White House Office of Science and Technology Policy
U.S. Department of Health and Human Services National Institutes of Health
ARPA-H Listening Sessions

Listening Session 9: Advocates for Research on Genomics, Biomedical Engineering and Imaging, Health Informatics, and Medical Libraries August 11, 2021

The ninth of 10 listening sessions to gather feedback on the proposed Advanced Research Projects Agency for Health (ARPA-H) was held virtually on August 11, 2021. Advocates for research on genomics, biomedical engineering and imaging, health informatics, and medical libraries attended the session. The National Institutes of Health (NIH) is working closely with the White House Office of Science and Technology Policy (OSTP) to establish ARPA-H to focus on ambitious and innovative projects that will shape the future of health and medicine for all Americans.

Participants

White House Office of Science and Technology Policy (OSTP)

Tara A. Schwetz, Ph.D., Assistant Director for Biomedical Science Initiatives

National Institutes of Health (NIH)

Francis S. Collins, M.D., Ph.D., Director
Patricia Flatley Brennan, RN, Ph.D., Director, National Library of Medicine (NLM)
Eric Green, M.D., Ph.D., Director, National Human Genome Research Institute (NHGRI)
Bruce Tromberg, Ph.D., Director, National Institute of Biomedical Imaging and Bioengineering (NIBIB)

Stakeholders

Kristine M. Alpi, Ph.D., M.L.S., M.P.H., FMLA, AHIP, University Librarian and Associate Professor, Medical Informatics and Clinical Epidemiology, School of Medicine, Oregon Health & Science University, Portland, OR; President, Medical Library Association (MLA), Chicago, IL

J. Daniel Bourland, Ph.D., Professor, Radiation Oncology, Wake Forest School of Medicine, Winston-Salem, NC; President-Elect, American Association of Physicists in Medicine (AAPM), College Park, MD

Tejal Desai, Ph.D., Ernest L. Prien Professor and Chair, Department of Bioengineering, University of California, San Francisco; President, American Institute of Medical and Biological Engineering (AIMBE), Washington, DC

Gillian Hooker, Ph.D., Sc.M., LCGC, Vice President for Clinical Development, Concert Genetics, Franklin, TN; Past President, National Society of Genetic Counselors (NSGC), Chicago, IL

Gretchen Purcell Jackson, M.D., Ph.D., FACS, FACMI, FAMIA, Vice President, Chief Health and Science Officer, IBM Watson Health, Armonk, NY; Associate Professor, Pediatric Surgery and Biomedical Informatics, Vanderbilt University Medical Center, Nashville, TN; President-Elect, American Medical Informatics Association (AMIA), Rockville, MD

Gail P. Jarvik, M.D., Ph.D., Head, Division of Medical Genetics, Arno G. Motulsky Endowed Chair, Medicine, Joint Professor, Medicine and Genome Sciences, University of Washington, Seattle, WA; President, American Society of Human Genetics (ASHG), Rockville, MD

Maximilian Muenke, M.D., FACMG, Chief Executive Officer, American College of Medical Genetics and Genomics, Bethesda, MD

Mitchell D. Schnall, M.D., Ph.D., Eugene P. Pendergrass, M.D., Professor and Chair, Department of Radiology, University of Pennsylvania, Philadelphia, PA; President, Academy for Radiology & Biomedical Imaging Research, Washington, DC

Taner Z. Sen, Ph.D., Research Biologist, U.S. Department of Agriculture, Albany, CA; Member, Public Affairs and Policies Committee, International Society for Computational Biology, Leesburg, VA

Meeting Summary

Welcome and Opening Remarks

Francis S. Collins, M.D., Ph.D., Director, National Institutes of Health (NIH)
Tara A. Schwetz, Ph.D., Assistant Director for Biomedical Science Initiatives, White House Office of Science and Technology Policy (OSTP)
Eric Green, M.D., Ph.D., Director, National Human Genome Research Institute (NHGRI)
Bruce Tromberg, Ph.D., Director, National Institute of Biomedical Imaging and Bioengineering (NIBIB)
Patricia Flatley Brennan, RN, Ph.D., Director, National Library of Medicine (NLM)

Dr. Collins welcomed participants and attendees to the ninth of 10 listening sessions to gather feedback on the proposed Advanced Research Projects Agency for Health (ARPA-H). NIH is working closely with OSTP on ARPA-H, which is a high priority for the Biden administration. ARPA-H is designed to catalyze ambitious ideas and approaches that will shape the future of health and medicine for all Americans. The new agency, which will follow the Defense Advanced Research Projects Agency (DARPA) model, will focus on high-risk, high-reward projects and will be guided by visionary project managers. ARPA-H will recruit researchers who might otherwise not apply to NIH for support, and its projects will be driven by clearly defined milestones. OSTP and NIH wish to gather opinions from stakeholders, who will play a critical role in the establishment and success of ARPA-H. The 10 listening sessions will focus on specific research areas and will involve NIH Institute and Center (IC) directors who represent those areas.

Dr. Schwetz said that ARPA-H will strive to be transformative for biomedical research. The United States has a strong biomedical research ecosystem that is supported by NIH-funded research. Results from such research have informed the pharmaceutical industry in its development of treatments for a range of conditions. However, the current system has some gaps between traditional fundamental research and industry. ARPA-H will help provide a new lens and a mechanism through which to support exciting biomedical research that can improve human health. Such ambitious and cutting-edge research requires a novel funding approach, and such approaches have been used in other areas of science. In ARPA-H, OSTP and NIH aim to create a distinct entity whose leadership will have the autonomy and resources to tackle some of the biggest challenges facing human health.

Dr. Green said that more than 30 years ago, the human genetics and genomics field only imagined sequencing the human genome. By using a different approach, NIH was able to launch the Human Genome Project, which used big science, new models of data sharing, and new ways to bring scientists together. If NIH had conducted business as usual, it is likely that human genome would still not be sequenced. Many lessons learned from the Human Genome Project have influenced other large initiatives at NIH, such as the creation of the Common Fund; the founding of new ICs, such as the National Center for

Advancing Translational Science; and the launch of the *All of Us* Research Program. For certain health challenges, processes need to be different to speed up progress.

Dr. Tromberg said that as an engineering institute, NIBIB supports a vibrant technology development community that wants to be an essential stakeholder and partner with ARPA-H. Cutting-edge technologies, such as nanomaterials that target cells and deliver therapies or vaccines, can dramatically change how diseases are understood, diagnosed, treated, and prevented. The public often wonders why these technologies are so slow to be put into clinical practice and what innovations can be expected. ARPA-H can address these issues in two ways. First, ARPA-H will create new mechanisms for optimizing and accelerating the design, building, testing, and deployment of technology, dramatically increasing the number and scope of medical technologies available for patients. Second, ARPA-H will expand opportunities to advance purpose-driven design methods that are the cornerstone of bioengineering. Regardless of the specific biomedical challenge, ARPA-H will provide new pathways for engaging technology innovators and entrepreneurs. A new generation of diverse interdisciplinary teams will be empowered to work together and create true solutions for long-standing biomedical problems. Based on its experience with the Rapid Acceleration of Diagnostics (RADx) initiative during the COVID-19 pandemic, NIBIB can be a strong partner for ARPA-H.

Dr. Brennan said that NLM is a partner for innovation, and ARPA-H will bring NLM some exciting opportunities. NLM acquires, preserves, and disseminates knowledge of all types, from datasets to articles and books, but its most important role is in biomedical discovery and translating biomedical research into practice. NLM's work forms the backbone of scientific communication. Science is changing quickly, science communication is evolving rapidly, and ARPA-H is an opportunity to see new approaches to scientific communication and computational tools that can accelerate the health in the moment as well as the delivery of health care around the world. The digital processes, algorithms, and communication tools needed for innovations are currently out of reach, but ARPA-H can make them a reality. The work of ARPA-H can lead to the development of privacy-preserving technologies that ensure patients' rights, protection of clinicians from inappropriate advice, and the delivery of knowledge to the point of care. NLM is ready and willing to be a partner with ARPA-H.

Comments from Invited Stakeholders

Maximilian Muenke, M.D., FACMG, Chief Executive Officer, American College of Medical Genetics and Genomics, Bethesda, MD

Gail P. Jarvik, M.D., Ph.D., Head, Division of Medical Genetics, Arno G. Motulsky Endowed Chair, Medicine, Joint Professor, Medicine and Genome Sciences, University of Washington, Seattle, WA; President, American Society of Human Genetics (ASHG), Rockville, MD

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Philadelphia, PA; President, Academy for Radiology & Biomedical Imaging Research, Washington, DC

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University of California, San Francisco; President, American Institute of Medical and Biological Engineering (AIMBE), Washington, DC

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Kristine M. Alpi, Ph.D., M.L.S., M.P.H., FMLA, AHIP, University Librarian and Associate Professor, Medical Informatics and Clinical Epidemiology, School of Medicine, Oregon Health & Science University, Portland, OR; President, Medical Library Association (MLA), Chicago, IL

Dr. Muenke said that one big idea that ARPA-H could tackle is sequencing people's genomes, even at birth, and linking those data in their electronic health records (EHRs). This genetic information, together with clinical diagnoses and other omics data, could be aggregated into a data repository that is deidentified and protected and supports research. This repository could be used to enable diagnoses of diseases that result in changes in clinical management, identify gene–drug interactions, and find genetic markers that can forecast the risk of disease early in life (e.g., coronary artery disease, cancer, Alzheimer's disease) so that early behavioral and medical interventions can be applied to prevent or slow down disease progression. Such a comprehensive data repository would improve our understanding of the causes of rare and common diseases and differences in drug responses, advance diagnostic capabilities, and spur development of new targeted treatments. Also, this repository should be representative of the U.S. patient population, thereby reducing health disparities in data research and therapeutic development. There are a few challenges, however. First, EHRs must be able to accommodate large genomic datasets and be interoperable to facilitate long-term follow-up and any changes between health care systems. Second, public trust around the use of genetic information is needed. This will require transparency, protection against misuse, and assurance of the privacy of patients' health care information through established policies; these policies must carefully balance those concerns with the need to easily share clinical and genetic information to advance research and improve health care. Third, in order to grow the medical genetics workforce, genetics and genomics should be a standard part of all medical school curricula and training in all medical specialties. There should be incentives for more professionals to pursue careers in genetics and creative solutions to accommodate the increased need for genetic counseling.

Dr. Jarvik said that ASHG is grateful to the Biden administration for proposing a bold and historic funding level for NIH in fiscal year (FY) 2022 and significant funds for ARPA-H; however, it will be important that NIH continue to receive investments to support its core portfolio of fundamental biomedical research, and ARPA-H should complement that core portfolio. As Dr. Green mentioned, the Human Genome Project is an example of how major investments and use of inspired breakthrough research can benefit human health. As NIH considers how ARPA-H will fit into the existing biomedical ecosystem, ASHG urges NIH to acknowledge two important issues. First, diversity, equity, and inclusion (DEI) should be at the core of ARPA-H mission, in terms of both its scientific priorities and its workforce. From all levels, from ARPA-H research workforce to public participation, diversity is essential to delivering health advances that will benefit all patients. Second, ARPA-H needs to make a strong commitment to responsible global data sharing. The results and data generated from ARPA-H should be made available to the larger biomedical community while protecting participant privacy. ASHG and the human genetic and genomics community can work with ARPA-H to create data-sharing policies for large-scale datasets.

Dr. Hooker said that NSGC is enthusiastic about ARPA-H. Genetic counseling field changes dramatically every day, but major challenges remain, including disparities in access to genetic testing and genetic specialty care and problems with optimizing services to bring the most benefit to people who need these services. Although genetic counselors are the fastest-growing group in the genetics workforce, there is a problem with the distribution of genetic counselors: Clinical patient-facing genetic counselors are heavily concentrated in academic medical centers. Additional funding for research into genetic counseling delivery models and access to care would help address these disparities and better position this growing workforce to respond to the needs of the population. This type of research needs to occur in the community and have a focus on justice and DEI. NSGC created a task force to identify priorities for conducting this research and published their recommendations in the *Journal of Genetic Counseling* in an article that NSGC shared with the ARPA-H planning group. The focus of this research should be on investing in resources to develop and validate quality and outcome measures for genetic counseling services; exploring measures for access, quality, and cost-effectiveness; and developing the infrastructure needed to collect patient- and provider-level data in a longitudinal way.

Dr. Schnall said that the Academy for Radiology & Biomedical Imaging Research has closely followed the ARPA-H proposal and recognizes the new agency's potential to build on foundational knowledge and accelerate image-targeted diagnostics and cures. The Academy believes that ARPA-H should complement and not detract from NIH's core mission of supporting basic investigator-initiated research. The Academy embraces the collaborative, ambitious, use-driven project culture envisioned in ARPA-H. The Academy has worked with OSTP as part of an intergovernmental working group on medical imaging to coordinate federal investment in medical imaging research and develop a strategic plan for future development. The Academy embraces the opportunity to work with ARPA-H but has several questions, including whether ARPA-H will follow the DARPA model and not have a tradition peer-review process; how project selection and peer review will work; whether there will be an opportunity for community input into

leadership positions, including the director and important program manager positions and how nominations will be solicited; how ARPA-H will incentivize public–private collaborations and partnerships; and how regulatory systems, such as the U.S. Food and Drug Administration (FDA), will be incorporated into the ARPA-H process to ensure that breakthroughs will have an opportunity to reach the market effectively.

Dr. Desai said that bioengineers have been trained to invent, build, test, refine, and reiterate, as well as to bring together skill sets from a variety of fields to solve hard problems. This mindset of needs-based design and problem-driven solutions, coupled with the cross-fertilization of disciplines, should be a hallmark of ARPA-H, which should closely associate with NIBIB and the bioengineering community. Additionally, ARPA-H should play a major role in facilitating partnerships with the FDA and biotechnology and medical device companies to ensure that its innovations achieve their potential and can reach the patient. ARPA-H should facilitate a regulatory and business pathway for each project to move forward if it finds success. Although its stated focus is to combat diseases, ARPA-H should consider cross-cutting platform technologies, such as engineered immune modulation, molecular scale imaging, and in situ nanosensors that can detect the earliest hallmarks of disease, that can have an impact on multiple diseases. Other cross-cutting platforms, such as digital medicine and predictive health, can improve quality of life, reduce health care costs, and create more equitable community access. ARPA-H should build a culture of equity, inclusion, and transparency. This will involve bringing teams of scientists and engineers with diverse backgrounds and ideas so that ARPA-H can pursue creative, bold new ideas and fully capitalize on innovation. Equity and diversity should be core values of ARPA-H, with an emphasis on not only supporting projects or platforms that address health equity but also supporting diverse teams and considering the impact of the work on all communities.

Dr. Bourland said that ARPA-H can be the incubator where the right scientific ingredients and enabling technologies are both created and brought together to generate biomedical devices and platforms for diagnoses and cures. Some opportunities and gaps that can be addressed by ARPA-H include accelerating the development of robust big data and artificial intelligence (AI) platforms and catalyzing the development of nanomedicine and theranostics, such as novel tracers and small molecules for personalized medicine. ARPA-H should also leverage the NIH archive of biological information and expertise related to sensor technologies and imaging radiomics. Furthermore, delivering cheaper, faster, smaller, portable diagnostic and high-tech solutions can reduce health disparities and lower the cost of providing high-quality care for people in resource-limited regions. ARPA-H needs to address regulatory aspects, such as agency memorandums of understanding, industry and academic partnerships, data privacy and governance, management of conflicts of interest, good laboratory practices, and a streamlined FDA approval process for new categories beyond devices and drugs. ARPA-H can be the bridge over the “valley of death” by lowering the translational hurdles needed for commercialization. ARPA-H will require multi-institutional partnerships (e.g., academia, industry, regulators, advocates) and diverse skill sets. One example of a successful, rapidly developed, multi-institutional consortium that uses AI and medical imaging is the Medical Imaging and Data Resource Center (MIDRC), which is led by AAPM and two other medical imaging organizations. Finally, strong leadership

and project managers are the key to finding game-changing projects for ARPA-H. Medical physicists can contribute as project managers, subject matter experts, and process experts. The projects that come to ARPA-H should be funneled in by NIH, based on strategic priorities set by ARPA-H, or independent pitches from outside.

Dr. Purcell Jackson said that AMIA and its members are truly excited about the prospect of a new agency with the mission to address the important unsolved problems in the field of informatics and nimbleness to produce tangible results. AMIA sees tremendous opportunity for ARPA-H to address the infrastructure of learning health systems, clinician documentation burden, and the sluggish research ecosystem. First, ARPA-H could accelerate advances in health by studying and creating the infrastructure needed to support a true learning health system. Currently, ideas, innovations, and lessons learned remain siloed within and are not propagated across institutions, vendors, and technology platforms. With the right infrastructure, a myriad of unintegrated data sources and a wealth of health care experiences could form a foundation for research, patient care, and operational improvements in health care. Second, optimizing the EHRs to fully realize health data and technologies as enablers rather than detractors to quality care is a critical challenge. ARPA-H can address a call to action made by AMIA to research enhanced EHR functions, such as real-time and automated information retrieval, documentation, and order entry; simplified and context-specific EHR views; clinical decision support that is tailored to clinician workflows; and automated charge capture without increased clinician burden. Billing and patient care data should be decoupled so that these health care data are not polluted with artifacts from billing requirements. Finally, ARPA-H can be a convener that allows big team science and big data science to occur at the pace of technology evolution. The COVID-19 pandemic has demonstrated what is possible when universities, nonprofits, government, and commercial entities come together to rapidly achieve major scientific advances. ARPA-H could foster an ecosystem for rapid responses to health emergencies, as well as coordinated efforts to address long-standing health challenges like obesity, health disparities, and addiction.

Dr. Sen said that collaboration and partnership studies can be complex, especially when dealing with research centers broadly distributed across the country. Startup culture and investment capital are heavily concentrated in a few locations. A successful strategy for ARPA-H could involve developing local incubators and replicating successful models on a much larger scale. Although AI and machine learning will transform health and disease, a precise understanding of the expected AI outputs is needed. Also, the creation and application of AI approaches should be equitable and nondiscriminatory. ARPA-H could create requirements for open research data, such as placing data in an open repository by the time a paper is published. ARPA-H should also employ automated science that uses an automated, computational-driven, experimental design for optimizing algorithms and AI and uses robotics laboratory equipment whenever possible. Automation will improve the efficiency and promote robustness and reproducibility of experiments. Several significant systemic gaps in the research and development are slowing or impeding progress: a lack of sustained funding of scientific resources, such as biobanks and competition infrastructure; issues with effective sharing of samples and data while enforcing data protection of personal data; limited international collaboration; and inadequate human diversity within the research community. There are also biases in the

data used to train machine learning methods and, consequently, biases and errors in the use of these methods. This problem encompasses a wide range of data types, from basic research (e.g., genetic sequencing data) to clinical settings (e.g., underrepresented demographic groups), in the final diagnostic algorithm. There is also a lack of standardization in data collection. For example, if human samples are being collected, then a minimum amount of standard metadata needs to be provided. Standardization will close understanding gaps instead of encouraging silos, improving the ability to make discoveries.

Dr. Alpi said that MLA sees that ARPA-H has the potential to support more inclusive approaches to team science, shared leadership, and ideas spearheaded by nondoctoral research. ARPA-H should be distinct and independent from NIH, benefiting both ARPA-H and NIH; however, fostering communication among investigators and with the public, sharing data and tools, and ensuring transparent participation will be essential. MLA agrees that ARPA-H funding must not reduce investments in NIH's base budget and that bringing team science, effective project management, and robust infrastructure to all ARPA-H projects would ensure that participants can have maximum impact regardless of the resources at their own institutions or in their own communities. Librarians can be a linchpin for a successful cycle of ARPA-H initiatives, from planning discovery to sharing findings for application to individuals or community health. Librarians can share their expertise with project managers at ARPA-H; their interdisciplinary perspective encourages broader partnerships by looking beyond typical institutions, identifying stakeholders with diverse viewpoints, and finding collaborators with skills and outlooks that complement team strengths and weaknesses. ARPA-H should evaluate team potential in the aggregate and focus less on individual team leaders or institutions. Librarian involvement during the exploration of these critical questions and the subsequent development of proposals can save time and avoid waste. To capitalize on existing knowledge, ARPA-H should fund rapid exploration of critical questions through open dissemination of evidence synthesis, systematic reviews, and scoping reviews using librarian expertise. Support for discovery through prior work, including funding to incorporate and translate global knowledge into languages other than English, would advance equity, inclusivity, and broader applicability of findings. ARPA-H's focus on equity aligns with MLA's commitment to DEI. ARPA-H should require implicit bias training and ongoing feedback for project managers and other staff who select or recommend projects for funding. There should also be training on how to evaluate the impact of publications to improve communication outside the academic environment.

Discussion

- *How will ARPA-H work?* Dr. Collins said that ARPA-H will not be like the rest of NIH; it will have a different strategy and culture that is intent on being flexible and taking risks. There will not be two levels of peer review associated with proposals. The director will have a lot of authority and will hire program managers who will survey the field, choose projects that seem ideal, and pitch them to the director. If these projects get a positive response, the managers will map out how the project could go forward and any collaborators who might be needed to support the project, including those who might never have had NIH

funding.

- *What kind of projects will ARPA-H fund?* Dr. Collins said that ARPA-H projects should be use-driven and not curiosity-driven. They should fill a gap. ARPA-H projects do not have to be about a certain disease but could involve a platform that has many applications, from molecules to society. Also, ARPA-H projects will be closely tracked, and progress will be monitored.

- *Will ARPA-H be guided by the Heilmeier Catechism, as DARPA is?* Dr. Collins said that ARPA-H will follow the Heilmeier Catechism, a list of questions created by DARPA Director George H. Heilmeier in the 1970s. DARPA still uses the list to determine whether a project being pitched is actually appropriate for this format. The questions are as follows:
  - What are you trying to do? Articulate your objectives using absolutely no jargon.
  - How is it done today, and what are the limits of current practice?
  - What is new in your approach, and why do you think it will be successful?
  - Who cares? If you are successful, what difference will it make?
  - What are the risks?
  - How much will it cost?
  - How long will it take?
  - What are the mid-term and final "exams" to check for success?

- *How will the community of biomedical experts have input into what kinds of projects are considered?* Dr. Schwetz said that a variety of different data points and stakeholder input and perspectives will be heard as these programs are developed. ARPA-H will rely on a lot of data points and use a market research approach to understand the landscape of scientific portfolios across NIH and the broader extramural community. Also, this will be an opportunity to actively engage with patients and providers early in the process, since they will be the end users of the innovations that will be developed through ARPA-H.

- *How will the peer review happen at ARPA-H? How will ARPA-H overcome issues of funding speculative or unorthodox ideas that have not been funded by NIH due to the risk-averse nature of the NIH Center for Scientific Review (CSR) review process?* Dr. Collins said that the review process will not involve a study section and Center review. Dr. Schwetz said that ARPA-H will follow the DARPA model. Researchers will be able to submit a one- to two-page description of their idea for the program—an abstract. ARPA-H program managers will respond with either an interest to proceed, no interest in proceeding, or a request to revise and resubmit. Then, the original researcher will need to submit a detailed proposal, which will be reviewed by a panel of scientific experts from across the federal government, such as NIH, DARPA, the Advanced Research Projects Agency–Energy (ARPA-E), and the National Science Foundation. This panel will not give projects rankings; rather, it will evaluate whether the proposed projects meet the criteria whether it is suitable for funding. The program managers will then decide

on a collection of projects that are suitable for funding and can make up a specific program. The list of projects will be shared with the ARPA-H director, who will give the final approval.

- *What is the timetable for the review and funding process?* Dr. Collins said that ARPA-H will be nimble. Dr. Schwetz said that the timeline will vary depending on the proposed program and its complexity, but the process will take weeks and months rather than the usual months and years.

- *How will the funding for APRA-H work, and when will ARPA-H be established?* Dr. Collins said that President Biden proposed a $6.5 billion starting point for ARPA-H, which could be spread out over 3 years. The House of Representatives' budget proposal allocated $3 billion that could be spread out over 3 years—less than the President's proposal but still a substantial amount of money. The House has expressed interest in increasing that amount rather than keeping it at a fixed level. ARPA-H can be launched as soon as the budget is passed, which may be toward the end of this year. This timeline is why so much work is being done now to determine the foundational components of ARPA-H: so that time will not be wasted once the funding for ARPA-H is set.

- *Where is ARPA-H going to be located?* Dr. Schwetz said that although the details of ARPA-H's location remain to be decided, it will not reside on the NIH main campus. ARPA-H will be geographically distinct from NIH, but it could be in the Washington, DC area. For example, DARPA is not far from the Pentagon, but its geographic separation provides a degree of independence for the agency, similar to what is envisioned for ARPA-H.

- *Can NIH support something this fast-moving and risk-taking?* Dr. Collins asked Dr. Tromberg to share NIBIB's experience with launching RADx. Dr. Tromberg said that Congress asked NIBIB to quickly create COVID-19 PCR (polymerase chain reaction) tests, because NIH has built confidence in its ability to quickly put together this type of operation. RADx leveraged an existing network of point-of-care technology research networks and enhanced it by partnering with industry experts and others from the innovation and entrepreneurial community. RADx also relied on nonprofits to facilitate rapid funding mechanisms. RADx had a low barrier to entry for good ideas, much like ARPA-H will. NIBIB opened its innovation funnel and reviewed more than 700 applications through a multiphase review process. Funded projects were managed by a concept team and additional experts. Through this process, there are now more than 500 million laboratory point-of-care and at-home COVID-19 PCR tests. All of this was done at NIH but required key collaborations across the government, industry, and nonprofits. Dr. Collins added that similarly, the development of COVID-19 vaccines in 11 months was due to NIH using a very different approach.

- *There are specific topics that ARPA-H should consider, including space health, robotics and brain surgery, chronic fatigue syndrome, and long COVID.* Dr.

Collins said that all of these are possible topics, but overall, the community should understand ARPA-H's process and the need to fund use-driven projects that meet the Heilmeier questions.

- *What type of person are we looking for to fill the director position?* Dr. Collins said that although there is no specific person in mind for this position, the ARPA-H director should have an entrepreneurial attitude, potentially have spent time in the private sector, and have had success but also know how to weather failures. The director should be someone visionary and capable of clearly communicating that vision with a variety of audiences, including Congress. The director should also be a good recruiter and judge of program manager candidates so that when the program is launched, program managers can be hired quickly and get projects started right away. Importantly, DEI will be an essential part of recruiting the ARPA-H director and the program managers. DEI must be written into every aspect of ARPA-H's processes, or else the agency will have failed in its responsibility. OSTP and NIH welcome suggestions for candidates for director. Dr. Schwetz added that the Biden administration is committed to supporting diversity and health equity. The pool of applicants for director and program managers should be diverse on multiple levels: race, ethnicity, geography, and scientific disciplines. Candidates could also be people not traditionally involved in biomedical research. All these types of diversity will have an impact on the types of programs that will be developed.

Dr. Schwetz and Dr. Brennan answered additional questions in the session platform's Question and Answer feature.

- *Will NIH consider co-funding projects with external partners (e.g., philanthropy)?* Dr. Schwetz noted that this approach could be considered as an option for some potential ARPA-H programs.

- *Will the ARPA-H program staff be chosen from existing NIH program staff, or will these be new hires?* Dr. Schwetz answered that ARPA-H will recruit top-notch program managers from industry, academia, nonprofit organizations, and government, including NIH.

- *In Arati Prabhakar's Day One Project piece on how to construct an ARPA clone, she points out that the mission and defining what's "ARPA-able" will be crucial, along with the recruitment and "other authorities" for hiring and funding projects. Are there any details about how the mission statement will be formulated and whether Congress will confer those flexibilities for who is hired and how they operate?* Dr. Schwetz noted that for ARPA-H to be successful, it must be granted broad, flexible authority to hire, recruit, and retain bold program managers through nontraditional mechanisms; mix and match the best ideas within different applications with minimal bureaucracy; allow for projects that do not fit neatly into 1-year intervals; allow for funding distribution over multiple years; provide a mechanism to challenge scientific teams and industry players to compete; and

have exemptions from traditional proposal review processes.

- *Will ARPA-H use traditional NIH mechanisms (e.g., R01, R21), or will there be new mechanisms?* Dr. Schwetz answered that ARPA-H will utilize contracts, Other Transaction Authority, cooperative agreements, and grants where appropriate.

- *Will the ARPA-H director be a political appointee or a career civilian?* Dr. Schwetz wrote that this is yet to be determined. The advantages and disadvantages of each approach are still being discussed.

- *Is there going to be a Funding Opportunity Announcement (FOA) or a process to submit ideas?* Dr. Schwetz answered that although initial programs have not been identified, there likely will be an open opportunity to submit ideas.

- *How will ARPA-H articulate private-sector partnerships in the project to ensure effective project management?* Dr. Schwetz noted that partnerships with the private sector and across the federal government will be critical to ARPA-H.

- *How will NLM help ensure that libraries around the country are able to participate and contribute? What skills and knowledge needed for ARPA-H can librarians bring, and how will NLM ensure they are part of the conversation?* Dr. Brennan answered that NLM will use its Network of the National Library of Medicine to provide information about ARPA-H, identify opportunities for building library skills for fast-track innovative approaches, and distinguish between ARPA-H and other NIH funding opportunities. NLM will listen to the community and rely on it to bring those messages to ARPA-H.

- *It sounds like the projects would follow more of an Agile development process. Is this correct?* Dr. Brennan agreed, noting that within NLM, the National Center for Biotechnology Information has adopted the Agile development process to manage its vast data resources.

Closing

Francis S. Collins, M.D., Ph.D., Director, NIH

Dr. Collins thanked participants and attendees for their interest in ARPA-H. ARPA-H is a work in progress, and OSTP and NIH will be hosting additional listening sessions to continue gathering information to help guide its establishment. Dr. Collins invited attendees to send comments and questions to the ARPA-H comment box (ARPAHcomments@nih.gov) and to visit the ARPA-H webpage.