The Johns Hopkins Vision for Personalized Medicine

Every living thing on Earth is built from an instruction manual — an organism’s DNA — that is found in our cells. The complete set of instructions as to how we function is called our genome. It is your blueprint and the key to understanding your unique biological make up. Since there is no one else like you, we believe that if we can encode your biological blueprint, we can tailor therapy that is individualized to you. Our ultimate goal is to prevent disease from occurring in your body before it happens. While others have expressed skepticism about the impact of the genomic revolution on the treatment and prevention of disease,¹ our approach offers a unique synthesis of genetics and clinical translational science in ways that will improve treatment outcomes and lead to improved strategies for disease prevention. Our contributions begin in the area of personalized medicine but will lead to the development of the field of individualized health.

What is Personalized Medicine and How will it Change Health Care?

Healthcare providers have long known that no two patients experience the same disease in the same way — the age at which the disease begins, the speed at which the disease progresses, its severity, and how each patient’s body responds to treatment all differ based on the individual. Some of these differences can be explained by environmental factors, such as if a person smoked; but, from the beginning of the 20th century, it has been clear that a person’s genetic makeup is a major contributor to the life cycle of his/her disease, from how and when it is acquired to how the body reacts to the disease and treatment.

Something as simple as a blood sample can reveal a person’s genetic makeup. By integrating this genetic information with other important health data, such as a person’s complete health history and profile, practitioners hope to eliminate the “best guess” or “trial and error” practice of medicine. The goal is to make health care decisions based on the individual — this is called Personalized Medicine.

This concept is revolutionary and is shifting the practice of medicine to a new 21st Century model, where health care providers will aim to prevent disease before it begins — helping people live longer, healthier lives.

Johns Hopkins and Personalized Medicine

Personalized medicine promises to increase the quality of health care and to decrease the burden of disease. One example is that genetic information will be used to improve drug development — bringing more efficient and less toxic drugs to patients faster. Furthermore, to help healthcare providers make effective and safe clinical decisions, central to a Personalized Medicine approach is the creation of a comprehensive electronic health record (EHR) for each person, which will include genetic information. EHRs will be coupled with other databases, such as tumor registries, high-risk cancer genetic registries, and family, environmental, social, cultural, and health care delivery data, in order to inform better health care decisions from both the patient and practitioner viewpoints.

Understanding people’s genetic differences can lead to individualized methods of preventing, diagnosing, and treating complex diseases — such as cancer, diabetes, heart disease and obesity. The challenge is that people are genetically very similar and the key is discovering the small genetic differences that drastically impact how people respond to treatments or determine whether or not a person will get a disease. Johns Hopkins has the expertise in disease diagnosis and classification, a strong tradition of translational research, and is a pioneer in genetics, which makes the institution the place to address this challenge and, in turn, to transform medicine.

In the next ten years, Hopkins aims to initiate a comprehensive program in Personalized Medicine, starting with a focus on cancer. Cancers are diseases of acquired defects in genes (genetics) and gene function (epigenetics) that drive malignant cells to grow uncontrollably, invade healthy tissues and organs, and spread throughout the body. Cancer is the first complex disease to be addressed by the Hopkins Personalized Medicine program because it is highly linked to genetics and because it has a large impact on the community, with 50 percent of men and 33 percent of women in the United States developing cancer in their lifetimes. It also has skyrocketing costs — America spends more than $200 Billion each year on cancer care.

One of the reasons Hopkins will be the leader in Personalized Medicine is the ease with which Hopkins can integrate the strengths of its schools, divisions, centers, and hospital — all of which share one vision.

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Members of the Johns Hopkins Personalized Medicine Team

- Applied Physics Laboratory
- Berman Institute of Bioethics
- Bloomberg School of Public Health
- Krieger School of Arts and Sciences
- Johns Hopkins Center for Computational Genomics
- Johns Hopkins Departments of Medicine, Surgery, Pediatrics, Psychiatry, Neurology, Otolaryngology, Biostatistics, Oncology, Pharmacology, Ophthalmology, Molecular Biology & Genetics
- McKusick Nathans Institute of Genetic Medicine
- Sidney Kimmel Comprehensive Cancer Center
- School of Medicine
- Whiting School of Engineering

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Johns Hopkins clinicians and researchers are developing new tools to translate health and genetic information into better care options.
In the years to come, Hopkins researchers, clinicians, and faculty will come together to develop new technology and systems to appropriately use genetic information to individualize health care; specifically, they will:

1. Develop genetic-based diagnostic tests for diseases at early stages when they are treatable by surgical or other existing therapies.
2. Improve patient outcomes by tailoring the application of existing therapies to the patients who, based on their genetic makeup and other individual characteristics, will benefit most.
3. Develop novel therapies based upon genetic information that contribute to disease initiation and promotion.
4. Create a genetic database, an invaluable, long-term health data resource comprised of patients’ biological samples, clinical data, and images, to formulate and test large-scale hypotheses.
5. Develop preventative strategies based upon the genetically-related susceptibility of individuals to diseases and, in so doing, decrease the incidence of these diseases.
6. Apply findings to patient populations across the region, nation and globe, through our expertise in epidemiology and public health.

In summary, Johns Hopkins will pioneer the development of the field of individualized health. The diagnosis and treatment of diseases as well as, ultimately, the prevention of these diseases will be advanced through innovative and integrative analyses of genetic information, clinical data, and medical images. Longitudinal follow-up of individual patients and populations will identify the best strategies for treatment and prevention of diseases.