Sectoral Asset Management - Innovation in Drug Discovery: The Emerging Role of Artificial Intelligence

GENEVA, SWITZERLAND, July 19, 2021 /EINPresswire.com/ -- The hallmark of biotechnology is innovation, the discovery of new targets and technology platforms for the development of safe and effective therapies to treat human disease. Exciting examples of these approaches, a number of which have already been launched or are progressing through clinical development, include gene and cellular therapies. These novel agents deliver into the body either a protein or mechanism to correct a disease-causing gene, while cellular therapies for cancer, such as chimeric antigen receptor T cells (CAR-T), involve the collection, modification, and re-administration of a patient's own immune cells to fight cancer. In addition to the pursuit of new therapeutics, the biotech industry is also advancing the technologies used to develop drugs, and an emerging subsector of biotechnology is applying artificial intelligence (AI) and machine learning (ML) to the process. Since 2020, a small number of companies in the field have entered the public markets through successful IPOs, with the featured companies closing between 74-195% above their IPO prices on their first day of trading, compared with an average 39% gain for bio- tech IPOs in 20201. Notably, this performance surpassed their biotech IPO peers during a period in which biotech IPO activity and performance was robust: 92 biotech IPOs reported an average return of +89% in 20201. Clearly, investors are paying attention and view AI to be a disruptive and transformational adjunct to drug discovery.

In this review, we will explore biotech innovations in drug discovery, taking a panoramic view of the emerging role of AI, and highlighting the proprietary technologies and capabilities of leading AI-driven biotechnology companies that have recently entered the public markets. Considering the breadth of therapeutic modalities, we will focus on the drug discovery of small molecules (chemical com- pounds), the most established area of research and development and the target of much AI-based innovation. This new subsector is continuing to advance; in so doing, it is validating its disruptive potential. Overall, the ongoing innovation provides further support for our positive long-term view of the biotechnology industry.

The promise of AI in drug discovery

John McCarthy, the father of AI, defines it as the science and engineering behind the making of intelligent computer programs.2. Machine learning, a subset of AI, is the method of developing algorithms to derive insights from datasets for decision-making and includes such methods as supervised, unsupervised, and reinforcement learning. Speech and image recognition are areas in which AI has shown much progress; indeed, these technologies are now omnipresent in our everyday lives: our conversations with Siri and Alexa, and our smartphones' ability to recognize when our pets are before the camera lens are only the most obvious examples of the range of AI platforms.

To truly comprehend how AI and ML can be applied to drug development, we need to understand the process, which includes target identification and validation, lead generation and optimization, and their shortcomings. The drug-development process for small molecules begins with identifying a biological target of interest implicated in the onset of a disease, followed by the application of animal and cell-based disease models to validate the target as one with the potential of offering therapeutic gain.

After validating the target, a company then moves to lead generation, which involves either the screening of novel chemical compounds synthesized by medicinal chemists or the use of one (or more) of the millions of created compounds. After the large number of com- pounds have been screened, high-throughput (ie, automated) techniques are used to identify 'hit' compounds (ie, those that show activity against a target) that can be advanced to lead optimization. This step involves taking the 'hits' and evaluating compounds with similar chemical structures or modifying side chains to identify or create a molecule with optimal properties of ADMET: absorption, distribution, metabolism, excretion, and toxicity. Preclinical studies in cells and animals are also required for evaluating such essential properties as safety, mode of administration, interactions with other molecules, and efficacy. In other words, lead optimization is one of the most challenging and time consuming steps in the drug-development process, particularly as multiple, potentially opposing, properties must be evaluated and balanced. Once a lead compound is identified and preclinical studies are completed, the agent will advance into human clinical trials.

Drug discovery and development are time-consuming, costly, and uncertain processes, with studies citing a 96% failure rate, a span of 14 years (on average) from start to finish, and a cost of USD2.6bn before the developmental drug reaches the market.4,5

As decisions are made at each step of the drug discovery process, AI can be employed throughout, with computation-based screening enabling the assessment of a broader set of chemical compounds, while obviating the need for their synthesis. Moreover, ML algorithms have the power to analyze multiple datasets and parameters for decision-making (Figure 4). The lead-optimization phase is exceptionally costly and time consuming, as it requires multiple iterations of chemical synthesis and characterization and is complicated by the need to balance potency and drug-like characteristics, which are often in conflict. By applying ML to large chemical libraries in lead generation and optimization, AI promises to improve drug discovery by

screening more molecules, thereby identifying drug candidates with better potency, safety, and drug-like properties. The end result is a greater likelihood of success, by bringing fewer compounds into lead optimization and shortening the development time. Taken together, the benefit reshapes the drug-development funnel, producing more screening with reduced optimization, both of which lowers the cost of drug development (Figure 5). These objectives are further aided by the addition of advanced computing and automation. The emergence of big data and its improved accessibility has also driven a need for AI to extract in- formation and draw conclusions, particularly with large '-omics' datasets, which include the large-scale study of proteins (proteomics), transcription of RNA to proteins (transcriptomics), and phenotypic or physical changes to cells (phenomics), among others.

See more on https://www.sectoral.com/PDF/Newsletters/2021-Q2%20Newsletter.pdf

Markus Baumgartner
b-public AG
+41 797078921
mba@b-public.ch
