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Preventing the Next Public Health Emergency

During the pandemic, small shifts in health data regulation revealed big insights for disease prevention.

By early June 2025, 174 million birds and more than 1,000 herds of dairy cattle across the United States had been affected by the rapidly spreading H5N1 avian flu, according to the US Centers for Disease Control and Prevention (CDC). Since January 2024, 70 cases of human H5N1 infections have been confirmed, and the first death was reported in January 2025. In the same period, the Kansas City metropolitan area has been dealing with an ongoing tuberculosis outbreak that has ignited fears of the resurgence of other once-controlled diseases. Meanwhile, the worst measles outbreak in decades has claimed three lives in 2025; as of early June, the CDC is reporting almost 1,200 cases across 35 jurisdictions.

Early detection, effective surveillance, and accurate reporting are essential for controlling threats like these before they become full-blown public health emergencies. Unfortunately, these are all areas of chronic underinvestment in the United States. Although the United States has the highest per capita health spending in the world, less than 5% goes to preventive care activities such as disease surveillance, public health education, and research. Funding shortfalls are felt most acutely by state and local health departments, which usually rely on a mix of federal, state, and other funding sources that fluctuate frequently. And, as a recent report from the National Association of County and City Health Officials points out, federal and state public health funding experiences "boom and bust cycles" linked to current events like disease outbreaks. This crisis-driven funding model leaves scant resources for addressing more perennial concerns like data modernization or workforce development in public health offices. Consequently, local agencies at the front lines of outbreak detection are often inadequately equipped with the necessary resources to use and share important disease surveillance data for timely decisionmaking.

In a public health system that is outdated and reactive, Americans are left vulnerable to the next outbreak. To provide better protection, the field of public health technology needs bold federal leadership to prioritize prevention, empower local action, improve coordination, and harness the full potential of modern technology. This transformation can be built upon insights gained from the COVID-19 pandemic, which showed the public health system is capable of rapid innovation at scale.

Public health data systems have been neglected

The problem begins at the local level, where many public health departments face substantial challenges related to accessing, managing, using, and sharing data. Approximately 3,500 local health departments serve as critical nodes of information on community health and disease detection at city, municipality, county,

regional, and state levels. These departments are under the control and oversight of the states, with funding, technical assistance, and policy guidance from the federal government.

Coordinated reporting from these disparate offices is key to successfully monitoring outbreaks, but health data systems used at city and state levels have been built independently and do not communicate with each other. Local agencies typically manage several separate data systems. For example, the National Notifiable Diseases Surveillance System records case information for patients with specific infectious and noninfectious diseases and conditions; the National Syndromic Surveillance Program tracks symptoms of patients in emergency departments and medical centers and facilitates the Electronic Surveillance System for the Early Notification of Community-Based Epidemics; and the Substance Abuse and Mental Health Services Administration collects data from multiple behavioral health sources and surveys. Managing so many independent data streams makes integration a challenge.

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In addition, critical disease surveillance systems still rely on outdated technology. A 2021 Government Accountability Office report found that critical information technology services across the US Department of Health and Human Services (HHS) utilized decades-old systems and programming languages and that HHS's modernization plans lagged behind other federal agencies. These challenges fundamentally hamper the ability of local officials to make informed decisions during public health emergencies.

In this uncoordinated system, few local health department staff are trained in informatics or other technical competencies needed to manage complex data systems. Public health informatics specialists, who constitute less than 2% of the governmental public health workforce, reported skill gaps in tasks such as identifying appropriate data sources, collecting valid data for decisionmaking, participating in quality improvement processes, and identifying evidence-based approaches to analyze and translate data into actionable programs.

During the COVID-19 pandemic, the impact of all these limitations became painfully clear: Reporting delays averaged 7–10 days for critical COVID-19 data, severely constraining real-time decisionmaking capabilities. Counties with limited public health data infrastructure had higher mortality rates from COVID-19 and significantly higher mortality rates from other health conditions that complicate COVID-19 infection.

An overlooked engine of innovation

In addition to highlighting the system's weaknesses, the COVID-19 crisis also motivated regulators to push through a wave of unprecedented changes to public health data infrastructure, which accelerated innovation in public health technology. The transformations unleashed during this period show that the system has the capacity for change, which policymakers should continue to foster.

First, the HHS Office for Civil Rights temporarily waived potential penalties for HIPAA privacy rule violations related to telehealth platforms during the COVID-19 public health emergency. According to the Centers for Medicare & Medicaid Services, this waiver led to a 63-fold increase in telehealth utilization among Medicare beneficiaries. Second, the Food and Drug Administration (FDA) issued nearly 400 emergency use authorizations (EUAs) for COVID-19-related medical products, including diagnostic tests, devices, drugs, and vaccines between January 2020 and January 2021. Pandemic EUAs were often issued within weeks of application, whereas the traditional approval process typically requires several years depending on the class of devices. The third major shift was the creation of "regulatory sandboxes": temporary frameworks or controlled environments established by regulators like the FDA to accelerate development, testing, and deployment of new inventions or innovation under modified regulations. In 2020, the FDA authorized a record 132 novel medical devices, surpassing the previous high of 106 in 2018. This provision also allowed the FDA's Digital Health Center of Excellence to expand regulatory flexibility for digital health technologies during the pandemic. And finally, the Coronavirus Aid, Relief, and Economic Security (CARES) Act allocated $500 million specifically for the CDC's Data Modernization Initiative in 2020, the largest one-time investment in

federal public health data infrastructure in US history.

Along with stimulus funding, these regulatory adaptations opened the door for several important innovations in public health technology for disease surveillance, which had seen only incremental progress before the crisis. The catalytic event compelled agencies to experiment with emerging technologies such as automated contact tracing and wastewater surveillance, but it also led to larger systemic shifts. The American Rescue Plan provided $1.75 billion to expand genomic sequencing capabilities to strengthen the nation's ability to detect, monitor, and respond to emergent variants of SARS-CoV-2, resulting in a dramatic increase in the percentage of cases sequenced. (Between early January and late April 2021, the number of cases sequenced in a two-week period rose from 3,275 to 25,000.) In essence, this investment created the first genomic surveillance network in the United States, allowing public health officials to detect and track emergent diseases in near real time, enabling widespread sequencing and data-sharing across states and laboratories, and providing crucial intelligence for decisions about vaccine updates and localized containment measures.

In addition, the CDC's National Syndromic Surveillance Program expanded emergency department coverage to all 50 states and Guam, and by 2022, approximately 73% of all US emergency departments were participating in the program (compared with only 54% in 2018), transmitting data often within 24 hours and providing near real-time data on emerging health threats. The influx of data prompted updates to standards involving large-scale public health data transfers between systems. The Office of the National Coordinator for Health Information Technology within HHS finalized new rules in 2020 mandating the adoption of standardized application programming interfaces for bulk data access, based on the Fast Healthcare Interoperability Resources, or FHIR, standard. The update made possible the extraction of critical information about an entire population—including medications, lab tests and results, and demographics—in a single request, eliminating need for manual queries and simplifying processes for both analytics and research. The resulting Bulk Data Access Implementation Guide for health IT products has led to development of open source tools for configuring, testing, and converting bulk data into various formats, which improves the efficiency of large-scale data exchanges.

The pandemic offered a proving ground for new health data platforms and network formations that pushed the nation's public health infrastructure to focus on prevention. Unfortunately, the gains from these advancements may soon be lost. Looming budget cuts and workforce reductions at agencies including the CDC and HHS threaten to stall critical progress. These cuts will undermine the technical capacity needed to implement, scale, and sustain the very innovations that proved effective during the last crisis. But the larger lessons from unleashing the innovative potential of a system many considered too static or fragmented to absorb real change remain significant.

A vision for decentralized, prevention-focused public health infrastructure

In the aftermath of the pandemic, much of the effort to learn from the experience has been directed at perfecting a response to the next crisis. This activity is necessary, but a more ambitious—and achievable—objective would be to apply the lessons learned about public health technology innovation to improving prevention capabilities, so there won't be a next crisis. A prevention-oriented approach can save lives and money by creating better data infrastructure to enable more efficient decisionmaking and coordination between local agencies. Such an effort would require a fundamentally different approach by the federal government.

First, the federal government must transition from primarily funding emergency response to supporting sustainable, "always-on" monitoring systems capable of detecting anomalies before they become crises. The COVID-19 pandemic revealed how delayed detection can overwhelm public health systems, erode trust, and cost lives. In contrast, Sweden's SmiNet, a national electronic monitoring system for communicable disease surveillance, enabled timely identification, coordinated response, and data-driven strategizing. Although Sweden faced early criticism for its pandemic strategy, it ultimately recorded fewer COVID-19 deaths than many other high-income countries, in part due to its real-time monitoring infrastructure. Today, international researchers under the auspices of the World Health Organizations (WHO) are collaborating on efforts to explore how AI and machine learning can enhance anomaly detection using public data streams, but the Trump administration's withdrawal of the United States from WHO means the United States will neither participate in nor benefit from those efforts.

Second, federal leadership should support development of a network of interoperable local and state systems that can function independently while sharing standardized data in a privacy-preserving way. The first step could be creating a national data exchange built on the CDC's Data Modernization Initiative to establish a secure, cloud-based platform for bidirectional sharing of public health data across jurisdictions. The federal government should also establish a framework for public health data exchange that mandates standardized and machine-readable formats for all federally collected health data; creates clear privacy guidelines that protect individual health information

while enabling public health analyses; establishes secure, cloud-based infrastructure for rapid data-sharing during emergencies; and provides technical assistance to help local jurisdictions connect to this framework. Development of mandatory minimum data standards for public health reporting—including standardized case definitions, data elements, and transmission protocols—should also be part of this effort. Representatives from all levels of government and from the private sector, academia, and other civil society organizations should participate in the design.

Standardizing data and interoperability at the local level would position the public health data system to take advantage of new technology and information in the future. Better interoperability could enable the expansion of public health data systems by allowing previously siloed information, including from nontraditional data sources such as environmental sensors, social media, and consumer health technologies like fitness trackers and smart watches, to be integrated into a unified, accessible framework. This integration could support the use of advanced AI tools for pattern recognition, anomaly detection, and predictive modeling, enhancing early-warning capabilities. It could also support development of more rigorous frameworks for evaluating the impacts of public health investments. And perhaps most importantly, a more integrated and standardized data system would be easier to align with international protocols, strengthening the United States' ability to coordinate with global partners on health security.

However, building a more decentralized system will demand more from local public health agencies. Federal leadership should focus on building local capacity through block grants specifically for public health technology infrastructure and workforce development, regional technical assistance centers to support local implementation of advanced technologies, and training programs to build data science and informatics skills in local health departments. Universities and schools of public health should update their curricula to equip their public health students with the skills needed to interact with and innovate with technology. (Arizona State University's new School of Technology for Public Health is a leader in this effort.) And to incentivize continued innovation, the federal government should encourage public-private partnerships with collaborative technology companies developing and implementing advanced surveillance and prediction tools.

Finally, federal health agencies must move away from rigid, one-size-fits-all regulatory requirements toward flexible frameworks that allow local innovation while maintaining essential standards. (This point is almost always discussed at gatherings of public health practitioners, though the actual practice remains the same.) In cybersecurity, for example, the National Institute of Standards and Technology offers core standards and best practices at the federal level, while allowing organizations and local institutions to customize their tools based on their needs and resources. Similarly, the Federal Reserve System and the Federal Deposit Insurance Corporation set strict standards and regulations in banking, while supporting development of new products in financial technology, digital services, and partnerships. Building on pandemic-era innovations, the federal government should create dedicated fast-track approval pathways for public health technologies; establish "regulatory sandboxes" where innovative approaches can be tested under controlled conditions; revise HIPAA and other privacy regulations to better balance individual privacy with public health needs; and develop adaptive regulatory frameworks that evolve with technological capabilities.

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These transformations require substantial investment and political will, but the potential return on investment is enormous. According to a systematic review, the median return on investment for public health interventions is 14.3 to 1. As the nation faces increasing threats from emerging infectious diseases, climate change impacts on health, and growing health disparities, we can't afford to wait; the time for this paradigm shift is now. Moving forward, the federal government must lead—not by centralizing control, but by helping advance a networked, resilient public health system that can prevent disasters before they occur.

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