WHY A REVOLUTION?

Many promises remain to fulfill the potential of precision medicine

The completion of the Human Genome Project in 2003 led to much excitement because scientists had finally decrypted human DNA, which contains the genetic instructions needed to develop and direct activities of an individual organism. Many scientists were anxious to see how this information would impact the way we predict and treat disease in a more precise, case-by-case way. In the years that followed the project's completion, however, investigators quickly realized that a one-gene, one-drug scenario is exceedingly rare. But, with appropriate molecular data and iterative computational and experimental analyses, we can still customize drug development and clinical use for distinct subgroups of patients.

Here at the University of Pittsburgh, we are driving the revolution that will succeed in making precision medicine a reality. Our nationally recognized strengths in both research and clinical informatics, in addition to our unique partnership with UPMC and collaborations with Carnegie Mellon University, will allow us to develop and test real-world precision medicine strategies that can readily be implemented. We have particular strength in spatial molecular biology, which allows us to track the location and amount of specific molecular changes in cells or tissues, and experience in computational medicine, which allows us to experiment and test our innovations in simulated computer-based trials.

Research is underway to advance precision medicine by harnessing patient data in three ways:

- Using structural biology to characterize selected drug-target interactions
- Using machine learning to model disease progression and responses to therapeutics
- Using human "organ-on-a-chip" devices to conduct safety and efficacy testing

We are using a quantitative systems pharmacology (QSP) approach, which determines the mechanisms of disease progression and drug reaction through integrated experimental and computational methods. Such a meticulous approach will help us to identify complex disease mechanisms that have eluded traditional research methods, and ultimately show us the optimal approach to health monitoring, disease prevention, and personalized treatment.

Appropriate data structure during both research and clinical implementation will support data mining and further advance our QSP approach. Therefore, we have created a comprehensive research data warehouse that accommodates electronic health records, genome sequences, traditional and computational pathology, and extensive additional molecular information. Physicians can use this resource to make data-driven medical decisions, and researchers can use it to enrich their insight into biological mechanisms.

Questions?

For more information on these and other QSP programs currently in development at the University of Pittsburgh, please contact:

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