Perspective

Enhancing the nation's public health information infrastructure: a report from the ACMI symposium

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ABSTRACT

The COVID-19 pandemic exposed multiple weaknesses in the nation's public health system. Therefore, the American College of Medical Informatics selected "Rebuilding the Nation's Public Health Informatics Infrastructure" as the theme for its annual symposium. Experts in biomedical informatics and public health discussed strategies to strengthen the US public health information infrastructure through policy, education, research, and development. This article summarizes policy recommendations for the biomedical informatics community postpandemic. First, the nation must perceive the health data infrastructure to be a matter of national security. The nation must further invest significantly more in its health data infrastructure. Investments should include the education and training of the public health workforce as informaticians in this domain are currently limited. Finally, investments should strengthen and expand health data utilities that increasingly play a critical role in exchanging information across public health and healthcare organizations.

Key words: public health informatics, health information interoperability, public health, public health schools, information systems

RATIONALE FOR THE SYMPOSIUM

The U.S. public health system is at a crossroads in its ability to monitor the health of the nation from routine clinical data. The COVID-19 pandemic exposed multiple weaknesses across local, state, and national levels of public health, including an inadequately prepared workforce and outdated information infrastructure.[1] Reporting of COVID-19 cases relied upon manual approaches involving fax machines and spreadsheets,[2] despite broad adoption of electronic health record (EHR) systems and electronic lab reporting mechanisms. The pandemic exposed that the United States lacks an integrated health information infrastructure. This renders the United States unable to facilitate data exchange in support of key public health essential services.[3,4]

As the nation develops its long-term response to and recovery from the pandemic, the Centers for Disease Control and Prevention (CDC), as well as state and local jurisdictions, face choices about how to address the modernization efforts. This entails considerations of how to invest funding appropriated for modernizing their data and information infrastructures as well as reorganize data and information policies, processes, and workforce. Over the next decade, public health agencies are expected to make investments in information systems as well as informatics education, training, and hiring, to increase capacity. To help the American College of Medical Informatics (ACMI) critically analyze the modernization needs and to develop recommendations for improvements in public health data systems, the 2022 ACMI Symposium focused discussion on public health informatics issues and needs.

SYMPOSIUM THEME AND PROCESS

The ACMI Symposium is an academic meeting designed to facilitate thoughtful discussion among the members of the College to advance the field of biomedical informatics. Prior symposia addressed topics such as the evolution of biomedical informatics as a discipline[5] and the burden of EHR-based documentation on US clinicians.[6] The symposium format includes presentations by invited experts and members followed by long discussion periods. Discussions are extended during social events that facilitate continued dialogue as well as fellowship among College members.

The program committee selected "Rebuilding the Nation's Public Health Informatics Infrastructure" as the theme for the 2022 symposium. Invited guests included individuals leading national, state, and regional initiatives which were focused on strengthening public health information systems (PHIS). Guests included leaders from federal agencies (eg, US Centers for Disease Control and Prevention, Office of the National Coordinator for Health Information Technology), public health associations (eg, Council for State and Territorial Epidemiologists, Association of State and Territorial Health Officers), and regional health information exchange (HIE) networks. Each speaker was invited to deliver a brief presentation (30 min). Following each presentation was a discussion period (60 min).

The goal of discussion was to generate a broad set of perspectives on the future state of the nation's PHIS infrastructure. Feedback on current government initiatives and future directions were encouraged. We oriented attendees to consider perspectives under a SWOT analysis framework during a presymposium online meeting. Specifically, we asked attendees to consider the strengths, weaknesses, opportunities, and threats to the PHIS. Attendees were not asked to vote on discussion points or work toward consensus. The goal was to elucidate all perspectives for thematic analysis. A separate article in this issue details the SWOT framework, methods deployed, and outcomes of the meeting.[7]

In this perspective, we offer an explication of major themes derived along with policy recommendations we think should be priorities for the American Medical Informatics Association (AMIA) and ACMI. We focus on 4 principal themes, capturing the core of the Symposium discussions. We then go beyond the discussions, advocating for specific policies that could be acted upon by lawmakers as well as state and federal agencies to strengthen the nation's public health information infrastructure.

POLICY RECOMMENDATIONS

The nation's health data infrastructure is a matter of national security

The federal government and informatics community need to view the nation's health data infrastructure as a matter of national security. The pandemic killed over 1 million Americans[8] and harmed countless others, making the pandemic a security concern as great as any foreign invasion or natural disaster. It will be impossible to identify the next pandemic, natural disaster, terrorist attack, or other acute national health event without critical infrastructure to capture, store, manage, and utilize data from the health ecosystem.[9] Key data for COVID-19 were captured in EHR systems but took herculean efforts and many months to mobilize for public health. Other data public health needed in the early months, including situational awareness, such as hospital and long-term care facility capacity, availability of beds, and the location of health workers were not available to decision-makers. Manual data entry processes that placed a burden on hospitals, clinics, and care delivery systems had to be instituted to overcome the lack of public health data infrastructure.

Going forward, AMIA and ACMI should advocate for a national health data infrastructure that is integrated, robust, and efficient. Critical data must be captured, stored, exchanged, and available to both healthcare (eg, C-Suite, incident command centers, nursing homes) and public health (local, state, and federal) authorities for timely decision-making. These data must be secured and protected using advanced cybersecurity approaches, as the cause of a public health outbreak might be the hostile actions of a foreign or domestic enemy or exploited technical weaknesses in the software deployed to manage health data.[10,11] True bidirectional exchange of data between public health agencies and patient-care providers must be seen as necessary for national security and sharing prioritized over competitive business practices. The biomedical informatics community understands best the importance of data and supporting infrastructure, especially in times of public health crisis. Moreover, public health informaticians understand that One Health[12] approaches—to infrastructure—which include animal, human, and environmental systems—are vital for global health security.[13,14]

We therefore recommend that AMIA and ACMI work with the federal government to secure the nation's health data infrastructure. Specifically, we believe that Congress should charge the Department of Health and Human Services (DHHS) and Department of Homeland Security (DHS) with jointly securing the nation's health data infrastructure. Combined financial and human resources could then be used to prioritize data sharing using advanced, secure methods for information exchange as well as cybersecurity across the national health data ecosystem. Specifically, joint efforts should prioritize updating the 2016 version of the "Healthcare and Public Health Sector-Specific Plan" for national infrastructure security[15] by the Cybersecurity & Infrastructure Security Agency, part of DHS, in the wake of the COVID-19 pandemic. The current plan briefly mentions EHR systems without any specific guidance or recommendations. There exist secure ways to exchange data effectively across clinical and public health enterprises. These need to be shared and adopted widely.

Like President Eisenhower in the 1950s, we need to argue that the nation's health data highways are necessary for the security of the nation and authorize funding for connecting a broader set of nodes that connect all public health and clinical care providers. Using vernacular from Ash and Lorenzi,[16] national security is "The

Why" we need a robust PHIS infrastructure. Public health, long-term care, commercial laboratories, social service agencies, Medicaid programs, etc., are all parts of the nation's vast PHIS infrastructure. If these entities remain fragmented, we will not be prepared for, or able to respond to, the next public health emergency. Authorization from Congress is the first step toward substantive change.

Health data utilities are critical infrastructure for the nation's health

State-level, not-for-profit HIE networks acted as public utilities[17] for delivery and integration of critical data during the pandemic,[18] albeit only in those areas where they had been previously developed and supported. These organizations played a crucial role in integrating data across the healthcare system on a regional basis, making laboratory results more available to decision-makers, physicians, and patients. HIEs further facilitated data exchange during transfers of care, including coordination between institutional settings (eg, nursing homes, prisons) and hospitals. In other words, they acted as "health data utilities."[19]

Critical to achieving better clinical outcomes and more resilient communities is a model in which an HIE organization becomes the informatics glue that binds together healthcare delivery organizations with public health and social service organizations. Combined, these organizations can serve the medical, social, behavioral, and environmental needs of populations. For example, HIEs possess the capability to manage referrals to social services, including food pantries and rent assistance programs, from both clinical and public health programs.[20] Moreover, HIEs can identify populations at-risk, which can be used by clinical and public health professionals for primary and secondary prevention efforts. Despite the push for HIEs in the Health Information Technology for Economic and Clinical Health (HITECH) era, these organizations are not available in all states, nor do they necessarily possess a sustainability model adequate to perform in acute events.

The existing PHIS infrastructure remains fragmented. Only some states have reliable, robust HIE networks. Some HIE organizations failed, prior to the pandemic, for several reasons: insufficient participation, lack of a sustainable business model following the initial, one-time HITECH investment, or inadequate governance.[21–24] Health data utilities need to be sustained where they exist and created in those areas without them.

Therefore, to ensure that benefits of health data utilities are widely available throughout the country in future health-related emergencies, AMIA and ACMI should advocate to financially sustain and strengthen the legal authorities of State-level Health Data Utility organizations. In conjunction with the authorization legislation for DHHS and DHS, Congress should direct the federal government to work with the states in creating robust, state-level health data utilities which would form the core of the nation's health data superhighway. States provide significant oversight of the public health enterprise, including credentialing of providers (especially long-term care facilities), epidemiology, and vaccination campaigns. Federal and state coordination will be critical to the success of efforts to strengthen the nation's PHIS infrastructure. Interoperable public health data utilities can serve as the focus for this coordination in and across states.

In addition, our community should explore feasible alternatives for communities where utilities may not be practical (eg, tribal lands, remote areas). Qualified Health Information Networks (or QHINs), which are the currently proposed nodes for the nation's

superhighway for clinical data exchange,[25] are insufficient for meeting the needs of public health as they continue to focus on individual document exchange for a single patient seeking care. Research by ACMI and AMIA members is needed to develop, pilot, implement, and evaluate solutions.

Funding for the public health information infrastructure remains insufficient

In the wake of the COVID-19 pandemic, Congress appropriated $200 million in a new federal funding line item for the nation's PHIS infrastructure.[26] In addition, the CDC received an additional $100 million for its Data Modernization Initiative (DMI), which is a 10-year, $1.1 billion effort to modernize core data and surveillance infrastructure across the federal and state public health landscape.[27] Although laudable, many jurisdictions are early in their efforts to develop and execute a comprehensive strategy for modernizing their PHIS infrastructure. Moreover, these funding levels are only a fraction of the requested amounts. The House-passed Build Back Better Act from November 2021 originally included $7 billion specifically for "core public health infrastructure," but this was cut entirely from the final bill.[28]

More funding is necessary to facilitate a national strategy with sustainable health data infrastructure that can integrate local, state, and federal public health authorities with healthcare delivery systems and health data utilities. A report from Healthcare Information Management Systems Society (HIMSS) estimates the public health system requires an investment of $36.7 billion over the next 10 years.[29] The report estimated the human and technical resources needed by state, local, and tribal territories across the United States. The estimate included $25 billion for modernization of core services, including electronic case reporting, immunization information systems, vital records, and syndromic surveillance systems. An additional $11 billion was estimated to ensure standards-based, interoperable approaches were leveraged to integrate with systems in healthcare delivery organizations.

Historically, public health funding has been "boom or bust."[1,30] Following major national health threats, a temporary increase in public health spending occurs. Yet, shortly after the threat subsides, public health funding is cut. Often these cuts resulted in levels of funding lower than before the health threat. We should not repeat this cycle following COVID-19. AMIA and ACMI should advocate for sustained increases in public health spending, especially investment in the PHIS infrastructure as well as the public health informatics workforce. Furthermore, the funding should be comprehensive and cross-cutting, breaking from the siloed, disease-specific approaches used previously in public health agencies. The infrastructure line item created for the FY22 budget is to be used for efforts "not segmented by disease, condition, or activity."[31] Although initial DMI efforts appear to focus on infectious diseases like COVID-19 and influenza, surveillance of chronic diseases and injuries is critical to our nation's health.

The AMIA community is well-suited to advocate for the appropriations necessary for the development of a comprehensive, integrated data infrastructure that covers all aspects of the public's health. In conjunction with authorization legislation, Congress could provide funding to DHS and DHHS to enhance the nation's PHIS infrastructure, including modernization of PHIS in state, local, tribal, and territorial jurisdictions to enable interoperability with health data utilities and the nation's health data superhighway. Moreover, funding should be invested in strategies that do not

segment by disease, condition, or activities. For example, investments in identity management (eg, master person index, client registry)[32] would strengthen the ability for PH agencies to link records across surveillance systems, case management, as well as social service data systems. In addition, PH agencies need investment in analytics capabilities that allow for the examination of population health trends and forecasting.[33]

Education and training in informatics remains a priority for the United States

Despite public health being an information intensive profession, currently less than 1% of public health workers are in informatics roles.[34] This is one-third of the proportion observed in healthcare delivery organizations.[35] The National Health Service (NHS) has defined competencies for healthcare workers in the era of digital health[35,36] but no comparable list has been created for public health practitioners in the typical noninformatics role. While informatics competencies for public health have been defined in the United States,[37] the competencies have not been adopted by PH education accrediting bodies and thus have not yet been embedded them into PH curricula. Given these multiple factors, there are few educational opportunities for the PH workforce to learn informatics competencies and extremely few specialized programs in PH informatics.[38]

Although limited, there is a foundation in PH informatics training upon which we can build. For more than a decade, CDC annually selects and hosts nearly a dozen informatics fellows that work across centers and divisions to bring informatics approaches to PH challenges.[39] The National Library of Medicine (NLM) institutional-based training program in biomedical informatics includes PH informatics as core domain.[40] In 2021, the ONC launched its Public Health and Information Technology training program with 10 academic centers, with a goal to increase representation of underrepresented communities within the PH IT workforce.[41] Moreover, the recent "Strengthening U.S. Public Health Infrastructure, Workforce, and Data Systems" funding from CDC,[42] awarded in FY23, includes some efforts at state and local levels to increase informatics training.

To ensure consistency in workforce training opportunities, we recommend creating centers of excellence in PH informatics. These centers could use an academic health department model, where a university-based program would partner with local and state health agencies to develop future PH workers with a specialization in informatics. While in training, the workers would intern with agencies ensuring they have training and experience to contribute to data modernization activities upon graduation. They would receive valuable experience working in teams with other PH and clinical professionals to develop and/or implement informatics solutions. These centers would further provide innovative research in PH informatics, advancing informatics methods and applications in the PH domain in partnership with jurisdictions. Moreover, these centers should be funded using core dollars from CDC to ensure sustainability. Where possible, centers should promote diversity in the PH informatics workforce[33] and partner with existing NLM and ONC programs to leverage existing assets such as curriculum and research infrastructure.

We further recommend funding public health departments to provide *in situ* training for the existing workforce, since not all training can occur in university-based programs. While many schools of public health offer short-term training opportunities in core disciplines such as epidemiology and biostatistics, extremely few programs offer anything relevant to informatics. We challenge PH and biomedical informatics departments to work together in creating opportunities for the PH workforce.

AMIA and ACMI should further advocate for PH curriculum and accreditation reform. Both the Public Health Accreditation Board and Association of Schools and Programs in Public Health need to recognize informatics as a critical, core competency for all PH workers. Currently, there is little recognition of informatics in PH educational programs beyond teaching students how to run analyses using R software. In addition, few PH programs teach data science or advanced analytics that PH workers could implement in practice following graduation. Concomitant with advancing the data infrastructure in PH agencies, the PH workforce must understand how to harness technology to improve how work is done in state, local, tribal, and territorial jurisdictions.

As educators, the AMIA community is uniquely positioned to advocate for more training and encourage collaboration across existing biomedical informatics programs and schools of public health. This includes training to ensure that informatics is taught as a team sport, emphasizing how informatics professionals work in concert with other clinical and PH professionals to use and advance PHIS. Degree programs and training courses may not need to be developed de novo and should leverage, where available, existing curricula in core informatics methods and competencies.

CONCLUSION

Communities must take advantage of lessons learned during times of crisis. Key actions that take advantage of what we have identified as informatics weaknesses identified during the COVID-19 pandemic are: recognize the health data infrastructure as critical to national security, repurpose and expand HIEs to become health data utilities, fund the health data infrastructure at the level needed to support public health, and educate public health practitioners to take advantage of and to advance PHIS. Members of AMIA and ACMI, whether individually or in collaboration, should intercede wherever possible to move these recommendations forward.

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CONFLICT OF INTEREST STATEMENT

None declared.

DATA AVAILABILITY

This manuscript leveraged original data generated from the 2022 ACMI Symposium. Given the nature of the data, it is not available for access.

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