Lab Manager®
Run Your Lab Like a Business

February 2015
(Circulation: 33,597)

How Single Molecule Measurement Works
By Quanterix

Problem: The human genome encodes thousands of secreted proteins, each of which is an actor in the delicate biochemical balance of diagnostics. Even a slight change in any one of these proteins can mean the difference between sickness and health. Such a change also provides a critical window into the body and helps to direct diagnosis and treatment, however, the vast majority of secreted proteins are present in concentrations well below what conventional technologies can measure, and their role in human health is poorly understood.

The field of proteomics has been around for decades and relies on targeted antibodies to detect biomarkers in the blood. Traditional ELISA readout systems require large volumes that ultimately dilute reaction product, requiring millions of enzyme labels to generate signals that are detectable utilizing conventional plate readers. Sensitivity is therefore limited and, if biomarkers are detected, it likely means the disease is already active and potentially widespread. For this reason, the clinical use of protein biomarkers to detect and monitor disease progression requires the measurement of extremely

low concentrations of proteins in complex samples in order to detect disease in its first stages, improving and accelerating patient care.

Solution: By measuring individual proteins at concentrations 1,000 times lower than the best immunoassays available today, researchers are able to detect, measure and validate new and existing biomarkers at concentrations previously unattainable and much earlier in the disease progression.

In order to achieve this new form of measurement, Quanterix developed a digital platform, called Simoa, to detect individual protein molecules in single molecule arrays. The technology first isolates individual immunocomplexes on paramagnetic beads using standard ELISA reagents. The main difference between Simoa and conventional immunoassays lies in the ability to trap single molecules in femtoliter-sized wells, allowing for a "digital" readout of each individual bead to determine if it is bound to the target analyte.

In contrast to conventional assay reactions, the signal generation volume in a Simoa assay is 2 billion times smaller, allowing for a single target molecule in a sealed microwell to quickly generate enough fluorophores to be measured using conventional fluorescence imaging—as opposed to millions of molecules needed for accurate measurement. Quanterix is currently working on several influential studies in fields such as oncology, neurology, and infectious disease detection. A couple of examples where Simoa has proven effective in research include:

- The platform was used to detect early increases in prostate specific antigen (PSA)—a biomarker commonly used to diagnose prostate cancer—following removal of the prostate in men with cancer. Earlier detection of these rising levels would allow men with cancer recurrence to immediately undergo more effective treatment for potentially better outcomes.
- It can also be applied to HIV detection and achieve results with 3,000 times greater analytical sensitivity than conventional immunoassays and at an affordable price—something that hasn't been available to underdeveloped countries.
- The platform has been used to measure brain biomarkers implicated in Alzheimer's disease and traumatic brain injury, where its inherent sensitivity allows those markers to be easily measured in blood, in contrast to today's immunoassays, which require a painful, costly lumbar tap to obtain cerebrospinal fluid.

For more information, visit www.quanterix.com/products/simoa-hd-1-analyzer.

PAN COMMUNICATIONS