Digital Health Lessons Learned During COVID-19 Workshop Report

Digital Health R&D
Interagency Working Group

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Executive Summary

The Networking and Information Technology Research and Development (NITRD) Program Digital Health Research and Development (DHRD) Interagency Working Group (IWG) held a federal-only workshop, "Digital Health Lessons Learned During COVID-19", on August 9, 2022. Over eighty participants from nine Federal agencies took part in the workshop to underscore the opportunities and challenges facing digital health research and development (R&D).

The goal of the workshop was to identify lessons learned about digital health during this public health crisis and the needs and opportunities for future R&D. Digital health has great potential to transform research and clinical practice as demonstrated during the COVID-19 pandemic; however, there are challenges that should be addressed. This report identifies some of the challenges and opportunities that should be tackled in future digital health R&D and summarizes the key findings from the workshop.

Introduction

The COVID-19 pandemic created an unprecedented expansion of digital health in the United States from the confluence of events that drove the technologies (e.g., telehealth, remote health monitoring, remote testing, education, and support for self-care) to new heights. This growth was caused by a surging requirement for care and recent advances in digital health technology (i.e., regulatory waivers, the ability of providers to deliver and bill for virtual services across state lines, and an increase in user acceptance). Technology platforms, such as videoconferencing, have been developed or purchased to perform virtual health visits; and medical devices, new sensors, and apps have begun the monitoring tasks traditionally provided by healthcare providers. While these highlight the possibilities of digital health, there are concerns that new technologies and remote services may have exposed health care disparities, for example in access to care, connectivity access, availability of devices, and socioeconomic and language barriers.

These issues prompted NITRD's DHRD IWG to hold the hybrid workshop to address the digital health R&D challenges and opportunities that have been identified during the COVID-19 outbreak. The focal point was not on digital health for COVID specifically, but on how responses to the COVID-19 outbreak have changed the U.S. medical and public health landscape for digital health. The workshop focused on digital health assessment, monitoring data collection, and telehealth with a goal of identifying successes and needs for future R&D in these areas.

The workshop began with welcoming remarks and a keynote talk focused on community connected health. This was followed by three sessions that addressed 1) remote monitoring and assessment for health and digital clinical studies; 2) data and COVID-19: at home and electronic health records; and 3) telehealth. Each session included presentations from federal partners highlighting advances in digital health technology R&D made by their agencies during COVID-19. To facilitate the breakout discussions, each group was asked to address three questions:

- What are the compelling R&D needs in digital health?
- Who should be represented to meet the R&D needs that are identified (such as the types of researchers, teams, communities)?
- What is needed to further facilitate interagency coordination and collaboration in digital health?

Compelling R&D Needs in Digital Health

The expansion of telemedicine during the pandemic led to advances in digital health but, it also highlighted areas that need attention, including tools for telehealth and remote monitoring, data and interoperability, and regulatory considerations.

Telehealth and Remote Monitoring. Many devices, including wearables, are used in telehealth and remote monitoring. An effective telehealth and remote-monitoring framework should maintain these devices in a way that provides diverse users with adequate educational materials in a range of formats (e.g., video, images, and text). For example, it would be beneficial to have appropriate education and associated materials on the use of telehealth, selfcare, and home monitoring tools – including how to use the system or device, support for problems and troubleshooting, and information on how the data are transmitted (or how to transmit for unconnected devices).

As telehealth usage expands, R&D should incorporate social determinants, e.g., socioeconomic status, education, neighborhood and physical environment, employment, social support networks, and access to health care. R&D also could address other risk factors in technology development that link ongoing "hybridization" of healthcare delivery to preventative care, messaging, and other technologies. Additionally, digital literacy should be a critical consideration at the outset for the development of consumer- and patient-facing technology.

New medical devices are being introduced into the home and health care environments on a regular basis. Many of these devices, such as ventilators, pulse oximeters, and testing kits were extensively utilized during the pandemic. Guidelines are essential on how these devices should be deployed in different settings, including user-accessible strengths and limitations and interactions with other devices. Tools and techniques to measure the safety and efficacy of these devices beyond the initial regulatory approval stage need to be developed and validated. This includes software, hardware, and issues related to data generation, capture, and transmission. Other R&D concerns involve privacy preservation, data security, and compatibility between the operating systems represented in the device ecosystem and those required for operation.

While the data generated from remote technologies have the potential to empower individuals to make better informed decisions about their own health, the evidence suggests that physicians and patients do not always know what to do with the streams of data they receive. Hence, R&D needs to generate and improve decision support systems – based on prior knowledge and current data and information – to support active health status monitoring and provide insight for clinical decision making.

Before the COVID-19 pandemic, earlier efforts were made to include fully remote, hybrid and distributed clinical trials.[1] The pandemic has made these technologies even more compelling. Therefore,

[1] Steinhubl, S.R., Wolff-Hughes, D.L., Nilsen, W., Iturriaga, E., & Califf, R.M. (2019). Digital clinical trials: creating a vision for the future. *NPJ Digit Med*. 2:126. doi: 10.1038/s41746-019-0203-0. PMID: 31872066; PMCID: PMC6908600.

it is key to create methods that will further empower digital trials, including a regulatory framework for these approaches.

One form of remote monitoring that gained prominence during COVID-19 was contact tracing, which has unique issues. Once a person is infected or in close contact with another infected person, digital contact tracing can be used to identify the entire network of people who have been potentially exposed to the disease. The current state of the technology, including infrastructure, barriers, and facilitators, needs to be reviewed to allow for successful implementation and to help inform future research directions for contact tracing.

Whenever remote monitoring and telehealth are discussed, the issues of coverage become key. Many who live in rural areas lack adequate access to health care facilities as distances to medical facilities are often inconvenient or prohibitive. As such, remote areas require better access mechanisms and the ability to train local people to handle simple tasks, such as testing and surveillance.

Data and Interoperability. A considerable amount of data is being generated by various commercial devices, electronic health records, and other information sources within the health care ecosystem. Notably, there remain persistent issues related to data capture, access, quality and transfer, and data platform use and access. Most systems have their own proprietary data formats and systems, which can make access challenging. Thus, it is important that there are sustained efforts and innovations to: 1) initiate guidelines for secure data capture and storage; 2) develop techniques to ensure data quality, including methods for identifying meaningful data and resolving inconsistencies; 3) identify methodologies for dealing with multimodal data (e.g., text, video, audio, and images); 4) establish standards for dealing with missing data; 5) advance methods to address bias in the captured data; 6) find ways to facilitate data interoperability; and 7) create methods that present data in a usable manner. There is also interest in improving methods that will test the validity of imputed and synthetic data (the latter considered to be the only way to test some sparse data or data associated with privacy issues). Support and incentives for deployment of the *Findability, Accessibility, Interoperability, and Reusability* (FAIR) guiding principles could be a start to address the data needs noted above. FAIR data principles may make it easier and more feasible for researchers to reuse data from clinical trials and other research.

Additionally, data-sharing platforms should be developed to ensure data easily can be shared and accessed to maximize future advancements. For example, as researchers in artificial intelligence (AI) use more accessible languages, it will allow for a broader audience to understand and interact with AI.

Regulation. As advancements rapidly emerge, the regulatory landscape and associated support require flexibility and understanding for leading edge technologies. This was demonstrated by the recent case of the pulse oximeter and its documented inaccuracies when used on individuals with darker skin tones. It is a stark reminder of the need to move forward with continued yet cautious oversight.

Finally, the group for this session noted that research outcome standardizations are necessary, and it is advisable agencies consider funding carefully to ensure R&D opportunities are provided to a diverse population of researchers.

Inclusive Representation

As the Nation comes out of the pandemic and prepares for the next challenge, it is crucial to contemplate different ways of evaluating digital health through a cultural and technical lens. This will ensure responsible use while encouraging innovation of digital health technologies. To address barriers and advance R&D in digital health, cross-cutting teams should be inclusive of different domains, including international partners on digital health initiatives. Important team members include but are not limited to biomedical and biobehavioral researchers, computer scientists and engineers, behavioral and social scientists, physical scientists, regulatory specialists, policy experts, healthcare and public health workers, payers, and a diverse set of patients. In addition, having an intermediate group who understands technology adoption and healthcare users will bridge gaps in digital and technological literacy and familiarity. The participants in this session noted that identifying the types of interested parties was needed for a diverse and convergent team in digital health.

Health Equity, and Diverse and Underrepresented Populations. R&D that addresses technologies targeted for diverse and underrepresented populations, including those with disabilities, is critical. Continued inclusive and collaborative R&D efforts will avoid biases in sampling and data, tackle health equity during the technology development phase, and create more usable technology for individuals with disabilities. Though some agencies do have funding opportunities that can catalyze specific end-user informed technology design and development, much more is desired.

Telehealth R&D Challenges. Besides cross-domain collaborations, challenges remain for R&D in community standards of implementation, payers' incentives, and impact on patient-provider interaction in digital health.

Workforce Development and Retainment in Federal Agencies. Another challenge for digital health R&D is retention of talent and workforce development at Federal agencies. Creative solutions, such as investing in early career "scholars" are needed. Talent varies across agencies, and the requirements and culture at different agencies will exert an influence.

Interagency Coordination and Collaboration

For the past several decades, there has been an exponential increase in the use of digital technologies in healthcare. The COVID-19 pandemic further highlighted exciting opportunities for tele- and mobile-health (mHealth) in diagnosis, disease management, and research. A widespread use of technologies and tools are shaping how healthcare is delivered, managed, and personalized, ranging from the development of smartphone applications to AI-enabled device technologies and image informatics. Their complexities have grown rapidly over time, and now encompass areas such as telehealth, mHealth, wearables, and augmented/virtual reality. These areas are broad, cross-cutting, multidisciplinary, and evolving with applications across the Federal Government.

Federal agencies need to collaborate to understand and continually adapt to new technologies that are regulated differently from past devices. For example, changes in AI-enabled technologies continue to change with increasing data, emerging technologies, refining of user preferences, and adapting for aging populations. This also points to questions about the standardization of research outcomes, their impact

on clinical workflows, and how best to communicate these changes on respective agency websites for the public. This requires new types of collaboration as decision-making and data analytics expertise are not distributed uniformly across agencies. At the session, there was agreement that the concern over technology misinterpretation or dubious use of data should be balanced with transparency and dissemination efforts.

Despite these concerns, it was evident at the workshop that a call for more integrative, synergistic discussions among Federal agencies on recent developments in different areas of digital health is essential. These efforts may open doors for more engagement, strategic planning, memorandum of understandings, and communication strategies between agencies. If priorities can be shared between agencies or international partners at meetings and conferences, a conduit for sharing knowledge will be created. This will develop a roadmap to establish federated infrastructure to support data management and knowledge systems. Sharing of data across agencies can enhance collaboration and provide other opportunities for multiagency workforce development.

While there has been considerable progress in the exchange of information among Federal agencies, the cooperation was often complicated by agencies focusing on their organizational mission and interests rather than the broader Federal enterprise. These are the key issues that the DHRD IWG should continue to address with changing administrations and priorities. Coordination entities, such as the NITRD program and/or task forces, can encourage collaboration by moderating processes and minimizing conflict.

Conclusion: Take Home Message

The breakout session discussions emphasized that the COVID-19 pandemic demonstrated the strength and resilience of federally funded researchers and healthcare providers. The pandemic required researchers and practitioners to make significant changes to traditional research and clinical practices, increasing flexibility in a changing environment to accomplish their goals. This also included developing a less siloed approach within the digital health sphere, which enabled a greater collaboration in research. COVID-19 adjustments accelerated the development and utilization of technologies supporting real-time data collection. Notably, telehealth was shown to be effective in numerous ways during the pandemic with this technology being adopted across the country to increase access to health care. As the acute emergency phase of the pandemic has passed, it is an ideal time to consider how researchers and practitioners can continue to support these trends and maintain the flexibility that was required. Federal agencies should take this opportunity to build a more robust collaborative network that can be leveraged for the use of digital health technologies to address public health threats in the future. However, current R&D gaps and challenges – such as digital equity (e.g., broadband access, device affordability), health literacy, socially responsible data stewardship, and interoperability and optimization of devices and data infrastructure – need to be addressed simultaneously and quickly. A holistic approach will enable progress in new R&D, including the evaluation of lessons learned and the development of evidence-based solutions.

The overall findings of the workshop showed advances in many areas of digital health and wide community acceptance of the technologies during the COVID-19 pandemic. The findings also suggested

continued collaboration amongst agencies that have different mission areas will bring a convergent approach to digital health R&D. These findings encourage the DHRD IWG to expand collaborations and explore new opportunities that support the integration and use of digital health tools, devices, and solutions within the healthcare and public health surveillance ecosystem. As DHRD IWG works to explore these topics through active engagement, collaboration, and partnerships among industry, academia, and the Federal Government, this continued effort will enable faster patient access to novel technologies and reduce health disparities.

List of Abbreviations and Acronyms

AHRQ	Agency for Healthcare Research and Quality
AI	Artificial intelligence
DHRD IWG	Digital Health Research and Development Interagency Working Group
FAIR	Findability, Accessibility, Interoperability, and Reusability
IWG	Interagency Working Group
mHealth	mobile health
NCO	National Coordination Office
NIH	National Institutes of Health
NIST	National Institute of Standards and Technology
NITRD	Networking and Information Technology Research and Development
NSF	National Science Foundation
R&D	Research and Development

About the Authors

The NITRD Program is the Nation's primary source of federally funded work on pioneering information technologies in computing, networking, and software. The NITRD Subcommittee of the National Science and Technology Council guides the multiagency NITRD Program in its work to provide the R&D foundations for ensuring continued U.S. technological leadership that meets the Nation's advanced IT needs. The National Coordination Office (NCO) supports the NITRD Subcommittee and the IWGs and teams that report to it. The NITRD Subcommittee's Co-Chairs are Kamie Roberts, NCO Director, and Margaret Martonosi, Assistant Director of the NSF Directorate for Computer and Information Science and Engineering. More information about NITRD is available online at https://www.nitrd.gov/.

The NITRD DHRD IWG focuses on more efficient and effective biomedical, healthcare, and public health R&D through digital health technologies that support effective health monitoring; individualized screening, diagnosis, and treatment; improved disease prevention and disaster and emergency response; and broad and inclusive access to health and healthcare information and resources. The IWG's activities also contribute to building and sustaining a vibrant community of professional digital health researchers and practitioners. More information is available online at https://www.nitrd.gov/coordination-areas/dhrd/.

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