A Unified Physics?

New Efforts to Unite Quantum Mechanics with Einstein’s Relativity
BLOOD TESTS FOR MENTAL ILLNESS

Levels of particular proteins could offer a new way to diagnose schizophrenia and depression

Sahina Bebe wants to change the way psychiatrists diagnose mental disorders. She has spent the past 15 years probing the blood and brains of patients with schizophrenia and bipolar disorder (in which someone's moods oscillate between mania and depression), searching for proteins that signal a person's likelihood of developing these conditions. The molecules, known as biomarkers, promise a more objective way to identify mental illnesses than the usual approach—testing diagnoses based largely on patients' self-reported behaviors.

Although biomarkers have improved diagnostic methods for many illnesses—among them diabetes and heart disease—they have not, so far, proven as helpful for psychiatric diseases. Still, Bebe, who heads a laboratory at the University of Cambridge, and a few other neuroscientists are convinced that biomarkers will soon become an indispensable component of psychiatry's tool set. Two blood tests—one of which is based on Bebe's research—are already commercially available.

In 1997 Bebe began looking at brain tissue that had been preserved from schizophrenic men and women who had died. She found that, compared with brain tissue from healthy people, the specimens had examined turned out unusually high levels of at least 50 proteins. Nineteen of the proteins were involved in the operation of mitochondria—the tiny, energy-producing organelles in cells. Bebe also found evidence that the neurons of schizophrenics could not use glucose efficiently, relying on a different molecule—lactate—as an alternative source of energy.

By 2006 Bebe and his colleagues had pinpointed the increase in their original blood samples to a chemical difference in the cerebral spinal fluid and blood of living people with schizophrenia. In two of her most recent investigations, she distinguished schizophrenic patients from healthy patients with around 80 percent accuracy by examining levels of 51 proteins in the blood. This group of biomarkers includes the stress hormone cortisol and a protein known as brain-derived neurotrophic factor (BDNF), which encourages the growth of new neurons, as well as the establishment of new connections between existing neurons.

Based on Bebe's research, the Austin, Tex.-based laboratory Myriad Genetics has developed a $2,500 blood test for schizophrenia called VeriPsych, which measures the amounts of the various proteins that she has identified. Although the test has not received approval from the U.S. Food and Drug Administration, psychiatrists are allowed to use it in part of their practices. (VeriPsych is a single test that is not to be FDA-approved as long as they meet rigorous standards for use in people.)

Similarly, San Diego–based Ridge Diagnostics has developed a biomarker test for depression that the company provides through a North Carolina lab for $2,500. Myriad, as the test is called (HSD stands for "heightened depressive disorder"), searches the blood for 60 biomarkers, including BDNF and cortisol. Researchers have not yet validated these blood tests in clinical trials—except for small studies funded by the companies themselves. Still, a few psychiatrists have found the tests helpful in distinguishing schizophrenia from a temporary drug-induced psychosis or in helping depressed patients accept the reality of their condition and the need for treatment.

SMART IMPLANTABLE DEVICES

New wireless monitors warn patients of an impending heart attack or help them to manage diabetes

Biomedical engineers are developing tiny, implantable devices that could one day alleviate some of the gueswork out of how best to treat patients with chronic conditions such as heart disease or diabetes. Several such devices—which send data wirelessly from any region of the body or the blood to external receivers—are now being tested in the clinic. Eventually, implanted monitors could play a more active role in treatment, not merely detecting dangerous arrhythmias, for example, but also jarring a stopped heart back to life. A couple of the innovations that are being developed target two of the most common medical problems:

Heart attacks. Manufactured by Angel Medical Systems in Shelbyville, N.Y., the Angelic Guardian implant is roughly the size of a pacemaker and tracks the heart, beat by beat. It is tuned to listen for abnormal patterns, such as a rapid increase in timing or an irregular pulse in people who have recently survived a heart attack (making them at risk for another) but who do not qualify for a pacemaker or implanted cardiac defibrillator. If the device senses another impending attack, it wirelessly and causes an external device to beep and flash, alerting the patient or others to get help. To prevent false alarms, the Guardian needs to detect a problem signal for more than a minute before it sends an alert. These and other cardiac details gleaned from the device can be downloaded wirelessly to a computer for analysis. Angel Medical has licensed its heart-rate-detection technology to a company that makes implanted cardiac defibrillators. The combined technology will allow the device to administer an electric current to the heart if the monitor picks up signs of cardiac arrest or a particularly dangerous arrhythmia, while also sending electrocardiogram results to a physician.

Abnormal glucose levels. A new implantable glucose sensor made by GlySens in San Diego might one day offer millions of diabetics a wireless monitoring system of their own. The device takes near-continuous readings under the skin of a patient's glucose level—which is then combined to the level in the blood. The result for more accurate and more complete information for guiding insulin dosing and timing than can be achieved by testing blood from finger pricks. And because the sensor is implanted, it requires less upkeep than current external monitors.

"We want to give the patient and the family a device where they can forget about the device and just have the information," says Joseph Luciano, a biotechnologist who is also president and chief executive officer of GlySens. "Treatment of diabe tes and many other chronic diseases is all about monitoring, recognizing and optimizing patterns of signals," he adds. So having a wireless link that delivers "large volumes of data at minimal cost can really enable a lot of things that we probably can't even anticipate."

Wireless sensors are likely to be even more subtle in the future. Researchers have developed a thin, flexible instrument that can be applied like a temporary tattoo to skin or inside the body and can collect readings on heart rate, muscle contractions and even brain waves. Being developed by nClx, a company in Cambridge, Mass., that creates flexible electronics, the futuristic circuit is on its way to being completely portable—with an internal power supply and a wireless transmitter. In all likelihood, the combination of wireless monitoring of internal organs with flexible, form-fitting technology will soon give patients and doctors instantaneous information about a wide range of chronic conditions that have long been difficult to manage.

—K.H.