

CENTER FOR PRECISION HEALTH AND INTEGRATED DIAGNOSTICS AT STANFORD

# THE PHIND VISION

PREDICT. DETECT. CURE. PRECISELY!

**“If only they’d caught it sooner.”** We’ve all said or heard this said about someone we love. A best friend battling late-stage cancer. A teenager who takes their own life. Or a brilliant parent abruptly silenced by a stroke.

## **Heartbreaking outcomes like these could be avoided**

if we had more warning. But we rarely do, and by the time symptoms appear, it’s often too late. On average, Americans go to the doctor a few times a year at best, and early disease detection depends on annual screenings that are usually given to patients based only on age and family history. There simply isn’t enough information, and it’s gathered too infrequently to reliably catch illnesses before they result in serious damage or death. Worse, both our health care and research infrastructure are built around treating people after they’re sick, not keeping them healthy in the first place.

## **The Precision Health and Integrated Diagnostics Center**

at Stanford (PHIND)—the first and only center of its kind in the world—is working to transform the practice of medicine with a more proactive approach. Our mission is to find ways to stop disease before it starts—and give everyone a chance at a long and healthy life. Unlike the rapidly growing practice of *precision medicine*, which is focused on using the latest science and technology to tailor treatments after disease has struck, *precision health* is focused on pinpointing the biological changes that mark the earliest transitions from health to disease and developing approaches so we can intervene before it’s too late.

**To stop disease before it starts,** we need to understand how it starts. Zeroing in on the precise tipping points that mark the transitions between disease and health, PHIND researchers are investigating changes down to the molecular level, searching for biological signals (called

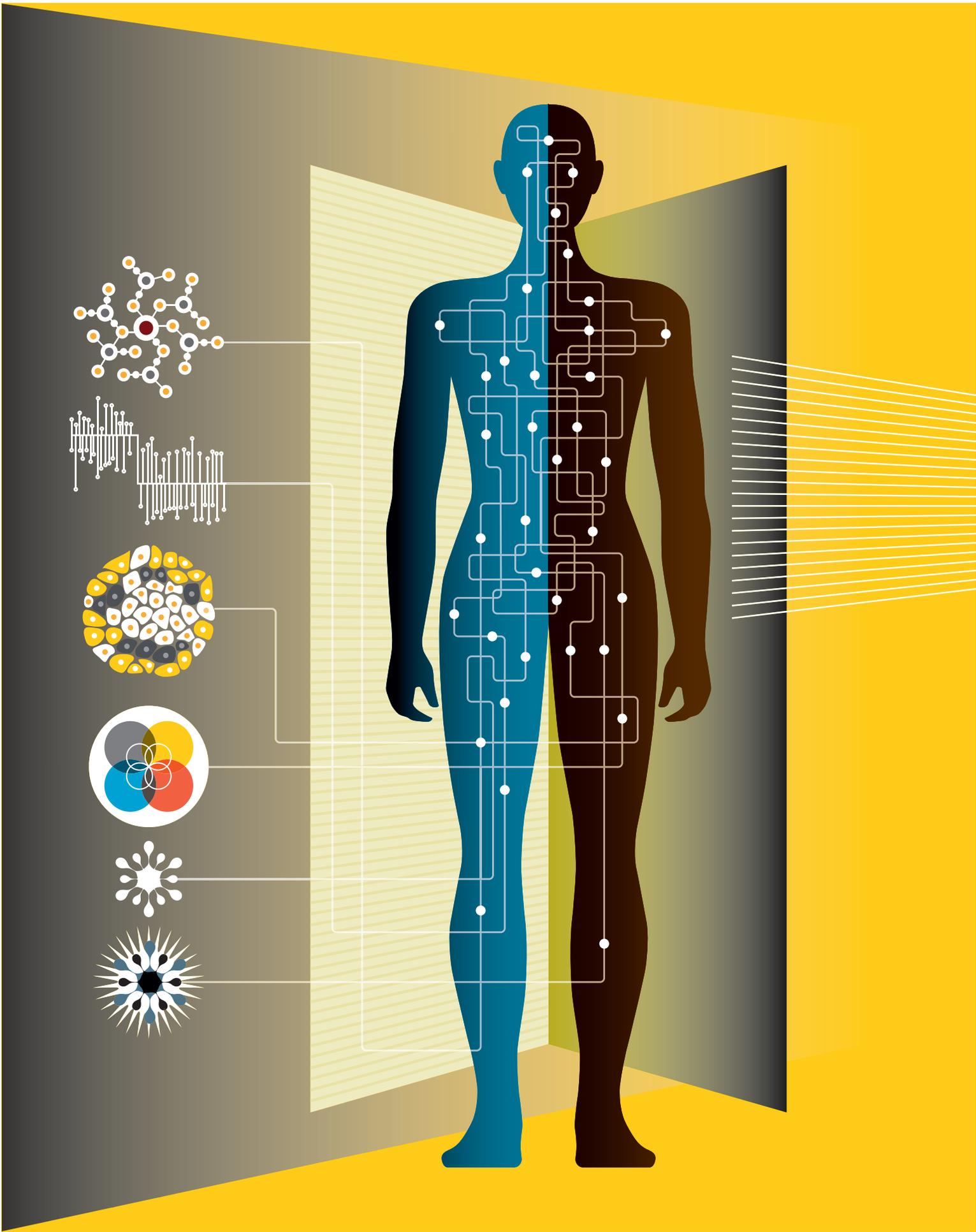
biomarkers) that announce the earliest pathological changes to tissues and organs before damage becomes irreversible—or better yet, before it even takes place. Defined as measurable indicators of some biological state or condition, biomarkers can take many forms. They can be molecular, physiological, image-based, and even behavioral—and they can tell us if a disease is present as well as if a health condition may occur in the future.

## **Once we find the right biomarkers, we can invent new sensing technologies**

that monitor for them on an ongoing basis. Non-invasive sensors on, in, and around you can provide an early warning system to alert you and your doctor as soon as there’s even a hint of a problem. Embedded in your clothes, home, car, and even your body, they’ll keep constant watch on your health without you even noticing they’re there.

**We also need new information technologies** that can analyze and integrate the signals we gather from multiple sources and across extended time periods for every individual. The goal is to create a complete and constantly updated “dashboard” of your health so you and your doctor can better predict and prevent illnesses or at least detect them sooner.

**Finally, we must make this approach accessible** to everyone. That means conducting careful economic analyses to ensure PHIND innovations are reducing health care costs and putting systems in place to protect patient privacy. It also means testing PHIND innovations in our world-class adult and children’s hospitals and clinics and forging new start-ups and partnerships with Silicon Valley to make these revolutionary advances available to patients around the world.



# PHIND PROJECTS

## A SAMPLING OF INNOVATIONS IN PRECISION HEALTH

### **Detecting Cancer Sooner with Liquid Biopsies**

Stanford researchers recently discovered that many cancers metastasize (spread to other parts of the body) long before the initial tumor is big enough to be detected by conventional methods. Because these metastatic cancers are so aggressive and lethal, PHIND is funding those same researchers to develop a blood test that detects cancer, and also reveals where it came from in the body and if it's about to invade other organ systems. All tumor cells, even in their earliest stages, shed fragments of DNA into the bloodstream. Called cell-free DNA, these snippets of genetic information can be collected in a blood draw and analyzed with advanced gene sequencing technologies to determine both the genetic sequence of a given tumor and its epigenetic signature, which can tell us how aggressive a malignancy is and where in the body it started. Ultimately this technology could be incorporated into everyone's routine annual checkup as a fast and inexpensive screening tool against some of the deadliest cancers.

### **Predicting Teen Depression and Suicide**

For the past five years, Stanford researchers have been conducting a comprehensive assessment of the mental health of more than 200 at-risk boys and girls from late childhood to early adolescence. Their cortisol levels; hormone levels; and brain structure, function, and connectivity were also measured. Now, as these children move into the higher-risk years of adolescence, researchers are using PHIND funding to expand the study and assess immune function, which has been linked to depression in adults. They're also assessing sleep and mobility via smart watches and mood and social behavior via a smartphone app. The objective of the project is to apply machine learning and other AI analytics to all these data in order to create a risk calculator so we can predict teen depression and suicide and intervene before it's too late.

### **Preventing Type 2 Diabetes**

Nine out of ten people who are prediabetic don't know it, and 70 percent of prediabetics will become diabetic. PHIND researchers are studying 100 people, all considered healthy

but potentially prediabetic. Each participant is monitored 24/7 by a device that monitors blood glucose levels, and samples are taken of each participant's microbiome (the bacterial community that resides in our gut) and metabolome (the collection of molecules produced during metabolism). The researchers are looking for "spikers," people whose blood glucose shoots up after they eat carbohydrates. These sharp increases are a telltale sign of diabetes, and it turns out that different people spike due to different things (e.g., bananas, rice, etc.). The project's ultimate goal is to compile all of this information—glucose readings, microbiome, and metabolome profiles—and use machine learning to predict who's at high risk for diabetes and prescribe precision diets to prevent its onset.

### **Going Beyond Glucose Monitoring**

Many diseases, and many chronic conditions, have early identifiable signals that often go unnoticed or unmeasured. Our ultimate objective is to develop convenient, cost-effective, frequent or real-time molecular analysis approaches that avoid the limitations of blood draws. We want to replace the syringe, and the associated complexities of the blood coagulation cascade, with minimally invasive, pain- and anxiety-free 3D-printed microarray patches on the skin to allow for molecular-level monitoring of interstitial fluid. We propose developing patches that can—enabled by geometries and functionality that heretofore have been impossible to achieve—collect miniscule amounts of interstitial fluid transdermally in a convenient and pain-free manner. Because this fluid has essentially all the molecules that are found in blood (which is not true for urine, sweat, and tears), we believe success in interstitial fluid sampling approaches will usher in a new era of routine and frequent molecular level check-ups. The ease of interstitial fluid sampling we believe we will be able to achieve will open the door to the identification of new indicators of health and disease, which lies at the heart of the future of precision health. This is important because longitudinal analysis of both known and unattributed biomarkers is necessary to deliver breakthroughs in the diagnosis, treatment, and prevention of cancer, mental illness, metabolic disease (diabetes), and cardio- and neurovascular diseases.

# JOIN US

*Help us create the future of Precision Health by supporting interdisciplinary research that is discovering ways to proactively prevent disease or detect it early when treatments are most successful.*

## **Why Stanford?**

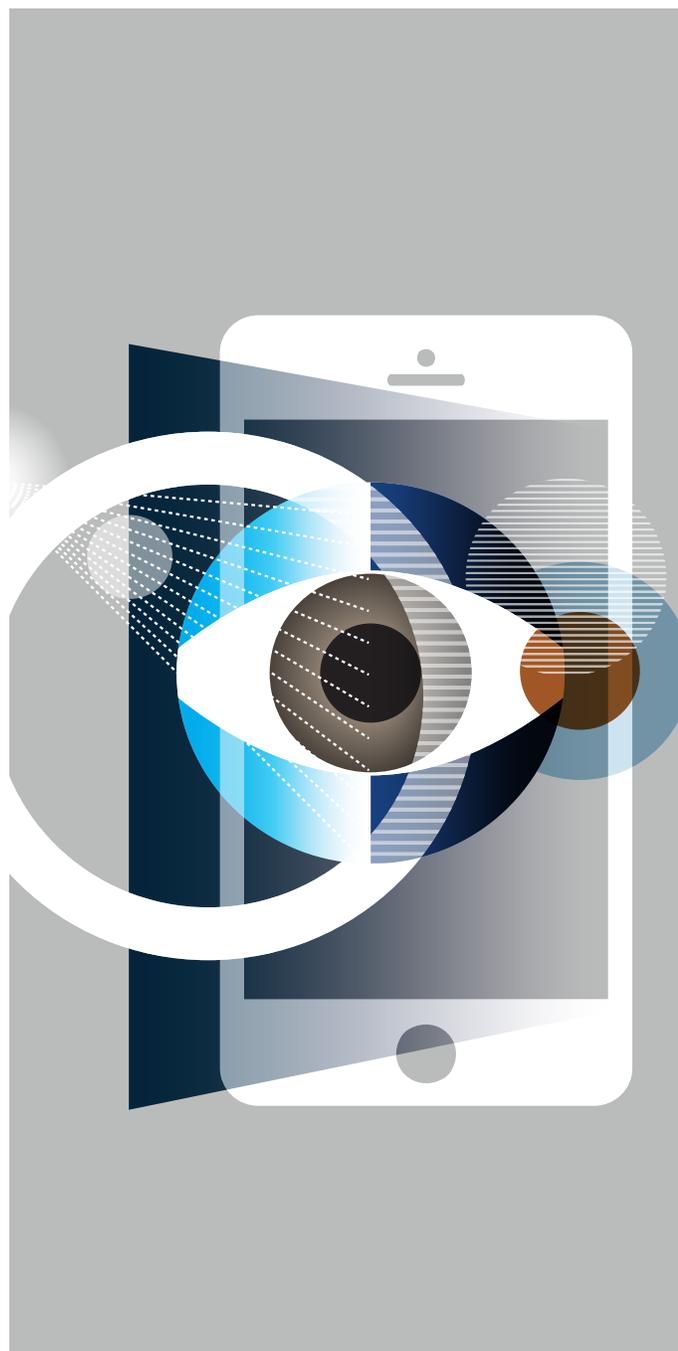
Stanford has long been a leader in mobilizing researchers across disciplines to solve challenging problems. Our small campus, and two hospitals, allows scientists, students, and clinicians from different disciplines to more easily share ideas and collaborate.

Precision Health is the 21st century's new frontier for medicine and health. Our goal is to fundamentally shift the practice of medicine from reacting after disease sets in to proactively predicting and preventing disease altogether. The PHIND Center is engaging Stanford scientists and Silicon Valley to tackle the future of health and wellness. Its Dream Team program is bringing together multiple labs to pursue major research questions, and its Seed Grant program is funding early-stage ideas.

## **Your Support Makes a Difference**

Groundbreaking initiatives like PHIND rely on the philanthropic support of partners who believe in pursuing a bold new vision. Your support has the potential to power discoveries and breakthroughs in precision health that will help patients and their families globally.

Kindly consider becoming one of our partners to help realize this vision of Precision Health. You may support the overall program with a gift to the Director's Fund, or direct your philanthropy to specific initiatives such as Dream Team awards, faculty, and post-doctoral support.



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