Electronic Discovery and Electronic Medical Records: Does the Threat of Litigation affect Firm Decisions to Adopt Technology?

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Abstract

Firms' decision-making is increasingly leaving an electronic trail. We ask how the threat of litigation affects decisions to adopt technologies that leave more of an electronic trail, like electronic medical records (EMR). On the one hand, firms may embrace a technology that allows them to easily document that their actions were appropriate if they have to defend them in court. On the other hand, firms may fear that the ease of 'electronic discovery' may increase their exposure to potentially costly litigation. EMRs allow hospitals to document electronically both patient symptoms and the health providers' reactions to those symptoms. We find evidence that hospitals are 33 percent less likely to adopt electronic medical records if there are state laws that facilitate the use of electronic records in court.

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1 Introduction

It is conventional to think of the computer revolution as increasing firm productivity. Changing from a paper-based document, communications and archival system to an electronic one cuts costs and helps firms respond more quickly to new challenges. However, there may be hidden costs in the form of increased litigation risk. In several high-profile cases, the 'electronic paper trail' has led to rulings against firms. In United States v. Microsoft, CA No. 98-1232, federal prosecutors used Microsoft executives' e-mails as evidence of anti-competitive intent towards Netscape.[1] The risk of litigation can also impose costs in terms of the archiving and preservation of electronic documents. For example, in Zubulake v. UBS Warburg, 2004 WL 1620866, an employee was awarded $29.2 million in a gender discrimination case, partly because of UBS's failure to ensure adequate backup for electronic documents relating to the case.

In this paper we study whether the change in litigation risks and costs from the presence of an electronic paper trail deters technology adoption. We study the case of Electronic Medical Records (EMR). EMR allows health providers to store and exchange information about a patient's medical and treatment history electronically rather than using paper. EMR provides an interesting case study, because while there is evidence that it can improve patient care and save health providers money, it is unclear whether it benefits medical providers in medical malpractice cases.

On the one hand, by automating documentation of a patient's care, EMR systems can help protect a health provider in a malpractice case if there is a question about whether hospital protocols were followed. EMR may provide provide better and more legible documentation with an audit trail. By helping to prevent medical mistakes, EMR may actually reduce the risk of a malpractice lawsuit.[2] Miller and Tucker (2008) find that the adoption of

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[1]William H. Neukom, Microsoft's general counsel, highlighted the trade-off between efficiency and litigation risk when he said that "E-mail is a big part of how we run this company [...] and candid, frank, open e-mail communication is a big part of our efficiency."

[2]Recently, a medical malpractice carrier (Midwest Medical Insurance Company) announced that it will

electronic medical records by hospitals is associated with a drop in neonatal mortality, and obstetrics is commonly categorized as a field of medicine that is characterized by malpractice lawsuits, so EMR could also lead to fewer malpractice lawsuits.

On the other hand, EMRs include more detailed information about patient care that is available in a traditional paper record. Therefore plaintiff attorneys may make extensive discovery requests for 'relevant' electronic information in medical malpractice litigation. In a medical malpractice case described in (Vigoda and Lubarsky (2006) and (Dimick, 2007)), surgery left a patient quadriplegic, and the lawsuit initially focused on the surgeon's competence, but it switched to focusing on the anesthesiologist's competence after pre-trial discovery, which released EMRs to the patient's attorneys. These records contained an electronic date stamp that cast doubt on whether the anesthesiologist was present for the entire procedure. This anecdote reveals the risk to health providers of EMRs being released during discovery. The increase in information that Electronic Medical Records provide over paper increases medical providers' access to information and also increases the chances that prosecuting lawyers will find some evidence of wrongdoing. There is also a more general increase in risk due to the potential for data loss or destruction, inappropriate corrections to the medical record that would be revealed by electronic data stamps, inaccurate data entry and unauthorized access. This is in addition to the potential for errors related to problems that arise during the transition to EMR, such as those documented by Han et al. (2005). EMRs make it easier to refer to a patient history, so courts may judge physicians more harshly who make errors because of not referring to a patient history, and it will be easier to tell when they have not referred to it.[3] Hospitals may also fear that in the course of discovery for a single malpractice case, the electronic information will reveal a system-wide error in the EMR system's clinical guidelines and alerts that would affect a large class of patients,

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offer a premium credit of 2% to 5% to physicians who implement EMR from January 2008, for this reason.

[3]This presents a change from the current paper-based systems, where failure to obtain past clinical history has had to be judged based on a comprehensive review of the individual case files.

thereby amplifying the risk relative to paper documents. Finally, electronic information also increases the potential for data mining (Terry (2001)).

To analyze whether this threat of increased medical malpractice litigation deters EMR adoption, we use panel data on EMR adoption by hospitals from 1996-2006. To measure the risk that EMRs may be released in medical malpractice trial proceedings, we exploit differences in state court procedural rules over time that govern the scope and depth of general electronic document discovery in pre-trial proceedings. We find that the existence of such state rules decreases the propensity of hospitals to adopt EMR.

We then examine which hospitals were most deterred by these procedural rules. First, we find that e-discovery laws hider adoption more in states with more malpractice litigation stemming from allegations that could be bolstered with EMR data. Perhaps surprisingly, we find no evidence that the discovery rules deterred large hospitals from adopting EMR, despite their greater exposure to malpractice litigation. Instead, we find evidence that it was smaller hospitals who were most deterred by these rules. A potential interpretation of this result is that small hospitals face a larger relative burden of maintaining electronic records in a situation where a malpractice suit is expected or underway. The burden of electronic discovery is larger for such hospitals, because the fixed costs of compliance are larger relative to the potential benefits from EMR. To comply with most electronic discovery requests, hospitals have to have implemented policies and procedures to address potential IT systems risks, such as special systems that can accurately record corrections or additions to the electronic record. In addition, hospitals who face the prospect of electronic discovery would need to invest in additional storage and IT management systems to prevent unintentional data loss.

The paper is organized as follows. Section 2 discusses our contribution to the literature. Section 3 sets out the data we use in this study. Section 4 covers the use of electronic documents in medical malpractice cases and state variation in electronic discovery regulations.

Section 5 reports our results and demonstrates their robustness. Section 6 investigates further the mechanism and the hospitals that are most affected. In Section 7, we discuss the implications of our findings.

2 Literature Review

In the medical ethics literature, several articles refer to the liability risks that accompany the adoption of new healthcare IT such as electronic medical records,[4] and that indicate the need for empirical analysis.[5] However, to our knowledge, we are the first study to attempt to quantify empirically how perceived litigation risk affects the adoption of EMR, or of technology adoption more broadly. We are also, to our knowledge, the first study in the general economics of technology adoption literature that has tried to assess whether the risk of an electronic paper trail does in fact deter information and communication technology (ICT) adoption. Therefore, our study contributes to developing literatures at the intersection of law, medicine, ethics and economics.

This paper adds to the nascent medical literature that attempts to calibrate the risks of electronic medical records from a health provider's perspective. As of yet the results are inconclusive. Feldman (2004) quotes survey evidence that shows that in 41 malpractice cases, there were no reported cases where an "automated record" hindered the defence process. He also discusses quotes from survey participants that suggest positive legal outcomes such as "I know of three cases where the anesthesia record directly contributed to the anesthesiologist being dismissed (from the suit)." Lane (2005) points out that it would be unwise to conclude

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[4]For an overview of medical ethics as they apply to information technology, see Reidl and abd M Rauhala (2001).

[5]"The significant advantages of facile information access for improved medical care, enhanced research, and more cost-effective management of medical institutions have to be traded off with the privacy consequences. In cold business terms, this comes down to assessing the value of health care information, the magnitude of risks of improper disclosure, the costs of an improper disclosure incident, and the costs of preventative measures." Rindfleisch (1997)

from anecdotal evidence that electronic systems do not increase practice exposure, because Feldman (2004) ignores the additional risk created by additional data stored in the electronic record. To try to understand how 'malpractice risk' and EMR adoption may correlate, Virapongse et al. (2008) sent surveys to 1140 physicians in Massachusetts. 6.1 percent of physicians with an EMR system had a history of paid malpractice claims, compared to 10.8 percent of physicians who did not use EMR. However, after controlling for sex, race, year of medical school graduation, speciality and practice size, this difference was no longer statistically significant.

There is also a small but growing legal literature that discusses the procedural aspects and risks of electronic medical records for malpractice litigation from a legal perspective. For example, Korin and Quattrone (2007) emphasize that to meet electronic document discovery challenges, attorneys will need to 'become familiar with systems and processes that are used to create, transmit and store health care information electronically; what electronic information is available; how routine computer operations in health care institutions may change or alter electronically stored information (ESI); and what is entailed in producing requested electronic documents.' More broadly, our paper contributes to a policy debate about the costs of electronic disclosure in court systems (Losey (2008), Dimick (2007)). While the focus so far has been on the complexity and cost electronic discovery adds to the litigation process, we suggest that it is also important for policymakers to consider whether potential litigants are being deterred from adopting welfare-enhancing technology.

This work relates to an established literature in health economics that attempts to assess how the risk of malpractice litigation affects health provider choices. The bulk of this research considers physician responses to the malpractice environment, and considers location (Matsa (2007)) and treatment decisions. For example, Kessler and McClellan (1996) show that medical malpractice tort reform affects how doctors treat heart disease patients. Dubay et al. (1999) study the effects on caesarean section rates while Currie and MacLeod (2008) study

birth outcomes. In contrast, this study considers hospitals decisions regarding technology adoption. In our robustness analysis, we control for the major tort reforms studied in the previous papers, such as payment caps and joint and several liability rules. Our focus, however, is on the impact of the rules of evidence, which have not previously been explored.

Finally, by exploring the role of malpractice risk on healthcare IT adoption, we contribute to a growing new literature concerning the diffusion of healthcare IT in the US. For example, Borzekowski (2002) investigates how cost-saving incentives created by the US healthcare finance system affected the adoption of healthcare information systems over time. Reflecting the national policy importance of EMR, there have been multiple studies that examine correlates of its diffusion. Simon et al. (2007) evaluate the role of practice size in the diffusion of EMR in doctors' offices in Massachusetts. Kazley and Ozcan (2007) emphasize the importance of both a hospital's organizational (size, ownership, system affiliation, public payer mix, teaching status, financial resources) and environmental characteristics (competition, rurality, per capita income, change in unemployment rate) for EMR adoption. Angst et al. (2008) investigate the role of "celebrity status" and spatial proximity in the diffusion of EMR, taking a mimetic adoption perspective. Miller and Tucker (2009) investigate whether privacy protection inhibits adoption of electronic medical records through the suppression of network effects. This paper is the first empirical investigation of the role of medical malpractice trial risk in the diffusion of healthcare IT.

3   Data

We use technology data from the 2007 release of the Healthcare Information and Management Systems Society (HIMSS) Analytics^{TM} Database (HADB). The 2004 release of this data has been used to study the diffusion of EMR technology in three RAND studies (Fonkych and Taylor (2005), Hillestad et al. (2005), and Bower (2005)), as well as in Angst et al.

(2008). We matched the HADB data with the American Hospital Association survey from 1995-2007, and were left with data on the timing of technology adoption decisions of 3,712 hospitals. The hospitals in our data were generally larger than the hospitals we could not match in the American Hospital Association Data. For example, they had on average 7,988 annual admissions compared to 2,717 average annual admissions for the hospitals for whom the HADB data did contain information on IT adoption. The HADB database covers the majority of US hospitals, including about 90 percent of non-profit, 90 percent of for-profit, and 50 percent of government-owned (non-federal) hospitals. However, it excludes hospitals that have fewer than 100 beds and are not members of healthcare systems. Also, we do not have information on hospitals that were in operation during the sample period but that closed or merged before 2007. Therefore, our estimates should be taken as representative only of the larger, urban, non-freestanding hospitals for which we have data. Looking ahead, in Section 6 we show that it is smaller and poorer hospitals that on average have the largest negative effect from the presence of electronic discovery laws, so it seems likely that by omitting smaller community hospitals our estimates are likelier to be biased downwards.

Table 1 describes the main variables in our regressions, including the multiple controls that we use to control for hospital-level heterogeneity.[6]

We measure EMR adoption by whether a hospital has installed or is installing an "enterprise EMR" system. This software is a basic EMR system that underlies other potential add-ins such as clinical decision support, a clinical data repository, and order entry. It is this software that potentially could provide the electronic meta-data such as time-stamps, file modification dates, user access details that could potentially increase the amount of information to lawyers in a medical malpractice case. The key variation in our data is the

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[6]In other research, Miller and Tucker (2009), we have documented the importance of privacy regulation as a driver of electronic medical record adoption. Since these laws are not the focus of study in this paper, we do not include them in the reported specification as right hand side variables. Regressions that include privacy regulation as controls have similar results to the ones reported in this paper.

Table 1: Summary statistics

Variable	Mean	(Std. Dev.)	Min.	Max.
adoptEMR	0.033	(0.179)	0	1
adoptQuality	0.028	(0.165)	0	1
E-Discovery Law	0.106	(0.308)	0	1
Years Opened	0.356	(0.614)	0	20.08
Staffed Beds	0.183	(0.175)	0.003	1.875
Admissions	0.753	(0.812)	0	9.817
Inpatient Days	0.427	(0.482)	0	5.82
Medicare Inpatient Days	0.192	(0.211)	0	4.769
Medicaid Inpatient Days	0.843	(1.431)	0	30.276
Births	0.897	(1.257)	0	16.463
Total Inpatient Operations	0.226	(0.287)	0	8.307
Total Operations	0.588	(0.664)	0	21.344
Emergency Outpatient Visits	0.235	(0.218)	0	2.901
Total Outpatient Visits	0.113	(0.147)	0	2.936
Total Payroll Expenses	3.574	(5.215)	0.004	111.646
Employee Benefits	0.819	(1.27)	0	29.45
Total Expenses	8.496	(12.519)	0.009	239.381
Length of Stay	0.101	(0.008)	0.1	0.2
No. Doctors	0.155	(0.65)	0	20.67
No. Nurses	0.219	(0.279)	0	3.325
No. Trainees	0.19	(0.822)	0	13.47
Non-Medical Staff	0.609	(0.769)	-0.017	12.054
PPO	0.645	(0.479)	0	1
HMO	0.559	(0.496)	0	1
Speciality Hospital	0.036	(0.186)	0	1
Non-Profit	0.599	(0.49)	0	1
Gross State Product Per Capita	32468.118	(4994.055)	20892.287	58792
EMR Prevent Malp. Payouts	234451.597	(104697.534)	29375	973700
EMR Document Malp. Payouts	258719.099	(109517.494)	21625	917837.813
EMR Unrelated Malp. Payouts	182813.99	(71894.624)	41150.379	811597.813
N		42106		

1,394 hospitals who adopted EMR during the sample period between 1994 and 2007.[7] The average annual adoption rate of EMR among hospitals who had not previously adopted the technology was 3.3 percent.

4 State Electronic Discovery Laws

In order to determine if the risk of litigation deters or encourages the adoption of Electronic Medical Records by health providers, we exploit variation in the legal environment that shifts the likelihood that electronic medical records would be used in malpractice cases. This variation is from state statutes and rules governing the use of electronic information in the discovery stage of litigation in state courts. We focus on state court rules governing the use of electronic information in this discovery phase because most medical negligence cases are filed in state courts.

The discovery phase of a medical malpractice case starts after the lawsuit is filed. During discovery, both the defense and the plaintiff have the opportunity to obtain relevant information and documents from the other parties in the lawsuit. The standard for discovery for paper records is generally very broad. Documents are 'discoverable' if they are likely to lead to the discovery of admissible evidence. They do not have to be necessarily admissible at trial. Requests for discovery are generally statutorily predetermined requests that must be produced without objection. Therefore all parties in a lawsuit must respond to discovery requests or face the penalty of being found in contempt.

For healthcare providers and their legal teams, the discovery phase requires extensive time and effort. In this paper we focus on the potential for use of electronic media in pretrial proceedings. However, these electronic media would typically be accompanied by interrogatories, which are written questions served by one party to another party, documents

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[7]These values exclude hospitals who reported IT adoption dates before the sample period and those who did not report the timing of their adoption.

concerning potential witnesses, potential experts and their testimony, expert witness depositions and the release of information about all people who were part of the medical team in question.

In the past decade, many states have adopted rules that govern 'E-Discovery,' or the use of electronic materials in the discovery stage of court proceedings. As shown by Figure A-1 in the appendix, these rules are geographically diverse. These rules have originated both from statutes and courts. Table 2 summarizes the rules that have been enacted. The majority of the rules add electronic documents as an additional class of documents that are governed by existing rules on discovery in pre-trial proceedings. This means that they fall without any room for dispute into the class of materials that must be automatically produced without objection in pre-trial proceedings. Without such a legal guarantee in place, the use of electronic materials is something that has to be hashed out between the plaintiff's and defendant's team lawyers. Since these agreements are not reliably recorded, there is no empirical evidence to document the outcome of these discussions. Interviews with medical malpractice attorneys suggest that they often reach an agreement with the other party to exclude electronic evidence from the discovery process. The rationale given for this course of action is that, without clarification from the courts about how electronic discovery should be conducted, e-discovery becomes costly for the defence and is not reliably likely to produce worthwhile evidence that offsets these costs. This anecdotal evidence was backed up by a recent '2008 Litigation Survey of Fellows of the American College of Trial Lawyers' ACTL and IAALS (2009). This suggested that nearly 77 percent of courts did not understand the difficulties associated with e-discovery and that 87 percent of trial lawyers said that e-discovery increases the costs of litigation.

In our regressions we use an indicator variable to signal the existence (or not) of a state rule: we do not exploit the variation in the wording of the rule. We do, however, check the robustness of our results to the exclusion of Texas, which appears to have the least 'plaintiff-

friendly' rules for e-discovery of the states in our sample. These results are displayed in Table A-6.

In the last year of the time period that we study (2007), there were sweeping changes to Federal Rules of Civil Procedure that broadened the reach of how much electronic data health providers may have to release in malpractice cases, to include electronic metadata such as creation date and modification dates. Since these rules apply to federal courts, they are unlikely to apply to most malpractice cases since these are prosecuted in state courts. However, because some of the state 2007 rules are reinterpretations of this federal laws at the state-level we estimated an alternative version of our main specification in table A-6 excluding 2007 from after our panel dataset. The results are similar.

We focus on how the risk of malpractice litigation affects hospital EMR adoption decisions, since it is at that organizational level that the decision to adopt the technology is made. Malpractice cases resulting from hospitals' medical care, however, may be directed at the hospital, the physician and other members of the medical team and the hospital, or at individual members of the medical team. Therefore, it is possible that the hospital adoption decision reflects not only the hospital litigation risk but also the litigation risk faced by its own physicians, if the hospital worries that litigation risk is a crucial factor in employing a high caliber of employee.

5   Initial Estimation

We first examine the aggregate impact of laws that clarify the use of e-discovery in the pre-trial stages of medical malpractice suits affects EMR adoption. As described in Section 4, these laws generally increase the amount of electronic information that is automatically part of pre-trial disclosure. As such, the laws are expected to amplify the impact of electronic information in the litigation process. We model hospitals as maximizing an objective function

Table 2: State Laws Governing E-Discovery

State	Law	Date	Statute:Court	Description
CT	Connecticut Practice Book, Superior Court - Procedures in Civil Matters Sec. 13-9. Requests for Production, Inspection and Examination; In General (see subsection (d), at p. 192 of 259-page .pdf document)	1/1/2006	Court	Amendments creating a procedure to address how e-discovery will take place
ID	Idaho R. Civ. P. 34	7/1/2006	Court	Amendments add ESI to existing rules relating to discovery of documents
IL	Illinois Supreme Court Rules 201(b)(1) and 214	1/1/1996	Court	Adds "retrievable" ESI to existing rules on discovery; requires provision in printed form of such ESI, and that they produce those documents organized in the order in which they are kept in the usual course of business, or organized and labeled to correspond with the categories in the request.
LA	CCP 1424 - Scope of discovery; trial preparation; materials: CCP 1460 - Option to produce business records: CCP 1461 - Production of documents and things; entry upon land; scope: CCP 1462 - Production of documents and things; entry upon land; procedure	6/25/2007	Statute	Adds ESI to definition of "writing" in a clause excluding discovery for materials prepared in advance of litigation or in preparation for trial. Allows interrogatories to be answered by specifying the ESI from which the answer may be obtained. Adds ESI to existing rules covering production of documents. Adds ESI to existing rules covering production of documents; requires ESI to be produced in the form in which it is "ordinarily maintained" or in reasonably usable form.
MN	Amendments to Rules of Civil Procedure 16, 26, 33, 34, 37, 45	7/1/2007	Court	Adds as a valid matter for pretrial conferences the reaching of agreements on e-discovery
MS	Miss. R. Civ. P. 26(b)(5)	5/29/2003	Court	"Requires that ""To obtain discovery of data or information that exists in electronic or magnetic form, the requesting party must specifically request production of electronic or magnetic data and specify the form in which the requesting party wants it produced. The responding party must produce the electronic or magnetic data that is responsive to the request and is reasonably available to the responding party in its ordinary course of business."""
MT	Mont. R. Civ. P. 16(b). Scheduling and planning, 26(b). Discovery scope and limits, 26(f). Discovery conference, 33(c). Option to produce business records, 34(a). Scope, 34(b). Procedure, 37(e). Electronically stored information, 45(a). Form issuance, 45(c). Protection of persons subject to or affected by subpoenas, 45(d). Duties in responding to subpoena	2/28/2007	Court	Adds as a valid matter for pretrial conferences the reaching of agreements on e-discovery, Limits discovery of ESI that would be "unreasonably burdensome or expensive", or "unreasonably cumulative or duplicative", Adds as a valid matter for pretrial conferences the reaching of agreements on e-discoveryAllows interrogatories to be answered by specifying the ESI from which the answer may be obtained. Adds ESI to existing rules covering production of documents. Adds an exemption from normal sanctions for failure to cooperate in discovery, for ESI "lost as a result of the routine, good faith operation of an electronic information system" Adds ESI to language governing subpoenas. Allows subpoenas to cover sampling of ESI. ESI must be provided as "kept in the usual course of business" or organized and labeled "to correspond with the categories in the demand." If subpoena does not specify form, ESI must be provided "in a form or forms in which the person ordinarily maintains it, or in a form or forms that are reasonably usable." Exempts ESI from sources that are not accessible because oif "undue burden or cost"
NC	Rules for Superior Court Judicial District 15B: Rule 6 - Discovery	7/1/2006	Court	Requires ESI to be provided in a "reasonably usable" form
NH	Superior Court Rule 62. (I) Initial Structuring Conference (see subsection (C)(4))	3/1/2007	Court	Adds as a valid matter for pretrial conferences the reaching of agreements on e-discovery
NJ	Part IV Rules Governing Civil Practice in the Superior Court, Tax Court and Surrogates Courts, Rule 1:9. Subpoenas, Rule 4:5B. Case Management; Conferences, Rule 4:10. Pretrial Discovery, Rule 4:17. Interrogatories to Parties, Rule 4:18. Discovery and Inspection of Documents and Property; Copies of, Rule 4:23. Failure to Make Discovery; SanctionsDocuments	9/1/2006	Court	Allows subpoenas for ESI that is not "unreasonable or oppressive", Adds as a valid matter for pretrial conferences the reaching of agreements on e-discovery, Allows claims that ESI is not reasonably accessible if party pre-specifies the sources that are not accessible, Allows interrogatories to be answered by specifying the ESI from which the answer may be obtained., Adds ESI to existing rules covering production of documents. Specifies that the ESI must be in a form or forms in which it is ordinarily maintained or in a form or forms that are reasonably usable., Adds an exemption from normal sanctions for failure to cooperate in discovery, for ESI "lost as a result of the routine, good faith operation of an electronic information system"
NY	Uniform Civil Rules of the Supreme and County Courts, 202.70 Commercial Division of the Supreme Court, Rule 8. Consultation prior to Preliminary and Compliance Conferences	1/17/2006	Court	Requires meeting of counsel before preliminary conference to address e-discovery, including "(i) implementation of a data preservation plan; (ii) identification of relevant data; (iii) the scope, extent and form of production; (iv) anticipated cost of data recovery and proposed initial allocation of such cost; (v) disclosure of the programs and manner in which the data is maintained; (vi) identification of computer system(s) utilized; (vii) identification of the individual(s) responsible for data preservation; (viii) confidentiality and privilege issues; and (ix) designation of experts."
TX	Tex. R. Civ. P. 196.4 Electronic or Magnetic Data	1/1/1999	Court	ESI must be specifically requested and its form pre-specified; limited to ESI "reasonably available to the responding party in its ordinary course of business"
UT	Utah R. Civ. P. 26. General provisions governing discovery: P. 33. Interrogatories to parties: . P. 34. Production of documents and things and entry upon land for inspection and other purposes: P. 37. Failure to make or cooperate in discovery; sanctions	11/1/2007	Court	Limits discovery of ESI that poses an "undue burden or cost"; Adds provisions covering inadvertent disclosure of privileged information. Allows interrogatories to be answered by specifying the ESI from which the answer may be obtained. Adds ESI to existing rules covering production of documents. Adds an exemption from normal sanctions for failure to cooperate in discovery, for ESI "lost as a result of the routine, good faith operation of an electronic information system."

that includes net revenues and patient outcomes, including potential costs associated with malpractice lawsuits. Hospitals choose to adopt EMR if the net benefits are positive. We model EMR adoption as an irreversible state and exclude hospitals who have previously adopted from the sample.

The discrete-time hazard model is an attractive alternative to continuous-time hazard models for this study, because our survival time data is discrete (the year of adoption) as opposed to precise timing (Allison (1982)). Discrete survival time models can be estimated using standard binary choice methods, if the panel is limited to time periods for each firm when it is still at risk of the event. We use a probit specification to model new adoption decisions among hospitals who have not previously adopted EMR. Our results are robust to a linear probability model and a logit specification. Table 3 reports our initial results. Column 1 reflects the results of our initial panel specification that includes the full set of state and year fixed effects. Here, the presence of a law that facilitates electronic discovery is associated with a reduced likelihood of adoption by 0.011 each year. This represents a large decrease (one-third) relative to the average propensity to adopt of 0.033 each year. These estimates are identified solely from within state variation in adoption rates around the time that state e-discovery rules are put in place.

As with any study that uses panel data to analyze the effect of legal regulation, there is a question of whether we can interpret this relationship in a causal manner given potential for the law to be endogenous. Specifically, the concern is that the enactment of the law that facilitates electronic discovery could be related to other factors which in turn deter EMR adoption, that are not controlled for either by the state or year fixed effects of the hospital-level controls. Generally, many of the factors that one might expect to be correlated with inclusion of electronic documents in pretrial proceedings (for example an increase in state wealth or technological sophistication) we would expect to positively affect EMR adoption. However, there are still potential alternative stories for a negative bias. One would be that the

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enactment of electronic discovery laws is associated with an increase in consumer protection sentiment at the state level, which also leads to problems for hospitals in collecting unpaid medical bills from consumers, which in turn leaves hospitals with less money to invest in technology.

We deal with this potential for endogeneity in three ways. First, we added additional controls to control for changes in how 'plaintiff-friendly' state courts were. Second, we use instrumental variables to control directly for the endogeneity of the presence of a law. Third, we observe how these e-discovery laws affect a placebo technology that will also improve quality of care but does not produce electronic metadata that can be used in court. As additional controls for changes in court friendliness to plaintiffs in civil cases, we used data from the database of state-level tort reforms (Avraham, 2006) on changes in state level regulations that affected caps on medical malpractice payouts, the use of contingency fees and the allocation of liability. The results are reported in the appendix on 2 in Table A-6 and are similar to before.

For instrumental variables estimation, we need an instrument that is related to the presence of e-discovery laws but is unrelated to the technology adoption decisions. We found such an instrument by investigating the institutional process by which such laws get enacted. Most of these laws have been prompted to an extent by court cases where e-discovery became a crucial issue at trial and there were no rules to govern the resulting fallout. Many of these early cases involved banks and other financial institutions, partially because they the first industrial sector to embrace a large number of ICT-type technologies that stored electronic data. For example, Merill Lynch's Jonathan Eisenberg noted that in his experience 98% of the records in discovery cases involving Merrill Lynch are Electronically Stored Information (ESI) (Losey, 2008). It is also a sector that has had the 'deep pockets' that have enabled lawyers involved in these cases to take on the substantial cost and complexity of reviewing electronic documents as part of the discovery process. For example, in New York's

well-known Zubulake v. UBS Warburg, 2004 WL 1620866 decision, UBS had to pay $29.2 million partly because they failed to properly store data. Conversation with e-discovery experts suggest that it was the holes in the existing discovery trial procedure guidelines that were exposed by the Zubulake case that prompted the New York courts to issue clarifying procedural rules in 2006. Therefore, we use the presence of financial firms as a potential exogenous shifter of the presence of a e-discovery laws. Specifically we use data from the annual 'County Business Patterns' survey on how many financial employees there were, and how large the annual payroll was for financial firms as described by their 3-digit NAICS code, to construct our instrumental variables.

Column (2) of Table 3 presents our results for a Newey two-step probit instrumental variables procedure. The coefficient for the negative effect of e-discovery laws is more negative than before and less precisely estimated. We conducted the usual tests of our instruments. Our first-stage results were significant in a joint-F test at the 0.01 level.

In next columns of the Table, we report results from a placebo or falsification exercise, in which we estimate our adoption model using an alternative technology. The goal of this test in the simple probit model is to shed light on the importance of omitted time-varying factors leading to endogeneity in the main probit regression. For the instrumental variables estimates, the placebo test is used to test for violations of the exclusion restriction on the instruments, that is, whether the presence of financial firms is not connected directly with hospital adoption of EMR technology.

We chose to study "Quality Management Software". This is an overarching name given to a suite of software applications that allow hospital managers to electronically manage the allocation of resources within a clinic. Such software systems also often facilitate the process where different hospital databases (for example a personnel database and a billing database) interact with each other. These systems can be used to ensure compliance with existing standards. Unlike with EMRs, the patient information these systems collect tends not to

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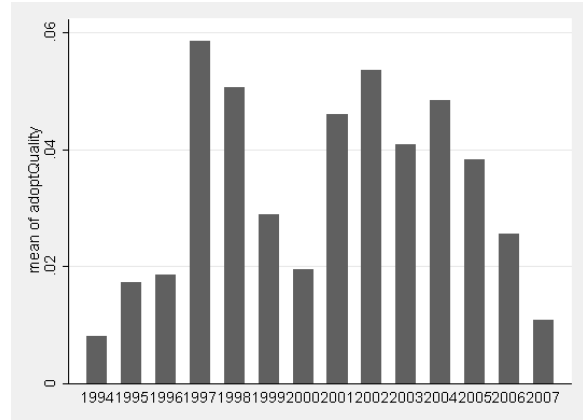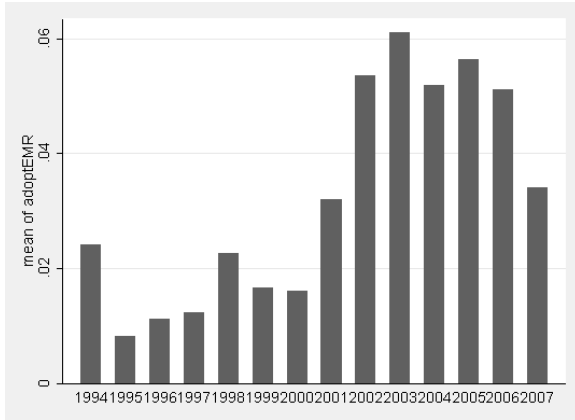
Figure 1: Adoption of EMR Software over Time

Figure 2: Adoption of Quality Software over Time

involve details of medical procedures but instead evidence about how the administrative arm of the hospital interacted with the patient. Such software systems also help ensure that a hospital's treatment of a patient conforms with local regulations concerning confidentiality and information security. For our purposes, Quality Management Software is an attractive placebo technology to study because like EMR it is a software system that is designed to store data to help a hospital manage its patients better, but unlike EMR it is unlikely to be used against a hospital in a medical malpractice case. Figures 1 and 2 show the different time trends of adoption for the two technologies.

Columns (3) and (4) of Table 3 display the results for this falsification test. There is no significant negative effect of electronic discovery laws for Quality Management Software.

6   Further Exploration

In this section we explore how the effect of e-discovery rules may be affected by the types of medical malpractice lawsuits a hospital faces.

We first examine how the effect of the law is mediated by the size and nature of the medical malpractice payments associated with practitioners working in that state. Our hypothesis

Table 3: How e-Discovery laws affect hospital adoption of EMR

	EMR		Placebo	
	(1)	(2)	(3)	(4)
	Simple	IV	Simple	IV
E-Discovery Law (d)	-0.0117***	-0.0399**	-0.00590	-0.0152
	(0.00261)	(0.0198)	(0.00388)	(0.0233)
Years Opened	0.00155	0.00132	-0.00443*	-0.00646**
	(0.000983)	(0.00132)	(0.00226)	(0.00307)
Staffed Beds	0.00661	0.0149	0.0699***	0.0911***
	(0.0166)	(0.0208)	(0.0188)	(0.0260)
Admissions	0.00462	0.00404	0.00975**	0.0108*
	(0.00380)	(0.00461)	(0.00490)	(0.00621)
Inpatient Days	0.00606	0.00517	-0.0235**	-0.0283**
	(0.00812)	(0.0101)	(0.00999)	(0.0130)
Medicare Inpatient Days	-0.0147	-0.0173	0.0124	0.0155
	(0.00954)	(0.0115)	(0.0110)	(0.0142)
Medicaid Inpatient Days	0.000545	0.000462	0.000749	0.000474
	(0.000940)	(0.00116)	(0.00114)	(0.00147)
Births	-0.000560	-0.000159	-0.000579	-0.000313
	(0.000883)	(0.00105)	(0.00110)	(0.00142)
Total Inpatient Operations	-0.00585	-0.00225	-0.00903	-0.0135
	(0.00732)	(0.00885)	(0.00939)	(0.0123)
Total Operations	0.00200	-0.000735	0.00106	0.00147
	(0.00243)	(0.00301)	(0.00323)	(0.00421)
Emergency Outpatient Visits	0.0120**	0.0136**	0.0155**	0.0176**
	(0.00523)	(0.00634)	(0.00659)	(0.00848)
Total Outpatient Visits	0.00773	-0.000245	-0.00934	-0.0128
	(0.00637)	(0.00799)	(0.00907)	(0.0117)
Total Payroll Expenses	0.000191	0.000652	-0.00140	-0.00198
	(0.000700)	(0.000880)	(0.00103)	(0.00132)
Employee Benefits	0.00289*	0.00321	0.000771	0.000411
	(0.00167)	(0.00211)	(0.00229)	(0.00304)
Total Expenses	-0.0000878	-0.000431	0.000486	0.000786
	(0.000286)	(0.000352)	(0.000387)	(0.000490)
Length of Stay	0.254***	-0.150	0.238***	0.316***
	(0.0710)	(0.126)	(0.0656)	(0.0825)
No. Doctors	0.0000727	0.000354	-0.000787	-0.000705
	(0.00131)	(0.00157)	(0.00179)	(0.00227)
No. Nurses	-0.0137*	-0.0125	0.000475	-0.00107
	(0.00797)	(0.00946)	(0.0104)	(0.0133)
No. Trainees	-0.00436***	-0.00465***	-0.00200	-0.00261
	(0.00131)	(0.00161)	(0.00159)	(0.00210)
Non-Medical Staff	0.00196	0.00573*	-0.00759**	-0.00809*
	(0.00271)	(0.00329)	(0.00362)	(0.00464)
PPO (d)	0.00214	0.00435	-0.00754***	-0.00978**
	(0.00234)	(0.00310)	(0.00280)	(0.00400)
HMO (d)	0.000896	0.000823	0.00709***	0.00840**
	(0.00231)	(0.00286)	(0.00253)	(0.00334)
Speciality Hospital (d)	0.0111**	0.0173***	0.0115**	0.0148**
	(0.00496)	(0.00648)	(0.00559)	(0.00715)
Non-Profit (d)	0.0176***	0.0191***	-0.00795***	-0.0127***
	(0.00162)	(0.00199)	(0.00207)	(0.00276)
Gross State Product Per Capita	0.000000745	-0.00000176*	0.00000117	0.00000209*
	(0.000000709)	(0.000000968)	(0.000000828)	(0.00000114)
State Effects	Yes	Yes	Yes	Yes
Year Effects	Yes	Yes	Yes	Yes
Observations	42106	33076	38549	29859
Log-Likelihood	-5592.2	-4819.9	-5455.5	-4847.4

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

is that higher malpractice payments by practitioners represent a greater financial risk to hospitals from malpractice, either because hospitals themselves face risks from litigation or because hospitals compete for physicians and would need to compensate them for increasing their exposure to malpractice risk. We use data from the national practitioner databank of all medical malpractice payments. The files are the universe of all claims paid in the United States, but do not include information on complaints and litigation that did not result in a payment.[8] We use payments from the previous year to predict new adoption, avoiding the potential reverse causality from EMR adoption to malpractice payments.

Using the 3-digit allegation claim category code, we determined if each payment fits into each of these three (non-exclusive) categories: Claims that might be preventable by EMR, claims that would be supported by EMR, and claims that probably would not be affected by EMR. An example of a claim that could be theoretically supported by electronic metadata in an electronic medical record is a 'failure to monitor' a patient sufficiently. An example of a claim that could be theoretically prevented by an electronic medical record is a claim of a 'wrong dosage' being administered by a nurse, since electronic medical records theoretically remove the uncertainties introduced by a physician's handwriting and idiosyncratic use of unit abbreviations. There are also claims that may be both documented and prevented by electronic medical records. These include categories such as 'a failure to diagnose,' where easy access to a patient's previous medical history may make diagnosis easier, but a failure to use the history would also be documented and could be used in court. An example of a claim that would not probably be affected by EMR is 'failure to use aseptic technique'. It is unlikely that the presence of an electronic medical record would affect the cleanliness of an operating room or physician procedure.

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[8]The practitioner databank is the most comprehensive source of malpractice payments, with full coverage of practitioners and inclusion of both settlements and verdicts. The Jury Verdict Research data exclude settlements and the Physician Insurer Association of America Data Sharing Project contains only about 12 percent of claims.

The first three columns of Table 4 show how the presence of an electronic discovery law is mediated by the average payment in a medical case for each of these claims classes. In each case, to ensure comparability, we use a standardized and centered measure of the average payment data. Unrelated claims and claims that are associated with practices that might be prevented by EMR have statistically insignificant effects on the estimated impact of an e-discovery law. In contrast, the average size of claims that are associated with practices that might be documented by EMR have a statistically significant negative interaction with the presence of a law. This suggests that when a hospital is in a state where there are large medical malpractice payouts for the kind of lawsuit that would be documented by electronic medical records that if there is a law facilitating electronic discovery then this would be incrementally negatively correlated with adoption. This negative interaction is particularly interesting given the positive level effect from malpractice payments in stimulating EMR adoption. This pattern may reflect the fact that having an EMR system in place can be an advantage for hospitals in documenting their compliance with standard practices. However, this benefit is eliminated when e-discovery rules put all electronic information in the hands of plaintiffs. The increased malpractice risk to hospitals with extensive electronic documentation increases directly when the control over that information shifts to plaintiffs through greater ease of electronic discovery. There is anecdotal evidence that some hospitals with EMRs attempt to gain control over this risk by engaging in costly activities such as retaining duplicate paper records or employing third-party document storage systems to limit the content included in the legal medical record.

As pointed out by Ai and Norton (2003), care is needed when evaluating the significance of interaction terms in non-linear models. Therefore, we also report the results of a linear probability model in Table A-7 of the appendix. The results and the relative significance of the results are similar.

Table 4: How the risk of medical malpractice claims mediate the effect of e-discovery laws on hospital adoption of EMR

	(1)	(2)	(3)
E-Discovery Law (d)	-0.0111***	-0.0111***	-0.0111***
	(0.00273)	(0.00273)	(0.00277)
Law*EMR Prevent Malp. Payouts	-0.00298		
	(0.00269)		
Law*EMR Document Malp. Payouts		-0.00523*	
		(0.00288)	
Law *EMR Unrelated Malp. Payouts			-0.00244
			(0.00294)
EMR Prevent Malp. Payouts	0.00396***		
	(0.00104)		
EMR Document Malp. Payouts		0.00263**	
		(0.00110)	
EMR Unrelated Malp. Payouts			-0.000343
			(0.00117)
Years Opened	0.00154	0.00153	0.00154
	(0.000981)	(0.000985)	(0.000984)
Staffed Beds	0.00629	0.00624	0.00633
	(0.0165)	(0.0165)	(0.0166)
Admissions	0.00481	0.00486	0.00467
	(0.00379)	(0.00379)	(0.00380)
Inpatient Days	0.00596	0.00591	0.00603
	(0.00810)	(0.00810)	(0.00811)
Medicare Inpatient Days	-0.0145	-0.0146	-0.0146
	(0.00951)	(0.00952)	(0.00953)
Medicaid Inpatient Days	0.000550	0.000556	0.000552
	(0.000938)	(0.000938)	(0.000939)
Births	-0.000589	-0.000599	-0.000571
	(0.000880)	(0.000881)	(0.000882)
Total Inpatient Operations	-0.00587	-0.00607	-0.00589
	(0.00732)	(0.00732)	(0.00732)
Total Operations	0.00191	0.00199	0.00200
	(0.00244)	(0.00244)	(0.00243)
Emergency Outpatient Visits	0.0121**	0.0121**	0.0120**
	(0.00521)	(0.00521)	(0.00522)
Total Outpatient Visits	0.00761	0.00764	0.00785
	(0.00635)	(0.00635)	(0.00636)
Total Payroll Expenses	0.000188	0.000187	0.000188
	(0.000698)	(0.000699)	(0.000699)
Employee Benefits	0.00284*	0.00288*	0.00291*
	(0.00167)	(0.00167)	(0.00167)
Total Expenses	-0.0000821	-0.0000862	-0.0000870
	(0.000285)	(0.000285)	(0.000286)
Length of Stay	0.254***	0.257***	0.254***
	(0.0708)	(0.0707)	(0.0710)
No. Doctors	0.0000878	0.0000895	0.0000639
	(0.00130)	(0.00130)	(0.00131)
No. Nurses	-0.0137*	-0.0135*	-0.0136*
	(0.00794)	(0.00795)	(0.00796)
No. Trainees	-0.00438***	-0.00434***	-0.00435***
	(0.00131)	(0.00131)	(0.00131)
Non-Medical Staff	0.00193	0.00187	0.00189
	(0.00270)	(0.00270)	(0.00271)
PPO (d)	0.00198	0.00196	0.00213
	(0.00234)	(0.00234)	(0.00234)
HMO (d)	0.00100	0.000955	0.000893
	(0.00230)	(0.00231)	(0.00231)
Speciality Hospital (d)	0.0112**	0.0112**	0.0111**
	(0.00496)	(0.00496)	(0.00496)
Non-Profit (d)	0.0175***	0.0176***	0.0176***
	(0.00162)	(0.00162)	(0.00162)
Gross State Product Per Capita	0.000000605	0.000000652	0.000000810
	(0.000000710)	(0.000000712)	(0.000000712)
State Effects	Yes	Yes	Yes
Year Effects	Yes	Yes	Yes
Observations	42106	42106	42106
Log-Likelihood	-5585.2	-5588.5	-5591.7

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1

6.1 Which hospitals are affected by electronic discovery laws?

We now consider how hospital characteristics may affect the correlations between hospital EMR adoption and the presence of e-discovery laws. We find evidence that the most statistically significant moderator along various dimensions was hospital size. Table 5 provides a summary of our results. The three columns summarize specifications that include interactions with an indicator variable that measures whether or not the hospital has a below-median number of total admissions, expenses and non-medical staff. In all cases we find a negative interaction with whether a hospital is small by that measure and whether a state has an e-discovery law in place. The largest interaction by size is the interaction with the size of the support staff. To control for the Ai and Norton (2003) critique, we also report the results of a linear probability model in Table A-8 of the appendix. The results and the relative significance of the results are similar.

We speculate that this result may reflect the costs and difficulties associated with preparing electronic data for discovery for civil trial. Hospitals that do not employ large enough legal and IT teams may be therefore placed at a relative disadvantage if electronic medical records are brought into the discovery process. Institutions who face substantial e-discovery risks are urged by authors such as Losey (2008) to establish an internal e-discovery preparedness and response team, consisting of one or more outside attorneys who specialize in e-discovery as well as representatives from the legal team, IT department, key business departments as well as records and compliance units. Such costly and complex organizational requirements may deter smaller hospitals more.

7 Conclusion

In this paper we document how the presence of state electronic discovery laws affects the adoption of electronic medical records. It seemed possible that the use of electronic records

Table 5: Which Hospitals' Adoption is Affected by E-Discovery Laws?

	(1)	(2)	(3)
E-Discovery Law (d)	-0.00794**	-0.00817**	-0.00782**
	(0.00329)	(0.00328)	(0.00331)
Law*Low Admissions (d)	-0.0110***		
	(0.00301)		
Law*Low Total Budget (d)		-0.0102***	
		(0.00311)	
Law*Low Non-Medical Staff (d)			-0.0112***
			(0.00300)
Years Opened	0.00143	0.00148	0.00141
	(0.000982)	(0.000985)	(0.000983)
Staffed Beds	0.00566	0.00574	0.00546
	(0.0165)	(0.0166)	(0.0165)
Admissions	0.00439	0.00455	0.00455
	(0.00379)	(0.00379)	(0.00379)
Inpatient Days	0.00683	0.00664	0.00675
	(0.00808)	(0.00809)	(0.00808)
Medicare Inpatient Days	-0.0151	-0.0151	-0.0151
	(0.00952)	(0.00953)	(0.00952)
Medicaid Inpatient Days	0.000501	0.000522	0.000515
	(0.000936)	(0.000937)	(0.000936)
Births	-0.000632	-0.000635	-0.000648
	(0.000879)	(0.000880)	(0.000879)
Total Inpatient Operations	-0.00613	-0.00604	-0.00603
	(0.00731)	(0.00732)	(0.00731)
Total Operations	0.00203	0.00200	0.00200
	(0.00243)	(0.00243)	(0.00243)
Emergency Outpatient Visits	0.0108**	0.0109**	0.0109**
	(0.00523)	(0.00524)	(0.00523)
Total Outpatient Visits	0.00823	0.00814	0.00817
	(0.00635)	(0.00635)	(0.00635)
Total Payroll Expenses	0.000148	0.000159	0.000160
	(0.000698)	(0.000699)	(0.000698)
Employee Benefits	0.00299*	0.00298*	0.00297*
	(0.00167)	(0.00167)	(0.00167)
Total Expenses	-0.000116	-0.000118	-0.000117
	(0.000285)	(0.000286)	(0.000285)
Length of Stay	0.252***	0.251***	0.250***
	(0.0709)	(0.0709)	(0.0709)
No. Doctors	0.000153	0.000156	0.000170
	(0.00130)	(0.00131)	(0.00130)
No. Nurses	-0.0131	-0.0132*	-0.0131*
	(0.00797)	(0.00797)	(0.00797)
No. Trainees	-0.00424***	-0.00425***	-0.00423***
	(0.00131)	(0.00131)	(0.00131)
Non-Medical Staff	0.00224	0.00218	0.00212
	(0.00269)	(0.00269)	(0.00269)
PPO (d)	0.00225	0.00223	0.00223
	(0.00234)	(0.00234)	(0.00234)
HMO (d)	0.000764	0.000803	0.000811
	(0.00231)	(0.00231)	(0.00231)
Speciality Hospital (d)	0.0111**	0.0109**	0.0110**
	(0.00495)	(0.00493)	(0.00494)
Non-Profit (d)	0.0174***	0.0174***	0.0174***
	(0.00161)	(0.00161)	(0.00162)
Gross State Product Per Capita	0.000000674	0.000000666	0.000000653
	(0.000000706)	(0.000000706)	(0.000000706)
State Effects	Yes	Yes	Yes
Year Effects	Yes	Yes	Yes
Observations	42106	42106	42106
Log-Likelihood	-5587.9	-5588.6	-5587.7

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

might facilitate a hospital's defense, by providing a broader and more robust standard of documentation. On the other hand, it seemed possible that the increase in the breadth of evidence and the possibility of 'data-mining' by the plaintiff's lawyers might increase the medical malpractice risk associated with the adoption of electronic medical records.

Our evidence suggests that state laws that clarify the use of electronic evidence in discovery are associated with a 33 percent decrease in adoption of EMR by hospitals. The implication of this finding is that there may be previously ignored welfare effects from the risk of litigation on the spread of certain new technologies that store electronic data. Although we have focused on the adoption of health IT, this deterrence effect may be present in other sectors of the economy where companies make choices about converting records from paper to electronic methods of storage. The adoption results on the extensive margin suggest the possible presence of additional deterrence effects on the intensive margin, where firms with electronic systems in place continue to rely on paper records or other forms of communication for many functions.

There has been a substantial federal push to ensure widespread EMR adoption, providing financial incentives of approximately $44,000 per physician under the 2009 HITECH Act. However, such policies have as of yet not addressed this issue of litigation risk when designing incentives. Our research suggests that hospitals' concerns about malpractice risk may limit the effectiveness of such financial subsidies. If the efforts to promote EMR adoption are to be effective, they should be coupled with efforts to streamline and guide the use of electronic data in court proceedings, to reduce hospitals' perceived costs from EMR-enabled malpractice claims.

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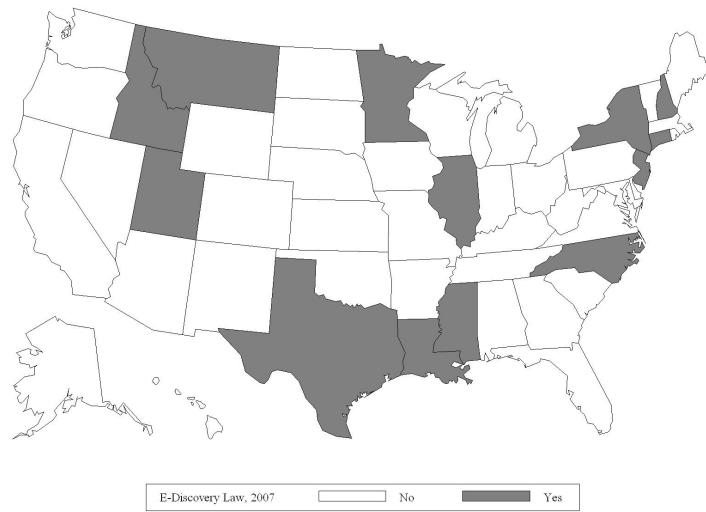Figure A-1: Distribution of E-Discovery Laws by 2007

Table A-6: Robustness checks for results in Table 3

	(1) No TX	(2) No 2007	(3) Legal Controls
E-Discovery Law (d)	-0.0148***	-0.0143***	-0.0114***
	(0.00267)	(0.00244)	(0.00264)
Years Opened	0.00295**	0.00134	0.00154
	(0.00116)	(0.00104)	(0.000975)
Staffed Beds	0.000420	0.00826	0.00685
	(0.0175)	(0.0168)	(0.0165)
Admissions	0.00413	0.00503	0.00464
	(0.00401)	(0.00388)	(0.00378)
Inpatient Days	0.00707	0.00276	0.00587
	(0.00850)	(0.00832)	(0.00807)
Medicare Inpatient Days	-0.0119	-0.0120	-0.0146
	(0.00999)	(0.00963)	(0.00947)
Medicaid Inpatient Days	0.000757	0.000754	0.000552
	(0.000985)	(0.000958)	(0.000934)
Births	-0.000489	-0.000357	-0.000562
	(0.000960)	(0.000892)	(0.000875)
Total Inpatient Operations	-0.00428	-0.00491	-0.00593
	(0.00772)	(0.00745)	(0.00727)
Total Operations	0.00157	0.00128	0.00197
	(0.00256)	(0.00248)	(0.00242)
Emergency Outpatient Visits	0.0107*	0.0117**	0.0119**
	(0.00557)	(0.00535)	(0.00519)
Total Outpatient Visits	0.00496	0.00437	0.00771
	(0.00679)	(0.00665)	(0.00632)
Total Payroll Expenses	0.000147	0.0000652	0.000193
	(0.000747)	(0.000718)	(0.000695)
Employee Benefits	0.00357**	0.00357**	0.00280*
	(0.00177)	(0.00172)	(0.00166)
Total Expenses	-0.000169	-0.000111	-0.0000808
	(0.000307)	(0.000295)	(0.000284)
Length of Stay	0.191**	0.242***	0.251***
	(0.0791)	(0.0730)	(0.0706)
No. Doctors	0.000350	0.000663	0.0000878
	(0.00137)	(0.00132)	(0.00130)
No. Nurses	-0.0132	-0.0115	-0.0136*
	(0.00841)	(0.00805)	(0.00791)
No. Trainees	-0.00479***	-0.00429***	-0.00433***
	(0.00141)	(0.00134)	(0.00130)
Non-Medical Staff	0.00338	0.00176	0.00192
	(0.00301)	(0.00274)	(0.00268)
PPO (d)	0.00217	0.00196	0.00209
	(0.00250)	(0.00237)	(0.00233)
HMO (d)	0.00147	-0.0000106	0.000928
	(0.00248)	(0.00234)	(0.00230)
Speciality Hospital (d)	0.00931*	0.0118**	0.0111**
	(0.00517)	(0.00512)	(0.00493)
Non-Profit (d)	0.0171***	0.0172***	0.0175***
	(0.00169)	(0.00164)	(0.00160)
Gross State Product Per Capita	0.000000904	5.34e-08	0.000000537
	(0.000000729)	(0.000000769)	(0.000000715)
Cap Punitive (d)			-0.00408
			(0.00420)
Cap Total Damages (d)			-0.0602***
			(0.00297)
Cap Non Economic (d)			-0.00197
			(0.00281)
Joint+Several Liability (d)			-0.00299
			(0.00465)
Contingency Fee (d)			0.00223
			(0.00922)
State Effects	Yes	Yes	Yes
Year Effects	Yes	Yes	Yes
Observations	38520	39850	42106
Log-Likelihood	-5217.5	-5250.8	-5590.4

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A-7: Effect of initial document access costs on effect of Electronic Discovery law (Linear Probability Model)

	(1)	(2)	(3)
E-Discovery Law (d)	-0.0173***	-0.0179***	-0.0176***
	(0.00456)	(0.00455)	(0.00465)
Law*EMR Prevent Malp. Payouts	-0.00227		
	(0.00338)		
Law*EMR Document Malp. Payouts		-0.00506	
		(0.00356)	
Law *EMR Unrelated Malp. Payouts			-0.00166
			(0.00358)
EMR Prevent Malp. Payouts	0.00544***		
	(0.00131)		
EMR Document Malp. Payouts		0.00363***	
		(0.00135)	
EMR Unrelated Malp. Payouts			0.000900
			(0.00136)
Years Opened	0.00170	0.00169	0.00170
	(0.00143)	(0.00143)	(0.00143)
Staffed Beds	-0.00966	-0.00979	-0.00966
	(0.0228)	(0.0228)	(0.0228)
Admissions	0.0119**	0.0120**	0.0118**
	(0.00565)	(0.00565)	(0.00565)
Inpatient Days	0.00423	0.00409	0.00423
	(0.0117)	(0.0117)	(0.0117)
Medicare Inpatient Days	-0.0215	-0.0217	-0.0215
	(0.0134)	(0.0134)	(0.0134)
Medicaid Inpatient Days	0.00185	0.00187	0.00185
	(0.00138)	(0.00139)	(0.00139)
Births	-0.00168	-0.00169	-0.00164
	(0.00129)	(0.00129)	(0.00129)
Total Inpatient Operations	-0.0187*	-0.0190*	-0.0189*
	(0.0101)	(0.0101)	(0.0101)
Total Operations	0.00552	0.00556	0.00553
	(0.00358)	(0.00358)	(0.00358)
Emergency Outpatient Visits	0.0161**	0.0160**	0.0160**
	(0.00770)	(0.00771)	(0.00771)
Total Outpatient Visits	0.0167	0.0168	0.0168
	(0.0102)	(0.0102)	(0.0103)
Total Payroll Expenses	0.000315	0.000315	0.000310
	(0.00113)	(0.00113)	(0.00113)
Employee Benefits	0.00958***	0.00962***	0.00964***
	(0.00270)	(0.00271)	(0.00271)
Total Expenses	0.000211	0.000211	0.000212
	(0.000439)	(0.000439)	(0.000439)
Length of Stay	0.378***	0.380***	0.379***
	(0.115)	(0.115)	(0.115)
No. Doctors	-0.0000807	-0.0000897	-0.0000838
	(0.00182)	(0.00182)	(0.00182)
No. Nurses	-0.0249**	-0.0246**	-0.0246**
	(0.0122)	(0.0122)	(0.0122)
No. Trainees	-0.0101***	-0.0101***	-0.0101***
	(0.00177)	(0.00177)	(0.00177)
Non-Medical Staff	-0.000363	-0.000373	-0.000314
	(0.00402)	(0.00402)	(0.00402)
PPO (d)	0.00170	0.00167	0.00181
	(0.00271)	(0.00271)	(0.00271)
HMO (d)	0.00124	0.00122	0.00121
	(0.00265)	(0.00265)	(0.00266)
Speciality Hospital (d)	0.0111**	0.0110**	0.0110**
	(0.00500)	(0.00500)	(0.00500)
Non-Profit (d)	0.0209***	0.0209***	0.0209***
	(0.00209)	(0.00209)	(0.00209)
Gross State Product Per Capita	0.00000130	0.00000133	0.00000145*
	(0.000000832)	(0.000000833)	(0.000000833)
State Effects	Yes	Yes	Yes
Year Effects	Yes	Yes	Yes
Observations	42106	42106	42106
Log-Likelihood	13313.8	13309.1	13305.3

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table A-8: Which Hospitals' adoption is being affected by Electronic Discovery Laws? (Linear Probability Model)

	(1)	(2)	(3)
E-Discovery Law (d)	-0.0113**	-0.0116**	-0.0108**
	(0.00536)	(0.00543)	(0.00544)
Law*Low Admissions (d)	-0.0128**		
	(0.00556)		
Law*Low Total Budget (d)		-0.0118**	
		(0.00558)	
Law*Low Non-Medical Staff (d)			-0.0132**
			(0.00562)
Years Opened	0.00159	0.00165	0.00158
	(0.00143)	(0.00143)	(0.00143)
Staffed Beds	-0.0106	-0.0105	-0.0108
	(0.0228)	(0.0228)	(0.0228)
Admissions	0.0113**	0.0115**	0.0115**
	(0.00565)	(0.00565)	(0.00565)
Inpatient Days	0.00526	0.00499	0.00518
	(0.0117)	(0.0117)	(0.0117)
Medicare Inpatient Days	-0.0221	-0.0221	-0.0222*
	(0.0134)	(0.0134)	(0.0134)
Medicaid Inpatient Days	0.00179	0.00182	0.00180
	(0.00139)	(0.00139)	(0.00139)
Births	-0.00174	-0.00174	-0.00176
	(0.00129)	(0.00129)	(0.00129)
Total Inpatient Operations	-0.0189*	-0.0188*	-0.0187*
	(0.0101)	(0.0101)	(0.0101)
Total Operations	0.00549	0.00543	0.00545
	(0.00358)	(0.00358)	(0.00358)
Emergency Outpatient Visits	0.0147*	0.0148*	0.0148*
	(0.00773)	(0.00773)	(0.00772)
Total Outpatient Visits	0.0176*	0.0175*	0.0175*
	(0.0103)	(0.0103)	(0.0103)
Total Payroll Expenses	0.000284	0.000298	0.000303
	(0.00113)	(0.00113)	(0.00113)
Employee Benefits	0.00971***	0.00971***	0.00968***
	(0.00270)	(0.00270)	(0.00270)
Total Expenses	0.000173	0.000167	0.000169
	(0.000439)	(0.000439)	(0.000439)
Length of Stay	0.378***	0.377***	0.376***
	(0.115)	(0.115)	(0.115)
No. Doctors	-0.0000284	-0.0000178	-0.00000494
	(0.00182)	(0.00182)	(0.00182)
No. Nurses	-0.0237*	-0.0239**	-0.0239*
	(0.0122)	(0.0122)	(0.0122)
No. Trainees	-0.00999***	-0.00998***	-0.00997***
	(0.00177)	(0.00177)	(0.00177)
Non-Medical Staff	0.0000700	0.00000215	-0.0000925
	(0.00402)	(0.00402)	(0.00402)
PPO (d)	0.00194	0.00192	0.00191
	(0.00271)	(0.00271)	(0.00271)
HMO (d)	0.00111	0.00114	0.00117
	(0.00266)	(0.00266)	(0.00265)
Speciality Hospital (d)	0.0109**	0.0107**	0.0107**
	(0.00500)	(0.00500)	(0.00500)
Non-Profit (d)	0.0208***	0.0208***	0.0207***
	(0.00209)	(0.00209)	(0.00209)
Gross State Product Per Capita	0.00000138*	0.00000137*	0.00000136
	(0.000000830)	(0.000000830)	(0.000000830)
State Effects	Yes	Yes	Yes
Year Effects	Yes	Yes	Yes
Observations	42106	42106	42106
Log-Likelihood	13307.7	13307.3	13307.8

Marginal effects; Standard errors in parentheses
(d) for discrete change of dummy variable from 0 to 1
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$