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Precision Medicine and Artificial Intelligence: Challenges and Potential in the Post-Human Genome Era

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Editorial
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Editorial

In the 2000s, following the sequencing of human DNA, there was strong excitement in the scientific, media and political communities regarding the game-changing potential of the Human Genome Project, as pointed out by well-known experts in the field such as Francis Collins and Craig Venter. However, the project has faced criticism from leading scientists such as James Watson for overlooking complex aspects of gene interaction and global genetic variability, leading to disappointments at a lack of solutions for complex diseases. This has prompted the development of "precision medicine", initially focused on oncology and targeted therapy.

The goal of precision medicine is to personalize therapies based on individual molecular data, a vision promoted by researchers such as Eric Lander. However, the complexity of the diseases has emerged as a barrier, requiring detailed analysis of the interactions between genes and environmental factors. Modern technologies offer molecular ("omics") data that can be analyzed to identify specific patterns in patients and tailor therapies.

Artificial intelligence (AI) appears to be a suitable tool for managing the complexity of diseases. AI has been successfully applied in various industries, but its application in precision medicine is questionable. The idea of "artificial neurons" and "neural networks" in AI was inspired by biology, but does not accurately reflect the complex functioning of real neurons in the human brain. Seminal works such as those of Marvin Minsky and John McCarthy laid the foundations for AI, but it is also important to consider the views expressed by scientists such as Roger Shank, who have questioned the expectations and definitions associated with AI.

AI could play a role in precision medicine, but a collaborative approach between doctors and data analysts is essential. The integration of skills, considering both clinical and analytical aspects, is essential to obtain meaningful results. The use of AI requires a thorough understanding of its limitations and capabilities, avoiding overestimating its ability to emulate human intelligence.

In the context of precision medicine, it is vital to mention immunology and virology as well. The precision medicine approach extends to these disciplines as well, as infectious diseases and immune responses are equally complex and varied. Leading researchers such as Peter Doherty and Luc Montagnier have contributed significantly to the understanding of immunology and virology. For example, in immunology, analyzing the molecular profiles of patients can help identify markers that indicate specific immune responses or potential susceptibility to certain infections.

In virology, precision medicine could play a crucial role in studying individual responses to viral infections. Identifying genetic variations that influence the susceptibility or severity of infections can guide scientists' work in finding targeted therapies and personalized vaccines. For example, during the COVID-19 pandemic, the approach of researchers like Anthony Fauci has highlighted the importance of considering the individuality of immune responses.

In both cases, the application of artificial intelligence and the analysis of molecular data could help to better

understand the complex interactions between pathogens, the immune system and human body responses. However, it is important to underline that even in these fields, the complete understanding of biological dynamics requires close collaboration between experts in medicine, immunology, virology and data analysis.