



## Introduction

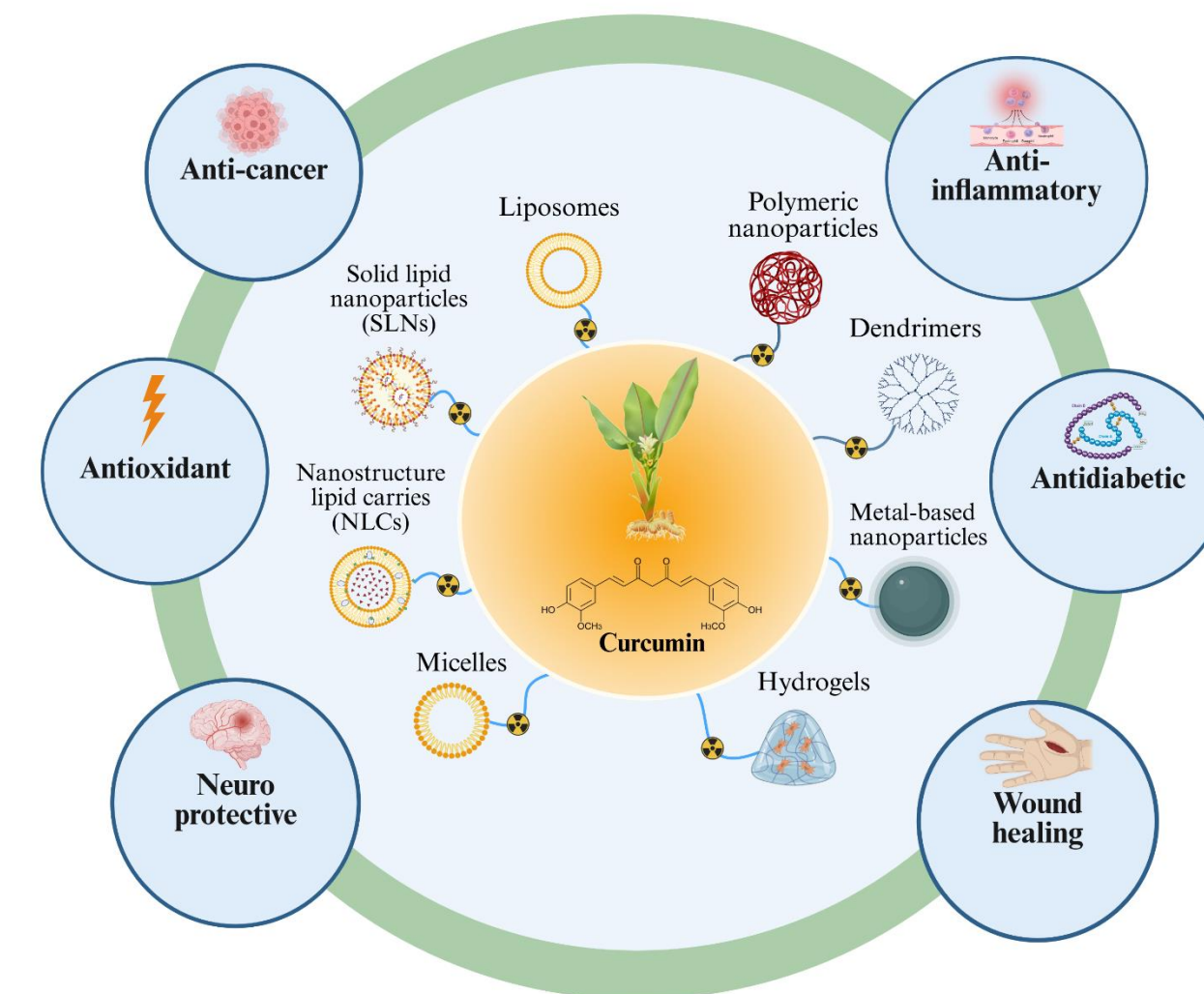
Curcumin is a natural polyphenol with well-documented anti-inflammatory, antioxidant, and anticancer properties. However, its poor aqueous solubility, rapid metabolism, and low oral bioavailability have significantly limited its clinical translation. Recent advances in nanotechnology have enabled the development of diverse nano-delivery systems that can enhance curcumin stability, improve absorption, and achieve controlled or targeted release. These nanoformulations offer promising potential for treating chronic inflammatory disorders and malignancies. This study summarizes recent progress in curcumin nano-delivery systems and highlights their therapeutic advantages

## Methods

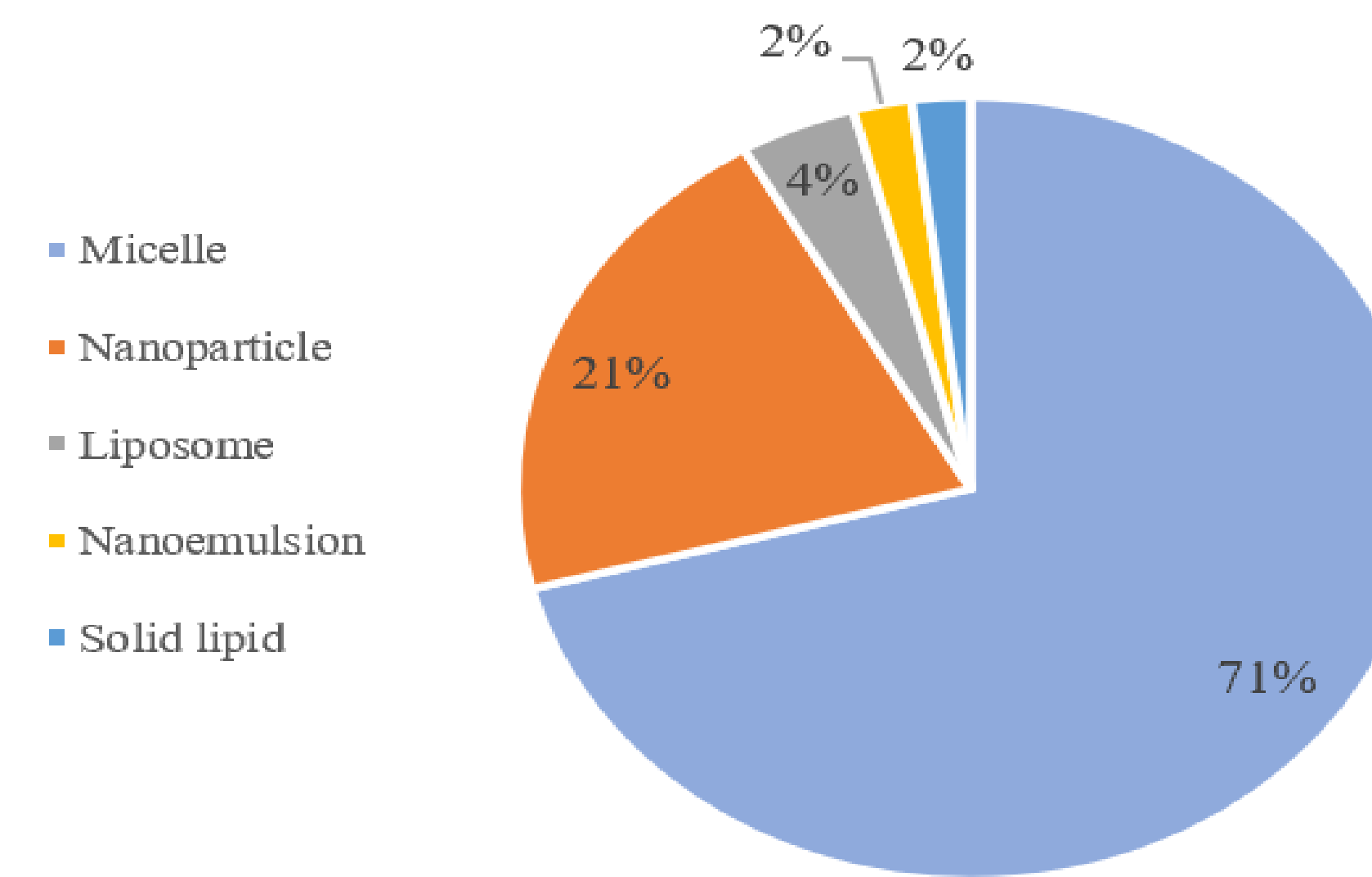
A structured literature analysis was conducted using Scopus, PubMed, ScienceDirect, and Web of Science databases (2015–2024). Keywords included “curcumin,” “nanocarriers,” “NLC,” “liposome,” “nanoemulsion,” “polymeric nanoparticles,” and “drug delivery.” Studies were screened for formulation parameters, physicochemical characteristics, release behavior, and biological or therapeutic outcomes. Comparative evaluation was performed between different nanocarriers regarding particle size, encapsulation efficiency, bioavailability enhancement, and in vitro/in vivo efficacy.

## Results

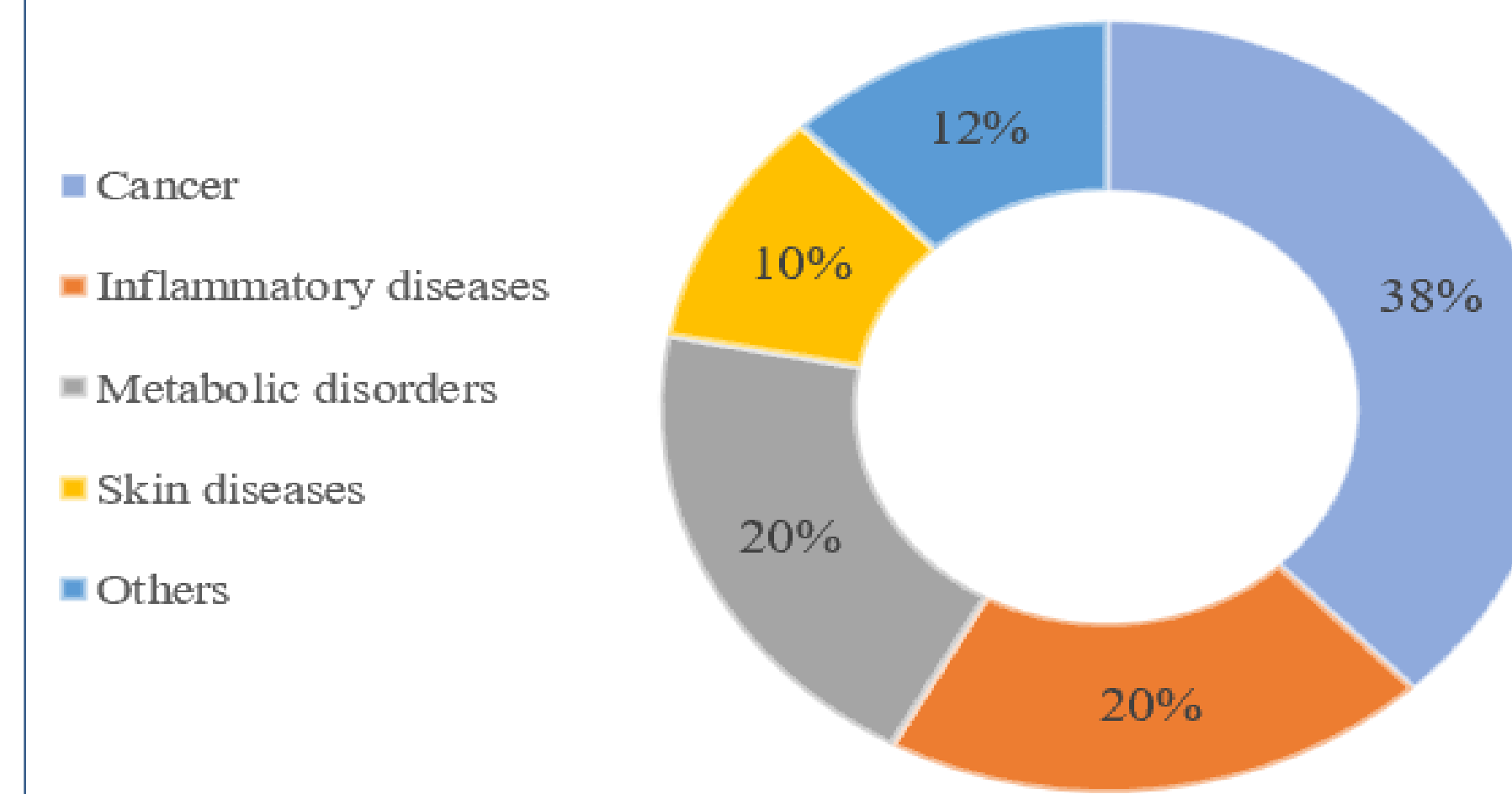
Nanocarrier systems such as nanostructured lipid carriers (NLCs), solid lipid nanoparticles (SLNs), liposomes, nanoemulsions, and biodegradable polymeric nanoparticles have significantly improved curcumin solubility and stability. Most formulations demonstrated high encapsulation efficiencies (>80%), sustained release profiles, and enhanced antioxidant or anti-inflammatory activity. In vivo studies showed improved pharmacokinetics and increased accumulation in inflamed or tumor tissues. Among different systems, NLCs and nanoemulsions displayed superior stability and bioavailability, while liposomes provided better biocompatibility and targeted delivery. Despite promising outcomes, variability in formulation techniques and limited human trials remain key limitations. Standardization of production methods and larger clinical studies are needed to validate therapeutic efficacy. The reviewed studies confirm that nano-delivery systems markedly enhance the therapeutic performance of curcumin by increasing solubility, protecting against degradation, and enabling controlled release. These advances offer strong potential for developing effective treatments for inflammatory diseases, skin disorders, metabolic syndromes, and cancers



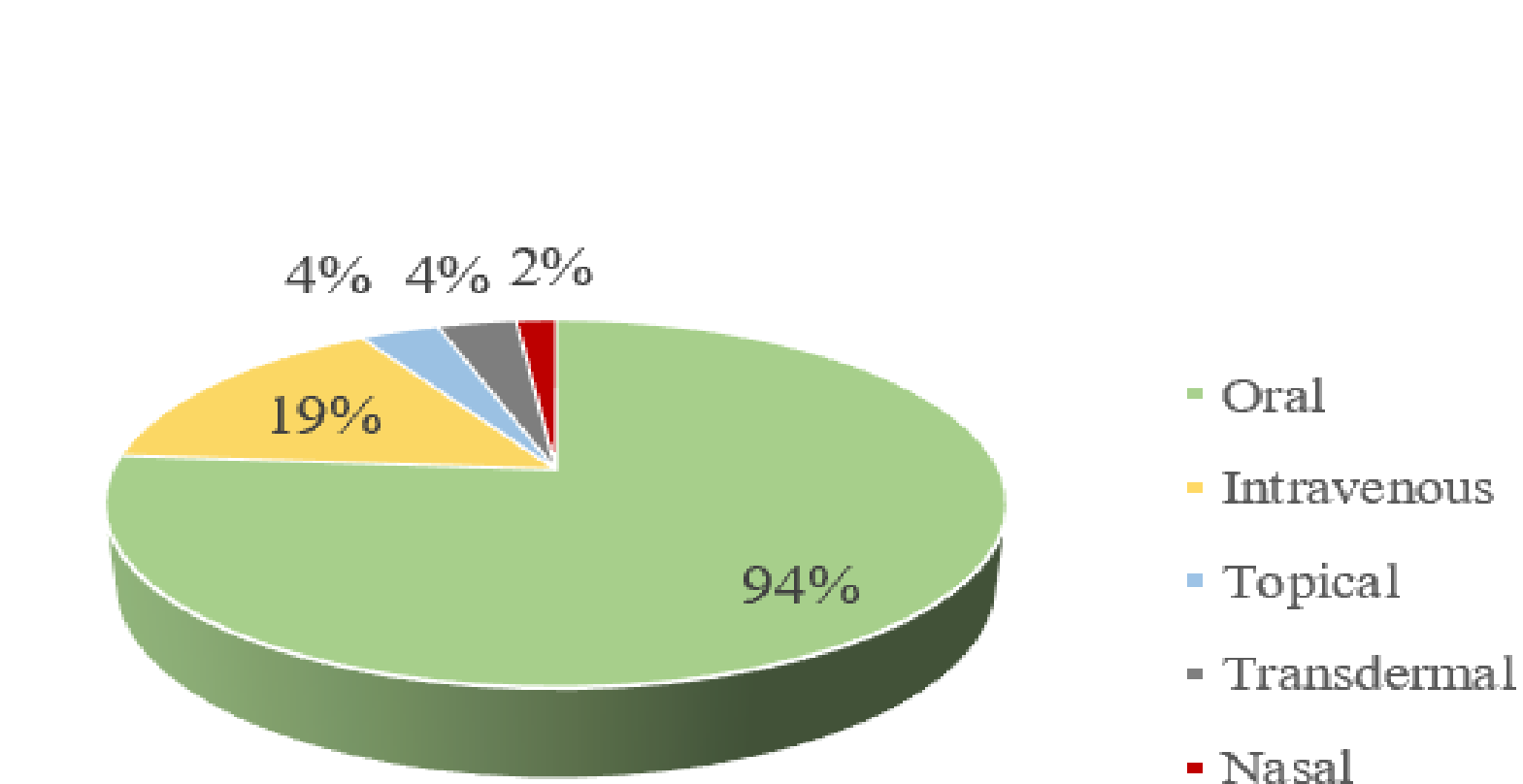
### A



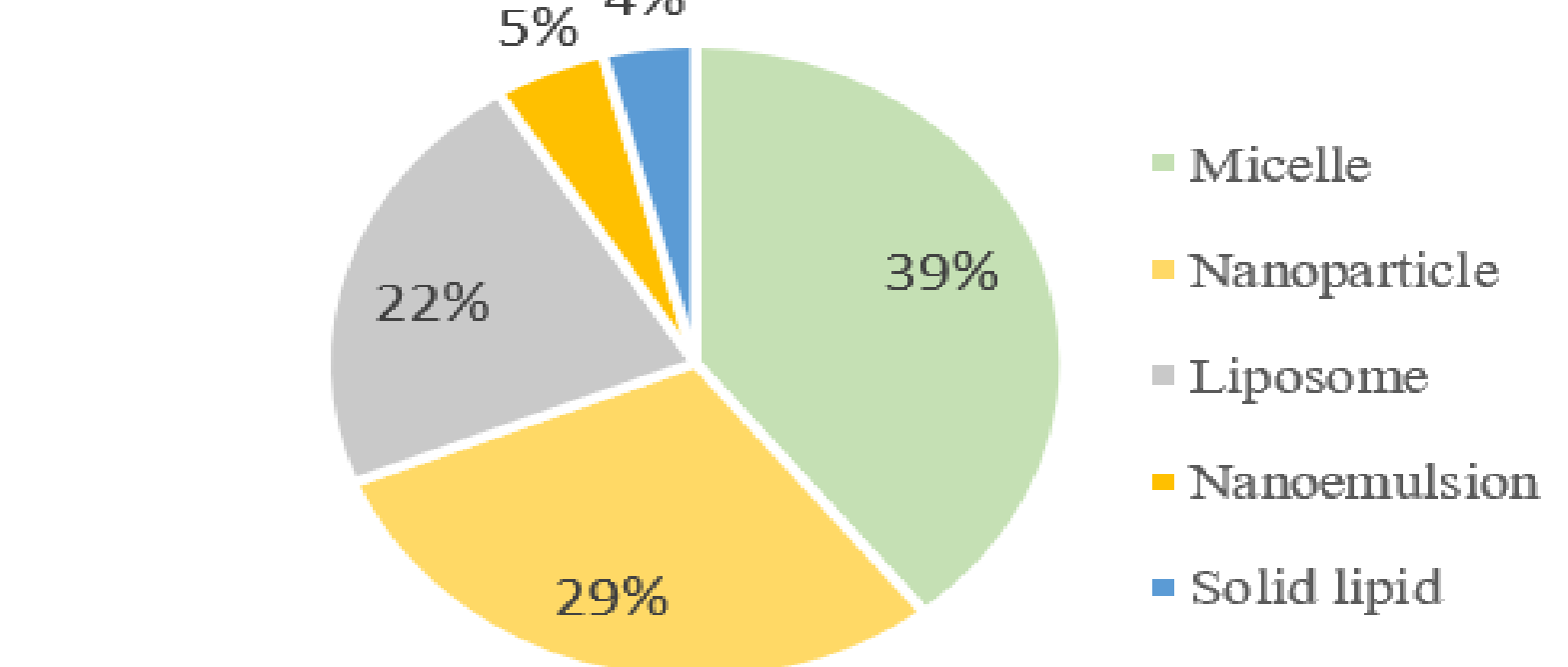
### C



### B



### D



## Conclusions

Nano-based delivery platforms represent a transformative strategy for overcoming curcumin's inherent limitations and maximizing its clinical benefits. Although current evidence is largely preclinical, the accumulated data strongly support further development toward standardized, scalable, and clinically validated nanoformulations. Continued research and well-designed clinical trials will be critical to translating these innovative systems into real therapeutic products.