Privacy Protection and Technology Diffusion: The Case of Electronic Medical Records

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We study EMR adoption to illustrate a broader point about privacy regulation and network technologies.

- ▶ Electronic Medical Records (EMR)
  - Allows healthcare providers to record and exchange medical information electronically
  - 50 % of US states have enacted privacy laws which restrict the exchange of electronic health information
- ▶ Research Question: How do state privacy regulations restricting exchange of health information affect EMR hospital adoption?
  - Do they inhibit benefits of being able to exchange information?
  - Or do reduce patient privacy-protecting behavior and increase value of content of EMR record giving incentives to hospitals to adopt?

We find that privacy laws decrease EMR adoption.

- ▶ In states with privacy laws adoption lower by 21-24 percent.
- ▶ Evidence that mechanism is through suppression of network externalities

Strengthening privacy protections involves difficult tradeoffs.

- ▶ $20 Billion to promote health it is an essential part of the stimulus package
- ▶ Intense debate over how to make privacy laws tough enough
- ▶ Broader managerial contribution: Highlighting potential costs of privacy regulation for information sharing technologies

EMR technology is expensive but offers large benefits.

- ▶ We look at hospital adoption of EMR.
- ▶ Costly technology (From \$100,000 + expensive to implement)
- ▶ EMR has network and stand-alone benefits.
- ▶ Stand-alone benefits are substantial:
  - Providers can reduce costs of administration within hospital
  - Reduce medical errors by facilitating quick access to info
  - Providers can document how they use health information (compliance)
- ▶ Network benefits
  - Can obtain information about a patient from another hospital
    - Useful for chronic disease and emergency room situations

Privacy regulation could increase or decrease EMR adoption.

- ► States have enacted own privacy regulations.
- ► Could encourage adoption if reduces patient privacy-protecting behavior. This would increase value of contents of record.
- ► Could discourage adoption if privacy regulation inhibits network benefits.

We use external data on state privacy regulation and EMR.

- ▶ Surveys of state health privacy statutes by Health Privacy Project at Georgetown University (we examine hospitals)
- ▶ There are 19 changes in state privacy laws over time
  - Pritts et al. (2002, 1999 and 1996)
  - Example: Georgia's state privacy law limits who can look at test results
  - Example: Massachusetts state privacy law limits flow of information on Psych., Drug/Alcohol-Use, HIV status.
- ▶ Hospital level EMR adoption data over time.

Estimation Road-Map

- (IV) estimates of effect of installed base in regimes with and without privacy laws
- (IV) estimates of aggregate effect of laws

We translate our conceptual model to an equation we could estimate.

$$adopt_{ijt} =$$
$$f(Installedbase HSA_{ijt}, X_{it}, \alpha_i, \gamma_t, \epsilon_{it} | PrivacyLaw_{it})$$

▶ $adopt_{ijt}$ is a hospital-year level indicator for adoption and implementation in 1999, 2002, and 2005.

▶ An observation is a hospital that has not previously adopted EMR

▶ Split sample by whether state has privacy law and quantify network effects

▶ $Installedbase HSA_{ijt}$ count of adoption decisions in HSA

We have a lot of variables in our regressions.

Variable Label	Panel		Cross-Section (2005)	
	Mean	Std. Dev.	Mean	Std. Dev.
Dependent Variables				
EMR Adopt	0.17	0.37	0.41	0.49
Endogenous Variables				
Hosp Privacy Law	0.61	0.49	0.56	0.5
Installed HSA	2.89	4.83	4.31	6.45
Independent Variables				
Numb Hospitals HSA	10.1	14.38	10.34	14.94
Years Opened	31.73	34.65	32.52	35.19
No Out-of-Reg. System Hosp	15.3	29.68	14.12	28.68
Independent Practice Association	0.17	0.38	0.14	0.35
Physician Hospital Organization	0.32	0.47	0.3	0.46
Fully Integrated Organization	0.25	0.43	0.26	0.44
Member System	0.6	0.49	0.64	0.48
Member Network	0.33	0.46	0.33	0.47
Total Payroll (USDm)	35.3	47.24	44.48	58.1
Staffed Beds (000)	0.2	0.17	0.2	0.18
Nursing Home Unit	0.32	0.47	0.28	0.45
Total Outpatients (000)	11.69	14.4	13.8	16.66
Births (000)	0.95	1.25	1.00	1.34
Medicare Patients (000)	3.11	2.94	3.57	3.37
Medicaid Patients (000)	1.28	1.86	1.53	2.09
HMO	0.21	0.4	0.16	0.37
Fee for Service	0.08	0.27	0.05	0.23
PPO	0.25	0.44	0.2	0.4
Population HSA	1.51	2.7	1.48	2.61
Income Median HSA (000)	25.26	7.28	25.29	7.4
Medicare HSA	0.2	0.36	0.2	0.35
Number of Observations		7139		2935

Hospitals considering adopting EMR respond differently to the EMR installed base in states that have privacy laws and those that do not.

	States with No Privacy Law	States with Privacy Law
Model	1	2
Data	Panel	Panel
Hospital Fixed Effects	Yes	Yes
Instrumental Variables	Yes	Yes
Installed HSA	0.021**	-0.000
Observations	2367	3446
Significance of First-Stage Regressions		
LM Statistic	335.630	211.205
P-Value	0.000	0.000

Dependent Variable: Whether Hospital has installed Enterprise EMR
Multiple Hospital and HSA-level control variables not reported.
Probit GMM Estimates reported as marginal effects calculated at mean.
Robust Standard Errors reported in parentheses below estimate: * p<0.10, ** p<0.05, *** p<0.01

We checked robustness by using a placebo.

▶ Standard tests of IV
▶ Want to falsify by repeating with another technology that should not be affected by Privacy Disclosure laws
▶ However, most hospital technologies (e.g. MRI/PET etc) produce data that hospitals might want to share with other hospitals (via EMR). And privacy disclosure laws get in the way.
▶ Possible placebos limited
▶ Use ICU (and also NICU) IT system software
  • Disposable Data
  • Similar Time Trend
▶ Results insignificant

We want to measure aggregate effect of law

▶ Back of the envelope suggests laws reduce adoption by around 21 percent through installed base effect

▶ Want to estimate aggregate effects of law

Hospitals considering adopting EMR respond negatively to state privacy laws

	EMR Adoption	Placebo Test
Model	1	2
Data	Panel	Panel
Hospital Fixed Effects	Yes	Yes
Instrumental Variables	Yes	Yes
Hosp Privacy Law (d)	-0.110***	0.061*
	(0.041)	(0.034)
Observations	6524	6524
Log-Likelihood	826.707	1985.335
	Joint-Significance of First Stage variables	
LM Statistic	472.304	16.951
P-Value	0.000	0.000

Dependent Variable: Whether Hospital has installed Enterprise EMR
Multiple Hospital and HSA-level control variables not reported.
Probit GMM Estimates reported as marginal effects calculated at mean.
Robust Standard Errors reported in parentheses below estimate: * p<0.10, ** p<0.05, *** p<0.01

Our results are supported by industry anecdote.

"The patchwork of state privacy laws is an impediment to health information exchange"

Alan Mertz, president of the American Clinical Laboratory Association.

▶ Collapse of Santa Barbara RHIO

EMR is important; it can save babies' lives.

▶ In a second paper we look at how adoption of EMR by hospitals affect birth outcomes

▶ Adoption of healthcare IT by an additional hospital in a county reduces infant mortality in that county by between 5 and 18 deaths per 100,000 live births.

▶ Rough cost-effectiveness calculations suggest that healthcare IT is associated with a cost of $450,140 per infant saved.

There are difficult trade-offs when it comes to privacy.

▶ Contribution: Empirical study documenting how privacy protection is inhibiting network benefits and diffusion of Electronic Medical Records

▶ Contribution: Understanding the potential for privacy regulation to affect technology diffusion
  - There are many reasons why privacy laws may be a good thing
  - However, it is important to confront trade-offs between swift diffusion and protecting patient privacy