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# Widespread Third-Party Tracking On Hospital Websites Poses Privacy Risks For Patients And Legal Liability For Hospitals

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**ABSTRACT** Computer code that transfers data to third parties (third-party tracking) is common across the web and is subject to few federal privacy regulations. We determined the presence of potentially privacy-compromising data transfers to third parties on a census of US nonfederal acute care hospital websites, and we used descriptive statistics and regression analyses to determine the hospital characteristics associated with a greater number of third-party data transfers. We found that third-party tracking is present on 98.6 percent of hospital websites, including transfers to large technology companies, social media companies, advertising firms, and data brokers. Hospitals in health systems, hospitals with a medical school affiliation, and hospitals serving more urban patient populations all exposed visitors to higher levels of tracking in adjusted analyses. By including third-party tracking code on their websites, hospitals are facilitating the profiling of their patients by third parties. These practices can lead to dignitary harms, which occur when third parties gain access to sensitive health information that a person would not wish to share. These practices may also lead to increased health-related advertising that targets patients, as well as to legal liability for hospitals.

In 2021 Mass General Brigham and the Dana-Farber Cancer Institute agreed to an \$18 million settlement with a group of plaintiffs who claimed that the hospital networks had violated their privacy.<sup>1</sup> Notably, the case did not involve medical records, personal health information, security breaches, or unauthorized use of patients' financial information. Rather, the plaintiffs alleged that the hospital networks had not obtained sufficient consent when using third-party tracking tools—including cookies and tracking pixels—on the networks' publicly accessible websites.

The plaintiffs' charges reflect growing concern about the privacy risks raised by third-party tracking, particularly on websites where visitors'

browsing behavior may reveal sensitive information about their or their family members' health conditions to advertisers, data brokers, and other companies that seek to monetize it.<sup>2–4</sup> Third-party tracking code is typically installed by website maintainers to add functionality such as advertisement campaign monitoring or social media linkage.<sup>5</sup> However, health systems might not fully appreciate the privacy implications of the code,<sup>6</sup> which allows third parties not subject to the Health Insurance Portability and Accountability Act (HIPAA) to observe people's browsing behavior across hospital websites.<sup>7–9</sup>

Although prior research has shown that third-party tracking is prevalent across a range of health-related websites,<sup>10–12</sup> little is known about

the prevalence, quantity, and characteristics of third-party tracking on hospital websites, despite the fact that for many patients, these websites are an essential point of contact to the health system. Joshua Niforatos and colleagues recently assessed third-party tracking on the websites of sixty-one hospitals and found that 90 percent included at least one third-party cookie.<sup>13</sup> However, their study was limited to the largest and highest-ranked hospitals and did not assess for differences across hospital characteristics or the types of third parties to which data were transferred. A recent investigation conducted by STAT and The Markup found that the websites of thirty-three of *Newsweek's* top 100 hospitals transferred data to Facebook, but the investigation did not include hospitals outside this group, nor did it detail other third-party data recipients.<sup>14</sup>

In this analysis we aimed to assess the prevalence and quantity of third-party tracking across the website home pages of all US acute care hospitals. Our secondary aims were to identify hospital characteristics associated with higher levels of tracking and to assess whether third-party tracking varied between hospital website home pages and patient-facing web pages that contain information about potentially sensitive health conditions.

## Study Data And Methods

**DESIGN** We conducted a cross-sectional, prospective, observational study evaluating third-party tracking on US hospital websites. Third-party tracking was assessed on a rolling basis over a three-day period (August 5–8, 2021).

**STUDY POPULATION** We studied all US hospitals ( $N = 6,162$ ) included in the 2019 American Hospital Association (AHA) Annual Survey. The AHA Annual Survey is the canonical source for information on US hospitals and has a more than 90 percent response rate. Our primary analysis consisted of nonfederal acute care hospitals in the US and US territories, stratified according to the populations they serve. Consistent with prior studies, we defined nonfederal acute care hospitals as those that had an emergency department; were not a freestanding long-term care facility or an ambulatory surgical center; and were not under military, Indian Health Service, or other federal control.<sup>15,16</sup>

**HOSPITAL URLS** To obtain hospital website home page URLs, we employed a distributed search strategy using Amazon Mechanical Turk, with manual verification by two study authors (Karim Farhat and Amey Maley). For each hospital, three Amazon Mechanical Turk workers were provided the name of the hospital and its

physical address, as listed in the AHA database, and asked to perform a Google search for the URL of the homepage of each hospital. If all three workers provided the same URL or agreed that the hospital had no website, the result was immediately accepted ( $n = 2,534$ ). For the remaining cases ( $n = 3,628$ ), a study author (Farhat or Maley) manually reviewed and selected the correct URL or confirmed that the hospital had no website.

Some hospitals shared a website, as they were a part of a larger health system. In these cases, the health system home pages were accepted as valid hospital URLs.

**HOSPITAL CHARACTERISTICS** We obtained hospital characteristics from the AHA database and the Census Bureau's American Community Survey (ACS). The AHA database provided information on hospital name and address, health system membership, ownership type (nonprofit versus for profit), number of beds, presence of an emergency department, and medical school affiliation reported to the AMA.

We used the 2019 five-year ACS to compile data on race, ethnicity, and population size for ZIP Code Tabulation Areas. Rural-urban commuting area codes from the 2010 census were used to assign an urbanicity score to each of a hospital service area's (HSA's) constituent ZIP codes, as defined in the *Dartmouth Atlas of Health Care*. HSAs constitute a geographic area in which residents receive most of their hospitalizations from the hospitals in that area, and they therefore serve as a proxy for where a resident in a particular ZIP code would most likely seek treatment. Metropolitan and micropolitan areas were categorized as urban, with all other areas being considered rural. If an HSA consisted of both rural and urban ZIP codes, it was classified as urban. ACS ZIP code data were then aggregated into HSAs by taking the average data of all ZIP codes in a given HSA.

We defined rural hospitals as those having a rural population percentage value in the top decile of all hospitals. We defined poverty-serving hospitals as those having a percentage of patient population living in poverty in the top decile. We defined historically disadvantaged minority-serving hospitals as those with a Black or Hispanic patient population percentage in the top decile, excluding Native American and other populations from this calculation because of a lack of available data.

**THIRD-PARTY TRACKING** To assess the amount and type of third-party tracking on each hospital's home page, we visited each web page using webXray, an open-source, automated tool designed to record third-party tracking, which has previously been used in academic studies.<sup>10,11,17</sup>

For each web page we recorded data requests that initiated data transfers to third-party domains. Transfers typically occur when the web page loads and include a user's IP address and the URL of the web page being visited. We also recorded the presence of cookies—small pieces of data stored on a user's browser that serve as persistent identifiers—allowing users to be tracked across multiple websites. We used the webXray database to link individual tracking domains to their parent companies (for example, doubleclick.net was determined to be owned by Google, which is owned by Alphabet).

To assess whether tracking differed between hospital home pages and condition-specific web pages within a hospital website, we selected 100 hospitals via simple random sampling and conducted a structured search of their websites. One author (Jackson Felkins) used each hospital website's own search engine to locate web pages covering six conditions that may reveal sensitive information about users by searching for the following terms: "Alzheimer's," "breast cancer," "congestive heart failure," "Crohn's disease," "depression," and "HIV." We recorded the URL for the first patient-facing web page returned in the search results. Using webXray, we visited the condition-specific URLs and the same hospitals' home pages and recorded all third-party data requests.

**STATISTICAL ANALYSIS** We calculated the percentage of hospital home pages with any third-party data transfer and any third-party cookie, both overall and by hospital type. Our primary outcome measure was the number of third-party transfers on hospital home pages. The number of third-party transfers has important implications for users' privacy because it directly captures the scale of dignitary harms that people suffer when third parties gain access to their sensitive health information<sup>7</sup> and because it correlates with the probability of data resale or targeted advertisement. We calculated the median number and interquartile range of third-party transfers per hospital home page and used the nonparametric equality-of-medians test to examine whether the number of third-party transfers differed by hospital characteristics. We used medians and correlation coefficients to compare tracking between condition-specific pages and hospital home pages. In adjusted analyses, we used linear regression with clustering by health system, with the number of third-party transfers as the dependent variable and with the following independent variables: hospital size, region, ownership type, system membership, medical school affiliation, location (rural versus urban), poverty serving, and minority serving. Sensitivity analyses explored additional definitions of medical school affilia-

## Hospitals have a responsibility to protect patients from unnecessary risks, including risks to their privacy.

tion. The variance inflation factor identified no covariates with multicollinearity.

Statistical analysis was conducted using Stata IC, version 16.1. All hypothesis tests were two tailed, using an  $\alpha$  level of 0.05. As this study used publicly available data, it was considered exempt from Institutional Review Board review.

**LIMITATIONS** This study had limitations. First, we investigated only two modes of tracking: data transfers to third-party domains and third-party cookies. Because other modes of tracking exist, such as browser fingerprinting, we likely underestimated the extent of third-party tracking on hospital home pages. Second, we were unable to assess tracking on password-protected sections of hospital websites, including patient portals. Third, we could not differentiate between uses of the data once transferred. However, although some third parties use data transfers to provide a service without using those data for other purposes, such as targeted advertising or resale, the majority are known to use the data, including on hospital pages.<sup>14</sup> Fourth, to assess whether tracking differed between hospital home pages and condition-specific pages, we analyzed a subset of hospital websites with patient-facing web pages for six specific conditions. Hospitals with such web pages may differ from those without them. Finally, we did not assess longitudinal trends in tracking because of data limitations.

### Study Results

We identified 3,747 nonfederal acute care hospitals with accessible websites, as shown in online appendix exhibit S1.<sup>18</sup> Overall, 98.6 percent of hospital website home pages had at least one third-party data transfer, whereas 94.3 percent had at least one third-party cookie (exhibit 1).

Alphabet (the parent company of Google) was the most common tracking entity among all hospitals in the sample, with 98.5 percent of all home pages reporting third-party transfers to

this entity. Other common third-party entities included Meta (55.6 percent), Adobe Systems (31.4 percent), and AT&T (24.6 percent). The twenty-five most prevalent third-party entities are reported in exhibit 2. Data transfers to third-party domains whose parent company could not be identified were present on 69.0 percent of home pages.

Overall, hospital website home pages had a median of sixteen third-party transfers. The median number of third-party transfers per home page differed across hospital characteristics in unadjusted analyses (exhibit 3 and appendix exhibit S2).<sup>18</sup> Medium-size hospitals had a significantly higher median number of third-party transfers (twenty-four) compared with both small (seventeen) and large (thirteen) hospitals. Nonprofit hospitals had a greater median number of third-party transfers (twenty-two) than both public (eleven) and for-profit (thirteen) hospitals. Hospitals in a health system had a greater number of third-party transfers than independent hospitals (median, twenty-one versus ten), whereas hospitals with a medical school affiliation had a greater number of third-party transfers than those without an affiliation (median, twenty versus fifteen). Urban hospitals had a greater number of third-party transfers than rural hospitals (median, seventeen versus eleven). Finally, non-poverty-serving hospitals had a greater number of third-party transfers than poverty-serving hospitals (median, seventeen versus thirteen). Compared to hospitals with any third-party data transfers, the small number (fifty-two, 1.4 percent) of hospitals on whose websites we did not observe third-party transfers were substantially (at least 10 percentage points) less likely to be part of a system, to have an academic affiliation, and to be nonprofit and more likely to be poverty serving, minority serving, and public (see appendix exhibit S3).<sup>18</sup>

In multivariate regression analysis, several factors were associated with a significantly greater number of third-party transfers on hospital website home pages (exhibit 4). Membership in a health system was associated with an increase of 10.0 third-party transfers compared with non-system membership ( $p < 0.001$ ). Having a primarily urban patient population was associated with an average of 3.6 more third-party transfers ( $p < 0.001$ ). Finally, having a medical school affiliation was associated with 1.8 more third-party transfers after adjustment ( $p < 0.05$ ). Results from sensitivity analyses are in appendix exhibit S4.<sup>18</sup>

Our manual search of 100 randomly sampled hospital websites for patient-facing pages related to six potentially sensitive conditions yielded thirty websites that had patient-facing pages for

## EXHIBIT 1

### Descriptive characteristics of nonfederal acute care US hospitals (2019) and frequency of third-party tracking tools on hospital websites (2021)

Characteristics	Hospitals		Hospital websites with:	
	Number	Percent	Third-party transfer	Third-party cookie
Overall	3,747	100.0	98.6%	94.3%
Size <sup>a</sup>				
Small (fewer than 100 beds)	1,814	48.4	98.7	94.2
Medium (100–499 beds)	694	18.5	99.3	98.9
Large (500 or more beds)	1,239	33.1	98.1	91.9
Region				
Northeast	452	12.1	99.6	95.8
Midwest	816	21.8	98.7	93.8
South	1,657	44.2	98.4	94.2
West	774	20.7	98.6	95.1
Puerto Rico	48	1.3	95.8	81.3
Ownership				
For profit	754	20.1	98.5	93.0
Not for profit	2,275	60.7	99.0	96.7
Public	714	19.1	97.5	88.2
Unknown	4	0.1	100.0	50.0
System membership <sup>b</sup>				
Part of a system	2,434	65.0	99.5	97.4
Not part of a system	1,313	35.0	97.0	88.6
Medical school affiliation				
Yes	1,199	32.0	99.4	97.5
No	2,548	68.0	98.2	92.8
Location				
Rural <sup>c</sup>	646	17.2	97.8	90.1
Urban	3,101	82.8	98.8	95.2
Poverty serving <sup>d</sup>				
Yes	398	10.6	97.0	91.7
No	3,349	89.4	98.8	94.6
Minority serving <sup>e</sup>				
Yes	695	18.6	97.7	92.1
No	3,052	81.5	98.8	94.8

**SOURCE** Authors' analysis of hospital website home pages, with tracking assessed via the webXray tool, August 2021; and hospital characteristics from the American Hospital Association (AHA) Annual Survey, 2019. <sup>a</sup>Total number of general medical and surgical beds. <sup>b</sup>Defined as hospitals with a listed system name in the AHA database. <sup>c</sup>Defined as having a rural population percentage value in the top decile of all hospitals. <sup>d</sup>Defined as hospitals with a percentage of patient population living in poverty in the top decile. <sup>e</sup>Defined as hospitals with a Black or Hispanic patient population percentage in the top decile.

all six conditions. Across these thirty websites, 100 percent of condition-specific pages had at least one third-party data transfer. The number of third-party transfers was similar between condition-specific pages and the hospitals' home pages, with a median of 18–22 third-party transfers per condition-specific page compared with a median of 22 per home page. The amount of tracking on condition-specific pages was highly correlated with tracking on the home page of the same hospital, with condition-specific correlation coefficients ranging from 0.87 to 0.95 (see appendix exhibit S5).<sup>18</sup>

## EXHIBIT 2

Number of US hospital websites transferring data to a given tracking entity parent company, 2021

Parent companies	Number	Percent
Alphabet <sup>a</sup>	3,691	98.5
Meta <sup>b</sup>	2,083	55.6
Adobe Systems	1,177	31.4
AT&T	922	24.6
The Trade Desk	813	21.7
Oracle	802	21.4
Verizon	791	21.1
Rubicon Project	712	19.0
Amazon	689	18.4
Microsoft	671	17.9
Hotjar	629	16.8
StackPath	596	15.9
Siteimprove	592	15.8
Cloudflare	592	15.8
Acxiom	551	14.7
Salesforce	543	14.5
Telenor	532	14.2
Nielsen Online	476	12.7
Lotame	446	11.9
Fonticons	446	11.9
JS Foundation	420	11.2
Crazy Egg	408	10.9
Golden Gate Capital	408	10.9
Drawbridge	386	10.3

**SOURCE** Authors' analysis of hospital website home pages, with tracking assessed via the webXray tool, August 2021. **NOTE** Of these hospital website home pages, 2,585 pages (69.0 percent) transferred third-party data to at least one domain whose parent entity could not be identified in the webXray database. <sup>a</sup>Parent company of Google. <sup>b</sup>Parent company of Facebook.

## Discussion

Our results demonstrate that across the websites of 3,747 nonfederal acute care hospitals in the US, third-party tracking is ubiquitous and extensive, with hospital website home pages initiating a median of sixteen third-party data transfers. Hospital websites transfer data to numerous third parties, including some of the largest technology and social media companies, advertising firms, and data brokers. In addition, our analysis of a random sample of hospital websites revealed no substantial difference between the amount of third-party tracking on hospital home pages and condition-specific web pages.

Thus, despite being subject to HIPAA's stringent privacy measures for protected health information, nearly all hospitals allow third parties to capture data about how patients and other users navigate their websites. A recent investigative report revealed that in some instances, data transfers from hospital websites to third parties may include protected health information re-

garding patients' prescriptions and doctor appointments and, hence, constitute HIPAA violations.<sup>14</sup> Our analysis suggests that if this phenomenon occurs across even a small proportion of third-party data transfers on hospital websites, many patients may be exposed to such violations.

In addition, a December 2022 bulletin issued by the Department of Health and Human Services (HHS) Office for Civil Rights clarified that HIPAA rules apply even to regulated entities' unauthenticated web pages, including web pages "with general information about the regulated entity like their location [or] services they provide."<sup>19</sup> The bulletin notes, for example, that including tracking code that collects a person's IP address on an "unauthenticated webpage that addresses specific symptoms or health conditions" would constitute the disclosure of protected health information to the tracking technology vendor. This guidance implies that HIPAA rules would apply to a potentially vast number of third-party data transfers on hospital websites.

We found that hospitals in health systems, hospitals with a medical school affiliation, and hospitals serving more urban patient populations all exposed website visitors to more third-party data transfers. Although further research is needed to examine the causes of this discrepancy, it may be influenced by multiple factors. These hospitals may strive to include more features on their websites, and the additional tracking is a product of including third-party functionality, such as embedding a Google Maps product onto a site. Alternatively, these hospitals may engage in higher levels of online advertising to drive revenues, and the third-party tracking is a consequence of the perceived need to monitor these advertising campaigns by installing tracking tools.

The high number of entities engaged in tracking on hospital websites heightens potential privacy risks to patients. Many of the third parties to which data are transferred have business models built on identifying and tracking people for the purposes of targeting online advertisements. Alphabet does not sell data to third parties but, rather, allows targeted advertising through profiles, including the targeted promotion of prescription drugs. Less prevalent tracking entities are more varied in their policies and purposes, including tracking companies that sell their data on to third parties (for example, Acxiom)<sup>20</sup> or allow health-related profiling (for example, Adobe and Oracle).<sup>21,22</sup> These practices have led to lists of patients with particular disease types and their information, including their telephone numbers and home addresses, being available

**EXHIBIT 3**
**Number of third-party data transfers per website (2021), by 2019 hospital characteristics**

Characteristics	Hospitals		Number of third-party transfers		
	Number	Percent	Median	IQR	p value
Overall	3,747	100.0	16	10, 29	
Size					<0.01
Small (fewer than 100 beds)	1,814	48.4	17	10, 30	
Medium (100–499 beds)	694	18.5	24	15, 36	
Large (500 or more beds)	1,239	33.1	13	7, 22	
Region					<0.01
Northeast	452	12.1	19	12, 32	
Midwest	816	21.8	15	8, 28	
South	1,657	44.2	16	10, 30	
West	774	20.7	16	9, 31	
Puerto Rico	48	1.3	5	4, 10	
Ownership					<0.01
For profit	754	20.1	13	10, 17	
Not for profit	2,275	60.7	22	12, 36	
Public	714	19.1	11	6, 19	
Unknown	4	0.1	3.5	2, 6.5	
System membership					<0.01
Yes	2,434	65.0	21	13, 35	
No	1,313	35.0	10	5, 17	
Medical school affiliation					<0.01
Yes	1,199	32.0	20	12, 34	
No	2,548	68.0	15	8, 27	
Location					<0.01
Rural	646	17.2	11	6, 21	
Urban	3,101	82.8	17	11, 31	
Poverty serving					<0.01
Yes	398	10.6	13	8, 25	
No	3,349	89.4	17	10, 30	
Minority serving					0.07
Yes	695	18.6	16	9, 28	
No	3,052	81.5	16	10, 30	

**SOURCE** Authors' analysis of hospital website home pages, with tracking assessed via the webXray tool, August 2021, and hospital characteristics from the American Hospital Association Annual Survey, 2019. **NOTES** A box and whisker plot of these data is in appendix exhibit S2 (see note 18 in text). Rural, poverty-serving, and minority-serving hospitals are defined in the exhibit 1 notes.

for purchase.<sup>23</sup> Third-party tracking code on hospital web pages may facilitate these types of health-related tracking.

Because little is known about the precise ways in which third parties use tracking data, the implications of extensive third-party tracking on hospital websites remain unknown but are potentially far reaching. Patients who visit hospital websites may see greater levels of online targeted advertisement for pharmaceuticals, medical supplements, and insurance products that potentially conflict with best practices or the advice of their physician, drive low-value health care spending, or substitute for more effective cures. Health-related information inferred from browsing behavior also may be incorporated into risk scores, which can be used in decisions about eligibility for credit and insurance products.<sup>24</sup> Although public health campaigns may also

use targeted advertising to reach specific populations, public advertising budgets are smaller than private spending, limiting their relative impact.

### Recommendations

Hospitals have a responsibility to protect patients from unnecessary risks, including risks to their privacy. Furthermore, as suggested by the recent settlement with Mass General Brigham and the Dana-Farber Cancer Institute,<sup>1</sup> similar ongoing lawsuits against other hospital systems,<sup>4</sup> and HHS's clarification that HIPAA rules apply to some data transfers from regulated entities' unauthenticated web pages,<sup>19</sup> hospitals may also face financial risks for exposing website visitors to unwanted tracking.

Policy makers should address tracking on

## EXHIBIT 4

## Adjusted association of US hospital characteristics (as of 2019) with the number of third party transfers on hospital websites (2021)

Variables	Difference	SE
Size (ref = small)		
Medium (100–499 beds)	1.1	1.1
Large (500 or more beds)	–1.0	1.2
Ownership (ref = for profit)		
Not for profit	11.2****	2.0
Public	4.8***	1.5
Unknown	–7.6**	2.9
Member of health system	10.0****	1.5
Medical school affiliation	1.8**	0.8
Urban location	3.6****	1.0
Poverty serving	–2.5**	1.1
Minority serving	0.5	1.2
Constant	8.5****	1.6

**SOURCE** Authors' analysis of hospital website home pages, with tracking assessed via the webXray tool, August 2021; and hospital characteristics from the American Hospital Association Annual Survey, 2019. **NOTE** Linear regression model with clustering by health system, with the number of third-party transfers as the dependent variable. \*\* $p < 0.05$  \*\*\* $p < 0.01$  \*\*\*\* $p < 0.001$

health-related web pages specifically in proposed privacy legislation that builds on the framework of the American Data Protection and Privacy Act,<sup>25</sup> ideally by prohibiting the practice. Hospitals should audit their websites to limit or eliminate third-party tracking. Hospitals that choose to allow third-party tracking should disclose this to website visitors and give patients simple methods for opting out of tracking completely. Any third-party tools installed should also have their privacy policies reviewed by a hospital's legal department in conjunction with a patient representative to ensure that the policies meet the hospital's legal and ethical obligations to protect patient privacy.

## Conclusion

This study documents that nearly all US acute care hospitals transfer data to third parties when patients or other members of the public visit their websites. This practice poses privacy risks for patients and may result in legal liability for hospitals. Hospitals should regularly audit their own websites, limit the amount of third-party tracking, disclose such tracking in a transparent format, and allow patients to easily and permanently opt out of such tracking. ■

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reported receiving grants from the National Science Foundation outside the submitted work, as well as gifts from Google, Facebook, and Carnegie Mellon CyLab. McCoy reported receiving grants from the Greenwall Foundation outside of the submitted work, as well as being an uncompensated member of the University of Pennsylvania's Data Ethics Working Group, which is funded in part by industry gifts to the university.

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