Attachment—Additional Questions for the Record

Subcommittee on Health

Hearing on

"The Future of Biomedicine: Translating Biomedical Research into Personalized Health Care"

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The Honorable Frank Pallone, Jr. (D-NJ)

1. Scientific advances like genome sequencing have made precision medicine a more attainable goal. There has been a lot of momentum around precision medicine and this idea of an individualized approach to health care. However, there remain a lot of questions around precision medicine, its scalability, and thinking beyond disease treatment toward disease prevention. You have been a very vocal proponent of what you call "P4 Medicine" – medicine that is predictive, preventive, personalized, and participatory.

    a. Why is this approach more effective than the current practice of disease response?

    P4 Medicine is a description of what ideal healthcare should be. The realization of P4 Medicine will come from precision population healthcare – generating lots of data measurements on lots of people. We have demonstrated a "proof of principle" for precision population health in the 4-year genome/phenome (blood analyte, gut microbiome, and digital health measurements) wellness study from the company Arivale, which brought scientific wellness to 5,000 individuals. These 5,000 personalized, longitudinal data clouds were analyzed to demonstrate that quantitative measurements demonstrate three important aspects of scientific wellness:

    (1) It could lead to hundreds of "actionable possibilities" to improve wellness or avoid disease,
    (2) It generated an algorithm for determining individual biological age (the age your body says you are rather than your chronological age) – we demonstrated this is a powerful marker for both measuring wellness and optimizing one's biological aging, and

(3) It showed that wellness-to-disease transitions could be detected by changes in levels of certain blood markers that could then be used to detect – and reverse – most chronic diseases years before they manifest clinically.

These observations form the basis for the science of wellness and prevention.

Between 2000 and 2010, the United States healthcare system invested an estimated 97% of its resources in the treatment of disease – that is, after the diagnosis of one or more potentially serious conditions[1]. P4 medicine offers a transformation from a reactive approach to a proactive approach to healthcare, driven by scientific discovery, big data, and advanced analytics and AI. This transformation will result in a greater focus on *wellness*, with emphasis on keeping people healthy and preventing disease before it gets to a point where severe interventions (such as surgery or drugs) are needed.

While the implementation of P4 medicine requires an up-front investment, the downstream cost saving potential is immense. For example, the treatment of diabetes alone costs over $325 billion annually[2], yet the vast majority of diabetes is preventable – and even reversible at the early stages. P4 medicine, through its inherent disease-agnostic approach, will mitigate this and many other healthcare costs while simultaneously increasing quality adjusted life years (QALYs) and yield a more productive US society.

Building on the importance of P4 medicine, we initiated the Beyond the Human Genome (BHG) project, a million-person precision health project that will take place over 10 years. Like the first Human Genome Project, we will be seeking federal funding to support BHG. It will be a large demonstration project for precision population health that will validate the science of wellness and prevention, it will use data-driven systems-biology approaches to deal with diseases employing precision medicine (lots of data measurements on each patient), and it will provide implementable solutions for each of the four major challenges of contemporary healthcare: the need for improving quality (through scientific wellness), the challenges of an aging population (healthy aging), an explosion of chronic diseases (by detecting and reversing early transitions), and excessive and escalating costs (through improved wellness that decreases healthcare costs). BHG will offer concrete solutions to the current challenges of healthcare. The million-person demonstration project is key to effectively demonstrating these and additional solutions for these challenges and at the same time demonstrating that we can scale precision population health.

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[1] Institute of Medicine (US). The Healthcare Imperative. Lowering Costs and Improving Outcomes: Workshop Series Summary (eds Yong, P. L., Saunders, R. S. & Olsen L. A.) (National Academies Press, 2010).

[2] https://www.cdc.gov/chronicdisease/programs-impact/pop/diabetes.htm

b. What additional information or data is needed to facilitate the precision population health program you describe?

As described above, data from genome and phenome analyses are critical to developing a P4 system of medicine.

The real key to facilitating general acceptance of precision population health is to carry out the 10-year, million-person BHG project. The data from this program will demonstrate that we can strikingly improve human health through scientific wellness, facilitate healthy aging so that most of us will move into our 90s or 100s mentally agile and physical functional, avoid chronic disease by early detection and reversal, and affect striking cost savings, for example, by identifying biomarkers that will identify patients that will respond to particular drugs.

Currently the top 10 selling drugs in the US work for less than 10% of the users and cost $600 billion a year. Imagine the savings if we only gave the drugs to those who could effectively respond. This effort will also lead to perhaps 10,000 new actionable possibilities, and we will employ AI to deliver them to physicians through decision support tools and to individuals by personalized lifestyle recommendations based on variation in their genomes and in the exposures and experiences assays by phenomic assays. This will persuade payers to cover all of these areas and make them a routine part of 21st century healthcare.

The goal of BHG is to use data to drive the scientific engine. There are several ongoing efforts to build AI-driven and other computational medical models, but it requires that both a substantial amount of data is collected and that the right kind of data is collected. Because the current approaches are somewhat lacking from this perspective, we established BHG to further research and develop targeted sets of biomarkers that are not currently collected as part of standard clinical care. We need to integrate next-generation technologies like DNA sequencing into standard practice and to measure and understand all the various proteins, hormones, and other molecules easily sampled through blood. The P4 approach leverages current and emerging technologies to integrate much deeper and broader analysis strategies at scale to yield a systems level understanding of human health to propel a true paradigm shift.

Because current research knowledge is too commonly siloed, we know that many medical insights are context specific and should be applied differently across the spectrum of human diversity. The goal of BHG, with support from federal funding, is to ensure that efforts result in medicine that is applicable to all Americans. It is critical that data for research and development comprises individuals that are representative of the general population and captures the broad spectrum of racial, ethnic, and socioeconomic diversity within our country.

2. This year marked the 20th anniversary of the project that we all know revolutionized modern medicine. This project was a massive, international, collaborative research program that determined the entire sequence of human DNA. It is hailed as one of the greatest feats in recent scientific history.

    a. Can you tell us about how this project came about and what factors made it possible for researchers such as yourself to take on such a huge effort?

    The Human Genome Project came about as a result of two forces. The automated DNA sequencing developed in my lab made it possible in the mid-1980s to consider sequencing the human genome. A meeting held in the spring of 1985 which I attended brought together 12 scientists to consider the merits of the Human Genome Project. We decided it was feasible, although difficult. The Department of Energy, at the same time, felt sequencing the human genome would provide insights into human radiation damage that came from dropping atom bombs in Japan and they pushed this new idea very hard. There was opposition to this because of the fear "big science" would destroy the then-typical "small science." The NIH initially opposed the Human Genome Project. A National Academy of Science's committee with both proponents and opponents in the late 1980s unanimously agreed to endorse the project. The government put in roughly $3 billion to achieve this goal. It started in 1990 and finished (under budget) in 2003. I am extremely proud to have been part of this transformational project and to take this research to the next level with BHG.

    b. Can you give an example of a project that has the same revolutionary potential, today?

    The BHG project that we are initiating leverages the knowledge gained by the Human Genome Project to accelerate discovery at a scale not seen before. The genome is a key piece in any personalized medicine approach, but it is not enough. In the vast majority of cases, the genome is not the sole determinant of disease. The BHG will integrate the static genome with the longitudinally measured and dynamic phenome, which is the reflection of genetics, lifestyle, exposures, and environment in the body at any given time. The phenome can be sampled and assessed through blood and other strategies (such as stool microbiome and digital health devices) to both assess the current state of health of an individual as well as predict their health trajectory to identify key actionable possibilities to optimize health. BHG represents the fact that measuring the human phenome across life is essential to optimizing the wellness life trajectory of each individual and to achieve P4 health.

    The Human Genome Project represented an unprecedented scale of scientific undertaking which resulted in correspondingly unprecedented large return on investment[3] with respect to technological and scientific advances. Ten years after

[3] https://www.nature.com/articles/nature.2013.13187

the completion of the Human Genome Project, the Battelle Institute estimated that the return on investment was about $800 billion, more than 250 times the $3 billion cost of the project. The BHG promises strikingly increased returns through technological innovation, medical advancements, and world leadership for the United States. The BHG has the potential to revolutionize a variety of disciplines, including:

- medicine (treatments and preventative measures)
- healthcare (focus on wellness)
- technology (sequencers and data generation), and
- data infrastructure (storage, analysis, standardization, and equity of large-scale phenomic data).

Just as the Human Genome Project drove down the cost of DNA sequencing more than one-million-fold, the BHG project will drive down the costs of phenomic analyses.

There are other large-scale precision population projects, such as the UK Biobank with 500,000 individuals and NIH's All of Us program, aspiring to collect one-million individuals, but there are many significant differences between these programs and BHG program: BHG will return results regularly to patients to improve their wellness. BHG will include brain health as well as body health. BHG will analyze and integrate many different types of phenomic data. BHG will draw patients from a population that will allow us to reflect the racial diversity of the US. BHG will validate the science of wellness and preventions. BHG will include business partners that will each analyze the immense amount of data collected from their own viewpoints and bring these findings to society. The data will be open and available to all participants, healthcare systems, academic and industry researchers, etc. BHG will guarantee us a world leadership in health care innovation.

The Honorable Anna G. Eshoo (D-CA)

1. Has your organization engaged with AI-related efforts of the federal government? If so, please share any of your comments or recommendations that you believe would be useful for the Subcommittee on Health with respect to enabling biomedical innovation.

   The Institute for Systems Biology has participated in a major NSF/NIH supported program on knowledge graphs. This program has involved three faculty members committed to determining the relevant relationships of all knowledge in the biological literature. Knowledge graphs provide a powerful tool for converting data into knowledge and mechanistic understanding of the transitions that occur in longitudinal phenome data (e.g. wellness-to-disease transitions, variation in which of several disease trajectories a given patient might follow, etc.). The Institute for Systems Biology is also supported by the federal government to develop digital twin models for various diseases (Alzheimer's and acute myelogenous leukemia). The idea is to accumulate all of the data on a given disease (or wellness) and then

make predictions about the wellness and disease trajectories of individual patients. We are also developing AI tools to deliver actionable possibilities to physicians. These AI approaches are going to be critical for 21st century medicine.

We also note that many are concerned about the biases in AI. These biases fall into two categories: (i) biases in writing the algorithms and (ii) biases that arise from the data currently lacking adequate representation of non-Caucasian populations. I believe that this latter bias is by far the more serious, so there should be a diversity requirement for the federal funding of further big-data accumulation. We also note that the recruiting of diverse racial populations must be actively aggressive and convincing in order to overcome the too-common lack of trust in government and traditional medicine.

We initiated the Beyond the Human Genome (BHG) project – a million-person precision health project that will take place over 10 years – to offer concrete solutions to the current challenges of healthcare. The BHG project builds on the Human Genome Project to integrate the static genome with the longitudinally measured dynamic phenome. The BHG project will analyze and integrate many different types of phenomic data - blood measures, microbiome, lifestyle tracking, etc. - in order to validate the science of wellness and prevention that will ultimately lead to lowering health care costs. To achieve this, BHG will engage in significant, aggressive recruitment of diverse communities so the data and results are applicable to all Americans and will include business partners to analyze the immense amount of data collected. Because of its significant application to US health care, we are seeking federal funding to support BHG.

Through our many partners, including Google and Deloitte, we have engaged in many efforts related to AI, spanning many industries. AI in healthcare poses a special challenge, especially in the area of "explainability" known as xAI (explanatory artificial intelligence, coined by DARPA) – being able to actually explain *why* an AI algorithm makes the decision it does. While this may not be as critical in other fields, it is a hugely important aspect in clinical applications where human lives are at stake. Clinicians that leverage AI-based tools in making patient-centered decisions need to be able to quickly understand *why* an algorithm is providing them with a certain answer (sometimes referred to as a "white box solution" instead of a "black box solution"). Putting forward resources and focus on this specific area of AI would help researchers bring AI-based clinical tools to market faster.

2. Please describe any legal, policy, technical, or other protections that protects the privacy of personal information used in research conducted by your institution.

   Let us give you a practical example of what we have done. When we set up Arivale, a scientific wellness company that delivered "actionable possibilities" to 5,000 participants, we were very conscious of the imperative of protecting individual patient information. We established the highest state-of-the-art security around this information. Indeed, we hired several firms to determine whether they could break through our precautions – they could not. It is imperative we employ the same type of security for the BHG project.

Personalized medicine, by definition, requires a significant amount of Personal Health Information (PHI) about an individual – medical history, on-going clinical data, and socio-economic/environmental data. We make great efforts to realize the implication of operating on this data and are dedicated to maintaining this privacy through world-class security techniques and cutting-edge practices. We have developed a first-of-its-type data platform that is specifically designed to handle state-of-the-art privacy and security strategies required in today's cyber-connected world.

It may be counter-intuitive, but most algorithms and tools that are developed within our institution and on our data platform do not require identities of individuals to be known. Instead, we operate on large amounts of anonymized, coded, and de-identified data to build large-scale models that allow us to predict and identify current and future medical situations. These models, informed with knowledge derived from thousands of anonymized patients, are then deployed in a "sandbox," a secure environment that touches only the data of a single patient at a time—adhering to the same infrastructure and privacy policies that Electronic Health Records (EHR) do today (like in the hospital or clinic).

Legally, we have strictly structured our business associate's agreements (BAAs), data transfer agreements, and other legal contracts to put patient privacy first, a critical aspect of P4 medicine (medicine that is predictive, preventive, personalized, and participatory). In all cases, we rely on our partners to provide us with anonymized and/or de-identified data. We do not accept PHI that our researchers can use to identify individual patients. We rely on our clinical partners to relay any personalized medical findings that are derived from our research back to patients within the structure of their policies and protections.

a. Do you believe the lack of a comprehensive privacy law reduces the desire of subjects to participate in biomedical research?

   Our experience with the 5,000 Arivale wellness patients was informative. We made a serious effort to educate these patients about the different types of data and their benefits. In the end, however, we had to admit that the two safeguards against discrimination (by insurers or employers), GINA and the Affordable Care Act, failed to provide complete protection against discrimination (for example, long term disability, a critical insurance as we age, was not covered). I believe it is imperative that these gaps be rectified by a law with complete health-care discrimination coverage. We found that between 5 and 10% of the individuals did not want to release their de-identified data for analysis because of their fears of discrimination.

   An individual's definition of privacy is greatly impacted by demographic and socio-economic status, making it a complicated, multi-faceted challenge, especially in the area of regulation. Today, the lack of articulated, clear, and

consistent messaging about the data being collected, why it is being collected, and the implications of the insights derived from data can lead people to be distrustful and confused.

One major step forward in helping people feel good about taking active steps towards participating in biomedical research would be supporting effort around better educating subjects as to the *what* and *why* of the data being collected—and how it can both positively and negatively impact them in the future. We are committed to doing this for the BHG project.

b. Do you believe federal privacy protections need to improve to protect individuals while also enabling medical research?

Protecting privacy at all levels of government is critical to the future of medical research. One thing is clear—the future is personalized medicine. Personalized medicine requires significant amounts of personal information. As such, strict protections regarding personal privacy are required to promote trust in our medical research system, and not just trust from physicians and patients, but from all stakeholders in the system.

3. Do your contractual relationships with Google and Deloitte, which you described in your testimony, limit how those entities can use personal information you provide them? Are those entities and others prohibited from using personal information for their own commercial gain (beyond acting as a service provider to you)?

All data collected by BHG will be owned by the federal government (for the one-million-person project) or by Phenome Health (for smaller projects funded by company partners). The data supported by the federal program will be de-identified and made open and available to all. We are in the process of recruiting partners from across the healthcare spectrum (data generators, Ilumina, Olink, Metabolon, pharma, technology companies, diagnostic companies, medical instrumentation companies, healthcare systems, etc.). Google and Deloitte act as operational partners, providing key support for technology and project management, respectively; no personal identifying information will be shared with Google or Deloitte.

The Honorable Michael C. Burgess, M.D. (R-TX)

1. In the hearing you elaborated on the benefits of integrating more personalized health care into practice. You mentioned the potential precision medicine has in reducing the cost of prescription drugs and treatments for patients by using pharmacogenetics to target the most effective and efficient treatment. How can we encourage greater patient access to precision medicine?

Patients (and their physicians) need to be educated as to the transformational possibilities of precision population health. We are approaching this in several ways.

Building on the importance of P4 medicine (medicine that is predictive, preventive, personalized, and participatory), we initiated the Beyond the Human Genome (BHG) project, a million-person precision health project that will take place over 10 years. Like the successful Human Genome Project, we will be seeking federal funding to support BHG. BHG will integrate the static genome with the longitudinally measured dynamic phenome and will analyze and integrate many different types of phenomic data to validate the science of wellness and prevention that will ultimately lead to lowering health care costs. The more we can predict for a patient, the more precise the medicine, the more opportunity to prevent, and the more participatory patients become.

In addition, I also started a K-12 education program at the Institute for Systems Biology in 2000 that has been remarkably successful. We are now putting together a 20-module, year-long course on P4 medicine. An earlier course we developed on systems biology has now been used in all 50 states and 100 countries—in total, it has reached more than 3 million students. We hope to have the same success with the P4 medicine course.

We have also contracted a film maker to produce a 90-minute documentary film on wellness that will visit "wellness locations" across the world. Further, we have contracted with Scientific American to push the idea of scientific wellness in a number of different contexts. Finally, Nathan Price and I have just finished a book for Harvard University Press on "What 21st Century Medicine Should Be: The Science of Wellness and Prevention". Bringing the science of wellness and prevention to the public is key in this regard.

Participation, including patient and physician education, is one of the biggest challenges we face in our attempts to revolutionize the way medicine is practiced. We and others have demonstrated the incredible value and success of predictive, preventive, and personalized science. We believe that engaging healthcare providers (such as primary care physicians) to deliver actionable interventions directly to patients is key. Thus, we need buy-in from both small and large systems (individual hospitals and large healthcare networks) for a commitment to providing P4 medicine. Pharmacogenetics is ready for use now for several known genes by drug interactions, but health systems have been slow to adopt the approach. Pharmacogenomics (integrating polygenic information into probability of drug response) is advancing to the point of utility in clinical care. Legislation that rewards heath systems for integrating these data-driven approaches, where validated, into quality-based care reimbursement structures would help drive implementation.

a. Do you envision specialists, such as genetic counselors, playing a role in increasing access to these services? If so, how can our health care providers better utilize these specialists?

   We found in Arivale (a scientific wellness company that delivered "actionable possibilities" to 5,000 participants) that wellness coaches versed in data-driven medicine, the optimization of lifestyle, and psychology ensured a very high

patient response to their actionable possibilities. A good coach could manage perhaps 100 individuals. Obviously, this will not scale to a million or eventually 340 million US citizens. We are beginning to explore—with several companies—the possibility of developing personal avatars that will eventually take the place of the coaches. In the meantime, genetic counselors and others could play a very important role in facilitating personalized medicine.

A related approach will be to develop an AI-based system to the delivery of actionable possibilities to physicians (and their patients). This delivery needs to provide the science rationale for the physician and then provide clear and concise summaries of the diagnostic and therapeutic possibilities (both for wellness and disease). Humans are complex organisms, and their wellness and disease related needs are also complex, so AI will be essential in this delivery process of actionable possibilities.

The key in delivering P4 medicine is not to replace clinicians; rather, it is to provide clinicians with data-driven knowledge that aids in the clinical decision-making process, whether it be for diagnosis or treatment of disease. This vision requires a deeper interdisciplinary approach which will indeed include specialists to help educate clinicians. Genetic counselors are one such specialization that will find increased opportunity in the P4 medicine era. However, other entirely new medical and health care disciplines will likely emerge with the coming paradigm shift.

The Honorable Richard Hudson (R-NC)

1. Public engagement, understanding, and meeting the public's needs is key to optimizing the impact of biomedical research in our communities. How can we best communicate and engage with the public as to the outcomes and impact of biomedical research on their day-to-day lives? In this communication and engagement, how do we best minimize misinformation and maximize public trust? If applicable, please explain the strategies and tactics your organization or entity are utilizing to best communicate and engage with the public with regards to your biomedical research work.

   Patients (and their physicians) need to be educated as to the transformational possibilities of precision population health. We are approaching this in several ways.

   First, I started a K-12 education program at the Institute for Systems Biology in 2000 that has been remarkably successful. We are now putting together a 20-module, year-long course on P4 medicine (medicine that is predictive, preventive, personalized, and participatory). An earlier course we developed on systems biology has now been used in all 50 states and 100 countries—in total, it has reached more than 3 million students. We hope to have the same success with the P4 medicine course.

   Second, we have contracted a film maker to make a 90-minute documentary film on wellness that will visit "wellness locations" across the world. Third, we have contracted with

Scientific American to push the idea of scientific wellness in several different contexts. Fourth, Nathan Price and I have just finished a book for Harvard University Press on "What 21st Century Medicine Should Be: The Science of Wellness and Prevention". Bringing the science of wellness and prevention to the public is key in this regard.

Fifth, in Seattle we have utilized our Town Hall as a public forum where relevant science can be discussed with lay audiences. Over the years we have discussed P4 medicine, Arivale (a scientific wellness company that delivered "actionable possibilities" to 5,000 participants) and Scientific Wellness, the one-million-person genome/phenome project (Beyond the Human Genome), etc. We will expand this program in the future. Sixth, we are exploring with several medical schools the possibility of helping them establish a course on precision population health that will take us right into the essence of P4 medicine. Seventh, we are working with the Seattle Science Foundation to create short and longer videos on various aspects of P4 medicine, precision population health, definitions of genome and phenome, etc. The Seattle Science Foundation is a physician education organization with very sophisticated communication equipment and an audience of more than 3 million physicians.

These are the efforts we have in progress with others on the drawing board. We understand that engaging the public and the health system is of paramount importance and are committed to doing so.

2. Public-private partnerships are a critical part of ensuring translational biomedical research continues to progress and achieve success. How can we better foster innovative public-private partnerships to maximize such progress and success? If applicable, please explain how your organization or entity is approaching the development and furthering of public-private partnerships.

   We fully subscribe to the idea of developing and fostering public-private partnerships. We created Phenome Health as a 501(c)3 organization to drive the Beyond the Human Genome (BHG) project and, specifically, to create public-private partnerships.

   By way of background, we initiated the Beyond the Human Genome (BHG) project—a million-person precision health project that will take place over 10 years. Like the successful Human Genome Project, we will be seeking federal funding to support BHG. The goal of BHG is to utilize the million-person data to demonstrate that we can strikingly improve human health through scientific wellness, facilitate healthy aging so that most of us will move into our 90s or 100s mentally agile and physically functional, assist patients in avoiding chronic disease by early detection and reversal, and effect striking cost savings, for example, by identifying biomarkers that will identify patients that will respond to particular drugs.

   Our public-private partnership falls into two categories—those that will help us carry out the BHG project and those that will bring technologies, clinical challenges, computation tools and differing point of view on how our data should be analyzed. In the first category is Guardian Research Network, a non-profit that has relationships with 120 hospitals with 30 million patients whose electronic health records (EHRs) are now available. Many of these are

"sticky patients" (those that stay with the system a lifetime) and includes a population with great racial diversity. Another partner, Posit, a for-profit corporation, will provide the digital brain measurement to optimize cognitive brain health. The Institute for Systems Biology (ISB) will provide expertise in systems biology, knowledge graphs, digital twin methods and in analyzing EHRs. Bioanalytica, a for-profit, will generate the genome/phenome data. Technicity, another for-profit corporation, is aiding us in building the latest up-to-date computational platform for muti-omic data analysis.

In the second category we have Deloitte, a consulting and management firm, that will help us recruit partners from across the entire healthcare spectrum. They have already made an invaluable connection to Google that will enormously enrich our computational infrastructure (Search, Digital Health, Cloud, and hyperscale AI). We have several other companies that are very interested, and we ultimately expect to have 10-15 partners spanning the entire healthcare spectrum. This will create a public-private open ecosystem for data and technology exchange that will benefit the entire healthcare systems with an underlying effective, scalable and sustainable model for transforming healthcare from its current disease-care to a wellness-care system

3. How can stakeholders – participants, patients, researchers, and providers – best work with state and local public health departments, as well as our communities, to maximize the public health impact and outcomes of biomedical research?

   I believe the key to working with local and state health departments as well as communities is critical to what 21st century health care should be. In my view, that should be the data-driven assessment and optimization of the health trajectory of each individual for body and brain health. BHG will develop the infrastructure for executing this vision. BHG will be a 10-year demonstration project to develop the technical, computational and clinical tools necessary to establish the power of this vision. It will allow us to demonstrate in a compelling way the science of wellness and prevention. It will allow us to assess the enormous improvements in wellness that this approach will bring while at the same time giving us an accounting of the striking cost savings that will result. We will be able to optimize individual wellness, to identify and reverse wellness-to-disease transitions at their earliest stages, and to apply precision medicine with data-driven approaches more effectively to managing disease. This project will convince patients, researchers, providers, payers, etc. at a local level about the power of this wellness-driven healthcare.

   In the current status quo, it takes over a decade for biomedical research to reach clinical practice or impact public policy.[4] This is far too long. The vision of the BHG project is to create a massive knowledge base that will drive a learning health care system to create rapid innovations and implement in much shorter time frames.

[4] https://aacnjournals.org/ajcconline/article/25/3/194/3121/Narrowing-the-17-Year-Research-to-Practice-Gap