



Artificial Intelligence in Precision Medicine: Current Applications, Challenges, and Future Directions

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Abstract:

Introduction: Precision medicine focuses on giving patients the best possible treatment with the fewest side effects. It does this by choosing the right medicines and exact doses based on each person's unique health details. Using Artificial Intelligence (AI) has made this progress much faster. AI helps understand complicated health information like a person's genes, digital hospital records, and medical scans turning it into clear directions that healthcare personnel can use to treat patients better. In this article, we reviewed the applications, challenges, and opportunities of AI for precision medicine. We discussed several state-of-the-art AI approaches including machine learning and deep learning and their applications throughout drug discovery. AI has been used to predict drug response for individual patients to inform clinical decision-making and even predict adverse drug reactions. Results we found from the literature show that AI can be used to create pharmacogenomic models that help clinicians better understand variability in drug metabolism between patients. AI has also been used in drug repurposing to help find new uses for existing drugs and more quickly develop drugs for complex or rare diseases. While AI has shown great promise to improve precision medicine there are challenges that need to be addressed before it can be fully implemented into clinical practice. These challenges include but are not limited to: data heterogeneity, bias in algorithms, lack of model interpretability/trust in black-box models by clinicians, and lack of regulation to address privacy and ethical concerns that arise with using patients' data. Our review indicates AI can help drive personalized drug therapy by allowing for better pharmacogenomic modelling and streamlining drug repurposing. The potential impact of this technology could change medicine as we know it by allowing for more accurate data-driven care but there are still many challenges that need to be addressed. We suggest that moving forward, there should be more emphasis on creating "explainable" AI models and developing clean, reproducible data pipelines. There should also be collaboration between data scientists and clinicians to create transparent regulations that address biases in algorithm creation and patient privacy.

Keywords:

Artificial Intelligence, Precision Medicine, Personalized Pharmacotherapy, Pharmacogenomics, Digital Health.