

Challenges and dynamics of public health reporting and data exchange during COVID-19: insights from US hospitals

John (Xuefeng) Jiang¹, Peter Cram^{2,3}, Kangkang Qi⁴, Ge Bai^{5,6,*}

¹Eli Broad College of Business, Michigan State University, East Lansing, MI 48824, United States

²The University of Texas Medical Branch School of Public and Population Health, Galveston, TX 77555, United States

³Temerty Faculty of Medicine, University of Toronto, Toronto, ON M5S 1A8, Canada

⁴Harbert College of Business, Auburn University, Auburn, AL 36849, United States

⁵Johns Hopkins Carey Business School, Baltimore, MD 21202, United States

⁶Johns Hopkins Bloomberg School of Public Health, Baltimore, MD 21205, United States

*Corresponding author: Johns Hopkins Carey Business School, Baltimore, MD 21202, United States. Email: gбай@jhu.edu

Abstract

The US health care response during the early stages of the COVID-19 pandemic unveiled challenges in public health reporting systems and electronic clinical data exchange. Using data from the 2020 and 2022 American Hospital Association information technology supplement surveys, this study examined US hospitals' experiences in public health reporting, accessing clinical data from external providers for COVID-19 patient care, and their success in reporting vaccine-related adverse events to relevant state and federal agencies. Results showcase significant disparities in reporting practices across government levels due to inconsistent requirements. Although many hospitals leaned toward automated data transmission, a substantial portion continued to depend on manual processes. Pertaining to electronic clinical data, while entities like large commercial laboratories outperformed others, a considerable number were sluggish in delivering critical information. Moreover, a small percentage of hospitals reported challenges in recording vaccine-related adverse events, emphasizing the need for transparent reporting systems. The study underscores the necessity for standardized reporting protocols, explicit directives, and a pivot from manual to automated processes. Tackling these challenges is pivotal for ensuring prompt and reliable data, bolstering future public health responses, and rejuvenating public trust in health institutions.

Key words: COVID-19; public health reporting; vaccine adverse effect; capacity.

Introduction

In the initial phase of the COVID-19 pandemic, the US health care system faced 2 pivotal challenges. First, public health reporting systems struggled to provide real-time data to key decision-makers, mainly due to data interoperability and analytical shortcomings. From March 2020 onward, both the Department of Health and Human Services and the Centers for Disease Control and Prevention mandated US hospitals to consistently report daily on COVID-19 cases. Concurrently, state and local health agencies set forth their data requirements, focusing on hospital capacities and supplies. These reporting obligations were instrumental for governmental monitoring, informed resource distribution, and public awareness.^{1,2}

The second significant challenge centered on the efficient exchange of patient data for COVID-19 treatment. Given the constraints on hospital resources, most patients were directed to seek hospital care only with severe symptoms. Many had previously seen other health care providers for initial evaluations and treatments. For hospitals, obtaining detailed electronic clinical records from outside sources was crucial for continuous patient care, particularly given the virus' acute nature and the rapid progression of symptoms in some patients.

Acknowledging these challenges, President Biden designated the enhancement of public health reporting and data sharing as a prime focus for the Office of Science and Technology Policy in 2021.³ The National Academy of Medicine echoed these sentiments, criticizing the health sector for its disjointed and inefficient data-exchange mechanisms.⁴

Despite the pressing nature of these challenges, there is a gap in the literature. Few studies have explored hospital experiences with public health reporting and their access to external electronic clinical data during the pandemic in depth. Our study aims to fill this void. We seek to offer insights to improve public health reporting systems, enhance pandemic response, and align with federal goals for data interoperability, like those outlined in the Office of the National Coordinator for Health Information Technology (ONC) Certification Program Final Rule.

Our study addresses several key questions. We examined the levels of public health agencies—federal, state, and local—to which each hospital was required to report capacity and supplies data, evaluated the uniformity of reporting criteria across governmental tiers, identified the reporting challenges faced, and analyzed the actual reporting methods hospitals used: automated, manual, or a combination. We also evaluated how effectively vaccine-related adverse events were reported. On the clinical information front, our focus

Received: October 10, 2023; Revised: November 20, 2023; Accepted: December 1, 2023

© The Author(s) 2024. Published by Oxford University Press on behalf of Project HOPE - The People-To-People Health Foundation, Inc.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com

was on understanding hospitals' accessibility to data, identifying which types of data were more readily available, and discerning the efficiency of different providers in transmitting this information. The emphasis on electronic data is rooted in its ability to integrate seamlessly, crucial for swift diagnoses and treatments.

Data and methods

This economic evaluation followed the Consolidated Health Economic Evaluation Reporting Standards reporting guideline. Since 2008, the American Hospital Association (AHA) in conjunction with the ONC has annually conducted a health care information technology (IT) survey. This survey gauges technology adoptions within hospitals and has been widely used in prior research.⁵⁻⁸

Each US hospital's chief executive officer received an invitation to participate in the survey, irrespective of their AHA membership status. The individual most informed about the hospital's health IT, usually the chief information officer, was asked to submit the data, either through a mailed survey or a secure online platform. To boost the response rate, follow-up mailings and phone calls were made to those who initially did not respond.⁹

Amid the COVID-19 pandemic, the 2020 AHA IT survey incorporated questions concerning hospital capacities for reporting to public health agencies and their experiences sharing COVID-19 data across institutions. Although slated for 2020, the survey was executed from April to October 2021. Given its real-time inquiry approach, responses were considered by the ONC as pertaining to 2021.⁹ Consequently, the 2021 IT survey was skipped. The 2022 iteration pivoted its emphasis towards the social determinants of health and interoperability, retaining only a few COVID-19-specific queries. We utilized both datasets to assess hospitals' dealings with COVID-19.

The 2020 IT survey received responses from 2885 hospitals, corresponding to a response rate of 54% for nonfederal acute care hospitals.¹⁰ The 2022 IT survey was conducted from July to December 2022 and received responses from 3127 hospitals, representing a nearly 60% response rate for nonfederal acute care hospitals.¹¹

In addition to the data from the 2020 and 2022 AHA IT surveys, we also incorporated information from the 2021 AHA annual survey to examine reporting differences across various hospital characteristics, such as ownership, system affiliation, and geographic location (rural vs urban). This comprehensive approach allowed us to explore not only the baseline technological capabilities of hospitals but also how these capabilities intersect with other institutional factors.

Additionally, we linked hospitals' reporting differences to their adoption of electronic health records (EHRs) and telehealth offerings, based on data from the 2019 AHA IT survey, as outlined by Jiang et al.¹² This multifaceted data integration provides a richer understanding of how diverse hospital characteristics and technological adoptions impact COVID-19 reporting practices.

Results

Table S1 shows that hospitals that responded to the AHA IT surveys tend to be larger, more likely to be nonprofit, system-affiliated, teaching hospitals, and located in urban areas compared with nonresponding hospitals. In the 2020 survey, out

of 2885 hospital respondents, a significant commitment to public health reporting is evident. Figure S1 underscores that 85% of hospitals relayed their capacity and medical supplies data to federal public health agencies. Simultaneously, an even higher 93% reported to state agencies. On the local level, just over half, at 51%, provided this critical information to their respective local public health entities. It is noteworthy that, amidst the COVID-19 pandemic, nearly half of all participating hospitals adhered to mandates by reporting to all 3 tiers of public health agencies.

However, while many hospitals are actively reporting, the standardization across agency requirements presents challenges. According to Figure S2, only a modest 18% of hospitals found the directives to be completely consistent across different government agencies. A majority, representing 66%, felt there was some degree of similarity, but not complete alignment. More disconcertingly, 16% of hospitals perceived the requirements from different levels as disparate, highlighting either noticeable differences or a complete lack of similarity.

Diving deeper into the challenges hospitals faced when reporting capacity and supplies data to public health agencies reveals specific hurdles across local, state, and federal levels (Figure 1). A notable 59% of hospitals indicated difficulty obtaining data when reporting to federal agencies, followed closely by 57% facing the same challenge at the state level and 26% at the local level. Inconsistencies in the definitions of reporting elements presented significant challenges as well, with 53% of hospitals highlighting this issue at the federal level, 50% at the state level, and 25% locally.

Furthermore, a lack of submission templates was another obstacle, identified by 43% of hospitals for state reporting, 31% for federal, and 23% at the local level. Ambiguous instructions posed problems for 42% of hospitals when interacting with state entities, 39% with federal agencies, and 19% at the local tier. Last, the inclusion of irrelevant measures in the reporting requirements was cited by 25% of hospitals at the federal level, 24% at the state level, and 11% locally.

Interestingly, across all challenges, reporting to local governments generally appeared to be less burdensome than at the state and federal tiers, highlighting a potential disparity in reporting standards and practices across these different governmental levels.

The AHA IT surveys discerned the varied methods that hospitals use to submit data to public health agencies. Among these, they identified an "Automated" mode, where data generated from EHRs are sent directly and electronically to the public health agency. In contrast, the "Manual" method entails processes like chart abstraction, with data being either faxed or manually input into a designated portal. Additionally, there exists a "Mixed" mode, which combines both automated and manual processes; for instance, files might be electronically generated from the EHR but would require manual intervention to transmit to the public health agency.

Based on the results from both the 2020 and 2022 surveys, there is a clear shift in hospital data submission practices. By 2022, hospitals predominantly using the "Automated" approach increased to 23%, up from 18% in 2021. This uptick is observed alongside a decrease in the usage of the "Mixed" approach, which dropped from 51% in 2021 to 45% in 2022. Meanwhile, the utilization of the "Manual" method remained steady, representing about 32% of hospitals in both years, as detailed in Figure 2.

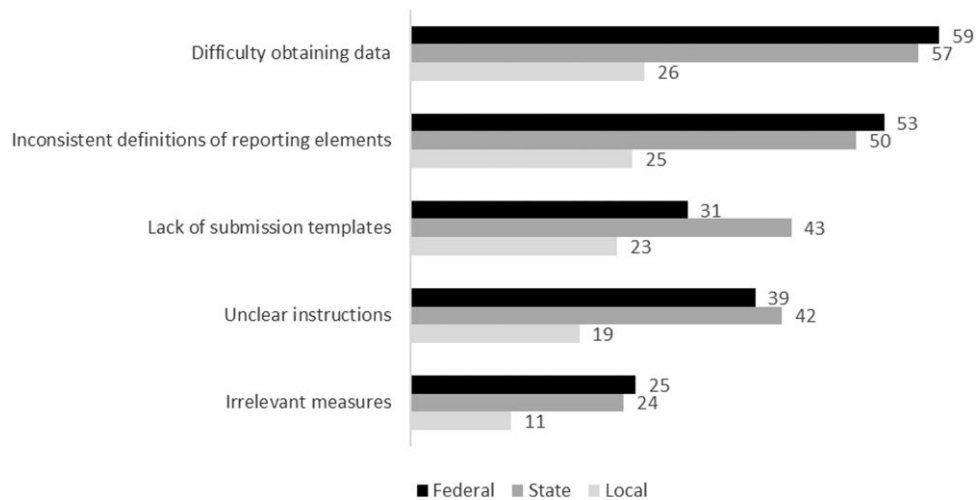


Figure 1. Hurdles encountered in reporting capacity and supplies data to public health agencies (%). Source: the 2020 AHA IT supplement survey conducted in 2021. The non-missing hospitals in each category: federal (2457), state (2679) and local (1477). Abbreviations: AHA, American Hospital Association; IT, information technology.

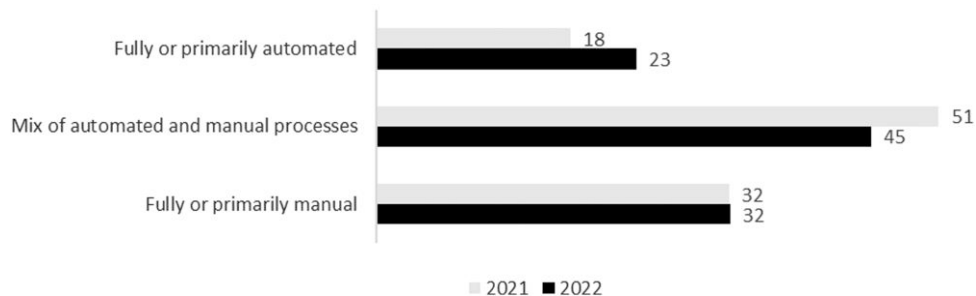


Figure 2. Mode of reporting capacity and supplies data to public health agencies (%) in 2021 vs 2022. Source: derived from the 2020 (conducted in 2021) and 2022 AHA IT supplement surveys. In the 2020 survey, 2029 hospitals provided non-missing responses to the capacity question. In the 2022 survey, this number was 2047. Abbreviations: AHA, American Hospital Association; IT, information technology.

Figure S3 displays hospitals’ responses to their success in submitting vaccine-related adverse events to relevant state and federal agencies, such as the Centers for Disease Control and Prevention (CDC) Vaccine Adverse Event Reporting System. A total of 48% of hospitals “strongly agreed” and 40% “agreed” with the statement. Meanwhile, 8% responded neutrally, as “neither agree nor disagree.” Notably, 4% either “disagreed” or “strongly disagreed.” Given that the survey predominantly involved larger hospitals in urban areas, the broader hospital population might have a higher proportion facing challenges in reporting adverse vaccine events.

In Figure 3, hospitals’ responses to their capacity for electronically receiving vital information from external providers for COVID-19 treatment between 2021 and 2022 are presented. Those agreeing with the statement, either “strongly” or just in agreement, saw an increase from 38% to 39%. Neutral responses, or “neither agree nor disagree,” increased from 28% to 40%. In contrast, hospitals that “disagreed” or “strongly disagreed” decreased collectively from 34% in 2021 to 21% in 2022.

Figure 4A displays the percentages of hospitals that frequently receive specific types of clinical information electronically from external sources for COVID-19 treatment. Medications top the list with 48% availability, while images are at the bottom with 20% availability. For other clinical data types, such

as laboratory results, diagnoses, problem lists, immunization details, and clinical notes, all register above 40%.

Figure 4B reveals that 41% of hospitals consistently receive external COVID-19 test results electronically from large commercial laboratories. In contrast, just one-quarter of the hospitals reported similar electronic availability from other hospitals and small/independent/regional laboratories. Further down the list, public health laboratories provided consistent electronic results to 17% of hospitals, traditional ambulatory providers to 12%, and emerging test providers trailed at 9%.

The COVID-19 reporting questions in our study primarily reflect hospitals’ external environments rather than their internal resources or technical capacities. However, 2 questions are exceptions: the methods that hospitals use to report capacity and supplies data to public health authorities and their success rate in submitting COVID-19 vaccine-related adverse events to government agencies. We first linked the responses to these questions with hospitals’ EHR adoption and telehealth services. Table S2 demonstrates a notable correlation between comprehensive EHR system adoption and more efficient reporting practices. Hospitals with comprehensive EHR systems were more likely to automate reporting of capacity and supplies data to public health agencies (21% vs 9% in hospitals without such systems) and were more effective in submitting COVID-19 vaccine-related adverse events (91% vs 84%).

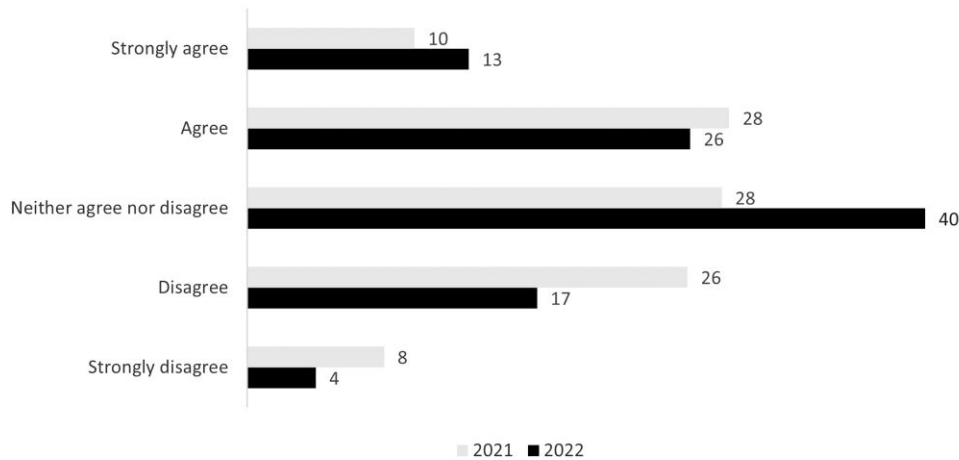


Figure 3. Hospital receiving external COVID-19 treatment info electronically (%) in 2021 vs 2022. Source: derived from the 2020 (conducted in 2021) and 2022 AHA IT supplement surveys. In the 2020 survey, 2531 hospitals provided non-missing responses to the external information question. In the 2022 survey, this number was 2788. Abbreviations: AHA, American Hospital Association; IT, information technology.

Additionally, hospitals offering telehealth services displayed superior reporting capabilities. They were more likely to use automated systems for reporting capacity and supplies data (21% vs 7% for hospitals not offering telehealth) and had a higher success rate in submitting COVID-19 vaccine adverse event reports (90% vs 85%).

These findings underscore the significant role of advanced technology adoption in enhancing hospital reporting efficiency, especially during the COVID-19 pandemic.

Furthermore, our analysis extends to reporting practices across different hospital characteristics. Table S3 shows that system-affiliated hospitals were more likely to automate reporting of capacity and supplies data (19% vs 13% for stand-alone hospitals) and had a higher success rate in submitting COVID-19 vaccine adverse events (91% vs 80%). Rural hospitals, in contrast, were less likely to use automated systems for reporting (10% vs 19% for urban hospitals) and had a lower success rate in submitting vaccine adverse events (82% vs 89%). Ownership also influenced reporting practices; nonprofit hospitals more frequently used automated reporting (23% compared to 3% for for-profit and 14% for government hospitals). The success rate for submitting vaccine adverse event reports was similar between nonprofit and for-profit hospitals (90% vs 91%), but higher than in government hospitals (79%).

These data highlight how hospital characteristics, in conjunction with technological capabilities, play a crucial role in reporting efficiency during health crises like the COVID-19 pandemic.

Discussion

To fortify the current public health reporting ecosystem, a more comprehensive and coordinated policy approach is imperative. The inconsistency in requirements across different government levels presents a clear opportunity for policy makers to introduce harmonized reporting standards. By doing so, they can reduce the administrative burden on hospitals, allowing them to channel more resources towards immediate patient care.

Furthermore, given President Biden's emphasis on improving public health reporting and the National Academy of Medicine's critiques, there is an evident mandate to streamline the electronic data-exchange process. Encouraging a shift

from manual to automated processes should not just be a recommendation but a policy priority. Speedy, reliable data are paramount during public health emergencies, and manual processes, as shown by the persistence over 2 years, can inhibit rapid response.

Moreover, the government, in collaboration with health care institutions, should consider investing in training and infrastructure to enhance the electronic exchange of clinical data. The fact that crucial data like images are less accessible is a significant concern and points towards the need to upgrade current IT infrastructures and systems in hospitals.

Our study's findings, highlighting the significant impact of advanced EHR systems and telehealth capabilities on COVID-19 reporting efficiency, further reinforce this argument. Policy efforts encouraging the adoption of these technologies can substantially improve public health reporting. The higher reporting efficiencies in system-affiliated and nonprofit hospitals offer insights for best practices, while the challenges in rural hospitals underscore the need for targeted support and infrastructure investment.

Last, public trust is the cornerstone of an effective health response, especially during pandemics. The challenges or failures noted by a small percentage of hospitals in reporting vaccine-related adverse events underscore the need for a robust and transparent reporting system. Policy makers should be cognizant of this and work on building systems that ensure that every adverse event is captured and addressed. The variation in reporting practices across different hospital types further emphasizes the necessity of a nuanced policy approach. Harmonizing reporting standards should consider the diverse capabilities and needs of hospitals to ensure effective compliance.

In essence, while individual hospitals have a role to play, it is a coordinated policy response that will ensure that the United States is better prepared for future public health emergencies. The insights from this study can serve as a blueprint for these policy initiatives, ensuring a more resilient, responsive, and robust health care system.

Limitations

This study has several limitations. It is subject to selection bias given the specific set of respondent hospitals. We also rely on

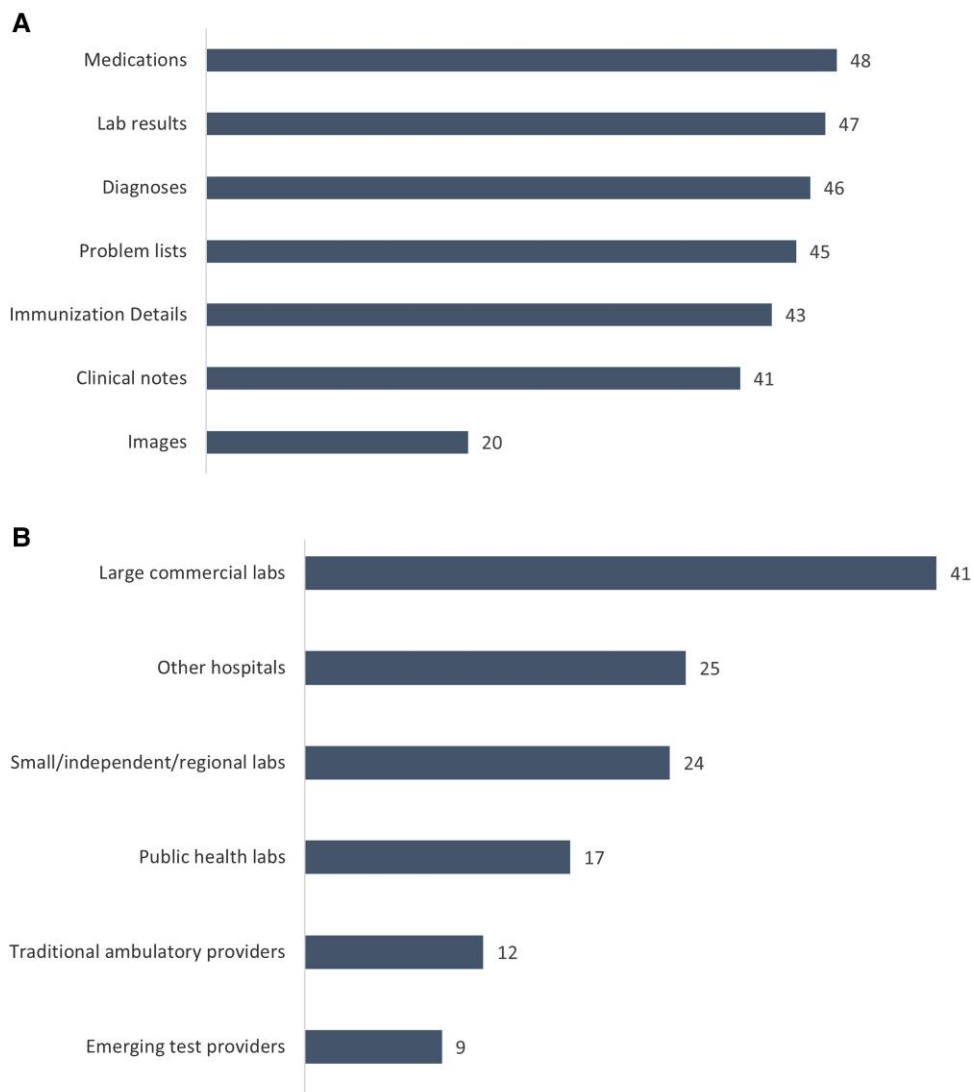


Figure 4 (A) Electronic availability of clinical information for COVID-19 treatment from external sources—always and often (%). (B) Electronic receipt of external COVID-19 test results by provider type—always and often (%). Source: the 2020 AHA IT supplement survey conducted in 2021. For panel A, the average number of hospitals providing non-missing responses is 2564, while for panel B, it is 2265. Abbreviations: AHA, American Hospital Association; IT, information technology.

self-reported survey data, which can introduce recall and social desirability biases. While we have data spanning 2 years, the survey might not capture the full dynamism and nuances of the COVID-19 pandemic's impact on health care communication throughout its entire course. Additionally, while the survey documents certain patterns, it lacks depth on specific issues, such as the reasons some hospitals might fail to successfully report adverse events to public health authorities or why they resort to manual submission of capacity and medical supplies data. The study does not investigate the impact of hospital strain during the COVID-19 pandemic on survey responses, an important aspect that falls outside the scope of this analysis.

Supplementary material

Supplementary material is available at *Health Affairs Scholar* online.

Conflicts of interest

Please see ICMJE form(s) for author conflicts of interest. These have been provided as supplementary materials.

Notes

1. Emanuel EJ, Persad G, Upshur R, et al. Fair allocation of scarce medical resources in the time of COVID-19. *N Engl J Med*. 2020;382(21):2049-2055. <https://doi.org/10.1056/NEJMs2005114>
2. Legido-Quigley H, Asgari N, Teo YY, et al. Are high-performing health systems resilient against the COVID-19 epidemic? *Lancet*. 2020;395(10227):848-850. [https://doi.org/10.1016/S0140-6736\(20\)30551-1](https://doi.org/10.1016/S0140-6736(20)30551-1)
3. Biden J. A letter to geneticist Eric Lander from President-elect Biden. 2021. Accessed October 2, 2023. <https://science.gmu.edu/news/letter-geneticist-eric-lander-president-elect-biden#:~:text=My%20hope%20is%20that%20you,government%20should%20adopt%20to%20ensure>

4. Lee P, Abernethy A, Shaywitz D, et al. Digital health COVID-19 impact assessment: lessons learned and compelling needs. *NAM Perspect.* 2022;2022.
5. Adler-Milstein J, Jha AK. HITECH act drove large gains in hospital electronic health record adoption. *Health Aff (Millwood).* 2017;36(8):1416-1422. <https://doi.org/10.1377/hlthaff.2016.1651>
6. Adler-Milstein J, DesRoches CM, Kralovec P, et al. Electronic health record adoption in US hospitals: progress continues, but challenges persist. *Health Aff (Millwood).* 2015;34(12):2174-2180. <https://doi.org/10.1377/hlthaff.2015.0992>
7. American Hospital Association. AHA data sources. Accessed June 10, 2023. <https://www.ahadata.com/aha-data-resources>
8. Everson J, Lee SYD, Friedman CP. Reliability and validity of the American Hospital Association's national longitudinal survey of health information technology adoption. *J Am Med Inform Assoc.* 2014;21(e2):e257-e263.
9. Richwine C. Progress and ongoing challenges to electronic public health reporting among non-federal acute care hospitals, 2023, ONC Data Brief, no. 66. Published June 2023. Accessed October 2, 2023. <https://www.healthit.gov/data/data-briefs/progress-and-ongoing-challenges-electronic-public-health-reporting-among-non-federal-acute-care-hospitals-2023>
10. Richwine C, Everson J, Patel V. Electronic public health reporting among non-federal acute care hospitals during the COVID-19 pandemic, 2021. ONC Data Brief, no. 62. Office of the National Coordinator for Health Information Technology. Published September 2022. Accessed June 15, 2023. <https://www.healthit.gov/data/data-briefs/electronic-public-health-reporting-among-non-federal-acute-care-hospitals-during>
11. Chang W, Richwine C. Social needs screening among non-federal acute care hospitals, 2022. ONC Data Brief, no. 67. Office of the National Coordinator for Health Information Technology. Published July 2023. Accessed October 2, 2023. <https://www.healthit.gov/data/data-briefs/social-needs-screening-among-non-federal-acute-care-hospitals-2022>
12. Jiang J, Qi K, Bai G, Schulman K. Pre-pandemic assessment: a decade of progress in electronic health record adoption among US hospitals. *Health Aff Scholar.* 2023;1(5):qxad056.