some improvement in quality associated with increases in pressure. However, even at the upper end of the 95 percent confidence interval, we find that the adoption of non-economic damage caps is associated with only a 6.6, 4.9, 4.3, 5.7, and 6.9 percent increase in those same quality measures, respectively, as indicated near the bottom of each of Tables IV-VII. That is, higher malpractice pressure within our given liability system—captured by the lack of a damage cap—can at most lead to a modest level of deterrence, inconsistent with the idea that the current medical liability system can be used to substantially improve health care quality through deterrent forces.

[10] To calculate this percent change (as distinct from a percentage-point change) for the obstetrics measures (which derive from linear probability models on the full delivery subsample), we divide the indicated coefficient by the mean incidence of such measures over the sample. Given the log specification for the AH rate and mortality rate specifications, the coefficient itself can be interpreted in such percentage terms.

In Table C1 of Online Appendix C, we present dynamic variants of the difference-in-difference specifications estimated in Tables IV-VII, which include leads and lags of the damage-cap incidence variable, allowing us to explore how the differential in quality across treatment and control states evolves on a year-to-year basis (where time is captured with reference to years before and after adoption). While the confidence bounds for each coefficient in this dynamic specification expand slightly with the inclusion of this additional set of policy variables, they continue to bound zero at a relatively tight rate confirming the conclusion of an at most modest association between damage-cap adoptions and the various quality indicators. Online Appendix C likewise demonstrates the robustness of these findings to various additional specification checks, including, among others, various alternative constructions of the AH rates and inpatient mortality rates and the consideration only of damage-cap adoptions that apply to tort contexts broadly, easing legislative endogeneity concerns—i.e., dropping states that adopted damage caps only in the malpractice context.

Finally, we note that the non-economic damage cap results generalize to the other traditional tort reforms included as covariates, suggesting a generally weak relationship between both inpatient and outpatient health care quality and a broader range of reforms. In the case of the inpatient mortality rate, maternal trauma and preventable delivery complications measures, the results of an F-test of joint significance of all remedy-focused tort measures fail to reject the hypothesis that the coefficients of the various tort reforms are all jointly equal to zero. In the case of the AH rate specifications, the estimated coefficient of the residual reform category – i.e., the "indirect" reform category specified according to Kessler and McClellan (1996) – is negative and bounded away from zero in some specifications, suggesting an improvement in quality in connection with such reforms and thus counter to any expectation that such reforms would relax malpractice pressures to the detriment of patient quality.[11]

The above-estimated specifications include state-year controls for physician concentration rates (and OB/GYN concentration rates in the case of the obstetrics measures). Such controls may absorb any impact of the reforms that occur through changes in the physician population. However, these simple controls may not absorb all supply-related consequences of such reforms. One effect of non-economic damage cap adoptions sometimes hypothesized is that lower-quality physicians may be attracted to the jurisdiction subsequent to the reform (Seabury 2010), a development which could otherwise confound any attempt to isolate the impact of malpractice pressure on the quality provided by any given provider. Of course, to the extent that non-economic damage caps would attract low-quality physicians and lead to a decline in observed quality – e.g., to an increase in the quality indicators explored in Tables IV-VII – this omission could only help to explain any positive effects of such reforms on the indicators explored. That is, a correction for this bias would likely push the estimated impacts of the reforms on the observed indicators even lower, only lending further support to the claim that liability pressure on the margin within our current liability system does not appear to be substantially improving the quality of care being delivered by physicians.

Cancer Screening Measures

As presented in Table VIII, the pattern of results from the cancer-screening / damage-cap analysis mirrors that from the AHRQ-inspired quality measures (with even greater precision in

[11] One component of this residual category is the reform of the joint and several liability rule. In alternative specifications (not shown), where we include the joint and several liability reform independently, we likewise estimate small, negative point estimates for this reform, suggesting an *improvement* in avoidable hospitalization rates in connection with joint and several liability reforms, perhaps consistent with the predictions set forth in Currie and MacLeod (2008).

the estimates). We estimate mean associations between damage-cap adoptions and the various cancer screening rates that are very nearly zero in magnitude. As above, we cannot rule out some level of reductions in quality—i.e., some reduction in screening rates—in connection with damage cap reforms that are designed to reduce liability pressure. However, the 95-percent confidence bounds for each rate suggest that we can rule out substantial reductions in screening rates in associated with caps. Lower bounds for these intervals suggest a 2.1, 3.0, 4.0, 1.7, 0.2 and 3.2 percent reduction (and an even lower percentage-point reduction) in mammography, physical breast, sigmoidoscopy/colonoscopy, PSA testing, and digital rectal and pap smear examinations, respectively. To simplify the presentation of these results, we present only the results from the naïve difference-in-difference specifications. In Online Appendix C, we demonstrate the robustness of these findings to the addition of a range of control variables, along with alternative constructions of the screening rates.

Alternative Codification of Damage-Cap Variable: Simulation Analysis

In the final column of each of Tables IV-VIII, along with Column 4 of Table V, we estimate specifications that take an alternative approach to the codification of the damage-cap incidence variable. While the malpractice literature customarily codifies damage-cap adoptions in a simple binary fashion (0/1), non-economic damage cap provisions, in fact, take on a range of forms across jurisdictions. For instance, California imposes a flat, nominal $250,000 cap on non-economic damages awards, while Wisconsin imposes a $750,000 cap. One might imagine that California's cap would entail a stronger reduction in liability pressure. Hyman et al. (2009) use closed-claims data from Texas during the period of time prior to the imposition of its non-economic damage cap (with information on the breakdown of economic versus non-economic damages associated with the claim) to simulate the potential impact of the various damage-cap provisions across the various states. More specifically, they simulate the percentage of a mean verdict that is reduced through the imposition of the various caps employed across states.

In the present analysis, we build on these preliminary efforts by Hyman et al. (2009) and use the results of this simulation exercise as the relevant damage-cap variable within the difference-in-difference specification, as opposed to the simple binary approach. In applying these simulated measures to each state-year cell, we appropriately adjust this simulated reduction to account for inflation in the case of those damage-cap provisions that do not tie their cap levels to inflation. Inspired by studies in public finance (Currie and Gruber 1996), this codification scheme provides an empirically-informed way to ensure the comparability of the legal modifications under investigation, effectively reframing the treatment of the law in terms of the common function provided by such laws (i.e., reducing awards), as opposed to some coarse measure of their existence.

The estimated mean coefficients from those specifications using this alternative codification of damage-cap variables do not differ substantially from those derived from the traditional binary approach. In the case of inpatient mortality rates for selected medical conditions, AH rates, low-discretionary AH rates, maternal trauma rates and preventable delivery complication rates, such estimates suggest a -0.1, -3.7, -3.0, -0.0 and -3.0 percent change in the respective quality indicator upon an increase from 0 percent to 100% in the simulated extent to which a damage cap reduces a jury verdict. These largely negative point estimates are also inconsistent with the expectation that reducing liability pressure through the imposition of a cap will lead to a decline in quality—i.e., an increase in these respective measures. As above, of course, these results are statistically insignificant and cannot rule out some degree of a positive association between these measures and the reduction in damage awards resulting from caps.

The associated upper ends of the confidence intervals for these estimates suggest a 17.1, 9.3, 6.1, 33.3, and 16.0 percent change respectively. While the upper bounds are larger than those for the traditional codification approach discussed above, bear in mind that these estimates are to be interpreted in terms of a shift in the law that leads to a full 100% reduction in malpractice verdicts.

B. **<u>Liability-Standards Analysis</u>**

AHRQ-Inspired Measures and Preventable Delivery Complications

The above approach identifies the influence of malpractice law by comparing quality across regimes marked by different levels of expected liability awards. Effectively taking as given the structure of the liability system itself, this initial approach allows us to explore the marginal influence of the present custom-focused liability system. In an alternative approach to exploring the link between malpractice and health care quality, we estimate the interaction specification indicated by equation (2) above and explore whether health care quality is influenced by potentially more impactful reforms that directly alter the clinical standards of care expected of physicians. The results of this exercise are presented in Tables IX-XII.

The coefficients presented in the first row of each of Tables IX-XII can be interpreted as the association between the given quality indicator and the adoption of a national-standard rule in those treatment states that began the sample period with initially above-average indicator levels (i.e., where the below-average indicator variable equals zero), representing those states with *initially low* levels of quality. In the case of inpatient mortality rates for our selected medical conditions, the AH rate, the low-discretionary AH rate, the maternal trauma rate and the preventable complication rate, we estimate that the adoption of a national-standard rule in such states is associated with a substantial and statistically significant (across nearly every specification) decrease in the respective indicator measure and thus a substantial *increase* in health care quality (considering, again, that high quality is captured by lower levels of these various indicator measures). More specifically, in the naïve difference-in-difference specifications with only state and year fixed effects, we estimate a 7.6, 47.4, 54.5, 12.6 and 40.3 percent decrease in the respective quality indicator in connection with national-standard adoptions. With the inclusion of various state-year covariates and state-specific linear time trends, these estimates remain nearly the same, suggesting a 9.0, 22.3, 27.2, 28.6, and 42.0 percent decline in the respective indicator. Considering that a national-standard adoption in such initially-low-quality states entails a shift in clinical expectations in the direction of higher quality, the results from this exercise suggest that liability reforms that affirmatively elevate the standards expected of physicians—a reform of a far different variety than damage caps—may indeed succeed in inducing higher quality practices.

In Tables C3 and C4 of Online Appendix C, we present results from dynamic versions of the specifications estimated in Tables IX-XII. For each measure of health care quality, the estimated pattern of lead coefficients for the national-standard indicators do not suggest any increasing trends in the differential quality attainments between treatment and controls states prior to the reforms. Pre-treatment trends of that nature may have undermined the assumption inherent in the difference-in-difference specification that, but for the change in the law, the quality indicators would have trended in the same direction in the treatment and control groups alike. As such, the fact that the differential in quality emerges only upon the adoption of the national standard rules themselves increases our confidence in a causal interpretation of the documented associations. Online Appendix C further demonstrates the robustness of these findings to a number of specification checks, including those listed above for the damage-cap analysis, along with the use of a randomization inference approach to explore the statistical significance of the findings.

While practices appear to improve upon a shift in clinical standards expecting higher quality, the results do not overwhelmingly suggest a corresponding decline in quality upon a shift in legal standards arguably condoning lower quality care. To assess this reverse question, we explore what happens to initially high quality states (states with initially low quality indicator levels) when they adopt national-standard rules, which, in the case of such states, arguably lower operable standards by expecting that physicians follow the lesser-quality practices applied elsewhere. These results can be obtained from the relevant interaction specification by adding the two coefficients presented in the various columns of Tables IX-XII (adding the baseline effect in the initially low-quality states to the interaction term capturing the subsequent change in the quality indicator associated with moving towards an initially-high-quality state). Across the various indicators, this addition suggests that a national standard adoption in the initially high-quality states is associated with a 5.2, -1.4, -1.1, -4.3, and an 11 percent change in the respective quality indicator. Only in the case of the inpatient mortality rate and the preventable delivery complication rate do we observe a decline in quality—that is, an increase in the respective indicator—upon this change in standards arguably condoning a lower level of quality. Even in those cases, of course, these responses are more modest than the responses indicated above for the initially low-quality states. Further, as demonstrated by Table C4 in Online Appendix, C it appears that the inpatient mortality rate response emerges largely in the period of time prior to the national-standard adoption, suggesting that it may not even be a true response to the law itself.

Cancer Screening Measures

For this liability standards analysis, our primary tables do not include results for the cancer screening measures. For some of these measures—e.g., PSA testing for prostate cancer—data are only available during the 2000s, affording no ability to draw upon relevant standard-of-care reforms. Likewise, with respect to sigmoidoscopy/colonoscopy screening for colon cancer, data are generally unavailable in the pre-reform years for the relevant treatment states to facilitate a difference-in-difference analysis. For the remaining cancer screening measures—e.g., those relating to breast and cervical cancer—data are available during a period of time—i.e., the 1990s—in which Indiana, Delaware and Rhode Island can be utilized as treatment states. Our intent, of course, is to separately test for the effect of national-standard adoptions for those treatment states with initially high and initially low cancer screening rates. For the breast-cancer-screening measures, this leaves only one state—Indiana—from which to explore the effect of a liability reform that entails a heightening of standards. In the case of pap smear testing, both Indiana and Rhode Island can be utilized as treatment states in exploring the effect of heightened standards. In either case, with only one or two treatment states, the point estimates from a difference-in-difference analysis are generally thought to be inconsistent (Conley and Taber 2011), leaving us with arguably unreliable estimates (given a higher degree of chance that spurious developments explain the findings). As such, we do not include them alongside the primary results from this analysis, which draw upon much more extensive legal variation. Nonetheless, we present such results in Online Appendix C. Encouragingly, such results likewise document an increase in quality attainment (in this case, an increase in cancer screening rates) upon a modification of standard-of-care rules that entail a heightening of expectations.

VI. DISCUSSION AND CONCLUSION

An extensive number of empirical malpractice studies have endeavored to test for the existence and scope of so-called "defensive medicine." While deterrence of medical errors can be viewed as a primary objective of the medical liability system, defensive-medicine is best characterized as a possibly unfortunate side-effect / cost of this system. Physicians may act defensively when they unnecessarily order costly tests, procedures and visits over fear of malpractice liability (OTA 1994). However, even if one's primary focus is to explore these side effects of liability, rather than to assess whether the law is achieving its stated goal of deterring medical errors, it is critical to bear in mind that labeling a response as "defensive" requires more than a mere understanding of whether liability encourages additional utilization of medical care. Since a defensive response is defined with reference to the necessity (or optimality) of the chosen level of treatment, this assessment requires a determination as to whether or not any malpractice-induced expansion in treatment is accompanied by corresponding improvements in quality or outcomes.

As such, whether the goal is to make an independent evaluation of the deterrent impact of medical liability or to properly diagnose a defensive response to liability, it is necessary to estimate the impact of the malpractice system on medical errors and health care quality. To date, however, nearly all studies which assess the impact of malpractice pressure on health care quality focus on coarse measures of quality such as aggregate mortality rather than more direct measures of physician behavior. A major contribution of our analysis is to use clinically validated measures of health care quality to estimate the effect of malpractice pressure on the quality of care provided by physicians. In this process, it is also important to bear in mind the structure of the malpractice system itself, a factor generally overlooked in most empirical discussions of this nature. In estimating the impacts of remedy-focused / non-substantive reforms such as non-economic damage caps, one is effectively teasing out the marginal impacts of the present structure of liability. The confidence bounds presented in our analysis suggest, at most, a modest degree of deterrence stemming from the present liability system. The mean point estimates suggest that this system generates little to no benefits in health care quality. We caution that these findings should perhaps not be interpreted so as to suggest that medical liability forces are universally incapable of improving quality. Rather, they should be interpreted in light of the largely self-regulatory nature of our present malpractice system.

Given the malpractice system's strong adherence to customary physician practices, practices which are themselves shaped through a variety of non-legal influences, it is perhaps unsurprising that when we roll back the force of the law through damage-cap-esque reforms we do not find ourselves in a situation where physicians face significantly weakened incentives to deliver quality care. The law itself is not designed to impose independent expectations regarding quality. Of course, the law may still elevate care to the extent that it discourages errant physicians seeking to deviate from industry custom. Even in such instances, however, it is important to bear in mind that customary physician practices themselves fall far short in promising the delivery of high quality care (e.g., rates of age appropriate cancer screening fall well below 100%), in which event legal enforcement of such custom will similarly fail to hold much promise. Finally, while the threat to physicians that courts may imperfectly judge their behavior relative to the standard of care may cause physicians to attempt to outperform industry custom, they are necessarily provided with no guidance as to how achieve that end.

The second half of our empirical analysis provides some hope, however, in the potential for medical liability to influence physician behavior. Drawing upon the one type of standard-of-care reform that states have experimented with to date—i.e., locality rule abdications—we investigate the impact of changing the clinical standards of care imposed upon physicians under the law, both in terms of elevated standards and slackened standards. All told, it appears that the relationship between health care quality and changes in clinical malpractice standards works in an expansionary direction only. That is, once physicians provide a high level of quality, they may maintain such practices even when the law may loosen its expectations at a later date. In contrast, physicians who provide a quality of care that is below what is expected by the law raise their practice to meet the higher expectations set by the law. Malpractice forces may therefore be effective in elevating the quality floor. This pattern of results is arguably consistent with an interpretation in which informational forces constitute the mechanism of action behind any responsiveness in behavior to legal standards, as hypothesized above and as distinct from traditionally hypothesized fear-of-liability channels. Further work, however, is warranted to tease out the underlying story behind such responses and to distinguish informational mechanisms from traditional fear-based liability mechanisms.

If our findings are taken to suggest that structural reforms to the way in which physicians are evaluated may substantially alter health care delivery practices, one may wonder whether subsequent reforms that blunt the impact of the now altered liability system—e.g., damage caps—may cause practices to revert back to where they were before the structural reforms. Informational considerations may likewise suggest why this may not be so. If physicians, especially newer physicians, form beliefs over proper practices to a large extent through their own past experiences or through the observation of the practices followed by others around them (Phelps and Mooney 1993), then a shift in medical practices that arises in any manner—even that arising from fear over being out of compliance with changed legal expectations—may more gradually come to be assimilated into the belief structure of physicians over time. As such, malpractice-induced changes in practices may come to shape more durable physician norms and customs that may survive subsequent diminishment of liability forces. These considerations may thus help us understand why damage cap adoptions—which primarily arose in states after previous retreats from the locality rule—did not cause physician practices to revert back to their locality-rule-era levels.

Empirical malpractice investigations that fail to consider the equilibrium reached between liability forces and non-liability forces over time, and that fail to appreciate the structural considerations underlying tort law, may misinterpret the findings derived from our experiences to date with traditional remedy-centric tort reforms. Such findings may suggest only a weak responsiveness to the law despite a potentially meaningful role for the law to play in shaping clinical practices and health care quality. Substantial work remains, of course, to understand the liability structure that will best serve society. Our analysis demonstrates that it would be premature to rule out medical liability from the health care quality discussion based on the limited findings that derive from damage-cap-focused studies.

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Figure 1

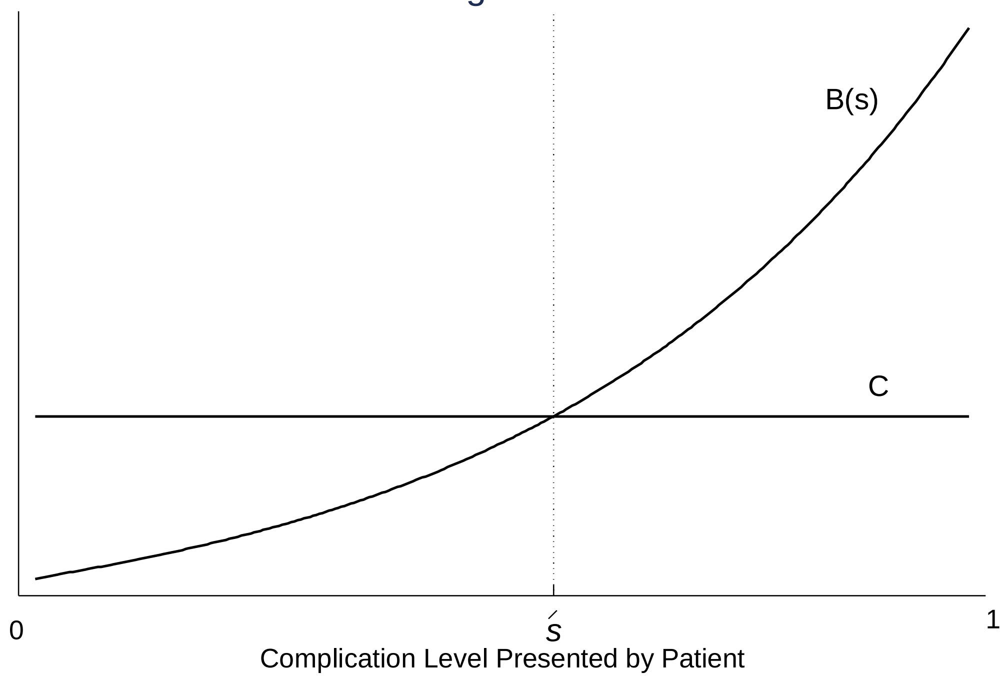

Figure 2

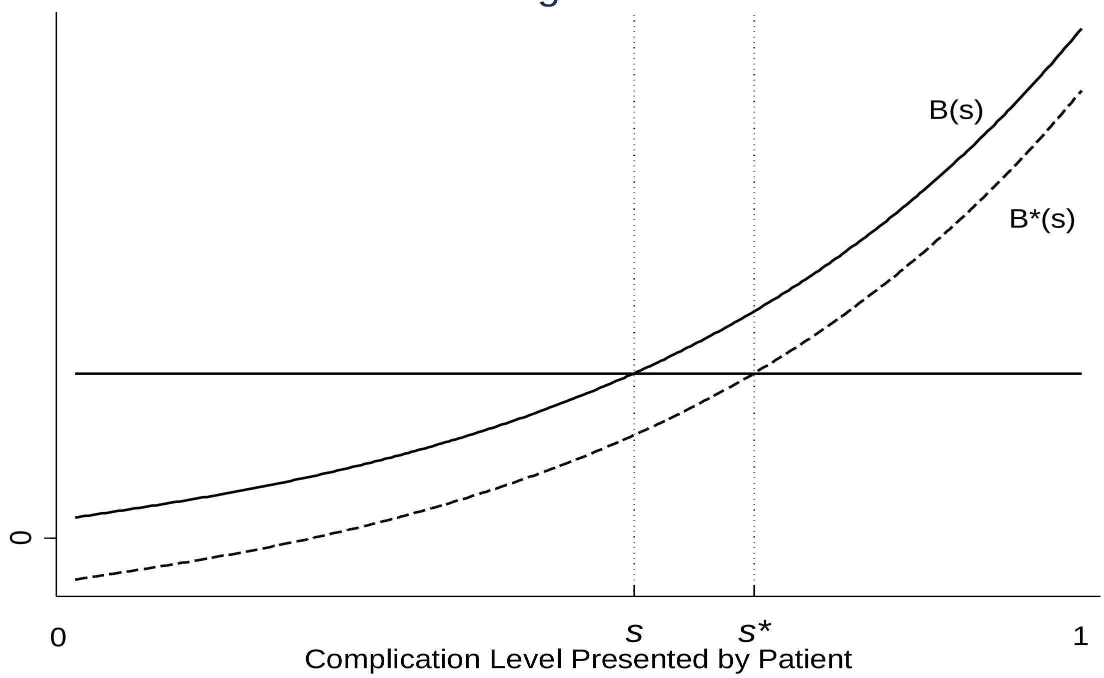

Table I. Variations in Non-Economic Damage Caps (1979-2005)

State	*Year Adopted*	*Year Dropped*	*State*	*Year Adopted*	*Year Dropped*
Alaska	1986		Mississippi	2003	
Alabama	1987	1992	Montana	1996	
Colorado	1987		North Dakota	1996	
Florida	2004		New Hampshire	1987 (2)	1981 (1); 1991(2)
Hawaii	1987		Ohio	2003 (2)	1992(1)
Idaho	1988		Oklahoma	2004	
Illinois	1995	1998	Oregon	1988	2000
Kansas	1987		Texas	2004(2)	1988(1)
Massachusetts	1987		Utah	1988	
Maryland	1987		Washington	1986	1990
Michigan	1987		Wisconsin	1986	
Minnesota	1986	1990	West Virginia	1986	
Missouri	1986				

Notes: years of adoption and invalidation/repeal (if applicable) of laws imposing caps on non-economic damage awards in malpractice cases (or tort cases generally) are indicated above. States are only included if their relevant malpractice laws varied over the 1979 – 2005 period. Legislative variation is excluded from this table if it represents a situation in which an adoption and invalidation/repeal occurred during the same year. *Source*: Database of State Tort Law Reforms (2nd).

Table II. Variations in National-Standard Rules (1979-2005)

State	*Year Adopted*	*Year Dropped*	*State*	*Year Adopted*	*Year Dropped*
Alabama	1980		Montana	1985	
Colorado	1983		Oklahoma	1984	
Connecticut	1984		Rhode Island	1998	
Delaware	1999		South Carolina	1981	
D.C.	1980		South Dakota	1988	
Indiana	1992		West Virginia	1986	
Maryland		1994	Wyoming	1981	
Mississippi	1983				

Notes: years of adoption and repeal (if applicable) of laws requiring that physicians follow national (as opposed to local) standards of care in malpractice actions. States are only included if their relevant malpractice laws varied within the 1979 – 2005 period. *Source*: Frakes (2013).

Table III. Descriptive Statistics

	Mean (Standard Deviation)	*Percentage Absolute Deviation between State and National Mean*
Panel A: Quality Measures (NHDS)		
Composite Inpatient Mortality Rate	0.08 (0.03)	0.16 (0.15)
Avoidable Hospitalization Rate (Avoidable Hospitalizations Scaled by Low-Variation Health Index)	1.70 (0.42)	0.17 (0.18)
Low-Discretionary Avoidable Hospitalization Rate	1.00 (0.23)	0.15 (0.15)
Maternal Trauma Rate	0.04 (0.02)	0.26 (0.25)
Maternal Preventable Complications Rate	0.16 (0.06)	0.20 (0.20)
Panel B: Cancer-Screening Rates (BRFSS)		
Mammogram (within last year, female age 40-75)	0.73 (0.45)	-
Physical breast exam (within last year, female age 40-75)	0.64 (0.48)	-
Proctoscopic exam (sigmoidoscopy or colonoscopy within last 5 years, age 50-75)	0.40 (0.49)	-
PSA Testing (within last year, age 50-75)	0.53 (0.50)	-
Digital Rectal Exam for Prostate Cancer (within last year, age 50-75)	0.50 (0.50)	-
Pap smear (within last year, age 21+)	0.60 (0.49)	-

Notes: Standard deviations are in parentheses. Quality measures in Panel A are from a sample of 1190 state-year cells from the 1979 – 2005 NHDS files. Quality statistics in Panel A are weighted by the relevant denominator used in the state-year quality rate (e.g., the state-year delivery count or the state-year low-variation health index).
Source: Panel A: National Hospital Discharge Survey (1979-2005), Panel B: Behavioral Risk Factor Surveillance System (1987-2008).

Table IV: Relationship between Remedy-Centric Tort Reforms and Inpatient Mortality Rate for Selected Conditions (Logged, Risk-Adjusted)

	(1)	*(2)*	*(3)*	*(4)*
Non-Economic Damage Cap	0.008 (0.030)	-0.012 (0.028)	-0.038 (0.030)	-
Damage Cap Strength: Simulated Percentage Decline in Mean Verdict	-	-	-	-0.001 (0.086)
Collateral Source Rule Reform	-	0.015 (0.025)	0.014 (0.041)	0.013 (0.023)
Punitive Damage Cap	-	-0.001 (0.038)	0.006 (0.047)	0.001 (0.038)
"Indirect" Tort Law	-	0.009 (0.027)	0.003 (0.027)	0.005 (0.029)
95% Confidence Band for Coefficient of Non-Economic Damage Cap Variable	[-0.052, 0.066]	[-0.068, 0.043]	[-0.099, 0.022]	[-0.172, [0.171]
F-Statistic (Malpractice Variables Jointly = 0)	-	0.15	0.49	0.10
Prob > F (p value)	-	0.96	0.74	0.98
Control Variables?	NO	YES	YES	YES
State-Specific Linear Trends?	NO	NO	YES	YES
N	1154	1141	1141	1141

Notes: robust standard errors corrected for within-state correlation in the error term are reported in parentheses. All regressions included state and year fixed effects and are weighted by the number of admissions (for the relevant state and year) in the sub-sample of discharges associated with the selected conditions (i.e., the sum of discharges for acute myocardial infarction, heart failure, acute stroke, gastrointestinal bleeding, hip fracture or pneumonia). Mortality rates are risk-adjusted for the incidence (among the sub-sample) of each of the conditions comprising the sub-sample of selected conditions.

Source: 1979 – 2005 National Hospital Discharge Surveys.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table V. Relationship between Remedy-Centric Tort Reforms and Avoidable Hospitalization Rates (Logged)

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
	RATES BASED ON ALL AVOIDABLE HOSPITALIZATIONS				RATES BASED ON LOW-DISCRETIONARY AVOIDABLE HOSPITALIZATIONS			
Non-Economic Damage Cap	0.003 (0.023)	-0.016 (0.026)	-0.010 (0.029)	-	-0.005 (0.024)	-0.023 (0.023)	-0.017 (0.024)	-
Damage Cap Strength: Simulated Percentage Decline in Mean Verdict	-	-	-	-0.037 (0.064)	-	-	-	-0.030 (0.045)
Collateral Source Rule Reform	-	0.020 (0.026)	0.012 (0.032)	0.019 (0.027)	-	0.007 (0.024)	0.018 (0.034)	0.004 (0.024)
Punitive Damage Cap	-	0.032 (0.033)	-0.012 (0.036)	0.033 (0.032)	-	0.002 (0.029)	-0.014 (0.040)	0.004 (0.028)
"Indirect" Tort Law	-	-0.082 (0.049)	-0.067** (0.032)	-0.083 (0.050)	-	-0.077* (0.043)	-0.076** (0.028)	-0.081* (0.042)
95% Confidence Band for Coefficient of Non-Economic Damage Cap Variable	[-0.044, 0.049]	[-0.069, 0.037]	[-0.068, 0.048]	[-0.167, 0.093]	[-0.052, 0.043]	[-0.069, 0.023]	[-0.067, 0.023]	[-0.122, 0.061]
F-Statistic (Malpractice Variables Jointly = 0)	-	1.28	1.89	1.45	-	2.17	3.43	2.51
Prob > F (p value)	-	0.29	0.13	0.23	-	0.086	0.015	0.054
Control Variables?	NO	YES	YES	YES	NO	YES	YES	YES
State-Specific Linear Trends?	NO	NO	YES	YES	NO	NO	YES	YES
N	1190	1177	1177	1177	1190	1177	1177	1177

Notes: robust standard errors corrected for within-state correlation in the error term are reported in parentheses. All regressions included state and year fixed effects and are weighted by the low-variation health index (i.e., the sum of discharges for acute myocardial infarction, stroke, hip fracture or gastrointestinal bleeding) associated with each state-year cell. The low-variation index constitutes the denominator for the relevant avoidable hospitalization rate.

Source: 1979 – 2005 National Hospital Discharge Surveys.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table VI: Relationship between Tort Reforms and the Incidence of Maternal Trauma among Individual Sample of Deliveries

	(1)	*(2)*	*(3)*	*(4)*
Non-Economic Damage Cap	-0.001 (0.002)	-0.002 (0.003)	-0.000 (0.004)	-
Damage Cap Strength: Simulated Percentage Decline in Mean Verdict	-	-	-	-0.000 (0.008)
Collateral Source Rule Reform	-	0.001 (0.004)	0.001 (0.004)	0.001 (0.004)
Punitive Damage Cap	-	-0.005 (0.003)	-0.006 (0.004)	-0.004 (0.003)
"Indirect" Tort Law	-	0.003 (0.004)	-0.000 (0.004)	0.002 (0.004)
95% Confidence Band for Coefficient of Non-Economic Damage Cap Variable	[-0.005, 0.003]	[-0.008, 0.003]	[-0.007, 0.007]	[-0.016, 0.015]
95% Confidence Band, scaled by mean trauma incidence	[-0.115, 0.057]	[-0.180, 0.073]	[-0.162, 0.151]	[-0.356, 0.333]
F-Statistic (Malpractice Variables Jointly = 0)	-	0.50	1.06	1.14
Prob > F (p value)	-	0.73	0.38	0.35
Control Variables?	NO	YES	YES	YES
State-Specific Linear Trends?	NO	NO	YES	YES
N	737193	565201	565201	565201

Notes: robust standard errors corrected for within-state correlation in the error term are reported in parentheses. All regressions included state and year fixed effects.
Source: 1979 – 2005 National Hospital Discharge Surveys.
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Table VII: Relationship between Remedy-Centric Tort Reforms and the Incidence of Preventable Delivery Complications among Individual Sample of Deliveries

	(1)	*(2)*	*(3)*	*(4)*
Non-Economic Damage Cap	-0.002 (0.006)	0.005 (0.006)	0.007 (0.008)	-
Damage Cap Strength: Simulated Percentage Decline in Mean Verdict	-	-	-	-0.005 (0.015)
Collateral Source Rule Reform	-	-0.008 (0.008)	-0.003 (0.010)	-0.006 (0.008)
Punitive Damage Cap	-	-0.004 (0.006)	-0.005 (0.007)	-0.005 (0.007)
"Indirect" Tort Law	-	-0.000 (0.008)	0.002 (0.010)	0.001 (0.001)
95% Confidence Band for Coefficient of Non-Economic Damage Cap Variable	[-0.014, 0.011]	[-0.007, 0.017]	[-0.009, 0.023]	[-0.035, 0.026]
95% Confidence Band, scaled by mean trauma incidence	[-0.086, 0.068]	[-0.043, 0.105]	[-0.056, 0.142]	[-0.216, 0.160]
F-Statistic (Malpractice Variables Jointly = 0)	-	0.50	0.44	0.26
Prob > F (p value)	-	0.74	0.78	0.90
Control Variables?	NO	YES	YES	YES
State-Specific Linear Trends?	NO	NO	YES	YES
N	737193	566249	566249	566249

Notes: robust standard errors corrected for within-state correlation in the error term are reported in parentheses. All regressions included state and year fixed effects.

Source: 1979 – 2005 National Hospital Discharge Surveys.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table VIII: Relationship between Remedy-Centric Tort Reforms and Cancer Screening Rates

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	MAMMO-GRAM	PHYSICAL BREAST EXAM	PROCTO-SCOPIC EXAM	PSA TESTING	DIGITAL RECTAL EXAM	PAP SMEAR
Non-Economic Damage Cap	-0.003 (0.006)	-0.005 (0.007)	-0.006 (0.005)	0.002 (0.006)	0.014 (0.008)	-0.007 (0.006)
95% Confidence Band for Coefficient of Non-Economic Damage Cap Variable	[-0.015, 0.008]	[-0.019, 0.009]	[-0.016, 0.003]	[-0.009, 0.013]	[-0.001, 0.030]	[-0.019, 0.005]
95% Confidence Band, scaled by mean screening rate	[-0.021, 0.011]	[-0.030, 0.014]	[-0.040, 0.008]	[-0.017, 0.025]	[-0.002, 0.060]	[-0.032, 0.008]
N	1009965	1155814	843960	252232	340931	1662616

Notes: robust standard errors corrected for within-state correlation in the error term are reported in parentheses. All regressions included state and year fixed effects.
Source: 1987 – 2008 Behavioral Risk Factor Surveillance System Records.
*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

TABLE IX. The Relationship between National-Standard Laws and Inpatient Mortality Rate for Selected Conditions (Logged, Risk-Adjusted)

	(1)	(2)	(3)
National-Standard (NS)	-0.076**	-0.093**	-0.090
Law Dummy	(0.035)	(0.040)	(0.081)
NS Law * Below Avg.	0.128*	0.171**	0.186
State	(0.073)	(0.65)	(0.109)*
N	1104	1093	1093
Control Variables?	NO	YES	YES
State-Specific Linear Trends?	NO	NO	YES

Notes: robust standard errors corrected for within-state correlation in the error term are reported in parentheses. All regressions include state and year fixed effects and are weighted by the number of admissions (for the relevant state and year) in the sub-sample of discharges associated with the selected conditions (i.e., the sum of discharges for acute myocardial infarction, heart failure, acute stroke, gastrointestinal bleeding, hip fracture or pneumonia). Mortality rates are risk-adjusted for the incidence (among the sub-sample) of each of the conditions comprising the sub-sample of selected conditions.. The regressions also include a separate dummy variable indicating whether the state has an initially below-average inpatient mortality rate (coefficient omitted). Utilization data is from the NHDS.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Table X. The Relationship between National-Standard Laws and Avoidable Hospitalization Rates

(Logged, Normalized by Low-Variation Health Index)

	(1)	(2)	(3)	(4)	(5)	(6)
	Rates Based on All Avoidable Hospitalizations			Rates Based on Low-Discretionary Avoidable Hospitalizations		
National-Standard (NS)	-0.474***	-0.331***	-0.223***	-0.545***	-0.399***	-0.272***
Law Dummy	(0.077)	(0.064)	(0.036)	(0.075)	(0.064)	(0.051)
NS Law * Below Avg.	0.460***	0.290**	0.201***	0.534***	0.381***	0.247***
State	(0.130)	(0.113)	(0.046)	(0.126)	(0.113)	(0.071)
N	1139	1128	1128	1139	1128	1128
Control Variables?	NO	YES	YES	NO	YES	YES
State-Specific Linear Trends?	NO	NO	YES	NO	NO	YES

Notes: robust standard errors corrected for within-state correlation in the error term are reported in parentheses. All regressions include state and year fixed effects and are weighted by the low-variation health index (i.e., the sum of discharges for acute myocardial infarction, stroke, hip fracture or gastrointestinal bleeding) associated with each state-year cell. The regressions also include a separate dummy variable indicating whether the state has an initially below-average avoidable hospitalization rate or low-discretionary avoidable hospitalization rate, as appropriate (coefficient omitted). Utilization data is from the NHDS.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.

Table XI. The Relationship between National-Standard Laws and The Rate of Maternal Trauma among Deliveries (Logged)

	(1)	(2)	(3)
National-Standard (NS)	-0.126	-0.195	-0.286***
Law Dummy	(0.190)	(0.124)	(0.082)
NS Law * Below Avg.	0.083	0.058	0.224
State	(0.229)	(0.177)	(0.215)
N	1089	1076	1076
Control Variables?	NO	YES	YES
State-Specific Linear Trends?	NO	NO	YES

Notes: robust standard errors corrected for within-state correlation in the error term are reported in parentheses. All regressions include state and year fixed effects and are weighted by the number of deliveries associated with the relevant state-year cell. The regressions also include a separate dummy variable indicating whether the state has an initially below-average trauma rate (coefficient omitted). Utilization data is from the NHDS.

*** Significant at the 1 percent level.
** Significant at the 5 percent level.
* Significant at the 10 percent level.

Table XII. The Relationship between National-Standard Laws and the Rate of Preventable Complications During Deliveries (Logged).

	(4)	(5)	(6)
National-Standard (NS)	-0.403***	-0.445***	-0.420***
Law Dummy	(0.086)	(0.070)	(0.101)
NS Law * Below Avg.	0.513***	0.466***	0.495***
State	(0.135)	(0.103)	(0.175)
N	1089	1076	1076
Control Variables?	NO	YES	YES
State-Specific Linear Trends?	NO	NO	YES

Notes: robust standard errors corrected for within-state correlation in the error term are reported in parentheses. All regressions include state and year fixed effects and are weighted by the number of deliveries associated with the relevant state-year cell. The regressions also include a separate dummy variable indicating whether the state has an initially below-average preventable complication rate (coefficient omitted). Utilization data is from the NHDS.

*** Significant at the 1 percent level.

** Significant at the 5 percent level.

* Significant at the 10 percent level.