Ethics in Personalized Medicine Using AI: A Case Study with the Cancer Genomic Atlas

Artificial intelligence holds great promise in personalized medicine, especially in oncology, where datasets like the Cancer Genomic Atlas (TCGA) enable treatment recommendations based on individual genetic profiles. However, ethical concerns particularly bias and fairness must be addressed to ensure equitable healthcare outcomes.

Potential Biases

One major issue is demographic underrepresentation. Many genomic datasets, including TCGA, disproportionately feature patients of European descent, while minority ethnic groups such as African, Hispanic, and Indigenous populations are underrepresented. As a result, AI models trained on these datasets may perform poorly or make inaccurate treatment recommendations for those outside the majority group.

Another concern is data linkage bias, if social determinants of health (e.g., access to care, income level) are not adequately represented in the model, it may overlook key non-biological treatment outcomes. Labelling bias may also arise from subjective or inconsistent treatment response evaluations across institutions.

Fairness Strategies

To address these challenges, researchers should adopt diverse, representative training datasets by incorporating data from global cancer registries and underrepresented populations. Federated learning can also be used to combine knowledge from decentralized, privacy-preserving sources.

AI models should be continuously evaluated using fairness metrics, such as performance parity across demographic subgroups. Techniques like reweighting, resampling, or adversarial debiasing can help reduce disparities during model training.

Importantly, transparency is critical—models must explain how predictions are made, allowing clinicians and patients to question recommendations. Collaborative research with bioethicists, patient advocates, and public health experts can also shape more inclusive policies and accountability frameworks.

Conclusion

While AI-powered personalized medicine has the potential to revolutionize cancer care, its ethical success depends on inclusive data, fairness-aware modelling, and constant human oversight. Only then can it truly benefit all patients, regardless of race, geography, or socioeconomic status.