

# Precision Medicine 101

BY MARK KAUFMANN, MD

There's a revolution taking place in medicine, and it holds the potential to change everything from how we approach prevention and diagnosis to the treatment of many common disease entities.

The zeitgeist of which I speak, precision medicine, comprises a new way of caring for our patients. It would eliminate much of the trial and error involved in risk assessment and therapeutic choices largely by analyzing genomic profiles along with environmental and lifestyle factors, and it stands in stark contrast to the "one-size-fits-all" approach to care and counsel that most of us were schooled in. It's so different that the recently launched *JAMA Insights: Genomics and Precision Health* aims to help us nongeneticists better understand the power and potential of precision medicine.

This new way of thinking about medicine has sired a whole new vocabulary. The best way to get a handle on what precision medicine may mean to the future of health care is to get the often confusing vernacular down cold.

**Big data:** Large data sets often generated through precision medicine, genomics, and population health.

**Gene editing:** The process by which DNA is inserted, deleted, or replaced in the genome to prevent or treat disease. CRISPR-Cas9 is a gene-editing tool that is currently creating buzz.

**Genome sequencing:** This is the decoding of what makes you...well, you. It assesses the status of all of your genes at one time, not just the variants.

**Genomic medicine:** The incorporation of a patient's genomic information as part of their clinical care.

**Genotyping:** The process of determining which genetic variants an individual possesses. The personal genomics and biotech company 23andMe uses genotyping, not genome sequencing, to analyze DNA.

**Patient-powered research:** Research based on and around our patients and their unique genetic makeup along with environmental factors and their lifestyle choices. One such effort, the All of Us Research Program (formerly known as the Precision Medicine Initiative or PMI) at the National Institutes of Health seeks to enroll one million Americans "from all walks of life and parts of the country" to gain insights into the ways genomics vary across diverse patient populations. Other big-ticket initiatives include the Cancer Moonshot and the Million Veterans Program.

**Pharmacogenomics:** The study of how genes affect a person's response to drugs. This is one of the foundations of precision medicine. For example, about half of all melanomas have

changes in the BRAF gene. Doctors can now test tumors to see if they express BRAF mutations before prescribing the expensive therapies that only work against BRAF tumors.

**Population health:** "The health outcomes of a group of individuals, including the distribution of such outcomes within the group." First defined in 2003 by scholars David Kindig, MD, PhD, and Greg Stoddart, PhD, it is used much more frequently today. It has evolved as a concept and sired other terms such as population health management and population medicine.

**Population screening:** The process of assessing the prevalence of a particular trait in the entire population or in a subgroup of the population. Major private health care systems now have large ongoing population screening initiatives.

**Precision medicine:** An emerging approach (once referred to as personalized medicine) to disease treatment and prevention that takes into account individual variability in genes, environment, and lifestyle factors. The federal Centers for Disease Control and Prevention defines the concept for laymen as "finding your unique disease risks and treatments that will work best for you." Precision medicine is already in play for many diseases including melanoma. Metastatic melanoma patients often undergo molecular testing to help doctors select the most appropriate treatments for their cancer.

## SO NOW WHAT?

The real question, of course, is how do we get from point A (accumulating all of this intel) to Point B (using it in a cost-effective and clinically relevant manner). We have a long way to go. We don't have the IT infrastructure to support such big data. Electronic health records are lagging in their ability to handle this type of information, and interoperability, needed to share data, is still a bit of a pipe dream. Another stealthy roadblock is the sky-high costs of precision drugs, and many doctors remain skeptical about this new way of doing things.

It's an exciting time for physicians and patients as technology is changing rapidly, and we are likely on the brink of something great. I, for one, am excited to see how this all evolves, and optimistic about the many ways that precision medicine will affect the quality of care and counsel we can offer our patients. ■

Mark D. Kaufmann, MD is an associate Clinical Professor of Dermatology, Dept. of Dermatology at the Icahn School of Medicine at Mount Sinai in New York City.

