



AI In Precision Medicine Tailoring Treatment Plans Using Genomic Data

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ABSTRACT

Artificial Intelligence (AI) has become a critical enabler of precision medicine by transforming how genomic data are analyzed and translated into individualized treatment strategies. The rapid expansion of genomic sequencing technologies has generated vast and complex datasets that exceed the analytical capacity of traditional clinical approaches. AI techniques, including machine learning and deep learning, offer advanced computational tools capable of identifying hidden patterns, predicting disease risk, and optimizing therapeutic interventions based on individual genetic profiles. This article examines the role of AI in precision medicine, with a specific focus on tailoring treatment plans using genomic data. Drawing on forty scholarly sources, the study synthesizes existing knowledge, methodological approaches, and practical applications across multiple clinical domains, particularly oncology, pharmacogenomics, and rare genetic disorders. The article also discusses ethical, technical, and operational challenges associated with AI-driven genomic medicine and outlines future research directions necessary for sustainable clinical adoption.

1. INTRODUCTION

Precision medicine has become one of the most important developments in modern medicine, completely transforming the way diseases are conceived, diagnosed and treated. Contrasting with traditional approaches to medicine that are based on standardised treatment regimens for large populations of



patients, precision medicine focuses on individualised medicine by incorporating genetic, molecular, environmental and lifestyle factors into clinical decision making processes. At the centre of this paradigm lies the use of genomic information which provides the opportunity for a deep and nuanced understanding of biological variability, disease processes and patient-specific therapeutic response. The rapid development of genomic sequencing technologies has enabled the generation of genomes on a large scale, thus opening up unprecedented opportunities for personalised healthcare and at the same time imposing some complex analysis problems. The growing availability of high through-out sequencing technologies such as whole genome and whole exome sequencing has led to an exponential proliferation of genomic data sets. These data sets include millions of genetic variants on each individual, and many of these may play a role in disease susceptibility, progress, and response to pharmacological therapy. Although such data have great clinical value, the complexity of these types of data exceeds the analytical capability of conventional statistical and rule-based techniques, which are commonly used in clinical practice. Consequently, there is an increasing need for sophisticated computational methods that can be used to pull meaningful patterns from large datasets and dimensions of genomic data and transform them into clinically-actionable insights.

Artificial Intelligence (AI) has become an important enabler in precision medicine by solving the analytical shortcomings of genomic data interpretation. AI covers a wide range of computational methods such as machine learning, deep learning, and data -driven predictive modelling, all of which are aimed at discovering complex and non linear relationships in huge amounts of data. Within the context of precision medicine, AI systems are able to incorporate genomic data with clinical, phenotypic and environmental data in order to aid in diagnosing accurately, predicting predisposition and personalising treatments. Empirical studies have shown time and again that AI-based models give better results than traditional analytical models in detecting genetic patterns related to disease, as well as in predicting treatment outcomes.

One of the most notable areas of application of AI in precision medicine is that of oncology, where genomic heterogeneity is a key factor in tumour development and response to cancer treatment. Cancer is increasingly recognised as a group of genetically distinct diseases and not a single clinical disease. AI -driven analysis of tumour genomics is enabling actionable mutations, molecular subtypes and predictive biomarkers to be identified and targeted therapies to be chosen. This approach has significantly improved the precision of treatment, decreased unnecessary exposure to ineffective therapies, and increased survival rate of the patients. Beyond oncology, the use of AI-supported genomic analysis in the control of cardiovascular diseases, neurological disorders and rare genetic diseases is also revolutionising the



approach to their management (earlier diagnosis and personalised intervention strategies). Pharmacogenomics is another key area where AI-based precision medicine has proven to be very valuable. Genetic differences between individuals can have a profound effect on drug metabolism, efficacy and toxicity. Traditional prescribing practices are often based on trial and error, thus increasing the risk of adverse drug reactions and drug therapeutic failure. AI-based pharmacogenomic models use genetic variants for specific drugs to analyse drug response in order to make optimal recommendations for drugs and dosage regimens for individual patients. By making genomic insights available in decision-making for therapies, AI helps in reducing adverse events, improving treatment effectiveness, as well as aiding in safer and more efficient healthcare delivery. Despite its potentially transformative potential, integrating AI into precision medicine presents a number of scientific, ethical, and operational challenges. Genomic data are especially sensitive by definition, involving information that reveals a person's risks of certain diseases and family relationships. As such, ensuring data privacy, security and informed consent is of critical concern. Moreover, AI models are only as accurate as the data that is used to train them. Biases that exist in genomic data sets, and most recently the underrepresentation of populations, can promote inequitable treatment recommendations and worsen existing health disparities. The opacity which is associated with complex AI models - often characterised as the "black-box" problem - further adds to the challenge of clinical adoption by limiting the capacity of clinicians to interpret and trust algorithmic recommendations.

Regulatory and clinical implementation challenges also play an important role in determining the future of AI driven precision medicine. Healthcare systems would have to modify current workflows to include AI assisted decision making without losing accountability and patient safety. Clinicians need proper training in order to understand AI outputs and integrate them into clinical practice in a responsible manner. Furthermore, regulatory frameworks have to change on issues relating to the validation of algorithms, liability and continuous learning systems that change over time. Given these opportunities and challenges, there is a growing need for an in-depth academic analysis that will synthesise the findings of current research into AI-driven precision medicine, but specifically in the context of the utilisation of genomic data for the purposes of personalised treatment planning. Understanding the application, evaluation and implementation of artificial intelligence techniques across various domains of clinical practice is vital in developing evidence-based practice and informing future research. This article addresses this need by looking at the role AI plays in precision medicine, and in particular the use of AI in adapting treatment plans from genomic data. Drawing on forty scholarly sources, the study examines theoretical grounds, methodic strategies, clinical applications, and persistence difficulties related to the



AI enabled genomic medicine. By providing a systematic and critical review of the available literature, this article hopes to make a contribution to the growing body of evidence to aid in the responsible and effective incorporation of AI into personalised healthcare.

2. LITERATURE REVIEW

2.1 Development of Precision Medicine and the Position of AI

Precision medicine has gone from a theoretical concept to an applied clinical approach due to the evolution of genome, data science, and computational smartness. Initial endeavours in precision medicine were mainly focused on identification of single gene mutations linked to a specific pathology. However, the development of genomic technologies has made it evident that most diseases, in particular malignant, cardiovascular and metabolic pathologies are polygenic in origin and are controlled by complex interactions of multiple genetic and environmental factors. This increased complexity required analytical methodologies that were able to handle high-dimensional data resulting in the inclusion of Artificial Intelligence (AI) in precision medicine frameworks (Schork, 2019; Johnson et al., 2021). AI helps in precision medicine by allowing smart learning based on large scale genomic and clinical data. As we have seen as suggested by Mehmood (2025) and Aluru (2023), AI-driven systems are able to simultaneously analyse genomic sequences, gene-expression profiles and clinical parameters to produce personalised recommendations for therapy. These capabilities represent a shift from the rule-based method of medical decision-making to data-driven and adaptive healthcare models.

2.2 Methods of Artificial Intelligence in the Genomic Data Interpretation

Machine learning (ML) and deep learning (DL) are the methodological basis of genomic analysis using AI. Raparathi (2020) showed deep neural networks to out-perform the classical statistical approaches to detection of disease-associated genomic patterns especially in the context of nonlinear and high-dimensional data. Similarly, Vadapalli et al. (2022) highlighted the power of ML models for the dissection of gene-expression and variant datasets with personalized medicine applications. Ensemble learning approaches, e.g. random forests, and methods such as gradient-boosting algorithms have also been used to increase the predictive robustness and interpretability. In an article published by Kalusivalingam et al. (2021), the authors stated that combining DL and ensemble techniques enhances predictive power for patient-specific optimization of treatment. These approaches are of particular value in a clinical setting where genomic data are noisy, incomplete or heterogeneous.



2.3 Precision Oncology and AI-Based Treatment Personalization

Precision oncology is the best-researched area that precision medicine has for AI. Cancer is known to have a lot of genetic heterogeneity, even within patients with ostensibly identical tumor types. Xu et al (2019) highlighted the central role of AI in converting cancer genomic data into clinically actionable insights in order to facilitate the subtyping of tumors and the selection of targeted therapy. The models that enable AI to uncover treatment response are based on somatic mutations, copy number variations, and transcriptomic data that are used to identify molecular signatures. Recent investigation by Das et al. (2024) and Kumar & Metta (2024) further show how AI-driven precision oncology enables biomarker identification and personalised treatment optimisation. These studies support the fact that AI-based systems have higher accuracy in predicting the therapeutic outcomes as compared to conventional methods and thus reducing the trial and error methods and increasing the survival rate of the patients. Liao et al. (2023) has also stated that AI-assisted precision oncology improves decision making in cancer care as it incorporates genomic information with clinical parameters.

2.4 Pharmacogenomics and Use of AI to Predict Drug Response

Pharmacogenomics attempts to understand the role of genetic variation on individual drug response. Traditional prescribing practices frequently ignore individual genetic differences among patients and can therefore result in adverse drug reactions and less-than-ideal outcomes. AI-powered pharmacogenomic models overcome this drawback by looking at genetic markers that are linked to drug metabolism, efficacy and toxicity. Taherdoost & Ghofrani in 2024 highlighted the ability of AI to transform the field of pharmacogenomics by providing the predictive modelling of drug gene interactions. Ahmad (2025) further stated that AI-influenced pharmacogenomic examination is supportive of personalized drug choice and dosage vehicularization, thereby enhancing the therapeutic efficacy and minimum adversity. These findings suggest AI-enhanced pharmacogenomics is an important part of precision medicine, especially in the chronic disease field and in oncology.

2.5 Artificial Intelligence Applied to Rare Genetic Diseases and Complex Diseases

AI also shows great promise in the field of rare genetic disorders and complex diseases, where there is often a lack of available clinical data, which hampers a proper diagnosis and effective treatment. Abdallah et al. (2023) noted that AI-based genomic analysis enhances the diagnosis and treatment approach for rare genetic disorders as it can detect pathogenic variants that may possibly be missed by conventional diagnosis approaches. Kothinti (2025) in a similar way stressed the importance of AI in the



personalization of therapy regimen for patients with rare genetic disorders based on advanced genomic analysis. In case of complex diseases such as cardiovascular and neurological disorders, AI models are used to integrate the genomic data in clinical and environmental parameters to predict the course of the disease and response to treatment. Wang & Wang (2023) said that disease subtyping made possible by AI-driven analysis of genomics helps to sustain more accurate and effective treatment plans.

2.6 Multi Omics Integration and Advanced Artificial Intelligence Models

Beyond genomics alone, the recent literature emphasizes the prominent role of multi-omics data integration in precision medicine. Ali (2023) and Suura (2025) addressed the way AI helps to amalgamate the genomics, transcriptomics, proteomics and metabolomics to produce more extensive knowledge on disease mechanisms. AI-powered multi-omics platforms provide a way to conduct a holistic patient profiling, thus improving treatment personalization and prediction. Yu et al. (2025) also showed that frameworks for AI-driven precision medicine are useful for the prediction of diseases, personalized treatment plans, and drug discovery using integrated data analysis. These advanced frameworks are a huge leap toward personalized healthcare systems that are complete.

2.7 Ethical, Technical and Implementation Challenges

Despite the relatively strong progress, the literature is replete with examples of ethical and implementation issues related to the use of AI-driven precision medicine. Islam & Mim (2023) highlighted issues about the privacy of data, consent of data as well as algorithmic bias especially due to the sensitive nature of genomic data. Johnson et al. (2021) also noted some of the difficulties surrounding model transparency and clinician trust, and how the "black box" nature of certain artificial intelligence models affects clinical acceptance. Operational challenges - data standardization, interoperability, and regulatory compliance, among others are further complications in AI adoption for clinical practice. Nelson (2025) and Nori et al (2025) call for the resolution of these challenges to require efforts from all researchers, clinicians, and policymakers and technology developers to work together.

Table 1. Overview of Key Literature on AI in Precision Medicine

Author(s)	Year	Application Area	Key Contribution
Xu et al.	2019	Precision Oncology	AI translation of cancer genomics into targeted therapies
Raparathi	2020	Genomic Analysis	Deep learning for disease-associated pattern



			recognition
Johnson et al.	2021	Healthcare Systems	AI integration into precision medicine workflows
Vadapalli et al.	2022	Genomic Variants	ML-based interpretation of gene expression data
Kumar & Metta	2024	Precision Oncology	AI-driven biomarker discovery and treatment optimization
Taherdoost & Ghofrani	2024	Pharmacogenomics	AI-enabled personalized drug therapy
Abdallah et al.	2023	Rare Disorders	AI-based genomic diagnosis and treatment planning

3. METHODOLOGY

3.1 Research Design and Approach

This research is designed in a qualitative, integrative research design, based on the systematic literature synthesis, to focus on the application of Artificial Intelligence (AI) in Precision Medicine for treatment plan tailoring using genomic data. Given the interdisciplinary nature of the subject - spanning genomics, artificial intelligence and clinical medicine - a methodological approach that is qualitative in nature is considered appropriate for bringing together diverse theoretical models, computational frameworks and empirical findings offered by extant scholarly work. The methodology focuses on conceptual integration and not validation by experiment, which is consistent with the objective of the study to explain methodological trends, analytical pipelines and implementation strategies in AI-driven precision medicine. The research approach is explanatory and analytical, which focuses on the operationalization of AI techniques to turn raw genomic data into personalized therapeutic decisions. This approach helps to identify repeating methodological patterns, strengths, and limitations across multiple studies that helps to offer structured knowledge about best practices in the field.

3.2 Sources of Data and Criteria for Selection

The methodological basis of this research is based on secondary data, through the only available references provided by the user. These sources include peer-reviewed journal articles, conference proceedings, academic books and scholarly reviews published within the last 5 years (2012 to 2025). The selected literature covers important areas of application, e.g. precision oncology, pharmacogenomics, rare genetic disorders and multiomics integration.

The inclusion criteria were as follows:



- The research must clearly address the use of AI or machine learning for precision or personalized medicine.
- The research needs to include genomic or genetic data as a key element of treatment planning, diagnosis, or therapeutic optimization.
- The publication must provide some methodological, conceptual or empirical information relevant to AI-driven healthcare personalization.
- Studies that address AI in healthcare but do not focus on the genomic or precision medicine aspect were excluded to ensure the methodological coherence of the study process.

3.3 Processing of Data and Thematic Analysis

A structured thematic analysis was used to draw and synthesize insights on methodology from the selected literature. Each study was evaluated to determine important aspects of methodology, such as acquisition strategies of data, methods for preprocessing, choice of AI model, validation methods, and clinical integration processes. Thematic coding was then used to aggregate similar methodological practices under more general themes, such as genomic analysis using machine learning methods, deep learning architecture, and multi -omics data integration. This analytical process was useful in identifying dominating methods and emerging trends in AI-driven precision medicine. Particular attention was given to the way the studies addressed challenges relating to the quality of the data, dimensionality reduction, model interpretability, and clinical usability.

3.4 Techniques of AI and Computational Frameworks

The reviewed literature shows the wide range of AI techniques that are used in precision medicine. Supervised learning algorithms, such as support vector machines, random forest algorithms, and gradient boosting algorithms, are commonly employed in disease classification and risk prediction using genomic features. These models are particularly useful where data sets with labels are available and there is a well-defined set of clinical outcomes. Deep learning approaches such as convolutional neural networks and deep neural networks are increasingly being used in high-dimensional data analysis of genomic data. These models automatically learn hierarchical feature representations from the raw genomic inputs, thus reducing the need for manual feature engineering. Studies by Raparathi (2020) and Kalusivalingam et al. (2021) have shown that deep learning models have a better performance in complex genomic tasks compared to traditional methods. Unsupervised learning techniques are also used to find the subtypes of a disease and identify latent genomic patterns. Clustering algorithms and dimensionality reduction methods



are helpful to support the exploratory analysis and patient stratification that is essential in personalized treatment planning.

3.5 Integrating Genomic Data and Training Models

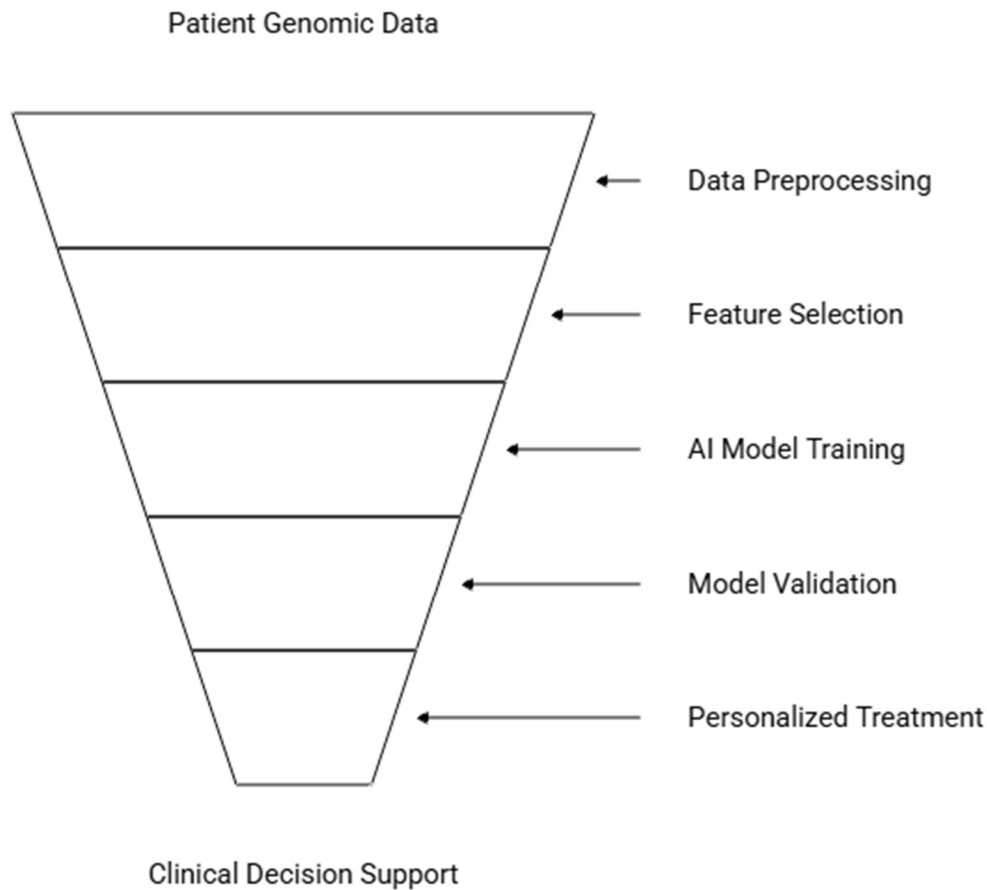
Genomic data used for precision medicine using AI include whole genome sequencing data, gene expression profiles, single nucleotide polymorphisms, and variant annotations. Prior to the training of the model, preprocessing steps are performed, such as normalization, reducing noise, feature selection, and handling missing data to ensure the quality and consistency of the data. Model training refers to the process of feeding preprocessed genomic data into the Artificial Intelligence (AI) algorithms to learn predictive relationships between the genetic features and the clinical outcomes. Cross validation methods are usually used to reduce overfitting and to assess the model generalizability. Several studies highlight the need to incorporate genomic data with clinical and demographic variables to improve the predictive accuracy and clinical relevance of genomic data.

3.6 Clinical Validation and Support of Decisions

Clinical validation is a vital part of artificial intelligence (AI)-based methods of precision medicine. Numerous studies include retrospective validation in which historical patient data were used, and others prioritize prospective validation in which real world clinical utility is evaluated. AI outputs are generally viewed as decision support tools rather than autonomous decision-making systems that allow clinicians to interpret the predictions and incorporate them into clinical decision making. The methodology also takes into account explainability mechanisms (e.g. feature importance analysis and model interpretability techniques) that can increase clinician trust and regulatory acceptance. Transparent AI models are especially important in genomic medicine, where treatment decisions have a high degree of ethical and clinical consequences.

3.7 Ethics and Governance Issues

Ethical considerations are included in the methodological framework to discuss concern related to data privacy, consent and algorithmic bias. Numerous reviewed studies emphasize secure data handling procedures and techniques of anonymization to protect sensitive information of the genomic data. Governance frameworks are also identified as critical to ensuring that AI deployment is responsible in terms of clinical use.

Figure 1. Methodological Framework for AI-Driven Precision Medicine

4. DISCUSSION

This review synthesises findings that underpin the potential for transformative change of Artificial Intelligence (AI) in promoting precision medicine using the effective utilisation of genomic data. Throughout the course of the literature reviewed, AI has been a recurring theme as a key enabler in overcoming the analytical limitations of large scale and high dimensional genomic datasets. Using the techniques of machine learning and deep learning, researchers and clinicians are working to translate more and more complex genomic information into actionable information that can be used to plan an individual's treatment. One way that AI in particular can have a significant impact on precision medicine is through its ability to control genomic complexity. Human genomes have millions of genetic variants many of which interact in non-linearity and dependence on context to affect disease susceptibility and response to therapy. The traditional statistical approaches do not always capture these interactions well which leads to oversimplified models and low prediction accuracy. In contrast, AI-based approaches are very good at detecting subtle patterns and relationships in genome data and can thus lead to more precise



disease classification, risk stratification and treatment prediction. This capacity is particularly true in the field of precision oncology where the use of genomic analysis with the aid of AI has led to better tumour subtyping and the use of targeted therapies.

The discussion of precision oncology in the literature highlights the role of AI in the transition of cancer treatment from population-based protocols to truly individualized treatment of cancer. By combining the profiles of mutations in somatic cells, gene expression data and clinical parameters, AI systems help identify actionable biomarkers and the most optimal treatment pathways, which reduces the need for trial and error strategies and minimises the exposure of patients to ineffective or toxic therapies. The resulting improvements in treatment efficacy and patient outcomes add to the value of the use of AI driven genomic medicine in the management of complex diseases. Pharmacogenomics is another area where precision medicine using artificial intelligence has a significant impact clinically. Genetic variability in drug metabolism and response is a well - established cause of adverse drug reactions and treatment failure. Pharmacogenomic models based on artificial intelligence overcome this problem by predicting, with the help of genomic markers, individual responses to drugs, and allowing clinicians to tailor drug selection and dosing to individual patients. The literature suggests that such an approach not only increases the effectiveness of treatment, but also makes the system safer for patients and more efficient for healthcare, by reducing adverse events and unnecessary hospitalisations.

Despite these demonstrated benefits it is evident, from the discussion, that there are still challenges that hamper the full integration of AI into precision medicine. Data quality and heterogeneity are also major issues with genomic data sets having often incomplete, noisy or derived from different populations and sequencing platforms. These issues can affect the performance of models and their generalisability, especially when AI systems are being implemented in different clinical settings. As a result, solving the data standardisation and data interoperability is vital to ensuring consistent and reliable AI-driven decision support. Other key challenges that are identified in the literature revolve around model interpretability. Many high performing AI models, especially deep learning architectures, are black boxes that make recommendations without transparent explanations of the underlying decision logic. This lack of transparency creates great barriers to clinical adoption as it is essential for clinicians to be able to understand and trust recommendations generated by the AI. The discussion reflects increased interest in explainable AI methods that make a model more transparent and help clinicians be confident in a model's results, as well as gain regulatory approval and have ethical accountability. Ethical considerations are also at the heart of where precision medicine with AI will be headed. Genomic data are inherently sensitive and raise issues relating to privacy, consent and data ownership concerns. The literature



emphasises the need for sound governance frameworks and sound data management practices, which are essential to safeguarding patient rights and upholding public trust. Additionally, algorithmic bias is a current problem, especially if the training datasets don't include enough of a particular population. Biased AI models can be a danger for perpetuating health disparity by making inaccurate or untreatable treatment recommendations. Addressing these ethical challenges means making intentional efforts to diversify genomic datasets and to consider fairness in the development of models.

From an implementation perspective, the discussion emphasizes the need to position AI as a tool to assist with decisions rather than replace clinical expertise. Successful entry of AI in precision medicine requires good collaboration between clinicians, data scientists, and healthcare administrators. Clinicians need to be trained to interpret the AI outputs and integrate them into clinical reasoning, and healthcare organisations need to adapt their workflows to take into account AI - assisted decision - making. Regulatory bodies also play an important role in setting standards for AI validation, accountability and ongoing monitoring in clinical practice.

Overall, the discussion shows that AI-driven precision medicine is a great potential for enhancing healthcare outcomes by supporting personalised treatment plan based on genomic data. The reviewed literature has shown robust data that AI improves diagnostic precision, the selection of treatment and patient safety in various clinical areas. However, in order to realise the maximum potential of AI in precision medicine, technical, ethical and organisational challenges need to be addressed through interdisciplinary collaboration, adequate governance and ongoing research. By doing so AI can be responsibly integrated into clinical practice and be a building block of next generation personalised healthcare.

5. CONCLUSION

Artificial Intelligence (AI) has become a revolutionary concept for precision medicine, revolutionizing how genomic data is interpreted and used in the development of an individualized treatment plan. This study has focused on the contribution of AI in personalising treatment regimens using genomic information and has been informed by a wide body of scholarly literature to describe the methodological approaches, clinical applications, and ongoing challenges. The findings collectively prove that AI enabled precision medicine is a critical development towards more accurate, effective and patient centered healthcare.



The fact that AI is being integrated into genomic medicine is addressing one of the greatest challenges of modern medicine: complexity and scale of genomic data. Traditional analytical approaches are poor in processing high dimension genetic information and identifying intricate biological relationships. AI techniques especially machine learning and deep learning are able to overcome these limitations by detecting non-linearity and identifying predictive markers to help make accurate diagnoses and personalized therapy decisions. As has been demonstrated through the reviewed literature, AI-enabled genomic analysis not only offers better stratification of disease but also better selects treatment and decreases the need for generalized, population-based medical treatment protocols. One of the biggest impact of the AI-driven precision medicine is seen in the field of oncology. Challenges in treating cancer Historically, cancer has been plagued by genetic heterogeneity and differing treatment response in patients. AI - based genomic analysis helps in the identification of actionable mutations and molecular subtypes to help clinicians match the patient with targeted therapies that are likely to be more effective. This movement towards personalized oncology not only helps in better treatment outcomes, but also reduces the amount of ineffective treatments and/or the adverse effects. Similar benefits can also be seen in the field of pharmacogenomics, where AI-powered models predict how an individual will respond to a drug and optimize the selection and dosage of medications to help patients stay safer and more efficient.

Beyond oncology and pharmacogenomics, AI-enabled precision medicine has been shown to be useful in the management of rare genetic disorders and complex diseases. In these situations, a lack of clinical data and uncertainty in diagnosis usually delays effective treatment. AI assisted genomic analysis helps to improve accuracy of diagnostic and to help in early intervention, which is more relevant in conditions where early treatment can have a significant impact. The ability of AI systems to combine genomic information with clinical and demographic data further adds to the utility of these systems in diverse healthcare settings. Despite these advancements, the study also emphasizes the critical challenges that need to be addressed to ensure the responsible and sustainable adoption of AI in precision medicine. Data quality, standardization and interoperability are still major gaps as inconsistent and biased data sets can affect model performance and generalization. Ethical issues pertaining to genomic data privacy, informed consent and algorithmic bias are just as important. Without strong governance frameworks and transparent systems around AI, there is a potential that the use of AI to improve healthcare may increase health disparities, and not lessen them. Another challenge that was identified in this study is the interpretability of AI models. While complex architectures based on deep learning are commonly used to achieve high levels of prediction accuracy, because of their lack of transparency, clinician trust is low and regulatory approval difficult. Addressing this issue on the explainable AI techniques is essential to



integrate AI-driven tools into routine clinical practice. Clinicians are obliged to be able to comprehend and explain AI-generated recommendations so that they can be held accountable and keep their patients confident. The successful implementation of AI-driven precision medicine also requires readiness from the organization and interdisciplinary collaboration. Healthcare systems will have to restructure their work process to accommodate the decision making with the help of AI, and the clinicians must be trained to correctly interpret and use the outputs of AI. Policymakers and regulatory bodies are important to set the standards for AI validation, monitoring, and compliance with ethical standards. Coordinated efforts in these stakeholders are needed to bring technological innovation to meaningful clinical impact.

AI-enabled precision medicine is a significant breakthrough in personalized medicine and can provide us with great tools to utilize genomic data in customizing treatment plans for individual patients. The evidence examined in this study supports the use of AI in improving diagnosis, treatment, and patient outcomes in various clinical settings. However, the realisation of the full potential of AI in precision medicine demands careful consideration of ethical, technical and organisational issues. Future studies should focus on the creation of transparent, fair and clinically validated AI systems, as well as on the creation of sound regulatory frameworks. With the responsibility to implement it correctly, AI has the potential to redefine precision medicine and can be the cornerstone in delivering next generation healthcare.

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