RESEARCH

Quantitative Biology & Pharmacology
Executive Summary
Driving Discoveries to Save Lives

The pharmaceutical and biotechnology industries are poised for strategic changes in the way drugs are discovered, tested, formulated, dosed, and delivered. We are entering a new era of personalized medicine where everything from the types, dosage, and combinations of therapeutics will be customized to fit the genetic and epigenetic profiles of individuals and demographic groups. In this rapidly changing and challenging landscape, the traditional approaches to drug discovery take too long, cost too much, and involve decisions made on the basis of ad hoc considerations.

We have to leverage the rich insights that have been afforded by “omics” projects and build on transformative changes in our understanding of how genes and environmental factors synergistically determine the onset and progression of infectious diseases and complex diseases such as aging-related disorders, cardiovascular disorders, and cancers. Engineering approaches, powered by machine learning to leverage big data repositories and quantitative modeling coupled to cutting-edge mechanistic investigations of molecular and cellular systems, are essential to transform the way we respond to the challenge of discovering, formulating, and delivering drugs.

We propose the launch of a strategic initiative through the creation of an Institute for Quantitative Biology and Pharmacology (IQBP). The three pillars of the IQBP should be mechanistic investigations, data science, and biological systems engineering. These pillars will support efforts in improved quantitative understanding of how complex diseases come about and how infectious diseases become resistant to existing drugs. Work within the institute should also help lower the barrier to discovering side effects through data-driven modeling of drug metabolism, developing optimal strategies for drug formulations, and designing efficient means of drug delivery. Finally, the efforts within the institute should accelerate the pace of drug discovery by pursuing enabling technologies in metabolic engineering and building on data-driven approaches. The scope of drugs to be discovered will include small molecules synthesized in the laboratory, protein and nucleic acid biologics, and natural products derived from plants and microbes.

The School of Engineering & Applied Science (SEAS) at Washington University in St. Louis has a critical mass of investigators whose research areas directly feed into the proposed institute’s mission. In addition, WashU has several organizations that would benefit from strategic initiative that forms the focus of the proposed IQBP. Within the St. Louis ecosystem, the proposed strategic initiative will build on the presence of the Danforth Plant Sciences Center, the St. Louis College of Pharmacy, a growing influence of partners who are advancing biosciences in the St. Louis area, and the presence of the North American hub for Bayer/Monsanto in St. Louis.

The time to act is now, and the way forward is for Engineering at WashU to step into a leadership role because this initiative is strategic given its impact on biomedical sciences and the fact that very few institutions can boast of the critical mass of enabling expertise and strengths.