Augmenting Clinical Trials with Deep Immune Profiling and Explainable AI

Immunai | BioMed Israel 2026

Background

Clinical trial failure is frequently rooted in inadequate patient selection, limited pharmacodynamic insight, and the inability to anticipate toxicity early. The immune system underlies all three challenges, yet its complexity has resisted scalable interrogation. We present a clinical trial optimization framework combining high-resolution single-cell multi-omic profiling, a large annotated immune reference database, and AI models designed to extract, rank, and explain the immune features that govern therapeutic outcome.

Platform

Our framework is anchored by AMICA™, a continuously expanding immune atlas spanning over 50,000 samples, integrating single-cell transcriptomics, proteomics, and spatial transcriptomics data. Clinical trial samples are mapped against this atlas, enabling contextual interpretation at single-cell resolution far beyond what bulk or flow-based measurements can provide. Two complementary AI architectures operate on this foundation: immune-centric foundation models pre-trained across AMICA, which encode deep biological priors and generalize across tissues and indications; and reasoning models that perform structured hypothesis evaluation, surfacing the top-ranked immune features most relevant to the clinical question and generating interpretable explanations of the underlying biology.

Applications

The framework addresses four high-value clinical questions. For **patient stratification**, baseline immune signatures identify likely responders before dosing. For **drug differentiation from standard of care**, immune profiling reveals mechanistically distinct pharmacodynamic profiles across treatment arms. For **mode of action**, temporal modeling reconstructs the immune cascade from dosing through response, distinguishing primary from secondary pharmacodynamic effects and intended from emergent biology.

Conclusion

By combining the world's most comprehensive immune reference with explainable AI reasoning, Immunai converts clinical immunology from a descriptive readout into a predictive and mechanistic intelligence engine — enabling smarter patient selection, deeper mechanistic understanding, and ultimately, higher trial success rates.