

## **Big Data, Smart Data, and Actionable Data: Shaping the Future of Precision Medicine and Healthcare**

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The key concepts of precision medicine are prevention and treatment strategies that take individual molecular profile and clinical information into account. Single-cell next-generation sequencing technologies (NGS), *liquid biopsy* for circulating tumor DNA (*ctDNA*) analysis, microbiomics, radiomics, and other types of high-throughput assays have exploded in popularity in recent years, thanks to their ability to produce an enormous volume of data quickly and at relatively low cost. The emergence of these big data has advanced the goals of precision medicine; however, across the entire continuum of big data capture and utilization, many more challenges lie ahead—from analysis of high-throughput biomarkers to maximum exploitation of the electronic health record (EHR), to the ultimate goal of clinical guidance based on a patient's genome.

In recent years, almost all top biomedical journals have published major findings using advanced data science technologies, including complex statistical modeling, machine learning, and AI. Interpreting these results for patients and applying them for clinical guidance, however, remain significant challenges.

In this presentation, I will offer some perspectives on the changing landscape for precision medicine, including the road map for choosing between statistical modeling and machine learning; the concept of treating unstructured text as quantitative data; the need for physicians to adapt their mindset around the explosive growth in information technology; machine learning; and the AI revolution. These areas present great opportunities for medical researchers to strengthen their role in precision medicine. I will finish up with some thoughts about future medical developments, including how to design and conduct pivotal trials, pragmatic trials, and real-world evidence studies in the precision medicine era.