

# **The Existence of Defensive Medicine in Cardiology:**

## **An empirical analysis of the effect of tort reforms on physician behavior and patient health outcomes**

Jennifer Kang  
Duke University  
Durham, North Carolina  
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**Abstract.**

This nation is currently facing a growing medical malpractice crisis. As the frequency and payouts of malpractice claims have increased, physicians have responded by increasing their level of care. While the increase may be considerably beneficial, economists, policymakers and healthcare providers believe it has caused no improvement in patient health outcomes and has been done purely to avoid lawsuits. Such inefficient behavior is known as positive defensive medicine.

This study aims to determine the existence of positive defensive medicine in cardiology. It does so by providing an empirical analysis of physician behavior and health outcomes as they react to changes in malpractice pressure. Using a fixed effects ordinary least squares regression on a national sample of cardiology patients between 1988 and 2003, the results show that high malpractice pressure has affected physician's treatment decisions but has had no effect on patient health outcomes. These results agree with the one other study that examined cardiology patients by Kessler and McClellan (1996), who also found evidence of defensive medicine in the specialty.

## **I. Introduction**

With a record payout of \$23.5 million, a landmark court case in 1997 affirmed the growing magnitude of the malpractice crisis in the 1990s (Romano and Russakoff, 2004). The defendant, an obstetrician, was accused of medical negligence for delivering a baby in distress and therefore causing the infant to have cerebral palsy. The case raised questions about the validity of the increasing number of malpractice cases going to the court and the justification of the rulings and payouts. Physicians reacted to this and other similar rulings by taking additional precaution while treating patients. Since the objective of the tort system, or malpractice law, was to use the pressure of lawsuits to induce physicians to take more care, such a reaction was ideal. However, speculation suggests that physicians are now taking too much precaution as a result of malpractice pressure, with little effect on health outcomes. Such behavior is known as defensive medicine, and is said to contribute significantly to health care costs and even reduce the quality of care.

In a broader sense, defensive medicine is any deviation from reasonable medical care caused by the threat of liability (Studdert et al., 2005). Physicians practicing defensive medicine may “increase the amount of care provided (through additional tests or treatment), replace care (by a referral to another doctors to healthcare provider), or reduce care (by refusing to treat certain patient” (Studdert et al, 2005). Some behaviors, termed positive defensive medicine, entails prescribing “additional tests of marginal or no medical value with the aim of reducing adverse legal outcomes,” by either deterring patients from filing malpractice claims or persuading the legal system that the standard of care was met (Studdert et al, 2005). A nationwide Harris Interactive survey conducted in March 2002 of 300 practicing physicians, 100 hospital administrators and 100 nurses found that the

“majorities of physicians (94%), nurses (66%), and hospital administrators (84%) believe that unnecessary or excessive care is provided because of the fear of malpractice (Harris Interactive, 2003). According to a calculation based on Kessler and McClellan (1996), these unnecessary procedures amount up to \$83.9-\$151.1 billion in additional healthcare costs per year. Furthermore, 76% of physicians report that malpractice liability has hurt their ability to provide quality healthcare (Taylor, 2002). To avoid blame for a test gone wrong, physicians may hesitate to prescribe procedures that might be beneficial, but risky. Lastly, the adverse effect of increasing malpractice pressure is triggering great inefficiency in the healthcare system because physicians are now prescribing more than the economically optimal amount of care. These effects expose the need to prove and quantify defensive medicine in order to place pressure on policymakers to reform the current medical malpractice system.

While the conversations regarding the matter center around the undeniable presence of defensive medicine, a key research question still remains: Can the existence of defensive medicine be empirically proven? Generally, previous empirical studies have been inconclusive on the matter, and most of those studies have focused on obstetrics, where dependent variables to determine defensive medicine are more easily defined (Baldwin et al., 1995; Dubay et al., 1999; Dubay et al., 2001; Localio et al., 1997; Sloan et al., 1995; Sloan et al., 1997; Tussing and Wojtowycz, 1992). Cardiology, which requires a more clinical background in order to identify variables to measure defensive medicine, has not been greatly studied. In fact, there is only one study, that by Kessler and McClellan in 1996, regarding defensive medicine in cardiology. This apparent gap in the literature calls for additional studies in the field of cardiology.

Because empirical evidence of defensive medicine in cardiology is scarce, and the one study that does exist has several limitations, I aim to determine the existence of defensive medicine in cardiology. Since Kessler and McClellan's (1996) findings suggest it, my hypothesis is that I will be able to identify empirically that defensive medicine occurs in cardiology. My hypothesis is also drawn from the responses of surveyed physicians, political conversations regarding the need to reform the malpractice system in order to combat defensive medicine, as well as the results of the two obstetrical studies on defensive medicine subject to the least criticism in their methodology which both concluded empirically that defensive medicine occurs (Dubay 1999; 2001).

Cardiology is an important field to study because the likelihood of defensive medicine is very apparent. The specialty of cardiology has higher than average litigation rates, and has one of the highest liability payout sums (Cardiology and Medical Malpractice: Medical Malpractice, 2005; Top Five Malpractice Diseases: Medical Malpractice, 2005). In most liability lawsuits related to heart attacks, misdiagnosis resulting in wrongful death or severe complication has been the key accusation (Top Five Malpractice Diseases: Medical Malpractice, 2005). Thus, it is extremely likely that cardiologists have begun to take additional precaution in response to malpractice liability.

This paper makes an original contribution to the literature by improving upon the limitations and shortcomings of the one study that does exist in the field, Kessler and McClellan (1996). It seeks to address the following research question: are cardiologists prescribing too much care solely out of fear of being sued? My hypothesis, that defensive medicine does occur, is investigated by determining a change in physician behavior as a result of legal changes, with an inconsequential effect on patient outcomes. If patient

health outcomes are unaffected by the same legal changes that trigger a change in physician behavior, it can be concluded that physicians are reacting adversely to the malpractice law system by no longer making decisions purely in the best interest of the patient, but instead making treatment decisions based on the state of legal pressure.

To address the limited scope of in Kessler and McClellan's sample, my paper samples a national, more recent dataset, which has data over a fifteen-year period. Kessler and McClellan's (1996) paper only looked at elderly, Medicare patients over a seven-year period. Since trends in practice patterns over time have been similar for elderly and non-elderly patients, the findings of my national sample should be qualitatively similar to their results (National Center for Health Statistics, 1994). The second shortcoming in Kessler and McClellan's paper is that their variable used to measure changes in physician behavior, expenditures incurred by a cardiac patient for the entire year after his/her initial visit, is faulty. Expenditures are not exact evidence of an increase or decrease in physician behavior because there are numerous other factors that are confounded with the relationship. For instance, expenditures may fluctuate according to the type of insurance a patient holds. Physicians may increase the cost of tests for private patients in order to compensate for the loss of money from the uninsured that are unable to pay. A more appropriate way to measure treatment intensity would therefore be to examine the change in diagnostic tests prescribed in the field. This is what my paper does and by using different variables for physician behavior and health outcomes, I obtain results which lend support for my hypothesis.

My results show that physician behavior changes as a result of changes in malpractice pressure, while patient health outcomes do not. Tort reforms are used to

measure malpractice pressure, and as will later be described, they indicate a decrease of malpractice pressure. As a result of tort reforms, the probability of cardiac catheterizations decrease by 2.2 percent, the probability of any major diagnostic test in cardiology being performed decrease by 2.7 percent, and the number of diagnostic tests performed on each patient decrease by 2.9 percent. The negative coefficients imply that previous to tort reforms, when malpractice pressure is high, physicians prescribe more tests. Moreover, I find no change on health outcomes as a result of a change in malpractice pressure. Therefore, the additional tests physicians are prescribing are not necessarily improving patient health outcomes and could be assumed to be the result of an inefficient malpractice system.

In summary, while results have varied, empirical evidence suggests that the threat of medical malpractice has had adverse effects on physician behavior, causing physicians to deviate from the efficient amount of care. My study improves upon the shortfalls of the one cardiology study done by Kessler and McClellan in order to answer the still looming question of whether defensive medicine occurs in that field. By using more comprehensive data and studying a more pertinent measurement of defensive medicine, diagnostic procedures, my results have concluded that defensive medicine does exist. As the second study in cardiology to prove the existence of defensive medicine in cardiology and with no other studies proving otherwise, this study thusly strengthens the argument that defensive medicine does occur, and leads to several policy implications for malpractice law and the healthcare system which will be elaborated in my concluding section.



This paper is divided into eight sections: Section II provides background on the events which have led to defensive medicine: the malpractice crisis and tort reforms. Section III discusses the conclusions of previous defensive medicine studies, and also further develops my contribution to the existing literature. Section IV establishes the theoretical framework that explains why defensive medicine occurs. Section V describes the data that will be used to perform the empirical analyses. Section VI outlines the methodology and Section VII presents the results. Section VIII sums up my conclusions, discusses the study's policy implications and limitations, and presents suggestions for further research.

## **II. Background**

Defensive medicine occurs as a response to increasing malpractice pressure. This section provides a brief history of the malpractice crisis and how its subsequent effects have called attention to the problem.

### **A. The state of the malpractice crisis**

During the 1990s, the malpractice crisis blew out of proportion, with total malpractice payments increasing from \$2.1 billion in 1991 to \$4.5 billion in 2001 (\$3 billion if adjusted for inflation) (Public Citizen, 2005). Since 1999, medical malpractice premium rates have been rising significantly for physicians (GAO, 2003). Premium rate increases can be explained by multiple factors; however, GAO found that “losses on medical malpractice claims – which make up the largest part of insurer’s costs – appear to be the primary driver of rate increases in the long run.” For instance, in Mississippi, “the amount insurers paid annually on medical malpractice claims, or paid losses,<sup>1</sup> increased by approximately 142 percent from 1998 to 2001 after adjusting for inflation” (GAO, 2003). Thus, the effect of medical malpractice lawsuits on malpractice premiums is evident.

### **B. The Effect of Malpractice on the Healthcare System**

#### *B.1. Excessive care*

Healthcare providers have responded to the increasing malpractice pressure through defensive medicine techniques, such as prescribing unnecessary care. As evidenced in the following table, physicians have admitted to prescribing more tests than necessary in order

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<sup>1</sup> “Paid losses are cash payments insurers make in a given period, such as a calendar year, on claims reported during both the current and previous years.” (GAO 4).

to reduce their chance of being sued and of being accused of negligence in court. Table 1 is taken from the Harris Interactive survey on 300 practicing physicians conducted in March 2002. The physicians were asked to respond to four changes in behavior they feel they have engaged in as a response to increasing malpractice pressure. The response of physicians to how many tests they prescribe over the ideal is based on the unrealistic assumption that the physician is fully aware of the optimal level of care.<sup>2</sup> Despite this, the numbers reflect the belief among healthcare professionals that defensive medicine leads to the provision of unnecessary or excessive care (Harris Interactive, 2003).

**Table 1: “Do concerns about malpractice liability ever cause you to...”**

	“Yes”
I order more tests than I would based only on professional judgment of what is medically needed	79%
I prescribe more medications such as antibiotics than I would based only on professional judgment of what is medically needed	41%
I refer patients to specialists more often than I would based only on professional judgment	74%
I suggest invasive procedures such as biopsies to confirm diagnoses more often than I would based solely on my professional judgment	51%

(Harris Interactive, 2003)

### *B.2. Impact on discussion of medical errors*

Not only has the increasing threat of malpractice lawsuits affected physician’s attitudes towards treating patients, it has also left a questionable impact on the openness of discussions on medical errors. Such discussions on medical errors are very valuable to the healthcare system, as they encourage providers to share possible causes of problems which ultimately lead to active solutions. The unwillingness for providers to continuing sharing

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<sup>2</sup> Optimal care is officially determined by an economic approach known as the Learned Hand Rule. This rule states that the additional test should be performed only if the marginal cost of the test is less than or equal to the probability of the injury occurring multiplied by its magnitude. See (Phelps, 2002) for further explanation.

their experiences with medical blunders will as a result, dampen the continued improvement of the healthcare system. The extent of the effect of malpractice pressure on such discussions is not yet certain. Most physicians (59%) believe that liability concerns are a primary reason why hospitals do not share the results of inquiries into patient injuries and that it at least discourages medical professionals from discussing and thinking of ways to reduce errors, while only a minority of nurses (33%) and hospital administrators (37%) believe this to be true. Still, this is another considerable motivation to study defensive medicine and encourage reforms to the current liability system (Harris Interactive, 2003).

### *B.3. Quality and patient access to care*

Lastly, if no reforms are done to combat the current malpractice crisis, the healthcare system is in risk of a lack of care in the future. Increasing malpractice premiums pose a threat to the availability and affordability of malpractice insurance to physicians (Studdert et al., 2005). Some physicians may find no other choice but to leave the industry due to financial reasons. Above financial reasons, just the theoretical threat of lawsuits discourages doctors from practicing. Such behavior, known as negative defensive medicine, includes physicians leaving the state they are practicing in, retiring early or leaving the practice altogether (Harris Interactive, 2003). “43% of currently practicing medical doctors (300 surveyed) say they have considered leaving medicine due to the malpractice liability system” (Harris Interactive, 2003). Such figures also question the impact of malpractice pressure on future physicians. With nearly half of already practicing physicians, who had already made the financial and time investments of medical school and residency, considering leaving the industry, future students who have even less

investment in the area may choose to avoid any step towards the now inseparable field of medicine and malpractice.

A survey of 289 practicing physicians in West Virginia suggests this threat is already occurring. 90% of the physicians surveyed believe that there are a shortage of doctors generally in West Virginia, with malpractice liability stated as the primary reason for the shortage (Harris Interactive, 2003). Moreover, a result of a lack of physicians will result in less access to care. “Most West Virginia physicians believe that patients are having trouble getting access to trauma services (83%) and OB/GYN services (80%)” (Harris Interactive, 2003).

### **C. Efforts to Revise the Malpractice System: Tort Reforms**

#### *C.1. Tort Reforms*

“This evidence (of the Harris Interactive surveys) for the need for malpractice reforms seems to us to be powerful, even if one discounts the special interests of those surveyed” (Harris Interactive, 2003). This statement, made by Humphrey Taylor, chairman of The Harris Poll at Harris Interactive calls upon the need for malpractice reform in order to address the undeniable adverse consequences of the current system. With the evident detriment on the quality and availability of healthcare, and great belief that both excessive amounts of care and shortages of care have resulted, some changes have already been done to revise the malpractice system in order to reduce legal pressure. Tort reforms have been the main methods to achieve this goal.

Since the malpractice crisis of the mid-1970s, all states have enacted some sort of tort reforms (Government Accounting Office, 2003). These reforms target the frequency

of claims, the size of payouts, and the time and costs associated with resolving claims (GAO, 2003). They are enacted mainly in direct response to increasing malpractice pressure so essentially, their presence indicates efforts to decrease malpractice pressure. As a result, tort reforms act as inverse proxies for malpractice pressure, and their intended effect should therefore be less defensive medicine.

Since tort reforms indicate a reduction in malpractice pressure, it is expected that physicians will react positively to such changes. With less pressure, physicians will have less need to prescribe additional tests when they are unnecessary. In addition, the lessening of malpractice pressure due to tort reforms will address the other aforementioned factors that have had adverse response to malpractice law, mainly the quality and quantity of healthcare overall. I thus intend to empirically estimate the effects of tort reforms on physician behaviors, and as will be later shown, results show that tort reforms had indeed triggered positive changes to the state of defensive medicine.

### **III. Literature Review**

Thus far, defensive medicine has not been quantified, and the literature regarding its existence has been inconclusive. Some empirical studies have concluded that doctors practice positive defensive medicine, others have concluded oppositely, and some have not found any relationship between physician behavior and malpractice liability. Most empirical studies measuring the relationship between medical malpractice liability pressure and physician behavior have focused around obstetrics (Baldwin et al., 1995; Dubay et al., 1999; Dubay et al., 2001; Localio et al., 1997; Sloan et al., 1995; Sloan et al., 1997; Tussing and Wojtowycz, 1992), while only one study focuses on cardiology (Kessler and McClellan, 1996). There is thus a gap in the literature regarding defensive medicine in the area of cardiology. Moreover, many of the studies have limitations in their methodologies. Studies that were subject to the least methodological criticism are deemed the most credible. The majority of these studies support the fact that tort law influences the behavior of physicians in undesirable ways.

The following analysis of the literature will begin with the four initial empirical studies on defensive medicine, which focus on obstetrics, followed by the studies that have built and improved upon the initial four to make more substantial claims regarding the presence of defensive medicine. The review will then go into the one study concerning cardiology by Kessler and McClellan (1996), and how the data and objective of this study will fill in gaps where Kessler and McClellan's did not.

## **A. Early Defensive Medicine Studies**

The earliest studies regarding defensive medicine were done in the field of obstetrics. The initial four studies in the field had conflicting results, and were also limited in their data. Tussing and Wojtowycz (1992) concluded that c-section rates decreased when liability risk was high. Baldwin et al. (1995) and Sloan et al. (1997) found no effect on c-section rates, while Localio et al. (1997) found that higher risk caused a higher probability of delivery by c-section. They all used data from only one year and a single state. In addition, none of the studies measured changes in health outcomes. Without this information, there is no way to determine whether the resultant changes in c-section rates led to more optimal results or not, and therefore the studies cannot justifiably conclude whether the changes in behavior were defensive medicine.

## **B. Developed Defensive Medicine Studies**

Three studies have built upon the initial four by either including health outcomes as a measure to study or expanding the sample size. First, Sloan et al. (1995) measured the effects of malpractice risk on infant health outcomes in Florida. Their study found that higher malpractice pressure led to worse outcomes, and thus did not improve care. This supports the notion that medical malpractice pressure leads to physician behavior that could have adverse affects on health outcomes. In other words, changes in physicians' behavior not only led to inefficient amounts care, but also negative effects on quality. Like the limitations of previous studies, however, this study used data from only one state. In addition, only two of the observed outcomes, fetal death and having a low Apgar score,<sup>3</sup> are directly influenced by obstetrician behavior, while the others, death within five days of

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<sup>3</sup> See Appendix A: *The Apgar Score* for definition of Apgar score.



birth, infant death, and having an adverse outcome within five years of birth, are more likely to be influenced by pediatrician behaviors after birth (Dubay et al., 1999).

Dubay et al. (1999) did a more comprehensive study than all their predecessors by studying national data over a period of several years, and analyzed both changes in physician behavior and health outcomes. Their data ranged from 1990-1992 and was collected from the National Natality Files, which contained information on method of delivery (vaginal delivery, primary cesarean section, vaginal delivery after cesarean section, and repeat cesarean section) and 5-minute Apgar scores. The predominant conclusion from the results is that physicians responded to malpractice claims risk by performing more cesarean sections. In addition, there was no significant change in infant health as a result of the increase in cesarean sections. Because more cesarean sections were being administered in conjunction with increasing medical malpractice risk, but there was no difference in health outcomes, Dubay et al. concluded that physicians practice positive defensive medicine.

A few years later, Dubay et al. (2001) studied a different dependent variable, and concluded that increasing liability threat caused physicians to practice negative defensive medicine,<sup>4</sup> demonstrated by a decrease in prenatal care visits and increase in the occurrence of delayed prenatal care. Their results showed that a US\$10,000 (22%) increase in malpractice premiums increased the incidence of late prenatal care by approximately 2.5 and 5.5 percent (Dubay et al., 2001). Despite the decrease in care, however, there was no difference in infant health, which would have been indicated by lower birth-weights and lower Apgar scores. Because there was no difference in health

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<sup>4</sup> Negative defensive medicine occurs when a physician avoids high-risk patients or risky procedures in order to reduce chance of a lawsuit.

outcomes, it can be concluded that the decrease in care was performed out of defensive medicine.

Both Dubay et al. (1999; 2001) studies have been subject to the least criticism and have both concluded that increased liability risk affected physician behavior, but had no significant effect on health outcomes. Thus, the two most credible previous studies in defensive medicine have concluded that defensive medicine occurs. These studies were all performed in the field of obstetrics, however, which provides room for greater research in other specialties. One such specialty, where the presence of defensive medicine is highly probable, is cardiology.

### **C. Previous Study on Defensive Medicine in Cardiology**

As previously stated, there is only one previous study done on defensive medicine in cardiology. Kessler and McClellan's (1996) paper concluded that positive defensive medicine was being practiced. Their results showed that malpractice tort reforms reduced medical expenditures 5 to 9 percent with no significant changes in mortality or medical complications. This outcome implies that physicians were previously prescribing more care than was necessary when medical malpractice pressure was high. The fact that quality of care was the same implied that the additional procedures performed before the reforms were superfluous and were practiced as part of positive defensive medicine.

### **D. Gaps in Previous Literature**

There are two gaps in their study that call for a more comprehensive study of defensive medicine in cardiology which I address in this paper. First off, the variable they

studied, hospital expenditures, is not a direct measurement of changes in physician behavior. While the decrease in expenditures alludes to the fact that there were less procedures prescribed when malpractice pressure was relieved, the decrease in expenditures could have come from other factors, such as pressure from insurance companies to keep costs down, decreasing costs of procedures, or a decreased patient volume. Since expenditures are a vague measurement of physician behavior, it is important to study changes in the number of procedures prescribed which is most directly related to changes in physician behavior. If physicians are prescribing more tests when medical malpractice pressure is high and there are no changes in health outcomes, then positive defensive medicine occurs. By analyzing the discharge summaries of each patient, I will identify trends in quantity of specific procedures before and after tort reforms.

The diagnostic procedures I hypothesize to be most affected by defensive medicine are cardiac catheterizations, stress tests, and electrocardiograms (EKGs). These are the principle procedures used when diagnosing a heart-related condition. They are the most commonly used because they are long-established and reliable, and are not unreasonably expensive compared to the newer advances in technology, which are very expensive and whose consistency in results is not yet certain.

While my study will strengthen the measurement for physician behavior, it is important to note that Kessler and McClellan have a strong measure of patient health outcomes, which my data does not have. Since they have longitudinal data on each patient, Kessler and McClellan are able to track health outcomes for a single patient following his/her initial visit to the hospital, which is an important potential advantage.

The second gap in the literature is the limitations of their data. Kessler and McClellan analyzed only a seven-year span, from 1984-1990. To address this limitation, I will analyze data over a longer and more recent period of time - a fifteen-year period, from 1988-2003. In addition, Kessler and McClellan's sample focused only on elderly Medicare beneficiaries (Kessler and McClellan, 1996). My study will use national inpatient data, which broadens the sample size to include nonelderly patients.

#### **E. My Contribution to the Literature**

Overall, this study will improve upon two shortfalls of Kessler and McClellan's study, and provide further empirical evidence for or against the existence of defensive medicine. Specifically, my data will be more comprehensive, including a more recent and wider range of years and ages, and my explanatory variable of diagnostic procedures will be more indicative than Kessler and McClellan's expenditure variable. The results of the study are relevant and important, given that policymakers, managed care payers, hospitals, physicians, and even civilians are all affected by its implications.

## **IV. Theoretical Framework**

The economic model that motivates medical malpractice law suggests that it will induce optimal care by physicians, while minimizing social costs. However, the model holds only under several assumptions, two of which are highly unrealistic: perfect information between all parties involved and a perfect judicial system. In reality, the model breaks down and the consequence is defensive medicine. When the initial assumptions do not hold, the legal system induces suboptimal or excessive care. Thus, the explanation for why defensive medicine occurs lies in the discrepancy between what the courts assume about physicians behavior and the true decisions physicians face, as well as a legal system filled with rulings based on imperfect assumptions. The lack of perfect information thus explains why the economic model only succeeds in theory.

The theoretical framework of the tort system can be found in a number of sources (Miceli, 2004; Posner, 2001; Shavell, 1987). I model my paper's basic theory after Miceli (2004), whose outline is most direct and pertinent to this study. This section is divided into four main parts: the societal model for care, the physician model for care, the uncertainties of the models that explain defensive medicine, and lastly, the applications of the theory to cardiology.

### **A. The Social Model of Precaution**

#### *A.1. How society determines the optimal level of care*

The basic social model of precaution shows how the courts determine the socially optimal level of care. Along the lines of economic efficiency, it is established where total

social costs are minimized. The total cost curve, illustrated as  $x + D(x)$  in Figure 1.1, is determined by summing the cost of care and expected damages at each level of care.

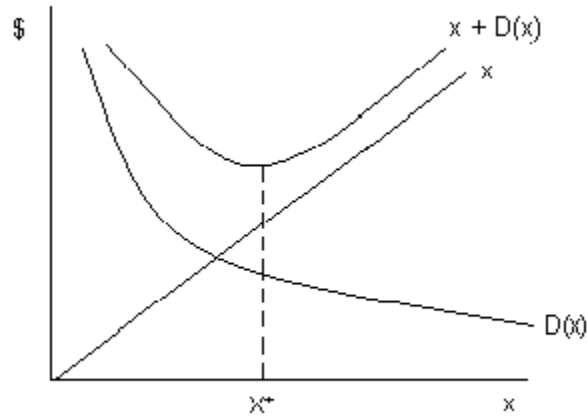


Figure 1.1 Social Model of Precaution

$x$  is the cost of care curve, which increases at a constant rate because the cost of each test is the same.  $D(x)$  is the victim's expected damages, and is calculated by multiplying the probability of an injury occurring,  $p(x)$ , by the dollar losses incurred by the victim if the injury occurs,  $d(x)$ .

$$D(x) = p(x)d(x) \tag{1}$$

$D(x)$  is decreasing and diminishing in  $x$ . It is decreasing because as additional care is taken, the probability of an accident occurring decreases, which decreases the expected damages. It has diminishing returns to  $x$  because with each test performed, there will be less added benefit to the patient's health.

To determine the social optimum, we minimize the total cost curve  $x + D(x)$ .

$$\min_x x + D(x) \tag{2}$$

Thus, the socially optimum level of care  $x^*$  occurs when the first order condition,

$I + D'(x) = 0$ .  $x^*$  is also referred to as the “due standard of care,” or what the courts determine as the adequate level of care.

#### *A.2. Assumptions of the Model*

This model assumes that doctors make decisions purely on financial costs. It assumes that legal errors do not exist and that there is perfect information between the courts, physicians, and patients. It also assumes that the physician is the only one that can impose injury to the patient, and that the patient could not have contributed to the injury in any way. Lastly, at this point, the model also assumes that the courts correctly establish the due standard at  $x^*$ .

#### *How the courts induce the due standard*

The courts use the negligence rule to induce the due standard. The negligence rule states the physician is liable for the victim’s injuries if s/he failed to provide the adequate level of care,  $x^*$ , but is not liable if s/he met (or exceeded) the due standard. The rule shifts the cost of injury from the victim to the physician, thus providing a financial incentive to take precaution.

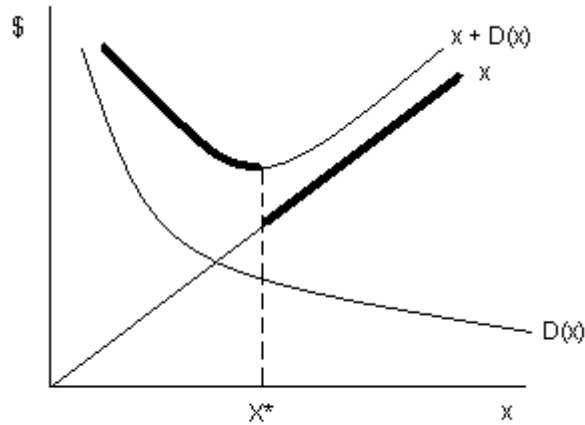


Figure 1.2 Efficient care under a negligence rule

The darkened region in Figure 1.2 illustrates the costs the physician is liable for under the negligence rule. The physician will make his decision by the following equation:

$$f(x) = \begin{cases} x + D(x) & x < x^* \\ x & x \geq x^* \end{cases} \quad (3)$$

Thus, assuming the courts establish the due standard at  $x^*$ , the negligence rule states that the physician will choose  $x^*$ , which is the minimum level of care he can perform to avoid liability for the victim's injury. By looking to this model, the courts believe they can effectively induce the efficient amount of care through the negligence rule; however, the model has two major weaknesses, which explains why the socially optimal level is not achieved in reality and why defensive medicine occurs instead.

### A.3. Weaknesses of the Model

Because the model assumes the physician's optimal decision to administer care is based solely on financial costs, it excludes keys costs and benefits that greatly influence and alter a physician's decision to administer care. In fact, most doctors carry malpractice insurance that covers their financial costs; thus, their financial costs serve little weight in their decision that the costs that are excluded from the model. Secondly, the basic model



assumes perfect information between the courts, physicians, and victims. In reality, imperfect information and legal error are the driving factors of defensive medicine and should be factored into the model.

## **B. Physician's Private Model of Precaution**

As the weaknesses of the social model suggest, the physician faces a different decision making process than the simple cost-incentive structure the court system assumes in the social model. Non-pecuniary costs of being sued, such as time, stress, and loss of reputation, factor largely into the physician's private model and were excluded from the social model. These costs that arise in defending a claim are not insured and become substantial non-pecuniary motivations to avoid litigation. As will be explained later, imperfect information makes it almost impossible for physicians to accurately predict these additional costs. These variables depend upon probabilities that vary with changes in the tort system, which can merely be estimated based on the physician's perceptions of the malpractice system. Thus, the physician's decision to administer care is highly influenced and variable by the state of insurance premiums and tort reforms.

The decision tree in Figure 1.5 explains the process of how the physician calculates the expected values of performing and not performing a test. Regardless of whether s/he does the test or not, the physician's final outcome is determined by a series of chance events, which fluctuates according to current malpractice pressure. The decision tree clearly breaks down where the outcome of the decision is left up to chance. Each square node is a decision the physician makes and each circular node represents an event that is under the control of chance. When making a decision, the physician chooses the branch

that yields the smallest expected value, which is essentially the choice that minimizes his/her costs. The expected value at each chance node is calculated by multiplying each event of chance by the probability that it will occur. To calculate the total expected value of each decision, we sum the products over all outcomes.

### *B.1. Physician's Decision Tree*

In cardiology, the physician has the choice of whether or not to administer a test. The worst that can happen if he performs the test is that the patient does not have the disease. The total costs in that case would merely be the cost of the test. On the other hand, if the physician does not administer the test and the patient has the disease, there are several events that could potentially occur, resulting in high expected costs.