DO HOSPITAL DATA BREACHES REDUCE PATIENT CARE QUALITY?

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2011 to 2015
264 hospital data breaches
5.8 million records exposed[1]

BUSINES

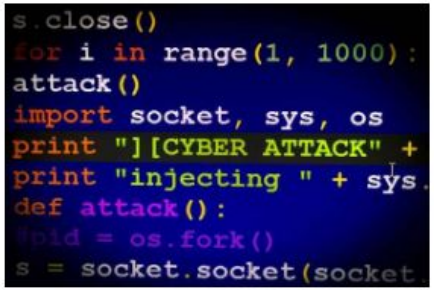
UCLA Health System data breach affects 4.5 million patients

UCLA's health system has reported a data breach that could affect 4.5 million patients.. (Damian Dovarganes / Associated Press)

In Case You Missed It

California's Obamacare exchange to collect insurance data on patients

JUN. 21, 2015



Getty Images

Emory Healthcare cyberattack affects 80,000 patient records

By Rachel Z. Arndt | March 2, 2017

Emory Healthcare has been hit with a cyberattack that compromised the records of some 80,000 patients who used an online appointment system.

The Atlanta-based health system's "waits and delays" appointments system was hacked sometime around the turn of the new year, Emory announced earlier this week. After removing the appointments database, the hackers demanded a ransom to restore the site. Emory Healthcare did not say whether it paid the ransom.

The breach affected 79,930 patients of Emory Clinic's Orthopaedics and Spine Center and Brain Health Center. The six-hospital system said the breached database did not include financial information and social security numbers. However, it did expose names, birth dates, contact information, internal medical record numbers and appointment information.

RELATED CONTENT

Special Report: Building a better cyber defense

NIST submits a draft update of the federal gold standard for cybersecurity

Verity breach exposes records of more than 10,000 patients

BREACH REGULATION

- Healthcare data breaches include loss, theft, unauthorized access, and hacking incidents
- Health care providers and health plans have to notify data breaches exposing more than 500 individuals to[1]:
  - Affected individuals
  - HHS
  - Media (sometimes)

Breaches Affecting 500 or More Individuals

As required by section 13402(e)(4) of the HITECH Act, the Secretary must post a list of breaches of unsecured protected health information affecting 500 or more individuals. These breaches are nov
the posted breaches. Additionally, this new format includes brief summaries of the breach cases that OCR has investigated and closed, as well as the names of private practice providers who have r
The following breaches have been reported to the Secretary:

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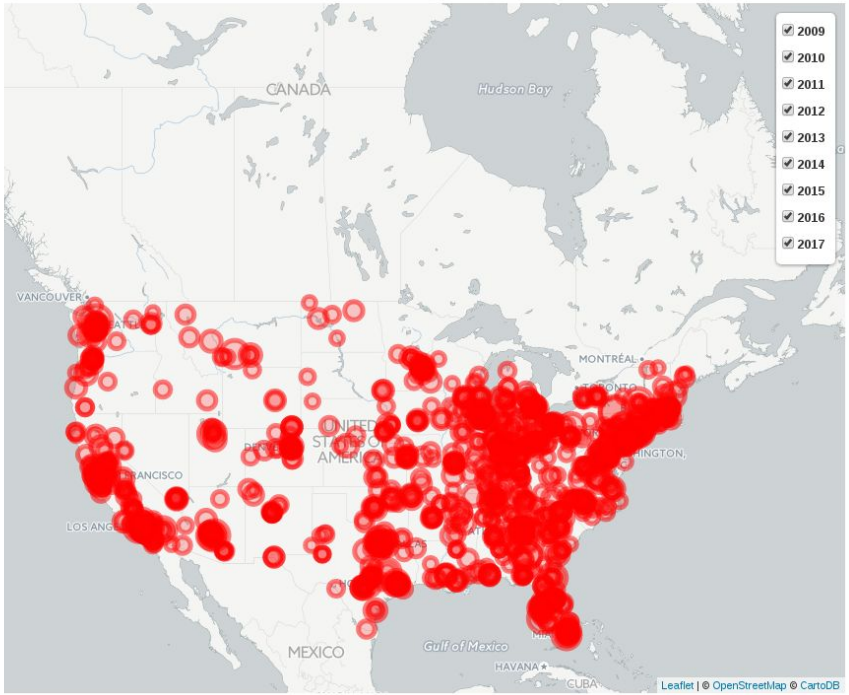
Breach Report Results					
	Name of Covered Entity	State	Covered Entity Type	Individuals Affected	Breach Submission Date
	Urology Austin, PLLC	TX	Healthcare Provider	279663	03/22/2017
	Highland Rivers Community Service Board	GA	Healthcare Provider	967	03/20/2017
	Rocky Mountain Health Maintenance Organization, Inc.	CO	Health Plan	1320	03/17/2017
	Houston Methodist Hospital	TX	Healthcare Provider	1417	03/17/2017
	St. Charles Health System	OR	Healthcare Provider	2459	03/16/2017
	Estill County Chiropractic, PLLC	KY	Healthcare Provider	5335	03/16/2017
	Local 693 Plumbers & Pipefitters Health & Welfare Fund	VT	Health Plan	1291	03/13/2017
	Denton Heart Group - Affiliate of HealthTexas Provider Network	TX	Healthcare Provider	21665	03/10/2017
	Metropolitan Urology Group	WI		17634	03/10/2017
	St. Louis Children's Hospital	MO	Healthcare Provider	643	03/09/2017
	Primary Care Specialists, Inc.	TN	Healthcare Provider	65000	03/09/2017
	CVS Health	RI	Healthcare Provider	724	03/08/2017

https://ocrportal.hhs.gov/ocr/breach/breach_report.jsf



Interactive Map of US Health Data Breaches

https://sungexplore.shinyapps.io/healthdatabreach/

MOTIVATION

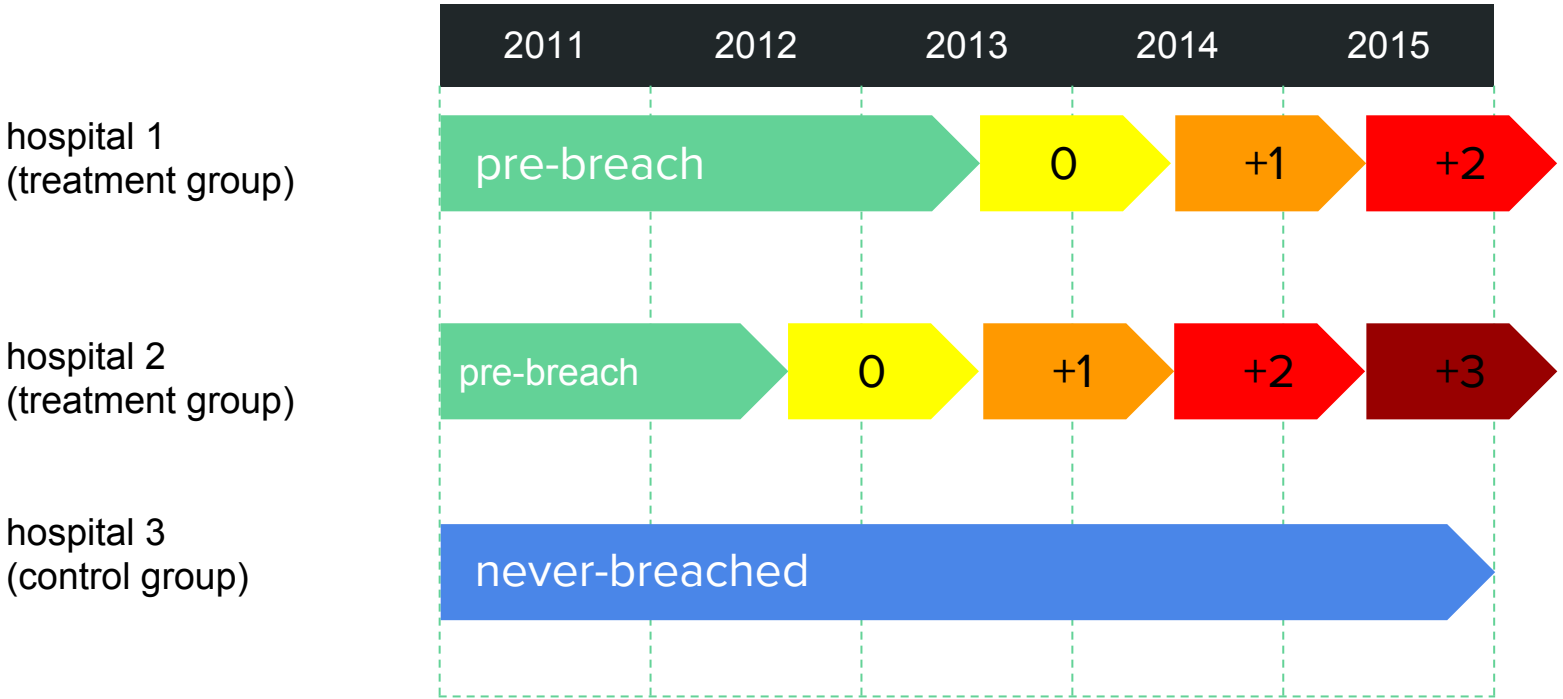
- A data breach may be an exogenous shock to hospitals, an opportunity for a natural experiment
- A breach triggers remediation expenses, regulatory inquiries, litigations, which could disrupt and delay hospital services and lead to worse patient outcomes

What is the relationship between health data breaches and hospital quality?

What is the relationship between health data breaches and hospital quality?

- We hypothesize that breaches may adversely impact patient mortality because remediation activities after a breach disrupt provider care-practices
- New security procedures, processes, and software worsen the usability of health IT for clinicians
- Costs to fix the damages from a breach may divert resources away from patient care

DIFFERENCE IN DIFFERENCE (DID) INTUITION



DIFFERENCE IN DIFFERENCE (DID) ESTIMATION - I

- For hospital i at year t

$$Y_{it} = \sum_{n=-4}^{4} \pi_n Breach_{it} + \beta X_{it} + \alpha_i + year_t + \epsilon_{it}$$

- Y : 30-day risk-standardized acute myocardial infarction mortality rate (%)
- Breach: dummy for whether 1. hospital was breached and 2.relative time from breach
- **π**: pre/post breach effect at n = -4, -3, -2, 0, . . . 4 years relative to the hospital specific time of breach
- n = 0 is the year of the breach, n = -1 was set as the omitted category

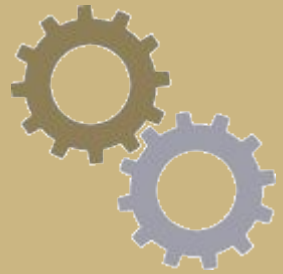
DIFFERENCE IN DIFFERENCE (DID) ESTIMATION - II

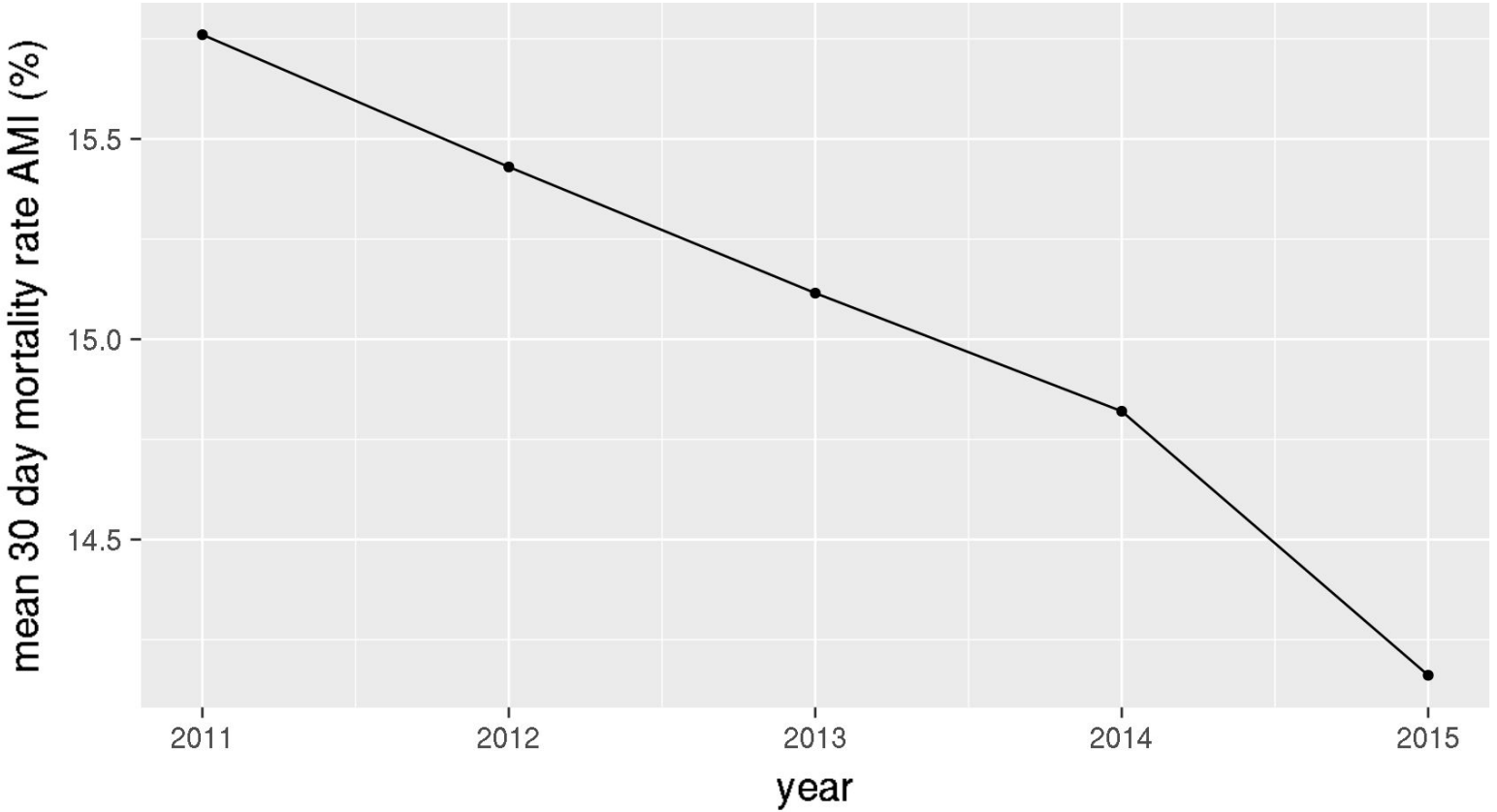
- X are the time varying hospital characteristics, including operating revenue, number of beds, length of stay, bed occupancy rate, meaningful use status (meaningful user of electronic health records defined in HITECH), patient satisfaction, and patient safety indicators
- Dummy for the control group, which was time-invarying, was omitted from the fixed effects estimation
- If multiple breaches in a year, only the first breach was used

DATA

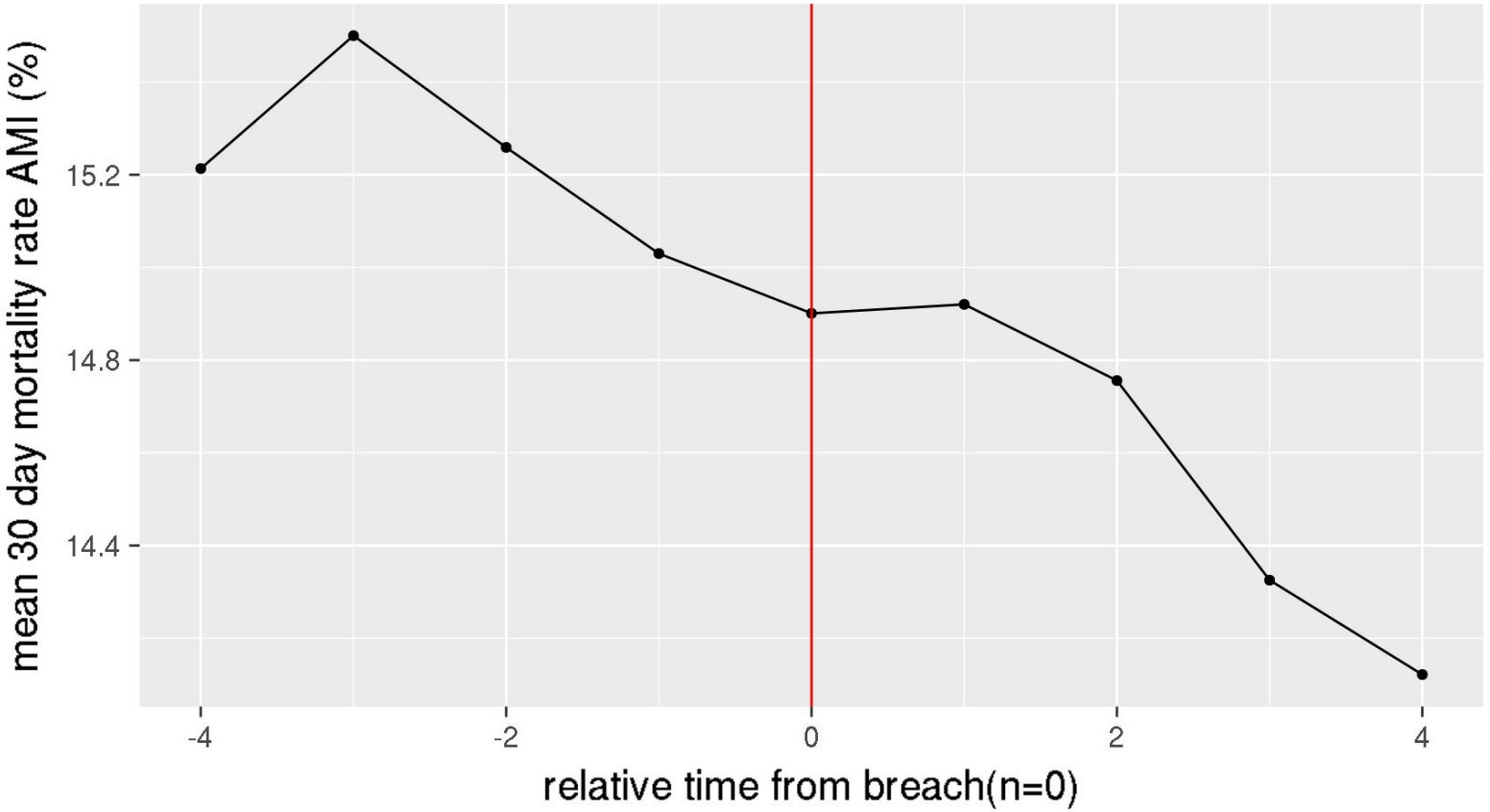
- Study population was a panel of 2,619 non-federal acute-care inpatient hospitals with 11,568 hospital-year observations from 2011-2015
- Data
  - Dept. Health and Human Services breach database (breach variables)
  - Medicare hospital compare (quality variables) [2]
  - Medicare cost report (time variant hospital characteristics) [3]

Results





Time trend of AMI mortality rate



Time trend of AMI mortality rate pre/post breach

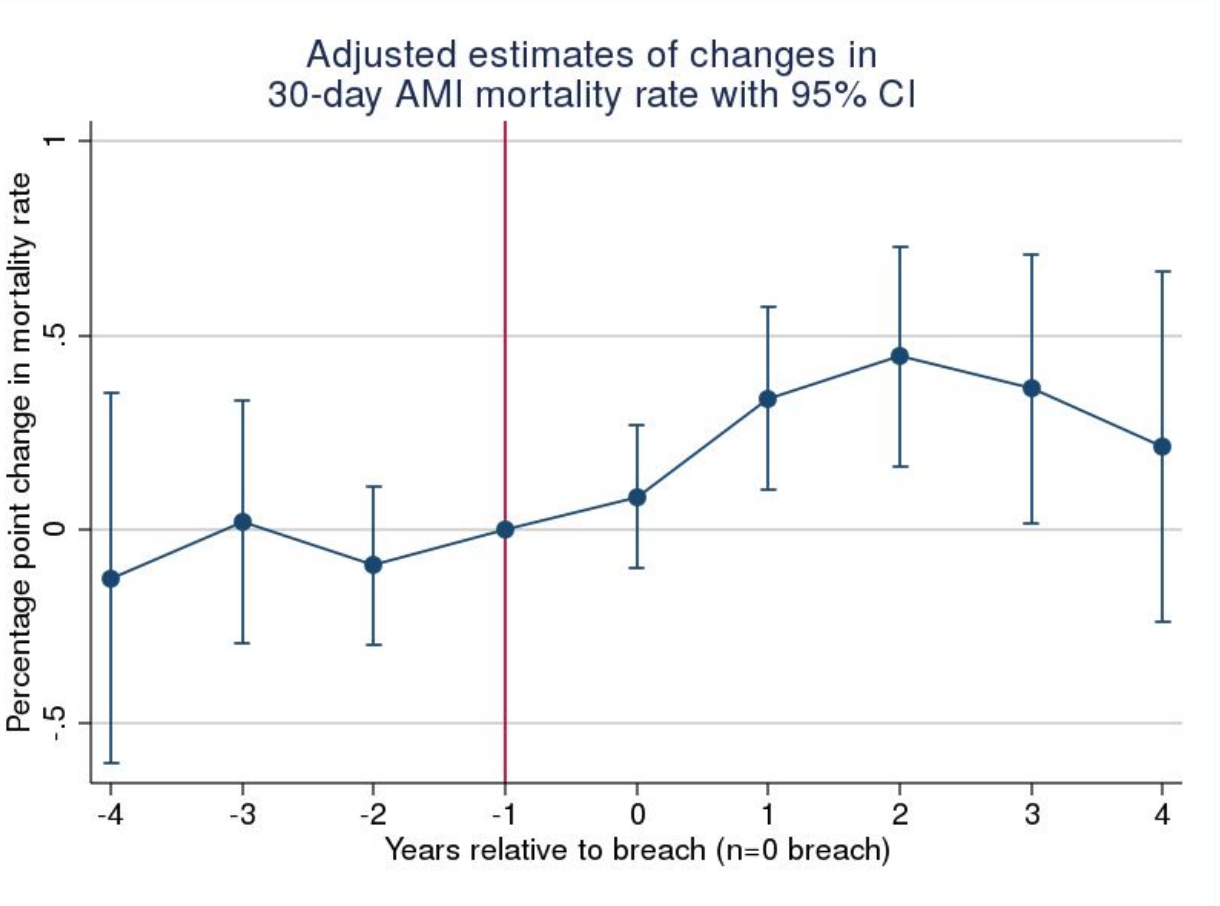
Count of reported breaches by type 2011-2015

Breach Type	N	%
Hacking IT Incident	23	8.7%
Improper Disposal	4	1.5%
Loss	73	27.7%
Multiple Types	3	1.1%
Other	13	4.9%
Theft	62	23.5%
Unauthorized Access Disclosure	86	32.6%
Sum	264	100%

DESCRIPTIVE SUMMARY

mean (sd)	**never breached**	**pre-breach**	**post-breach**
AMI mortality	15.1 (1.5)	15.2 (1.7)	14.7 (1.6)
Num beds	250.4 (183.8)	469.7 (321.7)	515.6 (420.2)
LOS	4.4 (0.8)	4.9 (0.9)	4.9 (0.9)
Occupancy rate	0.6 (0.2)	0.7 (0.1)	0.7 (0.1)
Definitely recommend	69.5 (8.7)	70.2 (9.4)	72.5 (8.2)
Patient rating 9-10	67.8 (7.6)	66.3 (8.6)	69.4 (7.1)
n obs	10511	366	691

DID ESTIMATES - PLOT

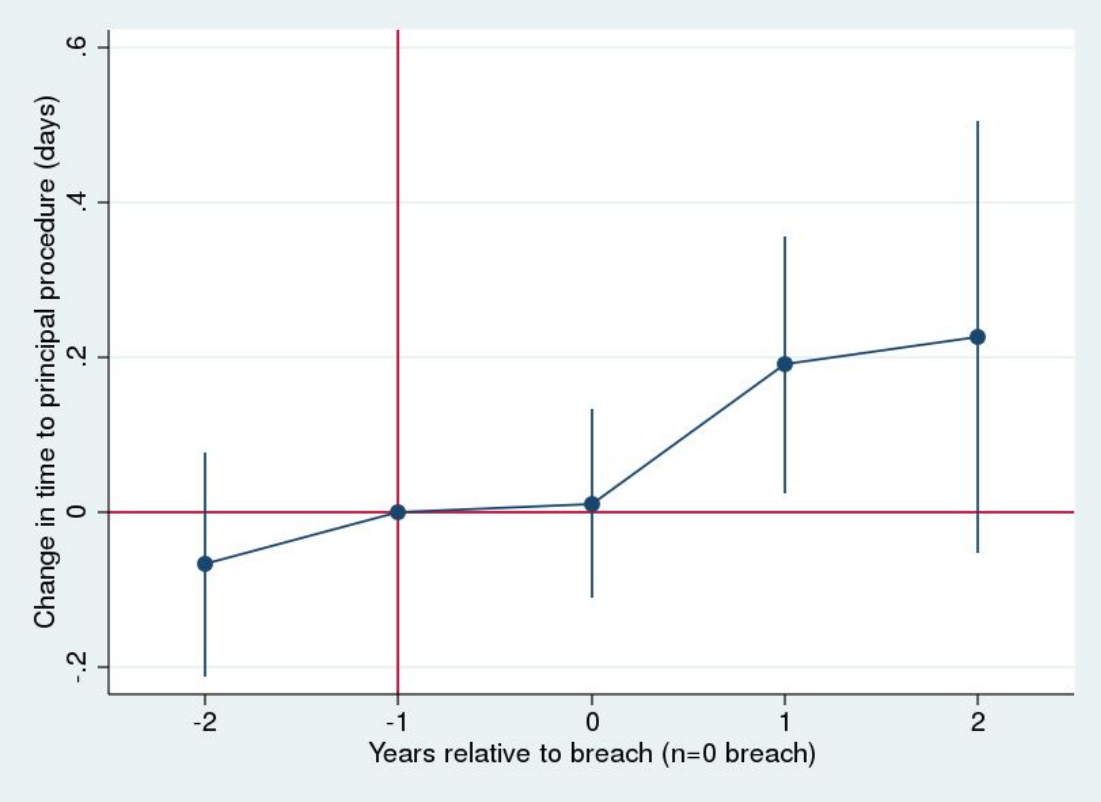


Data breaches were associated with higher hospital 30-day AMI mortality rates in the years following the breach

DID ESTIMATES - COEFFICIENTS

Y=AMI Mortality	**Coeff**
relative breach time (ref= -1)	
1	0.338**
	(0.121)
2	0.446**
	(0.144)
3	0.363*
	(0.176)
4	0.213
	(0.230)
* p<0.05, ** p<0.01, *** p<0.001	

PRELIMINARY FINDINGS



DISCUSSION

- We found that hospital data breaches were associated with higher 30-day AMI mortality rates in the years following the breach
- The .34 to.45 percentage point increase in 30-day AMI mortality rate after a breach was comparable to undoing a year's worth of improvement in mortality rate
- Changes in HIT and patient care processes in response to a data breach introduce usability challenges and unintended side effects that frustrate clinicians and disrupt patient care[4]

LIMITATIONS

- Hospital Compare Data measure 30-day mortality as a 36-month moving average, which would smooth the observed response to a breach
- The higher mortality rate at three years after the breach suggests this smoothing may be extending the observed time-impact

CONCLUSION

- Health data breaches have significant consequences for patients, providers, and payers, which could be framed as a quality of care problem
- We suggest that breached hospitals should carefully consider subsequent security initiatives to reduce the potential impact of new processes, procedures, and technologies on care quality
- The healthcare community must work together to jointly address the need to protect patient data and improve patient outcomes

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3. Centers for Medicare & Medicaid Services. Healthcare Cost Report Information System. 2016.

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