Background Cellular therapies require precise and versatile biological engineering at scale to generate effective and accessible products. However, current cell delivery approaches are often limited in the types of biology and range of cells they can engineer and have significant scale-up challenges. Microfluidic deformation using the Cell Squeeze® technology effectively delivers a variety of payloads to diverse cell types at scale while preserving cell health and function.

Methods We tested preclinically the performance of the Cell Squeeze technology in many cell types including T cells, PBMCs, HSCs, iPSCs, red blood cells, and TILs. We evaluated the efficiency of delivery of many materials including mRNA, gene editing factors, transcription factors, and membrane-bound cytokines. We further investigated the integration of our scaled cGMP process into an integrated manufacturing system for the rapid and cost-effective production of cell therapy drug products (point-of-care system).

Results We showed highly efficient mRNA delivery (>80%) to T cells, iPSCs, PBMCs, HSCs, and TILs while also maintaining cell function. Cell Squeeze technology also demonstrated efficient gene editing in multiple cell types. The technology further demonstrated engineering ~10B cells/minute and has been used in 3 clinical trials generating distinct investigational products. Furthermore, our point-of-care system demonstrated a fully closed automated unit for manufacturing cell therapies that integrates cell isolation, cell washing, cell delivery and bag filling. This portable system used a single-use sterile disposable tubing set and has the potential to be operated outside of a clean room. Our point-of-care system also reduced our operator hours by 90% and process time by ~50% to < 6 hours.

Conclusions Cell Squeeze technology has shown differentiated capabilities in applications such as therapeutic vaccines, immune tolerance, effector cell engineering, and directed differentiation of iPSCs. These results support a continued expansion of clinical impact of the Cell Squeeze technology leveraging the flexibility of the delivery platform. Our automated, point-of-care system incorporating the Cell Squeeze® technology could potentially further streamline manufacturing time and costs to achieve greater cell therapy accessibility and therapeutic impact potential.