Advancing Pharmaceutical Research through Innovations in Imaging

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The process of discovering and developing new therapeutic interventions to combat infection and human disease is an immense field of investigation characterized by long, highly complex studies, significant cost, and iterative improvement cycles. Each step from early discovery through production must be fully explored, characterized, and understood. The recurrent challenges, despite tremendous progress over the last century, have remained the limited understanding of disease pathology and progression and the variability in disease presentation. In addition, the function of biological targets and the pathways in which they reside are becoming increasingly more complex, thus requiring new capabilities and alternative strategies to untangle the fundamental disease-related science. For this reason, imaging technologies have become an integral part of the drug discovery and development program as they afford the ability to study various biological and chemical processes, including identifying disease-associated screenable phenotypes, understanding disease mechanisms, and predicting a drug's activity, toxicity or mechanism of action. This talk will focus on the use of various imaging modalities to examine drug formulation properties, drug delivery and uptake into tissues and cells, insights into biodistribution and subcellular trafficking patterns, investigation of viral infection and persistence, drug target engagement, and the pharmacological interrogation of cellular response. Examples of utilizing confocal, high-content screening, mass-spectrometry imaging, high-resolution microscopy and spatial transcriptomics will be highlighted. Case studies will be presented in the areas of oncology, infectious disease, and lipid nanoparticle delivery, with applications emphasizing the importance of combining imaging with multidimensional image analysis to increase the likelihood of finding novel drug candidates, deconvoluting the biology, and advancing new interventions into preclinical and clinical stages.

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