

# Layer-by-Layer Lipid Nanoparticles for Enhanced Gene and Drug Delivery

US Patent pending  
US19/160,019

TRL 3

Pre-clinical stage  
Extra-hepatic delivery *in vivo* of dual payloads

ONCOLOGY, IMMUNOTHERAPY

\$300K  
Research funds raised



**Business Opportunity:**  
Licensing and Co-development

**Market Opportunity:**  
Global market: \$101.2B USD for lipid nanoparticles  
CAGR: CAGR 9.3% (2028)

**TIMELINE**

→ **Q1 2026**

**Q1 2027**

In vitro and in vivo proof-of-concept of targeting efficiency (Done)

LNPs stability after lyophilization validated (Done)

Validation of LNP platform on first indication: CAR-M

Validation of LNP platform on second indication: Glioblastoma

Scalability potential under investigation

## THE PROBLEM

The development of nanocarriers capable of encapsulating, targeting, and delivering Drug Substances (DS) has become the main challenging issue during the last three decades for biotechnology and pharmaceutical industries.

Ideally, an optimal drug delivery system would be able to promote high encapsulation efficiency and adequate stability of DS in both storage and physiological conditions, while maintaining bioactive properties of loaded cargo.

Moreover, the carrier platform would be easily modulated to target specific sites, allowing controlled spatial and temporal delivery of DS. Successful accomplishment of those hurdles has been expected to allow improvement of bioavailability of DS as well as to minimize side effects for patients. Lipid-based nanocarriers have been frequently proposed to achieve such mentioned requirements.

## OUR SOLUTION

**A system that combines the advantages of LNPs and layer-by-layer assembly (LbL)**

The LbL technique allows surface modification of LNPs, thus creating an organized multilayered structure with tunable properties, functionalities, and applications. It results in a more efficient targeting process and gene delivery as compared to plain LNPs, or nanoparticles in general.

The system also provides a simple and effective way to develop drug combinations. Such combinations may include encapsulated nucleic acids and hydrophobic drugs for dual targeted treatment. In vitro and in vivo results obtained with these proposed LbL assembled LNPs demonstrate superior targeting ability as compared to commercially available delivery agents, enhanced gene delivery when compared to non-modified LNPs (current gold standard for gene delivery) and blood barrier crossing properties.

What sets our LbL apart is their remarkable stability after lyophilization, maintaining size, charge, and functionality. This ensures extended shelf life, efficient rehydration, and structural integrity. Additionally, their design supports hepatic bypass, reducing clearance and enhancing the bioavailability of active molecules for targeted clinical use.

## MARKET

**Target users include:** • Biotech and pharma companies  
• Research centres and academia  
• CRO and CDMO

**Market application:** • Drug development and formulation  
• Drug delivery systems  
• Gene therapy

- The global market for nanoparticles for life science applications reached \$102.7B USD in 2023 and is expected to grow to \$156.8B USD in 2028.
- The main application is drug delivery systems, which in 2023 accounted for just over 50% of the market, or \$53.8B US.
- In terms of the type of nanoparticles, liposomes represent the largest market (65%); \$101.2B US in 2028) and the fastest growth rate (CAGR 9.3% in 2028).

## TEAM

Pierre Hardy  
CHUSJ, Lead PI

Xavier Banquy  
Université de Montréal

Houda Tahiri  
CHUSJ

Victor Passos Gibson  
CHUJ

Chun Yang  
CHUSJ