NanoVac | An Advanced Platform for Nucleic Acid and Protein Delivery

June 2025

Non-Confidential Deck

LUNA LABS

NanoVac is backed by an experienced and innovative team

James Garrett, PhD, MBA – CEO

- 20+ years in corporate guidance and product development
- PhD, Penn State University
- MBA, William & Mary

Yang Xu, PhD – Principal Investigator

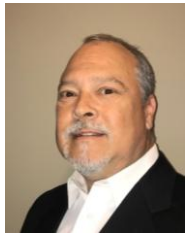
- 15+ years managing vaccine development pipelines.
- PhD, Nanjing University, Chemistry

Moriya Tsuji, PhD, MD - Professor of Medicine at Columbia University

- Aaron Diamond Aids Research Center
- 35+ years immunology and infectious diseases using HIS mouse models

Drake Goolsby, MBA – CCO

- 20+ years in business development including PepsiCo and Battelle
- B.S. Louisiana Tech ME
- MBA and MHA



Brad Brooks – Molecular Biologist

- 30+ years in cell/molecular labs
- B.S. Biology, Minor in Chemistry, UNC-Greensboro

Xiangpeng Kong, PhD – Professor of Molecular Pharmacology at NYU

- 30+ years in structural biology, structure-based immunogen design
- HIV/AIDS vaccine discovery

Chris Tison, PhD – Director

- 15 years managing biotech R&D
- PhD, Georgia Tech, Materials Science & Engineering, Biomaterials
- MBA, William & Mary (June 2025)

Jiang He, PhD – Associate Professor of Radiology & Medical Imaging at UVA

- 20+ years in isotope labelling for molecular imaging and therapy
- Clinical trials and radiopharma

Legal: Sean Liu, Nixon & Vanderhye

Regulatory: NSF Health Sciences and NAMSA

Pre-Clinical: MI State, UVA, CRL

NYU

MICHIGAN STATE UNIVERSITY

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UNIVERSITY of VIRGINIA

COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

NIXON VANDERHYE

NSF Health Sciences

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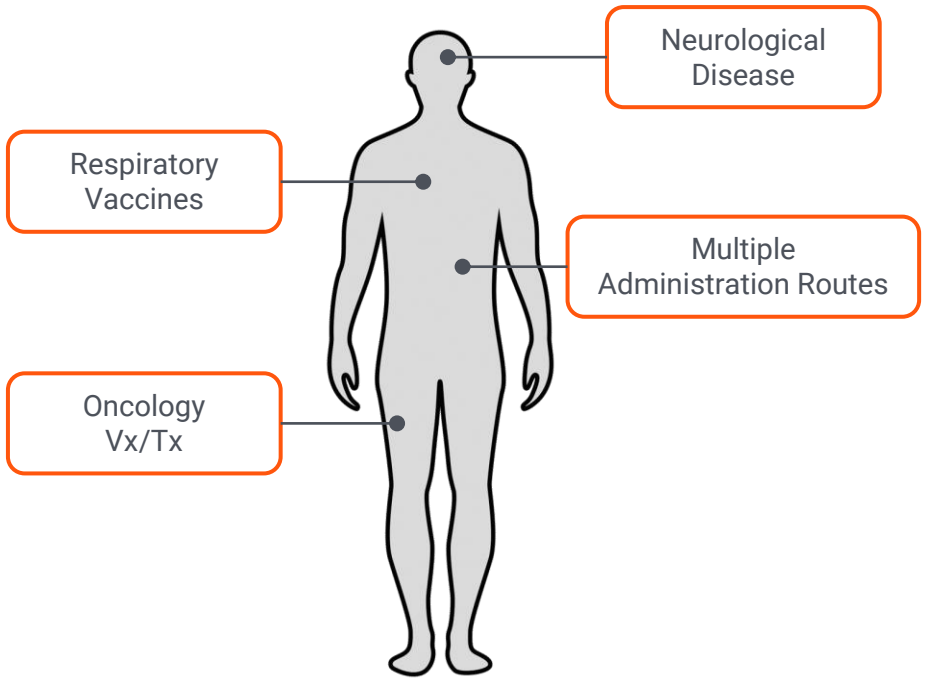
Market timing is right for NanoVac to be integrated in a wide range of disease targets

NanoVac is a Breakthrough Delivery Platform



Potential Markets

Respiratory Vaccines, Neurological Disease, Cancer Therapeutics

$128B mRNA product market size by 2030, growing at 13% CAGR

$74B combined global addressable market in current pipeline

Rapid Market Growth: 15% CAGR (PDAC), 9% (AD), 6% (Vax)

0.5M new PDAC patients per year, highest cancer mortality

6.2M Americans with Alzheimers, expected to double by 2060

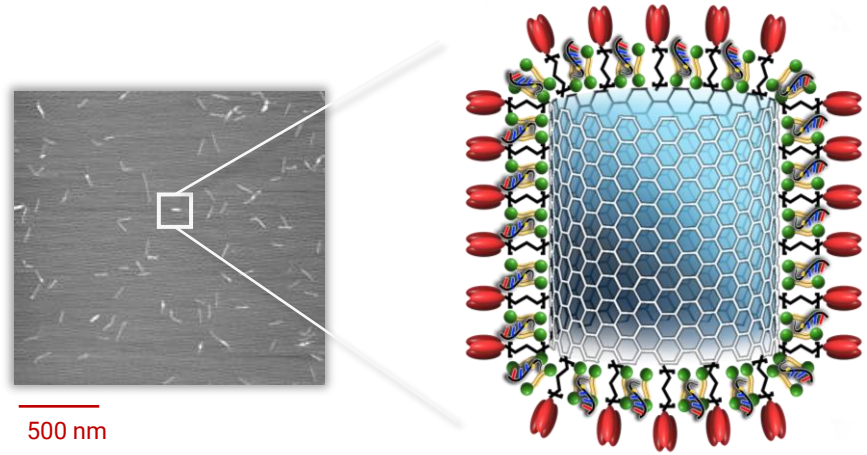
Sources: Precedence Research, Verified Market Research, Vantage Market Research

"The battle really is about [which company] is going to be, in the future, the go-to source that other companies may have to license from."

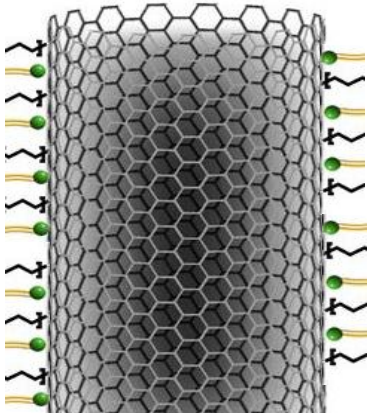
– Ameet Sarpatwari, Pharma Policy & Law, Harvard University, discussing mRNA intellectual property space

Value Drivers for Partnership

- **Diversity of verified payloads**: ranging from small siRNA to large proteins we can rapidly transition to new payloads for quick milestone-based joint development efforts
- **Avoids sequestration by the liver**: unlike LNPs, NanoVac reduces toxicity concerns and improves potential for tissue-specific targeting
- **Demonstrated non-immunogenic**: The NanoVac vehicle causes no immune response, but provides an adjuvant-like effect when loaded
- **Versatile delivery**: designed for compatibility with IN, IM, and IV administration
- **Reduces cold-chain transport requirements**: unique chemistry eliminates the need for deep freeze even for nucleic acid payloads.



NanoVac can be customized by delivery method and payload

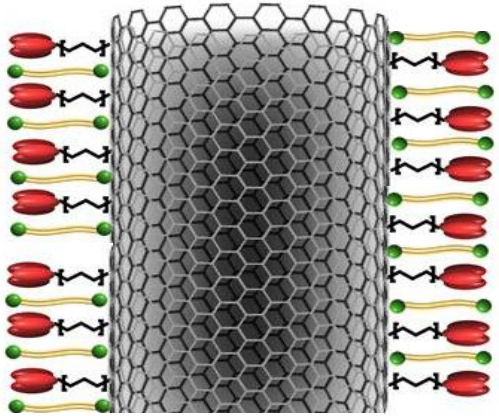


NanoVac Vehicle

-Controllable size

-Biodegradable

-Supports biocompatibility and circulation

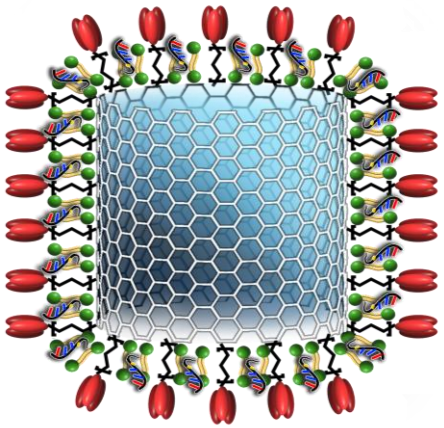


NanoVac Payload

-Can be immobilized with proteins, nucleic acids, or both

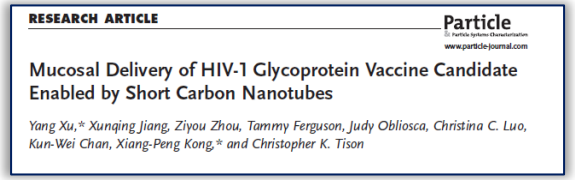
-Allows control of antigen density and presentation

-Therapeutic and vaccine applications



NanoVac-Asset

- Multiple funded partnerships



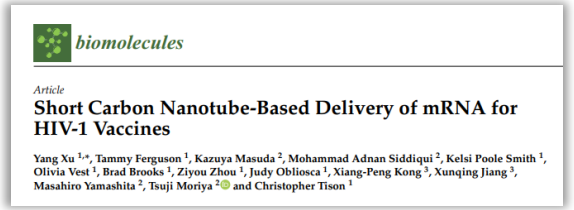
RESEARCH ARTICLE

Particle

www.particle-journal.com

Mucosal Delivery of HIV-1 Glycoprotein Vaccine Candidate Enabled by Short Carbon Nanotubes

Yang Xu,* Xunqing Jiang, Ziyou Zhou, Tammy Ferguson, Judy Obliosca, Christina C. Luo, Kun-Wei Chan, Xiang-Peng Kong,* and Christopher K. Tison



biomolecules

Article

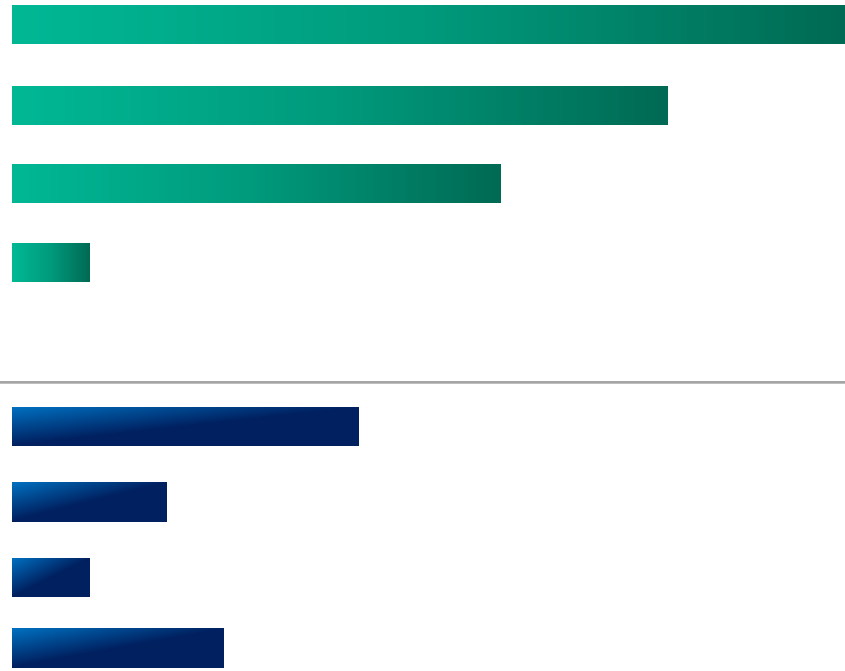
Short Carbon Nanotube-Based Delivery of mRNA for HIV-1 Vaccines

Yang Xu [1,*], Tammy Ferguson [1], Kazuya Masuda [2], Mohammad Adnan Siddiqui [2], Kelsi Poole Smith [1], Olivia Vest [1], Brad Brooks [1], Ziyou Zhou [1], Judy Obliosca [1], Xiang-Peng Kong [3], Xunqing Jiang [3], Masahiro Yamashita [2], Tsuji Moriya [2] and Christopher Tison [1]

[1] *Vaccine development effort funded by US Army Medical Research Acquisition Activity, National Institute of Allergy and Infectious Diseases, and National Institute of Mental Health*

Overview of current NanoVac pipeline

Payload / Indication	Discovery	IND-Enabling	Clinical
Vaccines			
Spike Protein mRNA (V1V2)			
Spike Protein (V1V2)			
Combo mRNA (trimer + T-cell peptide)			
Targeted mRNA (neoantigen, targeting)			
Payloads			
Mosquito hemocyte antigen (protein/peptide)			
Self-Assembling RNA (saRNA)			
Ab-Drug Conjugate (Radiopharma Theranostic)			
MAPT-targeting siRNA (Alzheimer's Disease)			



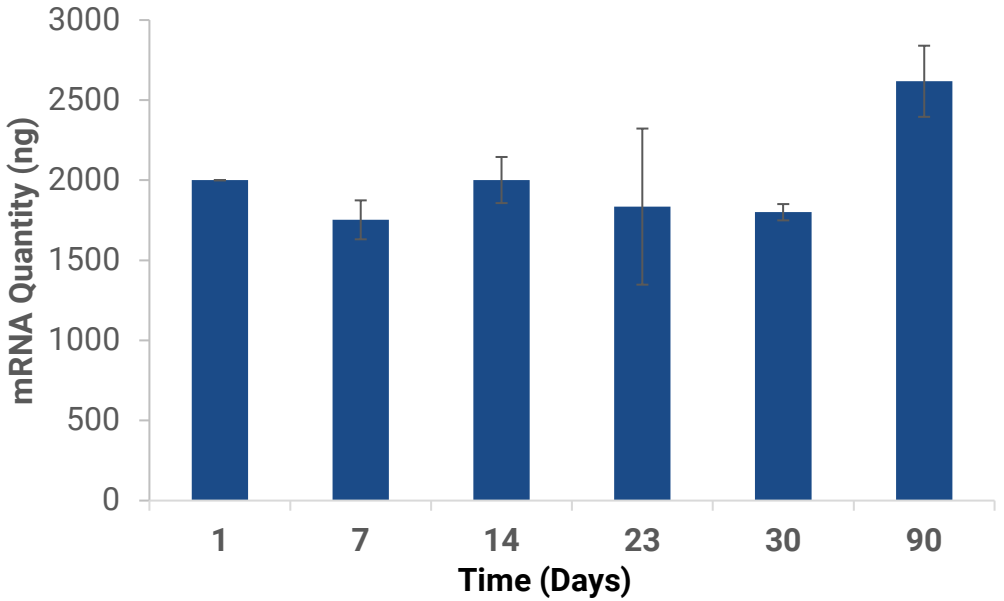
Luna Labs is exploring partnerships for our existing pipeline and for new payloads or indications.

NanoVac can deliver diverse payloads

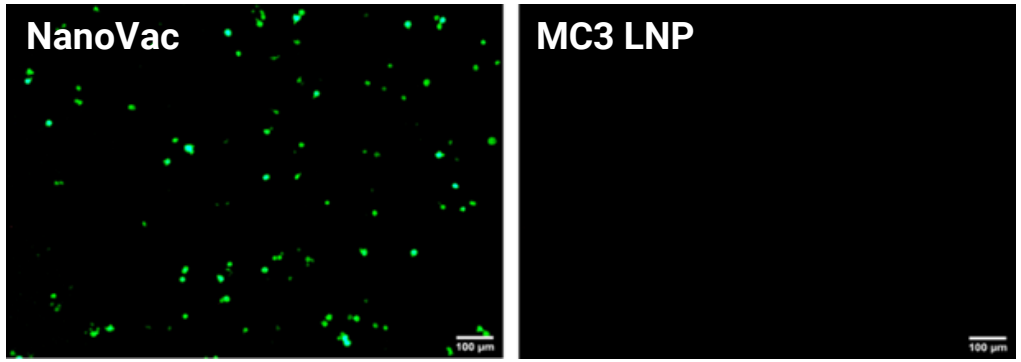
	RNA	Proteins / Peptides	DNA
Confirmed Loaded and Delivered	V1V2 encoding mRNA eGFP encoding mRNA GP140 encoding mRNA GFP saRNA MAPT-targeting siRNA	V1V2 Trimeric GP Luciferase BSA Catalase KLH T-cell targeting peptide	ssDNA Plasmid dsDNA
Size	**mRNA**: 300 – 2100 NT **saRNA**: 8600 NT **siRNA**: 21 NT	1100 Da – 4 MDa	10 NT – 12kbp
Loading Efficiency	70 – 100%	60 – 99%	75 – 100%
Loading Density (per vehicle)	37 – 236	1 – 470	4 – 526

The NanoVac vaccine platform stabilizes mRNA and enhances uptake and translation

mRNA remains stable with NanoVac over a 90-day period under refrigeration, and demonstrates significantly enhanced transfection and mRNA translation in THP-1 cells



mRNA immobilized on the NanoVac Vehicle was stable and undegraded over 90 days of refrigerated (4 ˚C) storage. Provides storage over months-long periods using only refrigeration.

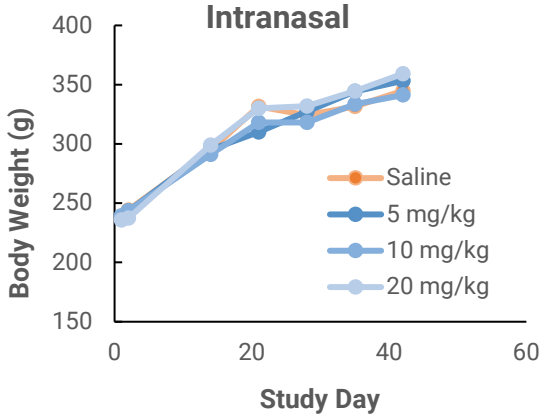


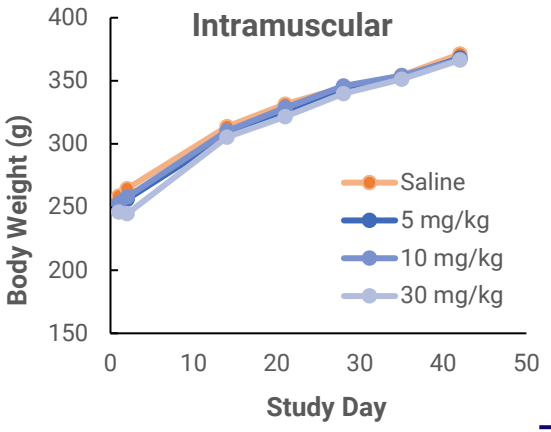
Cellular transfection studies in THP-1 cells for eGFP mRNA after 90 days of refrigerated storage with NanoVac or LNP.

The NanoVac vehicle is well-tolerated following both intranasal and intramuscular administration in rats

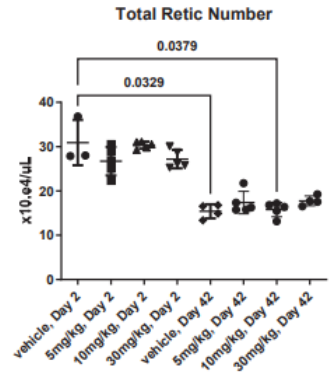
No adverse effects observed in body weight, organ weight, hematology (Retic), or biochemistry (BUN)

Body Weight

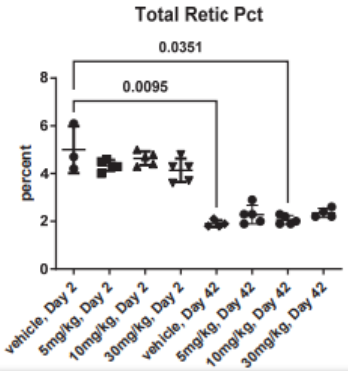




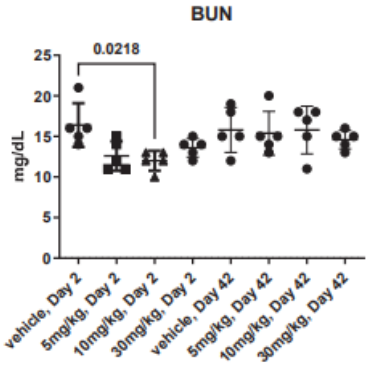
Hematology (Reticulocyte Analysis)



p-value shown if <0.05



Clinical Chemistry (Blood Urea Nitrogen)



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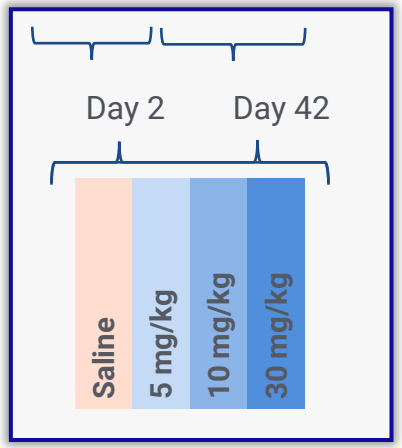
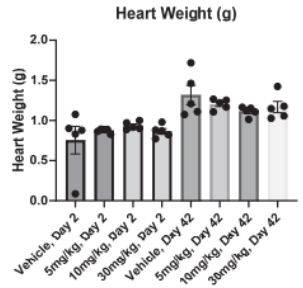
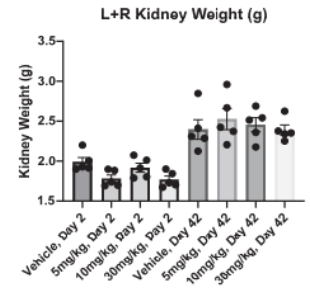
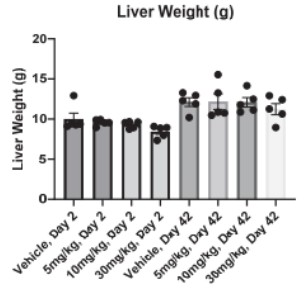
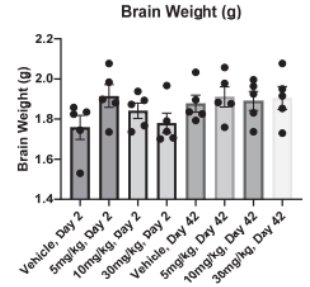


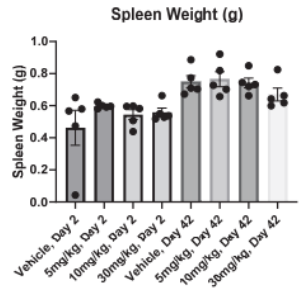
Organ Weight









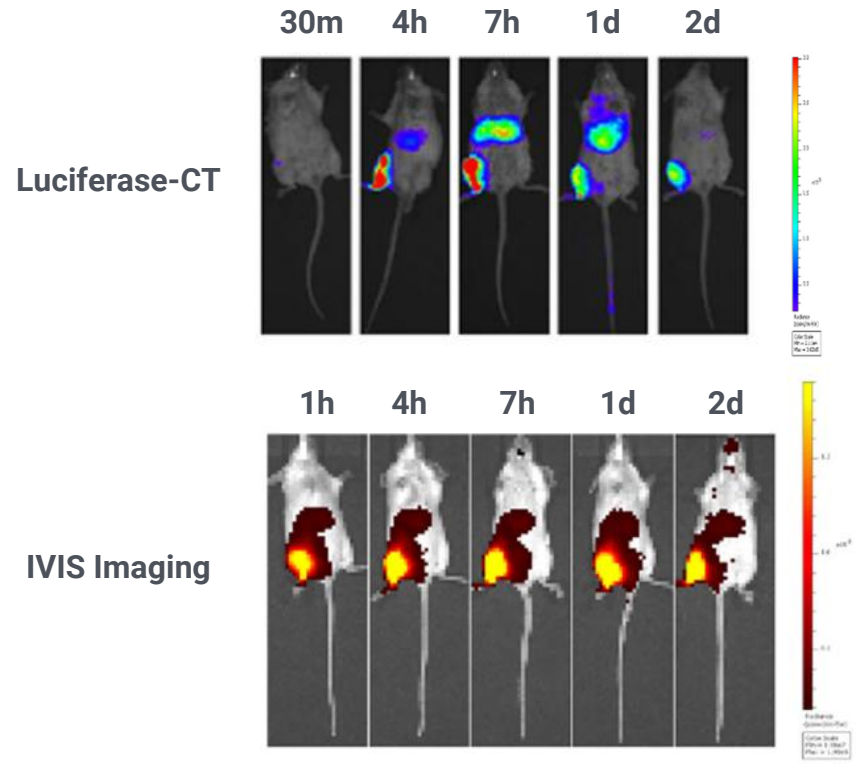


*Full **IM** data shown on right. Data available for IN.*

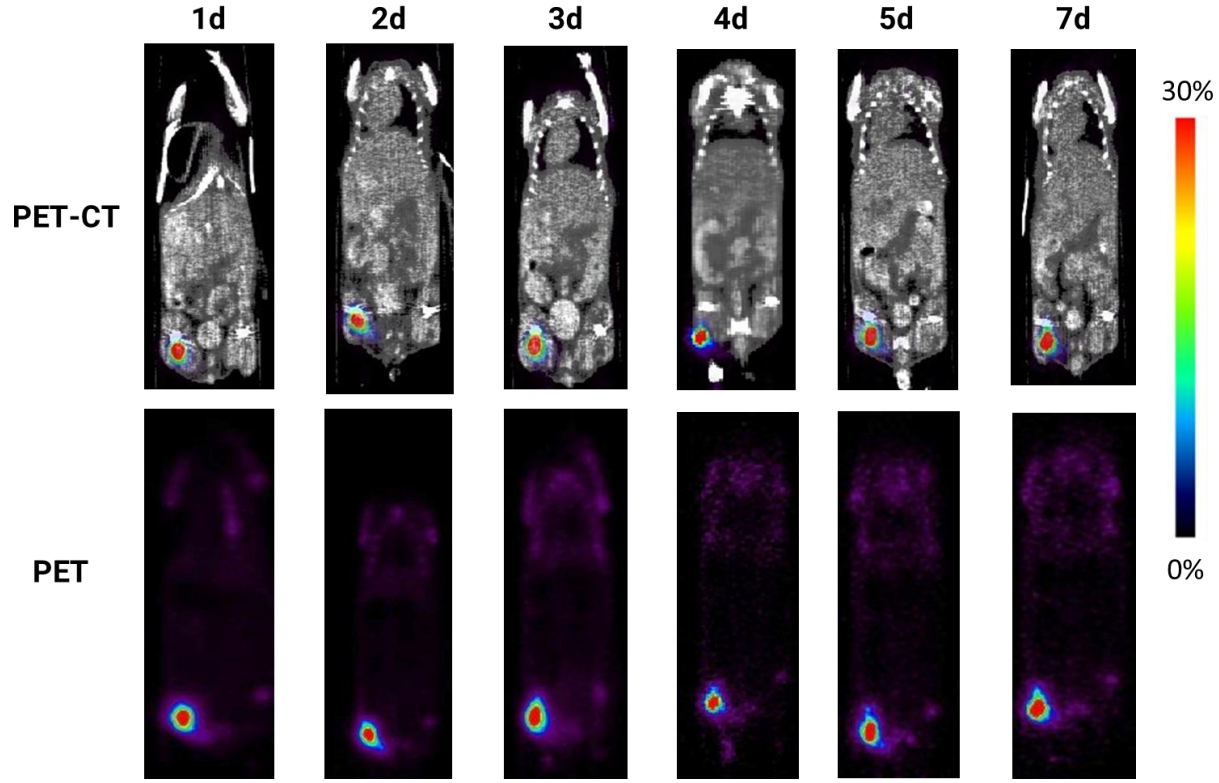
NanoVac avoids sequestration by the liver

- Up to 20% of lipid nanoparticles (LNPs) are captured by the liver in the first 24 hours after IM injection[1]
- Hepatic capture of NanoVac remains at 2% or less during entire 7-day study
- Broad distribution across all organs, with no statistical significance in distribution between liver, heart, kidneys, lung, spleen, stomach, or intestines, demonstrates potential for tissue targeting during circulation.

LNP Vehicle



NanoVac

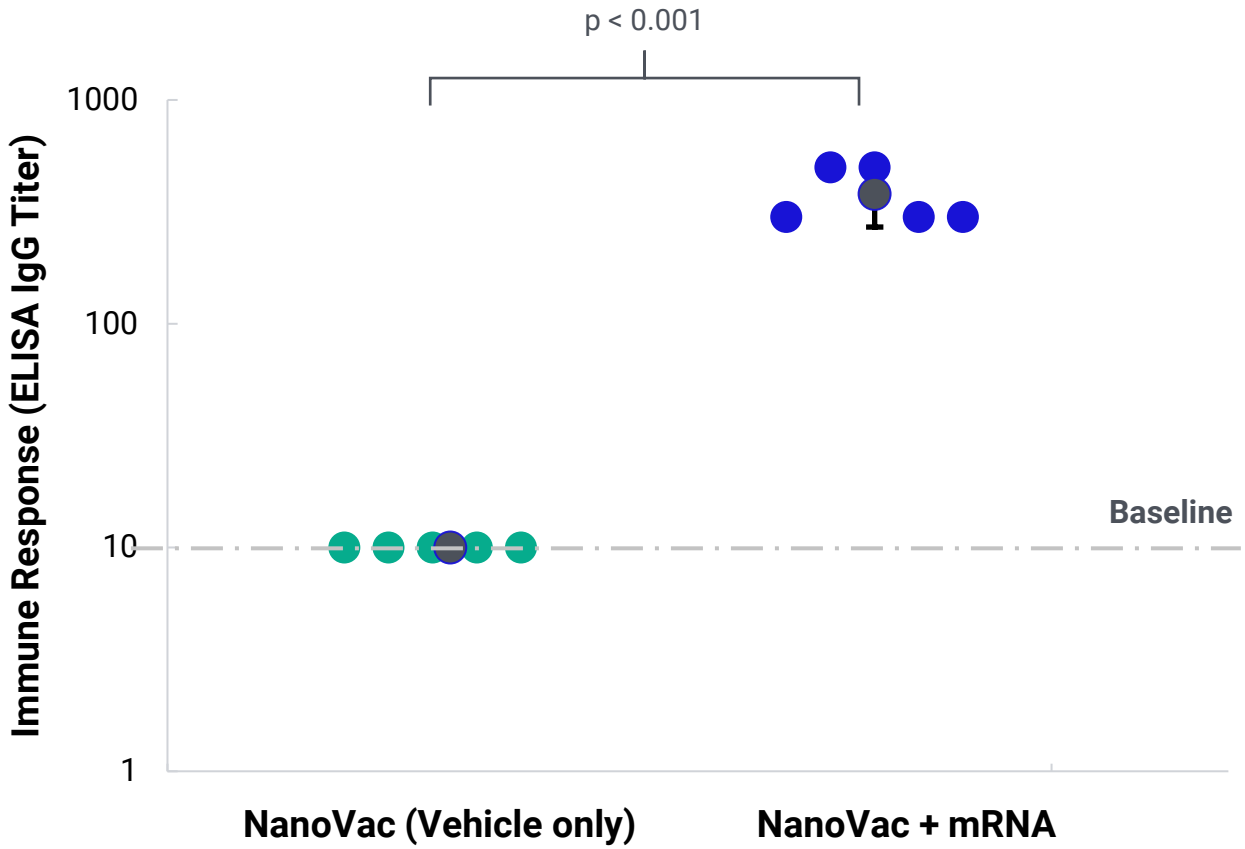


[1] *Di et al. Biodistribution and Non-linear Gene Expression of mRNA LNPs Affected by Delivery Route and Particle Size. Pharm Res. (2022) 39: 105-114*

Pre-clinical studies demonstrate the NanoVac vehicle is non-immunogenic

NanoVac vehicle alone shows a non-immunogenic baseline response, but an enhancement of IgG response with payload as compared to control

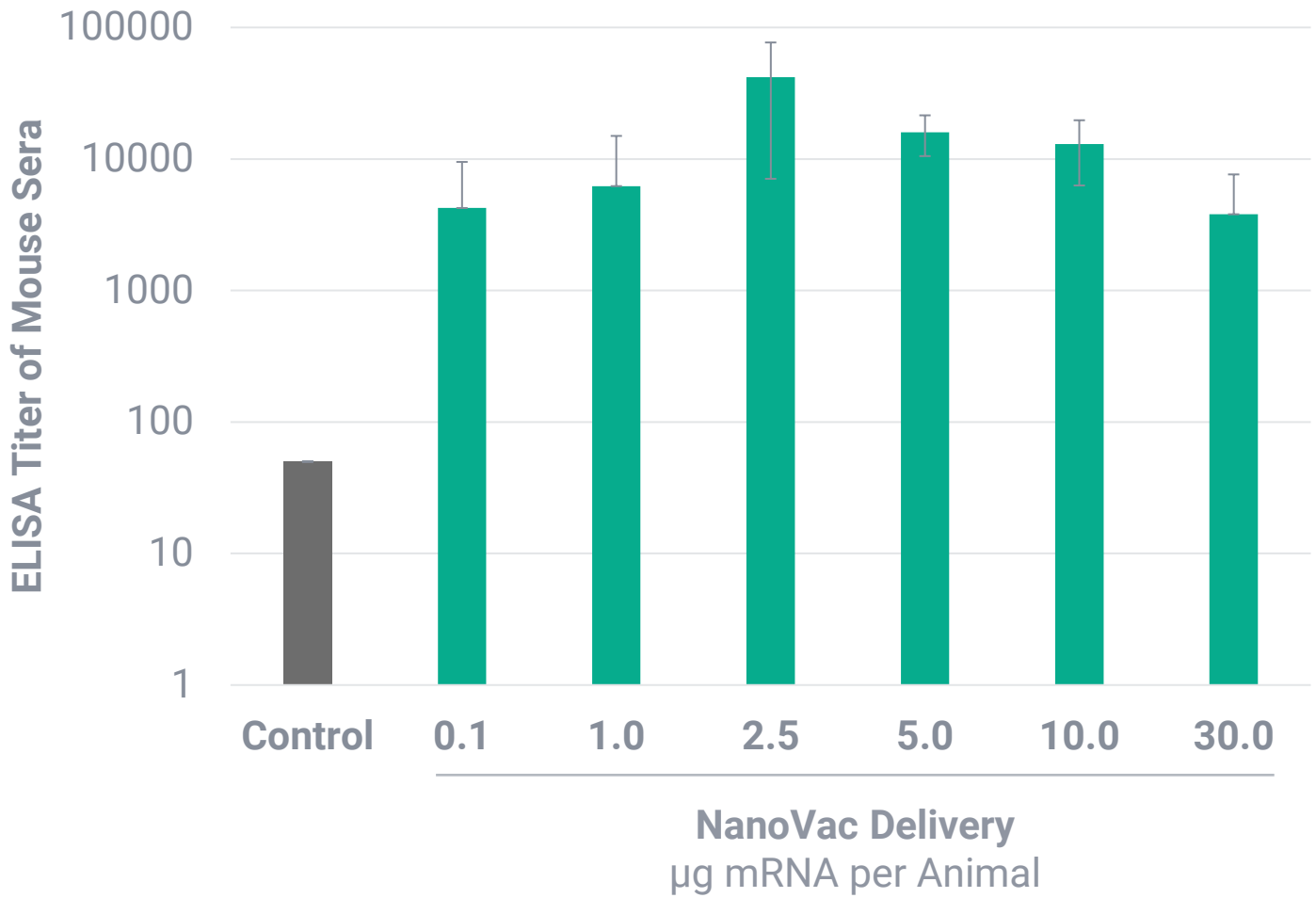
- Humanized mice
  - 300 µg/mouse dosing of vehicle
  - 30 µg/mouse dosing of payload*
- Animal serum evaluated via ELISA
- Results presented from two weeks post-dose



*Trimeric GP140; see Case Study

Dosing down to 0.1 µg payload per animal resulted in ELISA titer and immune response

- Dosing in mice using representative payload*
- Two doses (3 wk. interval) administered via IM.
- 5 mice per group.
- Analysis done 2 weeks after final dose
- Response at 0.1 µg/animal is statistically identical to that at 30 µg/animal.



Trimeric GP140; see Case Study

A cGMP NanoVac manufacturing strategy is now being implemented with Fortis Life Sciences

cGMP and ISO 9001:2015 compliant production of NanoVac began May 2025

- Standard operating protocol designed and approved
- Prepared to manufacture for GLP-Tox studies
- Produced using clinical grade material and reagents
- Processing modifies surface chemistry and enhances biodegradation of vehicle[1,2]
- Transition to scalable purification and sterilization processes

Elemental Analysis

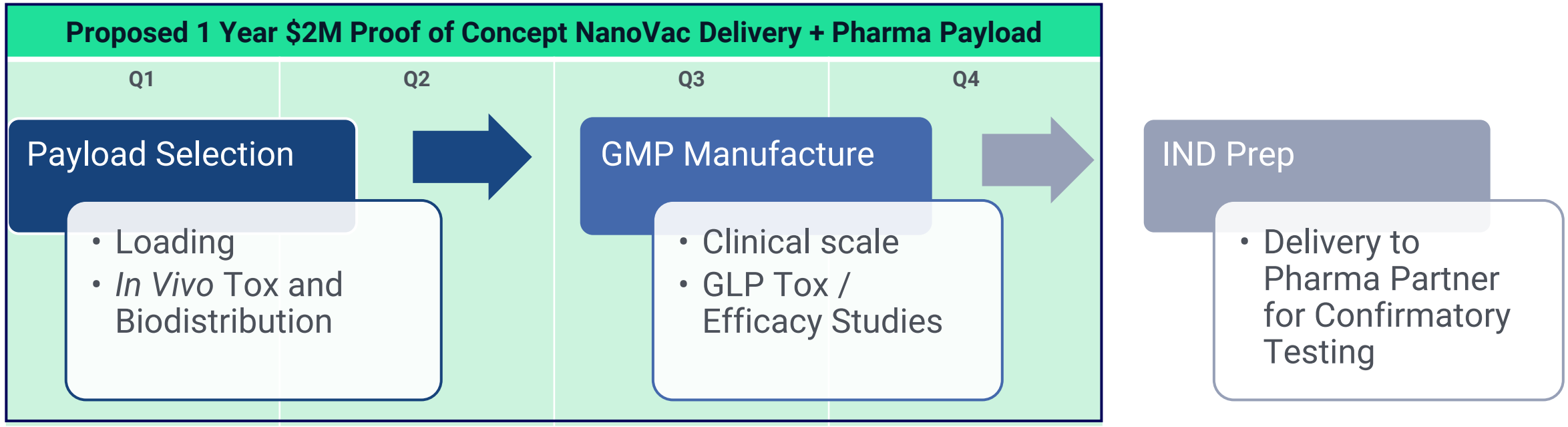
Label	Concentration (ppm) Average ± Std. Dev.
Na 589.592	1.806 ± 0.256 *
Co 238.892	0.001 ± 0.002
Cu 327.395	0.016 ± 0.001
Ni 231.604	1.808 ± 0.167

Vehicle Properties

Zeta potential (Surface charge mV)	Average size (DLS nm)
- 49.9	124.2 ± 24.61

[1]Yang and Zhang, *Biodegradation of Carbon Nanotubes by Macrophages*. Front. Mater. (2019). 6.
[2]Zhao Y, Allen BL, Star A. *Enzymatic degradation of multiwalled carbon nanotubes*. J Phys Chem A. (2011). 115, 34.

NanoVac is well positioned for proof-of-concept partnerships



- Single payload class selection and targeting molecule with clearly defined endpoints in rodent models
- Partner has option to cancel effort after each stage
- Milestones include GLP tox, demonstration of targeting, efficacy of payload expression at target tissue
- Final product delivered as pilot-scale GMP quality for confirmatory testing at partner site

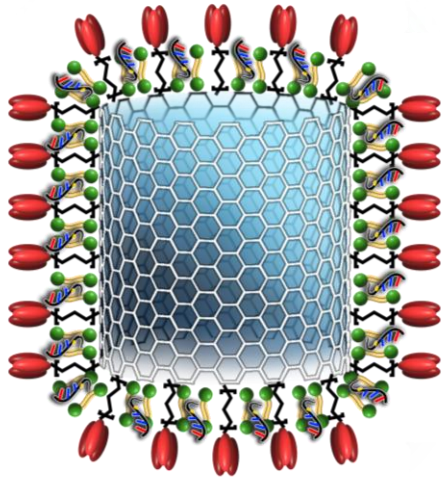
Case Study

HIV-1 Vaccine Asset Development

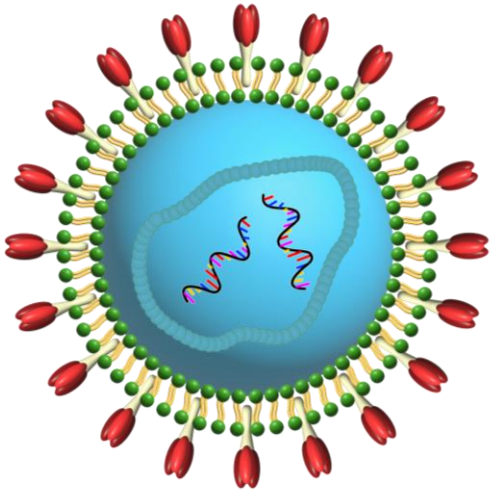
NanoVac is currently being implemented in HIV-1 vaccine development in partnership with Columbia University

Can be engineered to mimic size, shape, and antigen presentation of virion

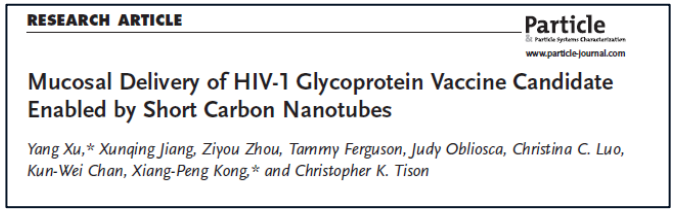
- Mimics **virion size and density** of its antigen presentation
- Optimizes **presentation of** antigens enhancing cellular uptake
- Stimulates **systemic and long-term** immune responses
- Multiple payloads (obtainable assets) including mRNA and protein V1V2, trimeric glycoprotein, and T-cell targeting peptide



NanoVac Asset Designed to Mimic Virion Structure



Virion



RESEARCH ARTICLE

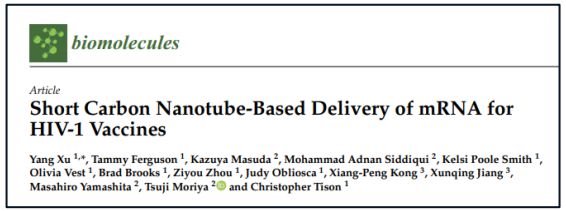
Particle

Particle Systems Characterization

www.particle-journal.com

Mucosal Delivery of HIV-1 Glycoprotein Vaccine Candidate Enabled by Short Carbon Nanotubes

Yang Xu, Xunqing Jiang, Ziyou Zhou, Tammy Ferguson, Judy Obliosca, Christina C. Luo, Kun-Wei Chan, Xiang-Peng Kong,* and Christopher K. Tison*



biomolecules

Article

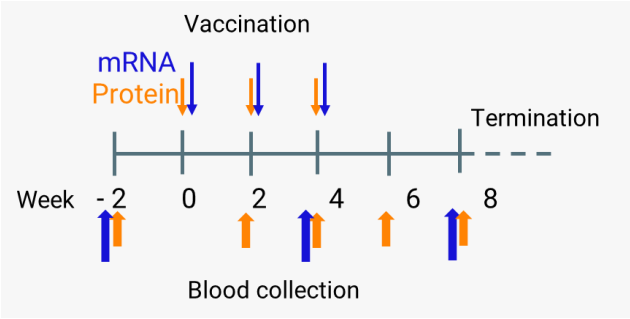
Short Carbon Nanotube-Based Delivery of mRNA for HIV-1 Vaccines

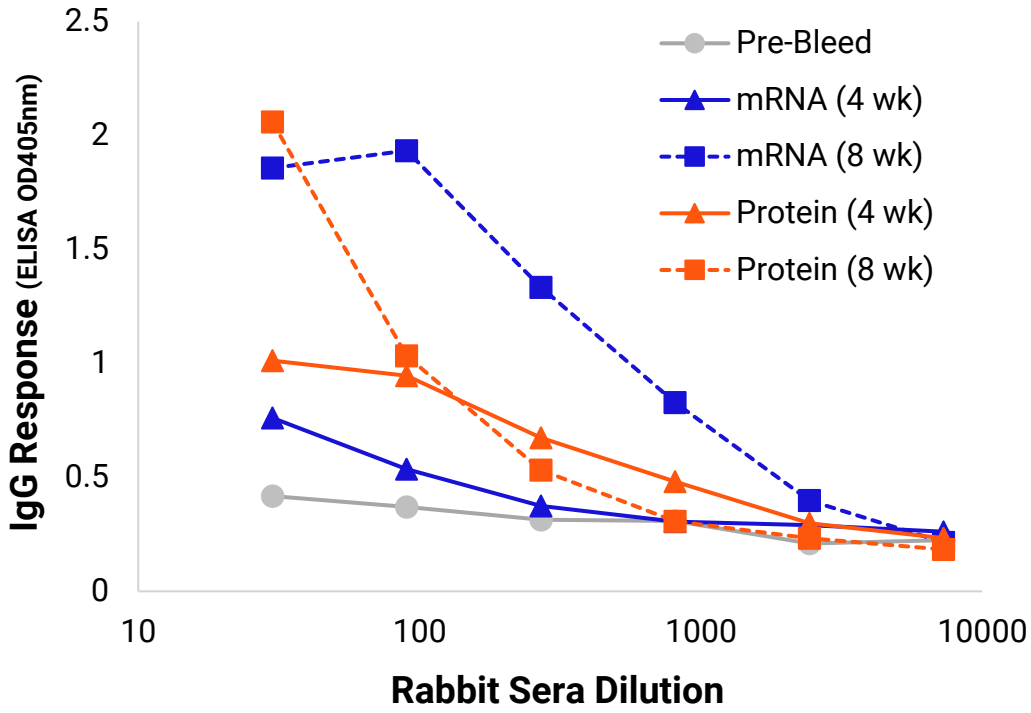
Yang Xu [1,*], Tammy Ferguson [1], Kazuya Masuda [2], Mohammad Adnan Siddiqui [2], Kelsi Poole Smith [1], Olivia Vest [1], Brad Brooks [1], Ziyou Zhou [1], Judy Obliosca [1], Xiang-Peng Kong [3], Xunqing Jiang [3], Masahiro Yamashita [2], Tsuji Moriya [2] and Christopher Tison [1]

NanoVac is a successful delivery platform for both mRNA and proteins in a preclinical rabbit model of HIV-1

Proof-of-concept data demonstrates feasibility for HIV-1 Vaccination and other mRNA-based therapeutics

- NanoVac V1V2 utilizing glycoprotein presentation stimulates an earlier immune response (**orange**)
- NanoVac V1V2 using mRNA-based protein production shows enhancement and preservation of a longer lasting response (**blue**)

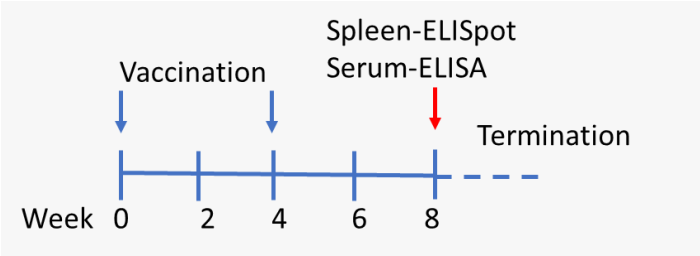


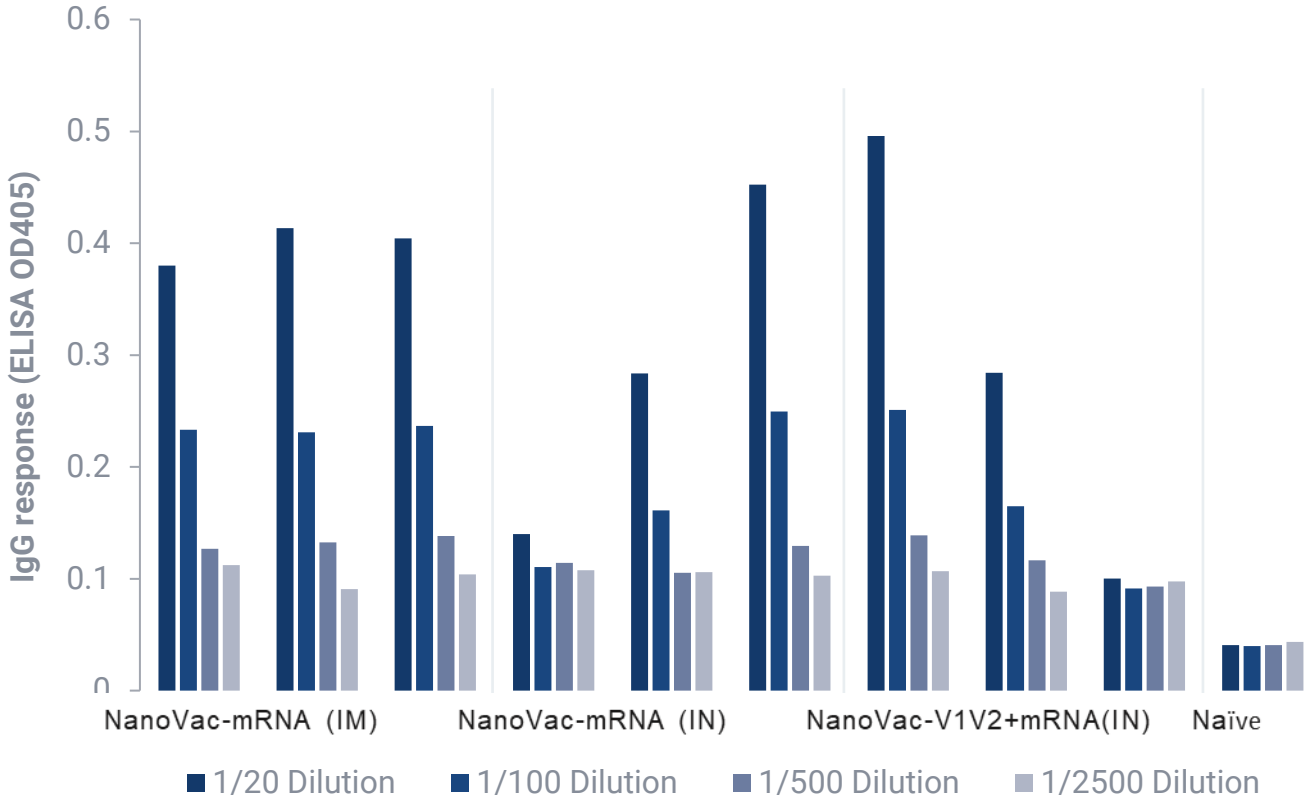


NanoVac V1V2 HIV-1 vaccination candidate generates significant humoral response

NanoVac intramuscular administration induces significant IgG response, with increased consistency via IM administration

- All three vaccine groups of HIS-A2/DR4 mice generated humoral responses that resulted in significant human IgG titers against HIV V1V2
  - NanoVac-mRNA (IM)
  - NanoVac-mRNA (IN)
  - NanoVac-V1V2+mRNA (codelivery, IN)
- IM administration of NanoVac-mRNA induced consistently high IgG response, even at 1/2500 dilution

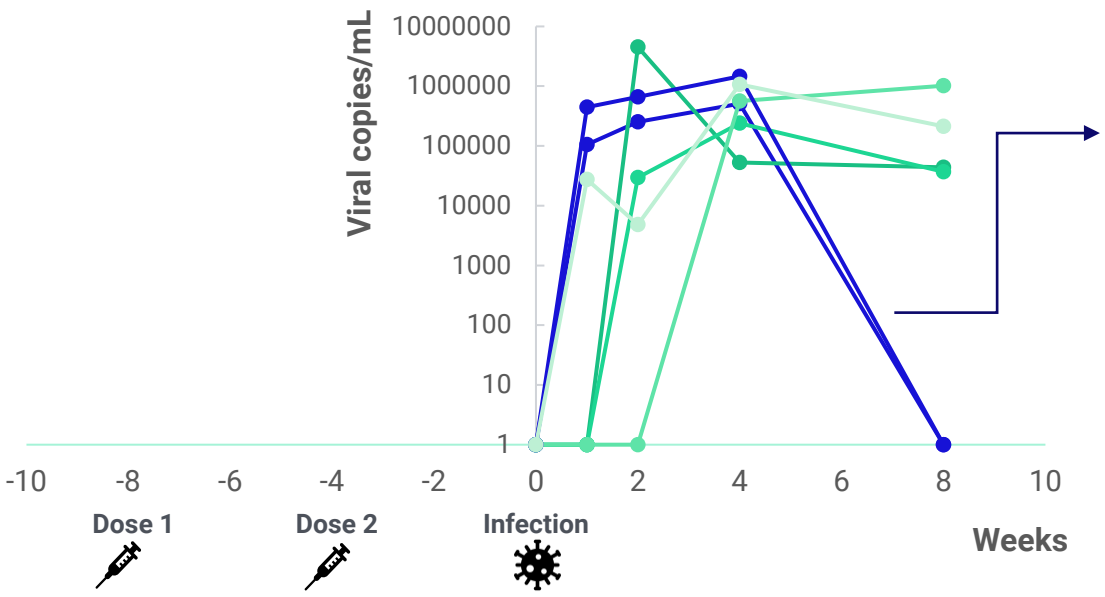


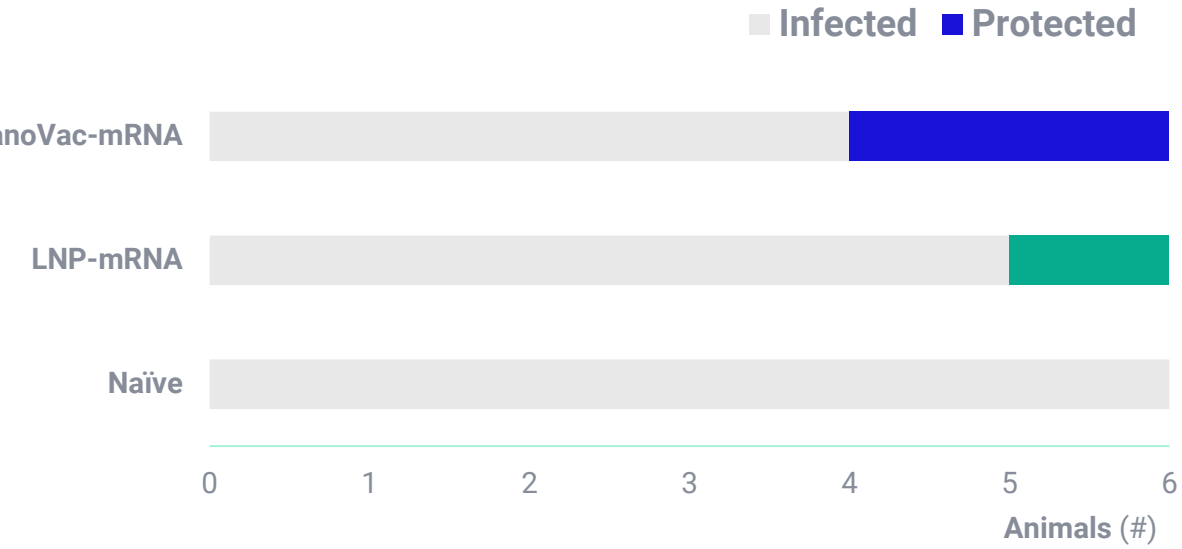


NanoVac mRNA V1V2 was more effective at vaccinating against HIV-1 than standard lipid NP-mRNA delivery

In a humanized mouse model, 2 of 6 NanoVac animals challenged with HIV-1 cleared infection vs. 1 of 6 of animals in the LNP control group

- Humanized mice were IM administered NanoVac-mRNA or Lipid NP-mRNA
- 33% protection rate demonstrated with NanoVac-mRNA after clearance of viral load



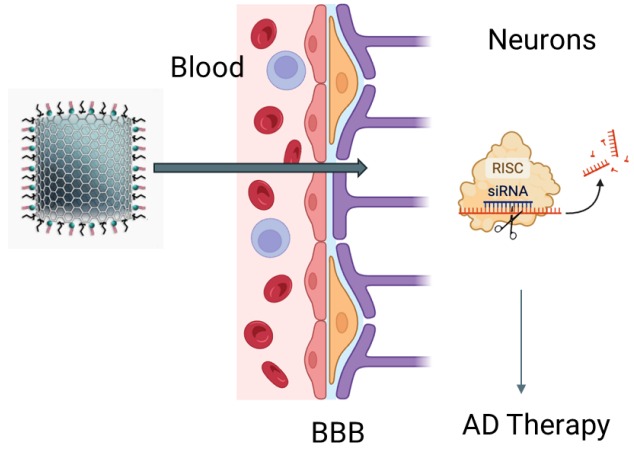


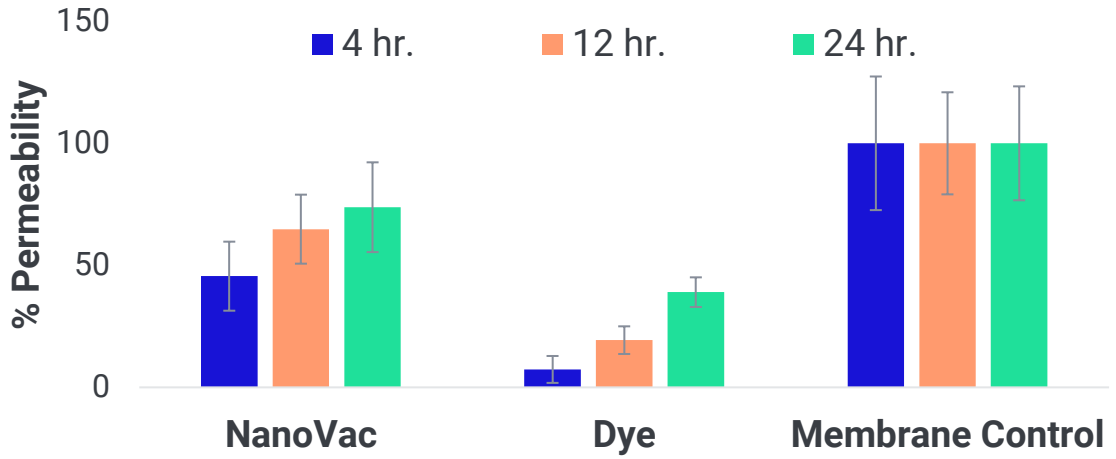
Pipeline Opportunities

siRNA | Neurological Disease Mitigation

- **Problem**
  - No cure for Alzheimer's disease (AD) caused by accumulation of tau tangles encoded by the MAPT gene in the brain
  - Challenges to siRNA delivery include crossing the BBB and maintaining effectiveness of the siRNA in the brain
- **Opportunity**
  - Overcome BBB and provide potential for targeted delivery of siRNA
  - Protect siRNA from degradation to allow effective MAPT gene silencing
  - Track delivery in real time (imaging capabilities)
  - MAPT dysfunction also implicated in Parkinson's Disease and other neurological disorders

Envisioned use case of NanoVac for BBB delivery for AD therapy

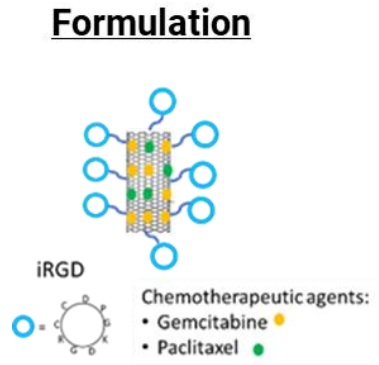


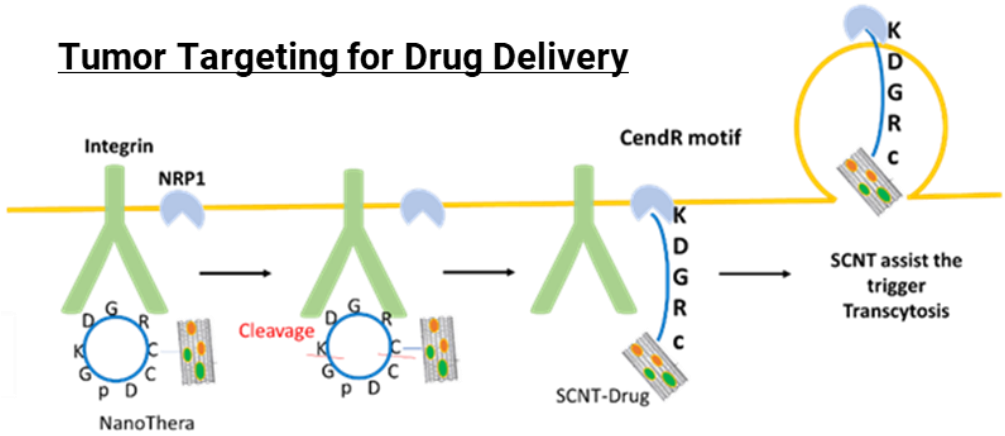


Permeation of NanoVac through simulated BBB membrane is significantly higher than payload alone, with up to 80% of delivered vehicle crossing barrier in 24 hours.

Ab-Drug Conjugates | Pancreatic Ductal Adenocarcinoma

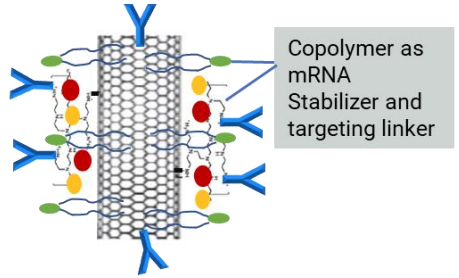
- **Problem**
  - Targeting of tumor stroma may improve localized delivery of chemotherapeutic agents in a complex cancer.
  - Off-target toxicity is a significant concern
- **Opportunity**
  - Enhanced iRGD targeting of tumors while also providing co-delivery of effective doses of anticancer therapeutics
  - NanoVac-bound ligands engineered to enhance binding strength and complex avidity to target cells
  - Reduced off-target toxicity and hepatic capture of vehicle
  - Cleavage of iRGD or Ab-targeting component releases delivery vehicle with demonstrated enhanced cell uptake

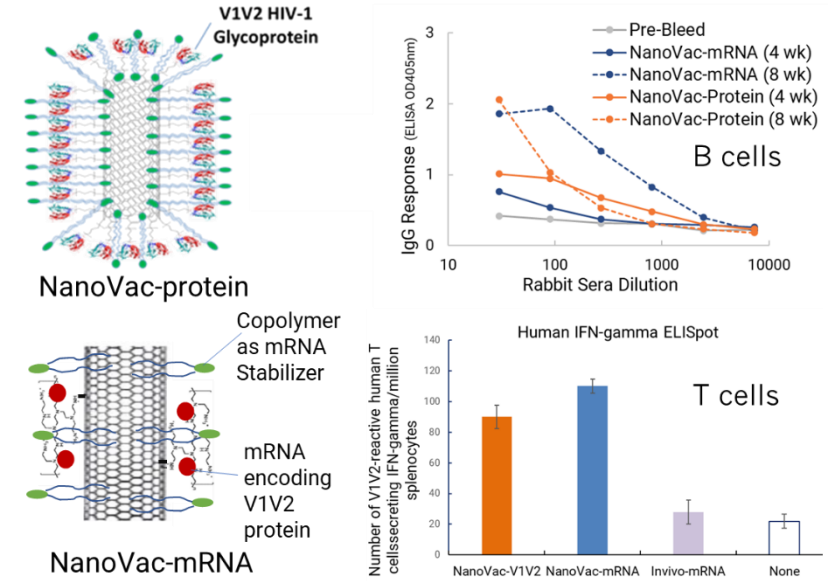




Cancer Vaccines | Pancreatic Ductal Adenocarcinoma

- **Problem**
  - PDCA is 4th leading cause of cancer death
  - Disease is drug resistant due to biology and stroma around tumor
  - Immunologically “cold” tumors; lack dendritic cells to uptake antigens and trigger immunity
- **Opportunity**
  - Targeted delivery with established B- and T-cell response
  - Delivery of neoantigen mRNA
  - Enhanced APC uptake and stimulation for maturation
  - 7DW8-5 NKT stimulatory agent (Columbia University)





Christopher Tison
Director of Biotech
chris.tison@lunalabs.us

James Garrett
Chief Executive Officer
james.garrett@lunalabs.us

Drake Goolsby
Chief Commercialization Officer
drake.goolsby@lunalabs.us