UCSF
University of California
San Francisco

Precision Medicine

Transforming the Future of Health

Precision medicine is an emerging field that will harness vast amounts of molecular, clinical, environmental and epidemiological data, so called “big data”, to better understand disease and ultimately transform the future of health.

Finding Patterns in Health

Today, medicine is “one-size-fits-all.” If you develop a chronic condition such as diabetes, your doctor will prescribe a drug that treats your symptoms. But drugs are developed based on what works best, with the fewest side effects, for the most people. So we don’t know whether it will work for you or what side effects you might have. And if it works for you, or doesn’t, there’s no way for your health provider to share that information with researchers or clinicians, to help other patients like you.

Each of us has a unique genetic, social and environmental background that affects our health. We have the ability now to collect a huge amount of that information from a variety of sources – from zip codes to health records, to mobile devices like pedometers and iPhones.

If we could collect this data on millions of people and pool it together in a data network, we could mine it to find the patterns that lead to individual diseases. That, in turn, will let us predict who is at risk for those diseases, devise strategies to prevent them and develop precise drugs to treat them.

Think of it as a Google Map of health. In Google Maps, they start with a map of an area and layer it with weather conditions, traffic flow and real-time phone data to recommend your best route. Like the Google Map, we need to build a knowledge network based on layers of information, so we can find patterns in health and use them to help patients worldwide.

What’s the Difference?

Personalized Medicine uses genetic and molecular understanding of disease to provide personalized therapies to individual patients for their specific conditions. Personalized medicine is already in use in a few situations, primarily oncology, such as in medications specifically designed to treat Her2-positive breast cancer, or in immunotherapy that uses an individual’s own tumor markers to develop a therapy specific to their form of cancer.

Precision Medicine is much broader and aims to transform medicine as we know it. It intends to harness the power of technology, global biomedical research, imaging data and each individual patient’s health histories, to learn enough about diseases and their subsets that we can create preventive and personalized care for patients worldwide.

Precision medicine is:

- Personal, using our personal health histories to identify whether we’re at risk for disease, and customize our health care to our individual needs.
- Predictive, comparing our personal background and genetics against global data, to help predict our risks.
- Preventive, using those predictions to focus interventions where they matter most.
- Precise, using new tools and biomarkers to precisely diagnose disease and develop targeted therapies that reach the right people, in the right dose, at the right time.

Precision Medicine at UCSF

UCSF has been at the forefront of the emerging field of precision medicine, ranging from basic research to pioneering clinical care and national leadership. The following are some of the many projects currently on campus:

- UCSF has developed a cloud-based software platform that significantly advances precision medicine for cancer. Built in partnership with Palo Alto-based Syapse, the system seamlessly integrates genomic testing and analysis, personalized treatments, and clinical and outcomes data directly into UCSF's Electronic Health Record (EHR) system. The result is a user-friendly report that enables clinicians to understand a patient's clinical history, receive guidance based on UCSF's best practices, query for information on other UCSF patient outcomes and, ultimately, provide better care for our patients.

- The UCSF/Kaiser Permanente Research Program on Genes, Environment and Health (RPGEH) has assembled the world's largest and most diverse research repository of genetic and health data, linking genetic samples from more than 100,000 volunteers to decades of health records, environmental exposures, medication responses and longevity markers. The data, which is now available to researchers worldwide through the National Institutes of Health, includes more than 70 billion genotypes, and the results of 1 million cholesterol tests, 30,000 mammograms, 60,000 EKGs and thousands of cancer diagnoses and therapies.

- An international epilepsy project is harnessing large-scale health data, collected across a broad team, to understand and treat the multiple forms of this devastating disorder. The two-pronged project, known as EPGP (led by UCSF) and Epi4K (led by Duke University), involves nearly 150 scientists in more than 40 institutions, as well as more than 4,000 patients, and already has yielded promising results.

- The Health eHeart study is using common mobile health apps on smart phones and other devices to gather daily health and lifestyle data on more than 1 million patients worldwide. These data are being combined with environmental factors, self-reported and clinical health data, and other tools to enrich our understanding of the basis of cardiovascular health and disease, and how it progresses on daily, hourly and individual level.

- An unprecedented new research initiative in Traumatic Brain Injury is bringing together leading academic clinician-scientists with innovative industry leaders in biotechnology and imaging technology, as well as patient advocacy organizations and philanthropies, to improve clinical trials and, ultimately, treatments. Launched in October 2014 through the Department of Defense and led by researchers at UCSF, the project will use data from imaging, lab tests and clinical results to create a massive national dataset that sheds light on TBI causes in a way never before possible.

A Golden Opportunity for California

California has a rich history of leading innovation and setting new standards for the world. It has the talent, the entrepreneurial spirit and the ability to question things other people take for granted. That is what has made this state a world leader in innovation and technology.

Take Silicon Valley, or stem cell research, or biotechnology. California is world-renowned for its role in creating the computer industry and can rightly claim a place in biomedical research history for its discoveries and investments in stem cells and biotechnology. Each has had an enormous impact on our economy, generating dozens of companies thousands of jobs, and hundreds of millions of dollars in new tax revenues.

Biotechnology was created right here, based on research at UCSF and Stanford University. Both of the first two biotech companies – Genentech and Chiron – had their origins at UCSF. Today, the University of California leads the nation in academic biotech patents, while the state boasts six of America's 12 top-performing biotechnology regions; no other state has more than one city on that list.

In each case, by investing early, California created industries that have transformed the state and the world. The number of companies and advances those have generated is enormous, providing an estimated $3.20 in economic benefit for every dollar spent, and is the envy of every state in the nation.

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