

## **NON-PROVISIONAL UTILITY PATENT APPLICATION DRAFT**

**Title:** Feedback-Regulated Cytokine Delivery System for Adaptive Immune Cell Expansion

**Applicant:** Oren Raphael

**Inventors:** Oren Raphael

**Filing Country:** United States

### **ABSTRACT**

This invention provides a comprehensive adaptive cytokine regulation platform for ex vivo expansion and education of immune cells, integrating real-time feedback from cytokine concentrations and immune phenotype markers. The system dynamically modulates cytokines (e.g., IL-2, IL-7, IL-15, IL-21, IL-12, IFN-gamma, GM-CSF) within a closed-loop GMP-compliant bioreactor. Leveraging patient-derived tumor lysates for autologous immune education, this method ensures personalized immune recognition, enhanced clonal diversity, reduced cellular exhaustion, optimized memory cell induction, and high therapeutic potency. Additionally, the system integrates real-time sensors, adaptive dosing algorithms, and automated cytokine infusion pumps to maintain optimal immune cell expansion parameters, substantially reducing batch variability and regulatory complexity in cellular immunotherapy manufacturing.