

What Are the Ethical Issues in AI-Driven Genetic Testing?

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Abstract

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The convergence of artificial intelligence (AI) and genetic testing is revolutionizing healthcare, offering unprecedented opportunities for personalized medicine, disease prediction, and drug discovery. By analyzing vast and complex genomic datasets, AI algorithms can identify patterns and insights that would be impossible for humans to discern alone. However, this powerful combination also brings a host of complex ethical challenges that demand careful consideration from health professionals, researchers, policymakers, and the public. Ensuring that these technologies are developed and deployed responsibly is paramount to harnessing their full potential while safeguarding fundamental human rights and promoting social equity.

One of the most significant ethical concerns in AI-driven genetic testing is the privacy and security of highly sensitive personal data [1]. Genetic information is uniquely identifiable and deeply personal, revealing not only an individual's health predispositions but also information about their family members. The use of AI requires the collection and processing of massive datasets, creating vulnerabilities for data breaches and misuse. Without robust security measures and stringent regulations governing data handling, ownership, and consent, there is a substantial risk of genetic information being used for discriminatory purposes, such as in employment or insurance, thereby eroding public trust in these innovative technologies [2].

Another critical issue is the potential for algorithmic bias, which can perpetuate and even exacerbate existing health disparities. AI models are trained on historical data, and if this data reflects societal biases or underrepresents certain populations, the resulting algorithms will inevitably

be skewed [3]. For instance, an AI tool trained primarily on genomic data from individuals of European descent may be less accurate when applied to individuals from other ancestral backgrounds. This can lead to misdiagnoses, inequitable access to treatments, and a widening of the health gap between different demographic groups. Addressing this requires a concerted effort to build diverse and representative datasets and to continuously audit algorithms for fairness.

The “black box” nature of many advanced AI systems presents a further ethical dilemma regarding transparency and interpretability. Many deep learning models arrive at conclusions through processes that are not easily understood by their human creators. In a clinical setting, this lack of transparency is problematic. For a health professional to make a responsible, informed decision based on an AI-generated recommendation, they need to understand the reasoning behind it. When an AI system cannot explain its output, it undermines the clinician's ability to verify the result and the patient's right to an informed discussion about their care options [2].

Furthermore, the complexity of AI-driven genetic testing complicates the principle of informed consent. True informed consent requires that a patient understands the nature of a test, its potential benefits and risks, and the implications of the results. When the analysis is performed by an opaque AI algorithm, it becomes exceedingly difficult to convey this information adequately. Patients may not fully grasp how their data will be used, who will have access to it, or the potential for secondary findings and their long-term implications. Establishing new frameworks for dynamic and ongoing consent is crucial to respecting patient autonomy in the age of AI.

Looking ahead, the power of AI in genomics raises profound questions about genetic manipulation and human enhancement. While not yet a widespread clinical reality, the ability to use AI to identify and potentially alter genetic traits opens a Pandora's box of ethical issues concerning the boundaries of medicine and the definition of what it means to be human. These long-term considerations necessitate broad societal dialogue and the development of clear ethical guidelines to navigate this uncharted territory [1].

In conclusion, while the integration of AI into genetic testing holds immense promise, it is accompanied by significant ethical responsibilities. Addressing the challenges of data privacy, algorithmic bias, transparency, and informed consent requires a multi-stakeholder approach involving robust regulation, a commitment to fairness and equity in AI development, and a continuous dialogue between technologists, healthcare providers, and the public. By proactively tackling these issues, we can ensure that AI-driven genetic testing serves the best interests of all members of society.

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